ANALYTICAL STUDY ON GAS LIFT OPTIMISATION AND PREDICTION OF PRODUCTION LIFE OF THE WELLS IN PLATFORM C, B-1 FIELD

by

Nurfuzaini Binti. Abd Karim

Dissertation submitted in partial fulfilment of
the requirements for the
Bachelor of Engineering (Hons)
(Petroleum Engineering)

MAY 2013

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CERTIFICATION OF APPROVAL

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A project final report submitted to the
Petroleum Engineering Programme
Universiti Teknologi PETRONAS
in partial fulfilment of the requirement for the
BACHELOR OF ENGINEERING (Hons)
(PETROLEUM ENGINEERING)

Approved by,

____

(Muhamamad Aslam B Md Yusof)
Project Supervisor

UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK
MAY 2013

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

NURFUZAINI BINTI ABD. KARIM

ABSTRACT

This report consists of five chapters which are introduction, literature review, methodology, results and discussion, and conclusion and recommendation. The project background portion explains about the background of the project, problem statement, project objectives and scope of the study, where mainly the study of this project is done on the B-1 Field which is located in Sarawak. The objectives of this project are to predict the production life of wells in B-1 Field as well as to optimize the production of wells in B-1 Field using the gas lift aid. Moreover, the scopes of study in this project includes the well modeling, gas lift design, gas lift optimization, dynamic reservoir modeling and prediction of production life of the wells. The problem statement for the project is based on a long shut in Platform C wells, thus the well behavior cannot be predicted.

The literature review of this report describes the research on the project topic which is gas lift and reservoir dynamic model using two software which are PROSPER and ECLIPSE 100. Various sources are referred for the literature review section to have a better understanding on the research topic. The methodology part contains research methodology process flow, project activities with Gantt chart as the attachment, and tools required to run the project. In the methodology part, the process flow is explained with respect to the objectives of the project.

The results and discussion section will discuss on the completed phase progress, in this case is the result for the first phase which is PROSPER modeling and the second phase which is the gas lift optimization in the PROSPER software while the third phase is ECLIPSE100 reservoir modeling. A thorough explanation will be provided in the section. Lastly, in the last chapter which is the conclusion and recommendation, the relevancy of the objective to the project progress will be stated and some recommendation is made to improve the future work.

ACKNOWLEDGEMENT

First and foremost, I would like to thank Allah the Almighty who has given me strength and blessings to complete my Final Year Project. The utmost gratitude goes to my supervisor, Mr. Muhammad Aslam B Md Yusof for having his time to guide and assist me in my Final Year Project. His guidance, support and encouragement have kept the work on the right track with continually motivation. I would also like to give appreciation to AP Aung Kyaw who has been helping me through many challenges during this project and for his willingness to teach and guide during the completion of this project. Moreover, my gratitude goes to all lecturers and lab technologists who had given their help, time, guidance and advice throughout this project. I would like to use this opportunity to express my deepest appreciation to everyone who has contributed towards this project directly or indirectly. Last but not least, the support and motivation from family and friends during the completion of this project is much appreciated.

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

Nowadays, oil reserves are depleting every day and oil prices are rising, thus the role of production optimization cannot be ignored. Production optimization means determination and implementation of the optimum values of parameters in the production system to maximize hydrocarbon production rate. Because a system defined differently, the production optimization can be performed at different levels such as well level, facility or platform level, and field level. This report describes the production optimization for the gas- lifted wells.

The production rate from a single flowing well is dominated by inflow performance, tubing size and wellhead pressure controlled by choke size, which on the other hand is called Nodal Analysis. Nodal Analysis is mainly focuses on the Inflow Performance Relationship (IPR) and Vertical Lift Performance (VLP) of the well. The Inflow Performance Relationship (IPR) is defined as the functional relationship between the production rate and the bottom hole flowing pressure. Productivity Index (PI) expresses the capability of a reservoir to deliver fluids to the wellbore. Productivity Ratio (PR) is the ratio of actual productivity index to the ideal productivity index where skin, s=0. Nodal Analysis can be used to generate tubing performance curve (VLP). Figure 1 is the production system of a well which shows the reservoir inflow and tubing outflow.

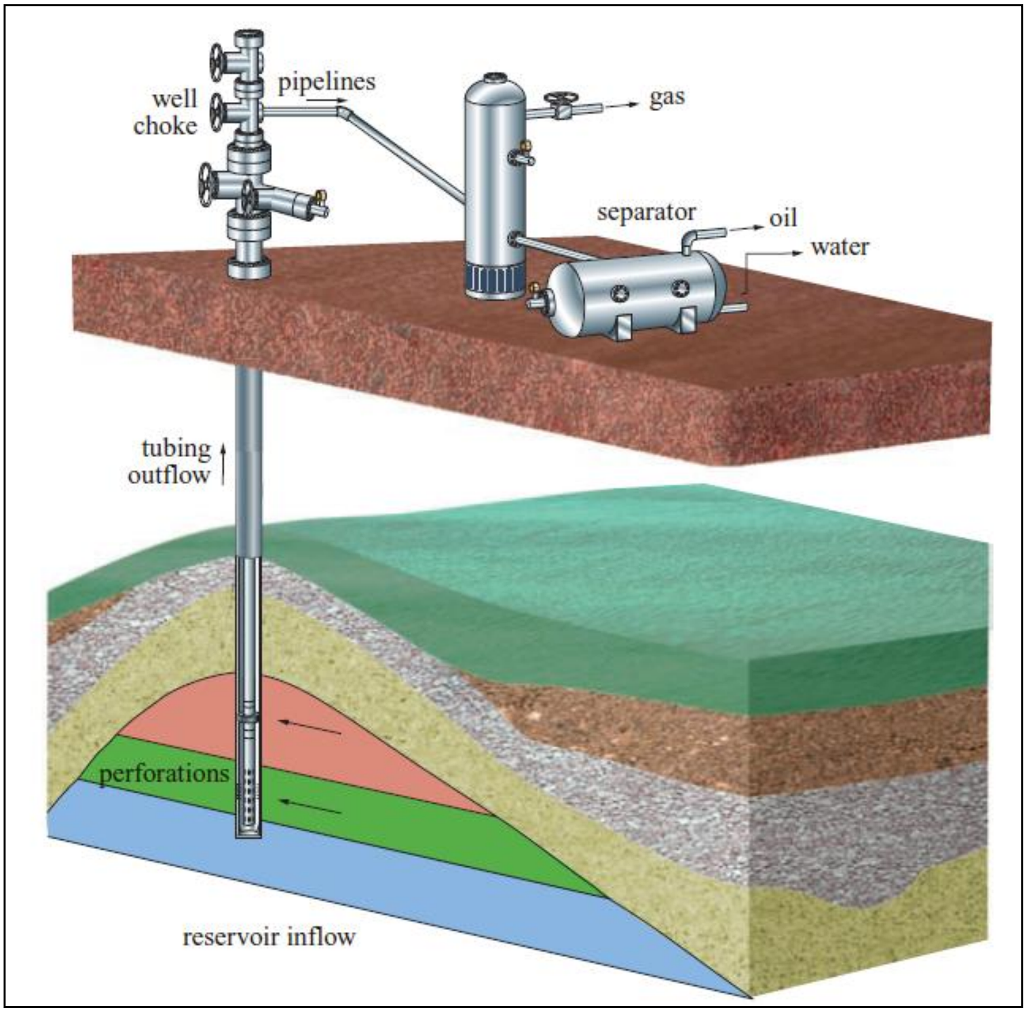


FIGURE 1. Production System**.**
*Source**:** Economides, M. J. (n.d.). Production Optimization. Volume 1/ Exploration, Production and Transport .*

This project is based on the data from one of the field located in Sarawak named B-1 Field. This project only focuses on the eight wells in the Platform C. The B-1 Field is located 80 km Northwest of Bintulu.The field is 14km long and 6 km wide with water depth of 90 ft which is quite shallow. In this project gas lift will be used for the production optimisation. Gas will be injected at high pressure from the casing into the wellbore and mixes with the produced fluids from the reservoir (see Figure 2).

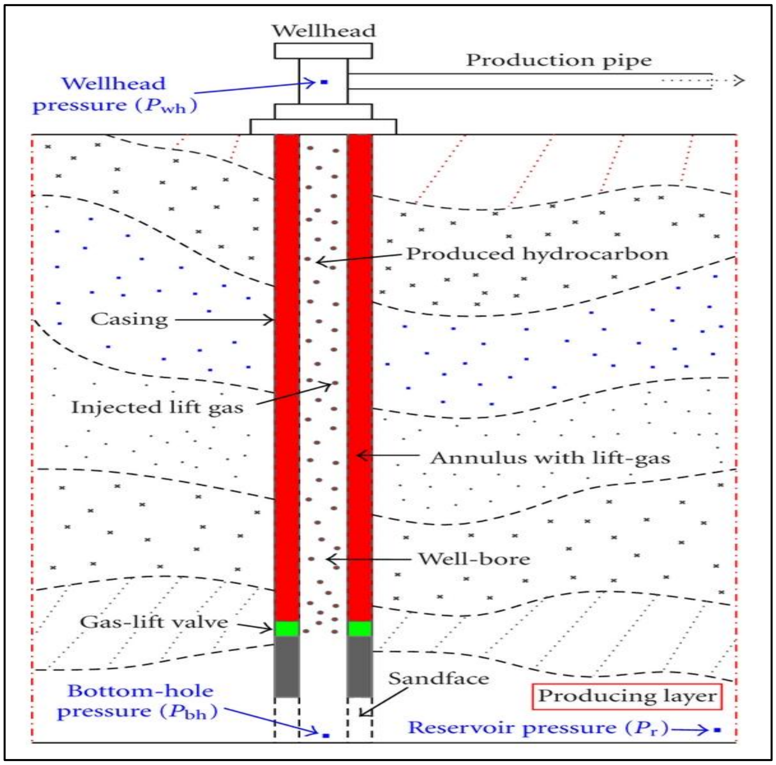


FIGURE 2. Gas Lift Well Schematic

Source: Kashif Rashid, W. B. (2012). A Survey ofMethods for Gas-Lift Optimization. Modelling and Simulation in Engineering

The continuous gas injection process lowers the effective density and thus the hydrostatic pressure of the fluid column, leading to a lower flowing bottom-hole pressure (Pbh). The increased pressure differential induced across the sand face from the in situ reservoir pressure (Pr), given by (Pr − Pbh), aiding in flowing the produced fluid to the surface. The method is easy to install, economically viable, robust, and effective over a large range of conditions, but does assume a steady supply of lift gas.

Oil and gas reservoir modeling involves two broad types of data: static (for example, core, well logs, and seismic interpretation) and dynamic (pressure and fluid production observed at wells). Incorporation of dynamic data together with static data improves the quality of the reservoir models produced and provides the reservoir engineers with a better basis for reservoir simulation and management.

The main focal point of the reservoir characterization and simulation area is the construction of a reservoir model. This model is represented numerically in a 3D collection of data and then serves as the input for a numerical reservoir flow simulator. The output obtained from the simulation run represents the expected performance production curve given a particular production or injection well trend. The optimization of massive investments allocated to reservoir exploitation strategies basically depends on the precision of this reservoir performance production forecast. Subsequently, the development of this reservoir model is one of the key aspects of the overall reservoir management process.

Previously, simulations for all the wells in Platform C have been done to determine the best gas lift injection point for optimum production. Since Platform C has been shut in since 2008, the early data obtain might be not accurate for the simulations by using the PROSPER software. Thus, in this project, simulations using PROSPER software will be done using the relevant data from B-1 Field. Moreover, with the recent PROSPER well models; dynamic reservoir model will be created using the ECLIPSE 100 software in order to predict the production life of the wells in Platform C.

1.2 Objectives

To ensure the project is successful, objectives are established. There are three main objectives for this project which are:

- To remodel the wells in B-1 Field using the relevant data.
- To optimize production of the wells in B-1 Field.
- To predict production life of the wells in B-1 Field using ECLIPSE 100.

1.3 Scopes of Study

The scopes of study of this project include:

- Well modeling
- Gas lift design
- Gas lift optimization
- Dynamic reservoir modeling
- Prediction of production life of the wells.

The scopes of study will be divided into three simulation phases. For the first phase and the second phase, it includes the well modeling, gas lift design and gas lift optimization; where the simulation will be done using PROSPER software. The third phase is the dynamic reservoir modeling and prediction of production life of the wells by using the ECLIPSE 100 software.

1.4 Problem Statement

Due to long shut-in of wells in B-1 Field because of the high water cut in production and no gas lift facilities, well modeling is crucial to optimize the production. Moreover, since it has been shut in for a long time, the well behavior cannot be predicted. Furthermore, the optimization problem is to optimize the daily production by choosing the optimal gas lift rates subject to pressure and properties of the wells.

Project Title: Analytical study on gas lift optimization and prediction of production life of the wells in B-1 Field.

1.5 The Relevancy of the Project

This project will provide a good platform to improve knowledge on the artificial lift optimization, especially the gas lift optimization which is the focus of this project. In this project, student gets the opportunity to perform simulations on the surface and subsurface modeling using the software PROSPER where student can identify the operating point of the well by generating VLP/IPR graph. Furthermore, this project includes the usage of ECLIPSE 100 where student has to create a dynamic reservoir model based on the field data gathered. Thus, giving an opportunity for the student to work on their own and to practice on becoming a production technologist in the future.

1.6 Feasibility of the Project within Scope and Time Frame

The project scope and time frame is referred to the project key milestone and Gantt chart. In this project, student has to focus on the design, data gathering and simulation for the eight wells at B-1 Field. This project is feasible and can be done within the study period.

CHAPTER 2

LITERATURE REVIEW

2.1 Production Optimization and Nodal Analysis

Nodal analysis as explained by (Bitsindou & M.G. Kelkar, 1999) involves calculating the pressure drop in individual components within the production system so that pressure value at a given node in the production system (e.g., bottom hole pressure) can be calculated from both ends (separator and reservoir). The rate at which pressure is calculated at the node from both ends must be the same. This is the rate at which the well produces.

As explained by (Munoz, 1999) the performance curves generated using a steady-state software will represent a very specific “operating point”, valid for one set of flowing well-head and bottom-hole pressures for a specific production rate, and under one casing head injection pressure and gas- lift injection rate. Thus from the performance curve the production rate is known and can be optimised.

Based on the (Economides), at a certain point in the life of a well, recovery may not satisfy physical or economic constraints and the well will be shut. At this stage, a remediation action or workover would be performed if the preliminary analysis predicts additional economic value creation.

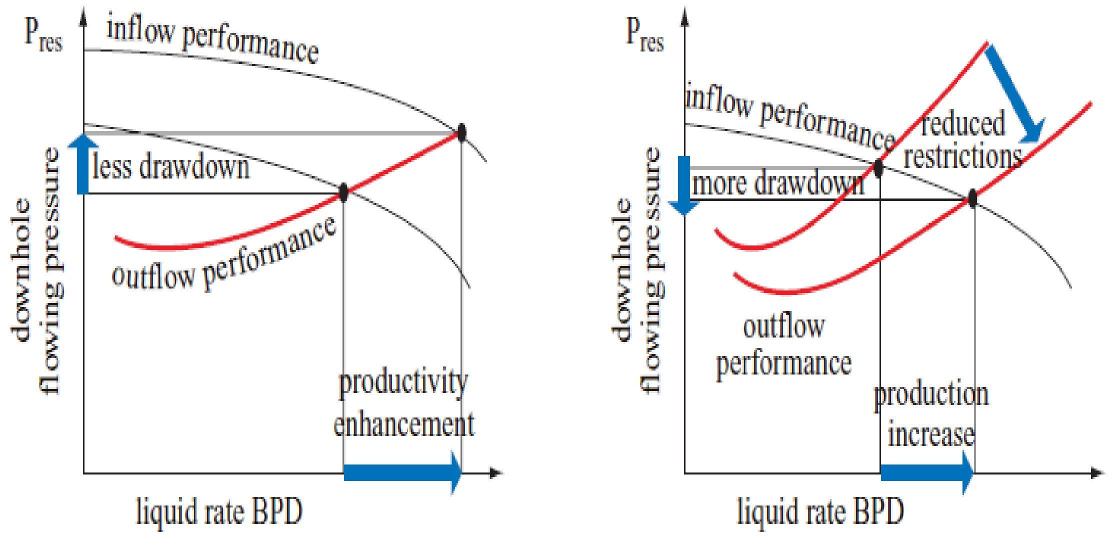


FIGURE 3. Production Optimization via Outflow Enhancement

Source: Economides, M. J. (n.d.). Production Optimization. Volume 1/ Exploration, Production and Transport .

The objectives of production may be to enhance reservoir inflow performance or to reduce outflow performance. The results could be more production with less pressure drawdown. Moreover, the concept of reservoir inflow, as exemplified by the well IPR, with the tubing performance curve, which essentially accounts for all pressure drops associated with the plumbing of the well. This combination brings the components of the petroleum production system together and also be used for well diagnosis, analysis and identification malfunctioning parts of the system.

According to Boyun Guo (2007), "Although the entire production system is analyzed as a total unit, interacting components, complex pipeline networks, pumps and compressors are evaluated individually using this method. Locations of excessive flow resistance or pressure drop in any part of the network are identified".

2.2 Gas Lift Optimization

In this project, firstly gas lift optimization will be done to the wells in B-1 Field. The amount of gas to be injected to maximize oil production varies based on well conditions and geometries. Too much or too little injected gas will result in less than maximum production. Generally, the optimal amount of injected gas is determined by well tests, where the rate of injection is varied and liquid production (oil and perhaps water) is measured. Injected gas aerates the fluid to reduce its density; the formation pressure is then able to lift the oil column and forces the fluid out of the wellbore. Gas may be injected continuously or intermittently, depending on the producing characteristics of the well and the arrangement of the gas-lift equipment. (Wikimedia Foundation Inc, 2012)

According to (Q.Lu, 2012) continuous gas lift injection to production wells or risers is an important method to maintain and improve hydrocarbon production. The availability of lift gas is limited because it is typically provided by produced gas; the gas lift operation is also constrained by the resources of surface facilities, such as the separator and compression facilities. Therefore in this project, the gas lift injection rate is minimized to produce the optimum rate of oil which is very economical.

Since the B-1 Field has a high water cut, according to (Y.C. Chia, 1999) gas lift becomes critical to sustain production as oil fields mature. Increasing water cut and decreasing reservoir pressure eventually cause wells to cease natural flow. Subsequently, gas lift is required to kick off and sustain flow from these wells.

In the gas lift design, the new setting of the gas lift valve will be proposed to the injection depth. As explained by (H.K. Lee, 1993), the depth of the first valve is determined by the static fluid gradient, kick off injection pressure gradient, and the wellhead tubing pressure. Usually the well design assumes the well is filled with kill fluid and the top valve is placed to allow unloading against this gradient. Moreover, the valve port size is determined by calculating the amount of gas required by using equations similar to Thornhill-Craver equations. Port size must be large enough to pass the required amount of gas, but not so large that it produces a large pressure loss across the valve.

2.3 Reservoir Modeling

According to (Cunha, 2004) Oil and gas reservoir modelling involves two broad classes of data: static (for example, core, well logs, and seismic interpretation) and dynamic (pressure and fluid production observed at wells). Integration of dynamic data together with static data enhances the quality of the reservoir models generated and provides the reservoir engineers with a better basis for reservoir simulation and management. The uncertainty of simulated production scenarios is then reduced, allowing a more realistic economic evaluation. In general, however, integrating these two sources of data is still a challenge in petroleum reservoir modeling.

According to (V. Singh1 & Sotomayor1, 2013) 3D reservoir models are constructed for various purposes in the E&P business and support value-based decisions including: development planning, estimation of reserves, commerciality decisions, acquisitions or farm-in opportunities, re-development of old fields and asset management throughout the production period, execution and monitoring, water flood / EOR planning, production cessation/ abandonment. The reservoir modeling process is cyclic and never really ends (new data, new technology or new analogs).

2.4 PROSPER Software

The main software used are PROSPER and ECLIPSE100. Firstly, PROSPER is a software which models Inflow Performance Relationship (IPR) of the well and wellbore hydraulics. (Tony Tianlu Liao, Michael H. Stein, 2002). PROSPER is designed to allow the building of reliable and consistent well models, with the ability to address each aspect of wellbore modeling viz, PVT (fluid characterization), VLP correlations (for calculation of flow-line and tubing pressure loss) and IPR (reservoir inflow). PROSPER provides unique matching features allowing a consistent well model to be built prior to use in prediction (sensitivities or artificial lift design). (IPM- Integrated Network Modeling, 2012).

In this project, the purpose of running the PROSPER software is to obtain Inflow Performance Relationship (IPR)/ Vertical Lift Performance (VLP) curves. Production rates at various drawdown pressures are used to construct the IPR curve, which reflects the ability of the reservoir to deliver fluid to the wellbore. Combining this with a curve reflecting the tubing performance (VLP) identifies the operating point. (Schlumberger Limited, 2012). Thus from generating the IPR and VLP from PROSPER software, gas lift optimization can be done to the wells in B-1 Field.

2.5 ECLIPSE 100 Software

Sclumberger Limited (2013) stated that “The ECLIPSE family of reservoir simulation software offers the industry’s most complete and robust set of numerical solutions for fast and accurate prediction of dynamic behavior, for all types of reservoirs and degrees of complexity—structure, geology, fluids, and development schemes. ECLIPSE software covers the entire spectrum of reservoir simulation, specializing in black oil, compositional and thermal finite-volume reservoir simulation, and streamline reservoir simulation. By choosing from a wide range of add-on options—such as coal bed methane, gas field operations, calorific value-based controls, reservoir coupling, and surface networks—simulator capabilities can be tailored to meet your needs, enhancing the scope of reservoir simulation studies".

Furthermore, ECLIPSE 100 software will be used in this project as well. ECLIPSE 100 is used to build the reservoir dynamic model. Dynamic Model of the studied reservoir which is up scaled by using static model (Nezhad & Hesam Sheikh Darani, 2008). Thus, by the dynamic model reservoir, prediction of production life of the wells in B-1 Field can be done. Reservoir simulation divides the reservoir into a number of discrete units in three dimensions and models the progression of reservoir and fluid properties through space and time in a series of discrete steps. As in material balance, the total mass of the system is conserved. (Geoquest Sclumberger, 1999).

Results of well modeling by PROSPER software, considering different flow scenarios, were imported into the reservoir simulator and final recoveries were observed during a certain period of time. (Nezhad & Hesam Sheikh Darani, 2008)

In addition in this project it is needed to incorporated the gas lifted wells from the PROSPER well models. According to (Sclumberger, 2009) the effects of gas lift are modeled by VFP tables (keyword VFPPROD). The tables must be prepared in advance with a suitable range of lift gas injection rates. The lift gas injection rate is equated with the Artificial Lift Quantity (ALQ value) in the tables. In ECLIPSE 100, lift gas injection rates lying in between tabulated ALQ values are handled by linear interpolation, by default, like the other parameters in the table. Gas lift effects are modeled by interpolating the VFP table with an ALQ value equal to the current lift gas injection rate. The ALQ values in each table must span the expected range of lift gas injection rates for the well, as extrapolation of the tables can give unrealistic behavior.

CHAPTER 3

METHODOLOGY

3.1 Project Activities

This project refers to waterfall model whereby first task is finished before being able to move to the next task.

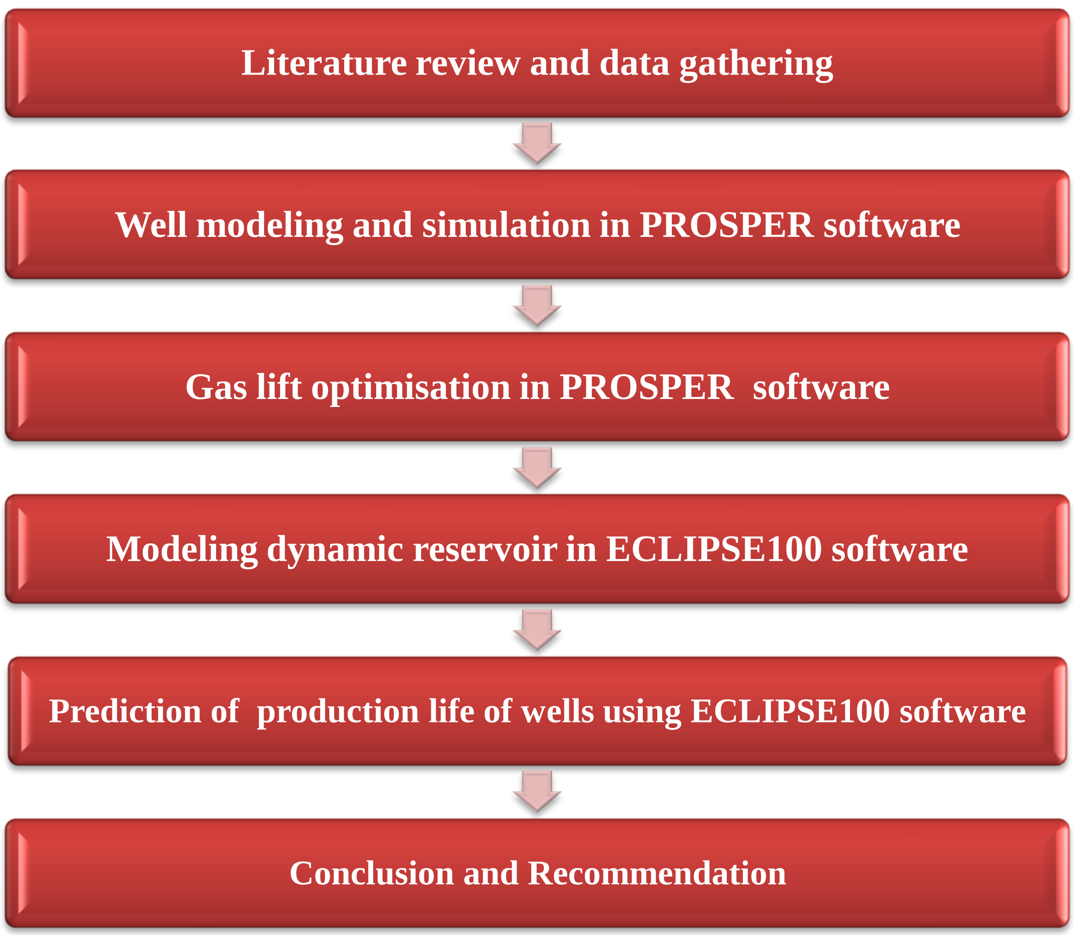


FIGURE 4. Project Activities Flow Chart

Firstly, to start this project research is done to gain useful information to be used in the project. Thus, literature review and data gathering is done in order to get more insight on the project as well as finding guideline for the study. Secondly, after sufficient information is obtained, simulation of eight wells in Platform C is done to obtain the operating point in every well by plotting the Inflow Performance (IPR) and Vertical Lift Performance graph. Thirdly, the PROSPER model for the eight wells is then undergoes the gas lift optimization in PROSPER software. The suitable injection valve depth will be selected for the production optimization and optimum gas injection rate will be obtained to have the optimized production rate.

Then, the project will continues in ECLIPSE 100 software, where the integrating of PROSPER well model is done in the ECLIPSE 100, followed by the static and dynamic reservoir modeling. Furthermore, prediction of production life of wells is done by the results obtain from the dynamic reservoir model in ECLIPSE 100. Last but not least, conclusion and recommendation is done for the future work.

3.2 Key Milestone of Project Activities

TABLE 1. Key Milestone of Project (FYP1)

No	Activities	Date
1	Topic selected	31 January 2013 (Week 2)
2	Extended Proposal submission	27 February 2013 (Week 6)
3	Oral defence presentation	11-12 March 2013 (Week 9)
4	Literature review studies	(Week 4 – Week 12)
5	Procurement of materials	(Week 10)
6	Draft of interim report submission	10 April 2013 (Week 13)
7	Final interim report submission	17 April 2013 (Week 14)

TABLE 2. Key Milestone of Project (FYP2)

No	Activities	Date
1	Project Work Continues	(Week 1- Week 15)
2	Submission of Progress Report	Week 8
3	Pre- SEDEX	Week 10
4	Submission of Draft Report	Week 11
5	Submission of Dissertation (soft bound)	Week 12
6	Submission of Technical Paper	Week 12
7	Oral Presentation	Week 13
9	Submission of Project Dissertation (Hard Bound)	Week 15

The Key Milestone in this project will undergoes these activities in order to be accomplished within the time given:

- **Project Charter/Draft**
    1. Topic discussion
    2. Topic approval by supervisor
    3. Draft deliverable

- **Project Execution**
    1. Requirement Gathering
    2. Data Research
    3. Record all the network activities

- **Project Closed Out**
    1. Final documentation
    2. Project Presentation

3.3 Gantt Chart

TABLE 3. Gantt Chart of Project (FYP1)

NO	DETAIL/WEEK	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Topic selection/ Proposal	■	■					SEMESTER BREAK							
2	Preliminary Research Work and Data Gathering		■	■	■	■									
3	Literature Review Studies					■	■								
4	Remodeling wells in PROSPER					■	■		■	■	■	■	■	■	△
5	Submission of Extended Proposal						■								
6	Proposal Defense (Oral Presentation)								■	■					
7	GasLift Optimization in PROSPER										■	■	■	■	△
8	Submission of Interim Draft Report													■	
9	Submission of Interim Draft Report														■

TABLE 4. Gantt Chart of Project (FYP2)

NO	DETAIL/WEEK	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Project Work Continues	■	■	■	■	■	■	SEMESTER BREAK								
2	Submission of Progress Report															
3	Dynamic Reservoir Modeling								■	■	■	■	■	■	■	△
4	Pre- SEDEX										■					
5	Submission of Draft Report											■				
6	Submission of Dissertation (Soft Bound)												■			
7	Submission of Technical Paper												■			
8	Oral Presentation													■		
9	Submission of Project Dissertation															■

Legend:
△ Objective is achieved

3.4 Tools

There are many aspects involved in successful project and program. One of the aspects is the tools used in a project. Since this project is a simulation project, there are two main tools used which are:

TABLE 5. Tools for the Project

NO.	SOFTWARE	APPLICATIONS
1.	PROSPER	Designed to allow the building of reliable and consistent well models, with the capability to address each aspect of well bore modeling viz; PVT (fluid characterisation), VLP correlations (for calculation of flowline and tubing pressure loss) and IPR (reservoir inflow).
2.	ECLIPSE 100	Use 3D reservoir simulations to support wide-ranging well controls, field operations planning.

3.5 Project Methodology

3.5.1. Objective 1: To remodel the wells in B-1 Field using the relevant data.

This will be achieve by creating new well models for every wells in Platform C in PROSPER software by referring to the gathered relevant information on every well. Well model in Platform C is matched with the relevant production data. This is executed by building single well model for each well in Platform C using PROSPER. The data to be input includes PVT, reservoir characteristic, well deviation and well construction. Matching done to ensure correct data and well performance is matched with the model. This process requires data and information needed includes the Well test, Deviation Data, Well Diagram, Pressure Profile, Schematic Diagram of Platform C and PVT data.

Well model in Platform C is then matched with the latest production data.. The data gathered includes PVT, reservoir characteristic, well deviation and well construction. Matching done to ensure correct data and well performance is matched with the model. This process also requires recent well test data and pressure profile.

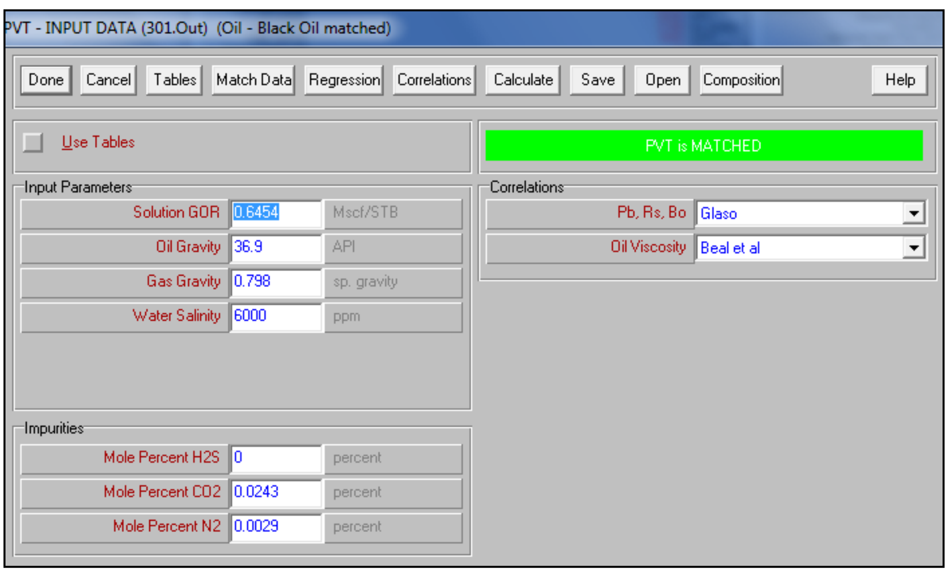


FIGURE 5. PVT- Input Data

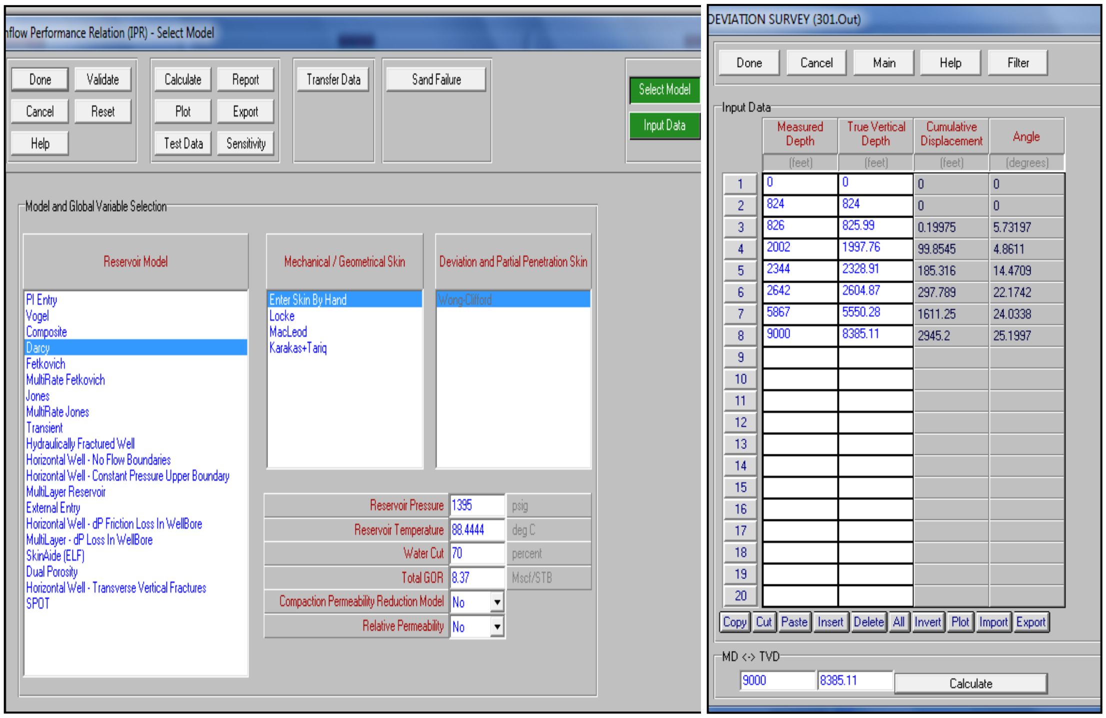


FIGURE 6. Example of the parameter needed in matching the well models

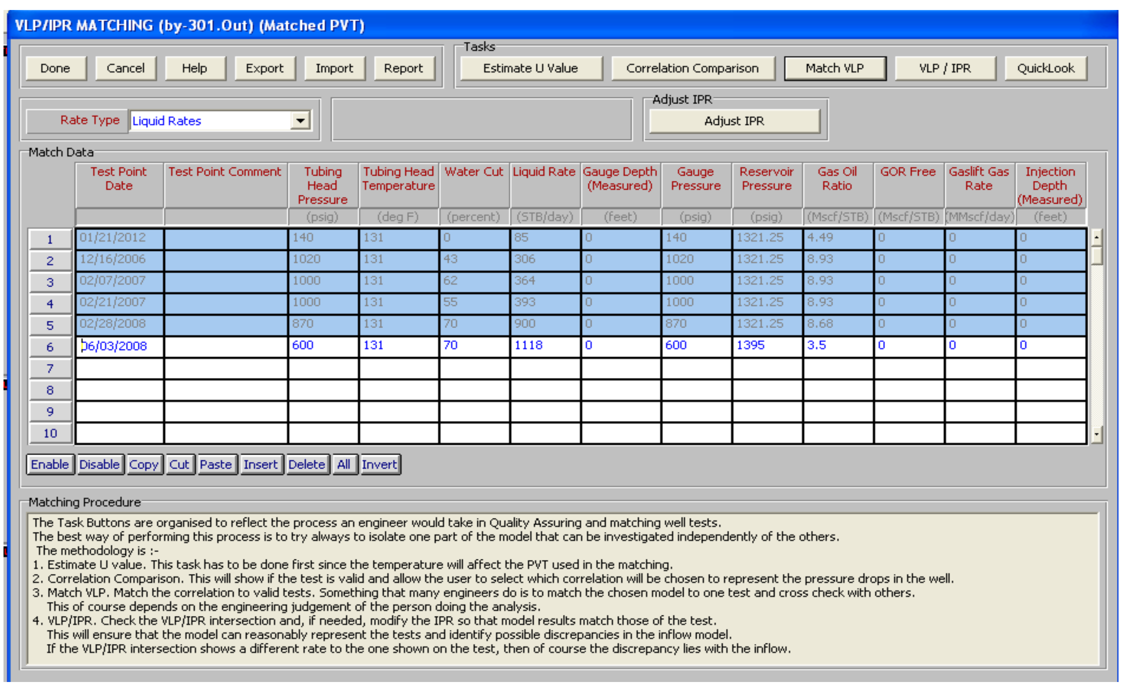


FIGURE 7. VLP/IPR matching in PROSPER

Based on Figure 6 and Figure 7, there are several important data that need to be input in order to generate IPR and VLP curves as well as to match the model which are mainly the reservoir pressure, gas oil ratio, water cut and reservoir temperature. Moreover, when the Darcy Model is selected, other parameter such as permeability, reservoir thickness, drainage area, skin and wellbore radius is to be input to create the model.

After all the data has been key- in, the matching is done to obtain the IPR/VLP graph. The intersection point between the IPR and VLP curves, we can obtain the operating point which is the point of the well start to flow with respect to the bottom hole flowing pressure. Figure 8 is the example of IPR/VLP graph obtained . Thus from the IPR/VLP graph, the production rate of the well daily can be determined.

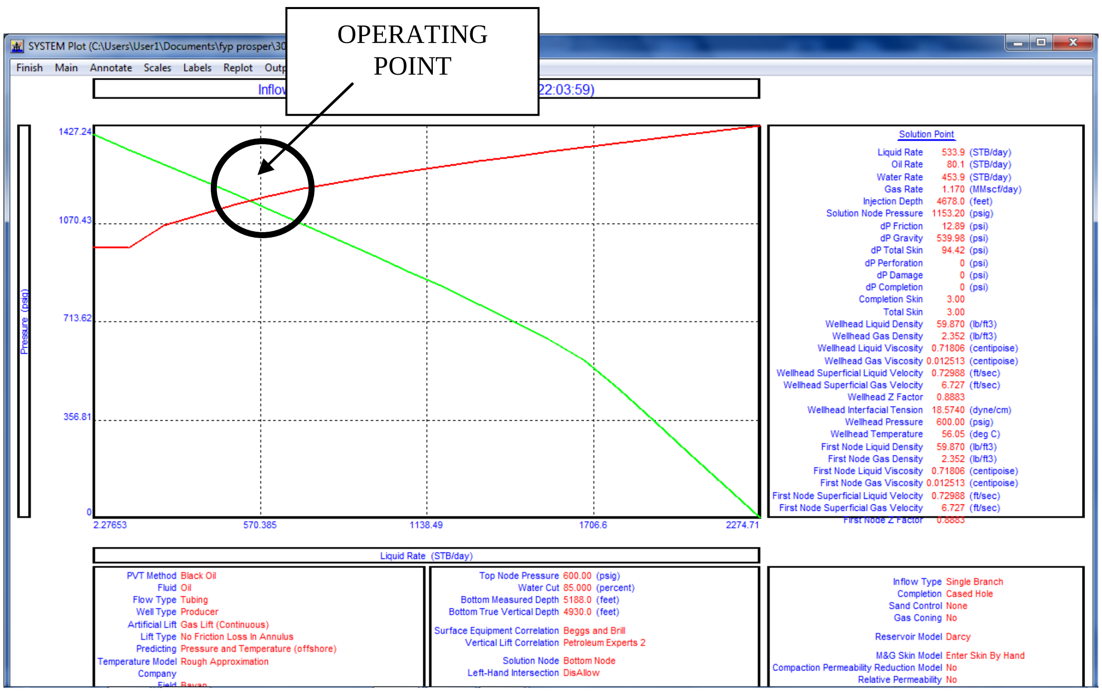


FIGURE 8. VLP/IPR graph in PROSPER

3.5.2. Objective 2: To optimize production of the wells in B-1 Field.

This will be achieved by designing the gas lift facility in every well using the PROSPER software in the process of remodeling the wells. Thus, multiple cases on gas lift optimization are done. Two cases were run for field-wide optimization in this project which is:

i. **Base case (do nothing)**

   The PROSPER model is run without the gas lift facilities with relevant data from the field that will be used for the Case 2.

ii. **Case 2 (gas lifted all wells with optimised gas lift parameters)**

   The PROSPER model is run with the new Gas lift design with relevant data from the field.

The first step in designing gas lift is to specify the depth of injection point in the well based on the wellbore diagram where the side pocket mandrel has already been installed. Then, the parameter of the well is input in the PROSPER software in order to specify the well condition and properties as shown in the Figure 9.

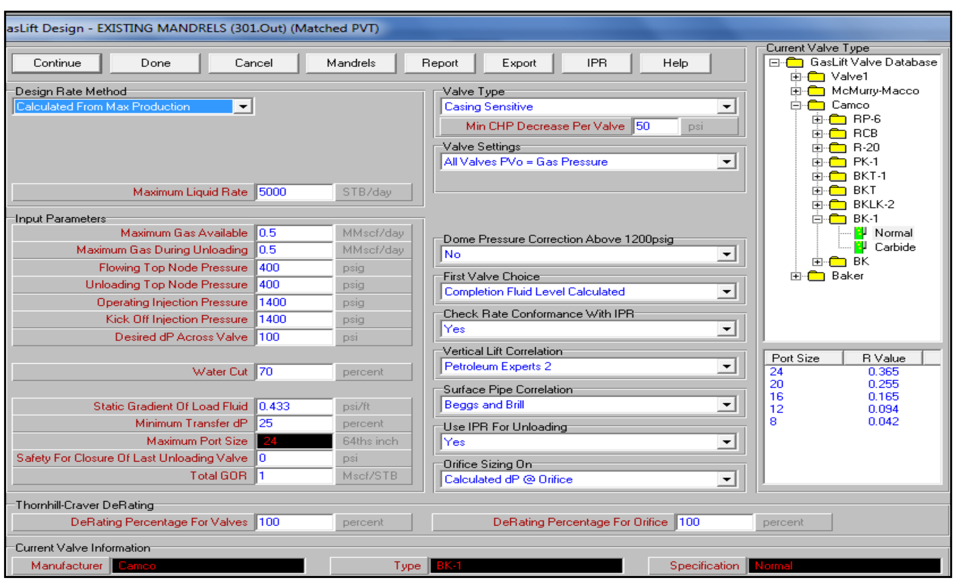


FIGURE 9. Input Data for the Gas lift Design

3.5.3. Objective 3: To predict production life of the wells in B-1 Field using ECLIPSE 100.

This will be achieved by developing a static and dynamic reservoir model in ECLIPSE100. The dynamic reservoir model is created using some of the keywords that is specifically chosen to integrate the gas lifted wells. Before the dynamic model is created, the static model is first created in the FILENAME.DATA file. For the reservoir static modeling the keywords used are RUNSPEC, DIMENS, OIL, WATER, FIELD, TABDIMS, WELLDIMS, START, NSTACK, GRID, EQUALS, BOX, TOPS, PROPS, EQUIL and SUMMARY. These keywords are basically to initialize the properties of the reservoir. For example in the PROPS section it is also included with the PVT data to specify the parameter such as the rock properties, formation volume factor for oil and water, the density for oil, water and gas, and the bubble point pressure. Moreover, the reservoir specification such as the depth, width and length is also needed in order to create a reservoir model.

Then the modeling is continued with the dynamic modeling. The dynamic modeling is done by adding the SCHEDULE section in the FILENAME.DATA file. Some of the keywords needed in order to incorporate the gas lift wells modeled by the PROSPER software are VFPPROD, WELLSPECS, COMPDAT, WCONPROD,WEFAC, LIFTOPT, WLIFTOPT, WTEST and TSTEP. The PROSPER model of every well is integrated in the ECLIPSE100 dynamic reservoir model by the VFPPROD table output generated from the PROSPER software. The VFPPROD table contains the well information on the datum depth, liquid rates, water cut percentage, gas oil ratio and artificial lift value. The FILENAME.DATA file is then run and if errors occur in the simulation, it is corrected using the corrected parameter. After all the errors is corrected, the reservoir model is run in the Eclipse 100 , Floviz and Office.

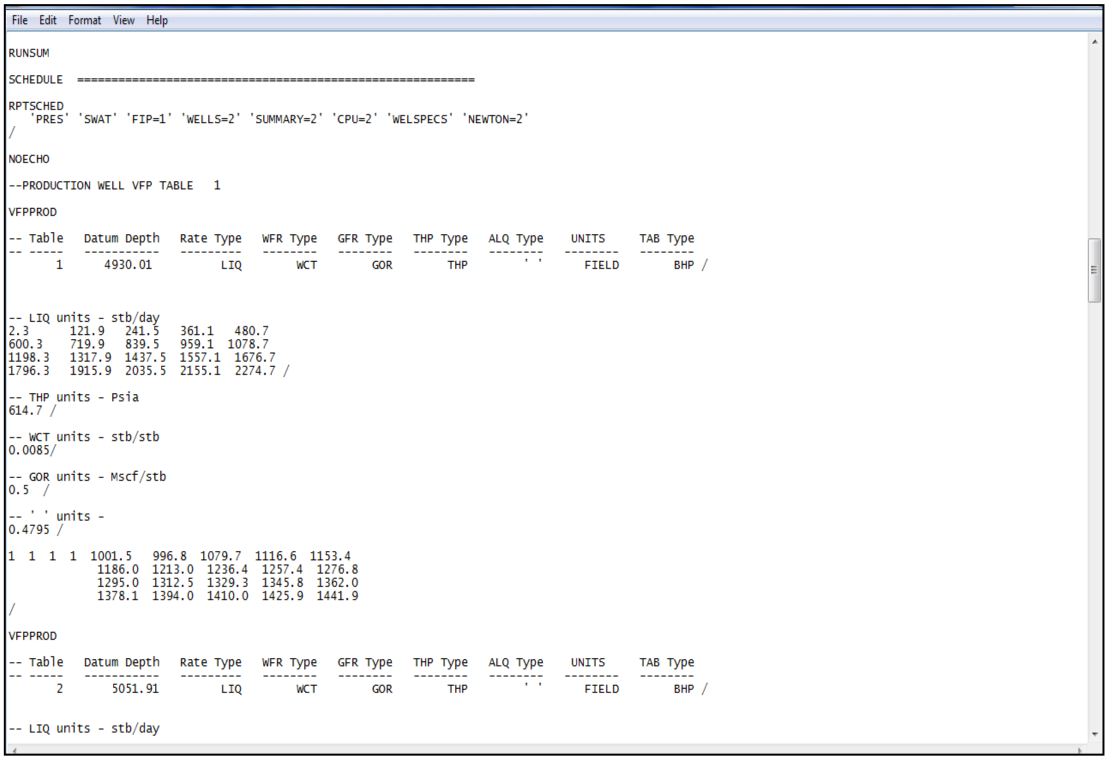


FIGURE 10. FILENAME.DATA file

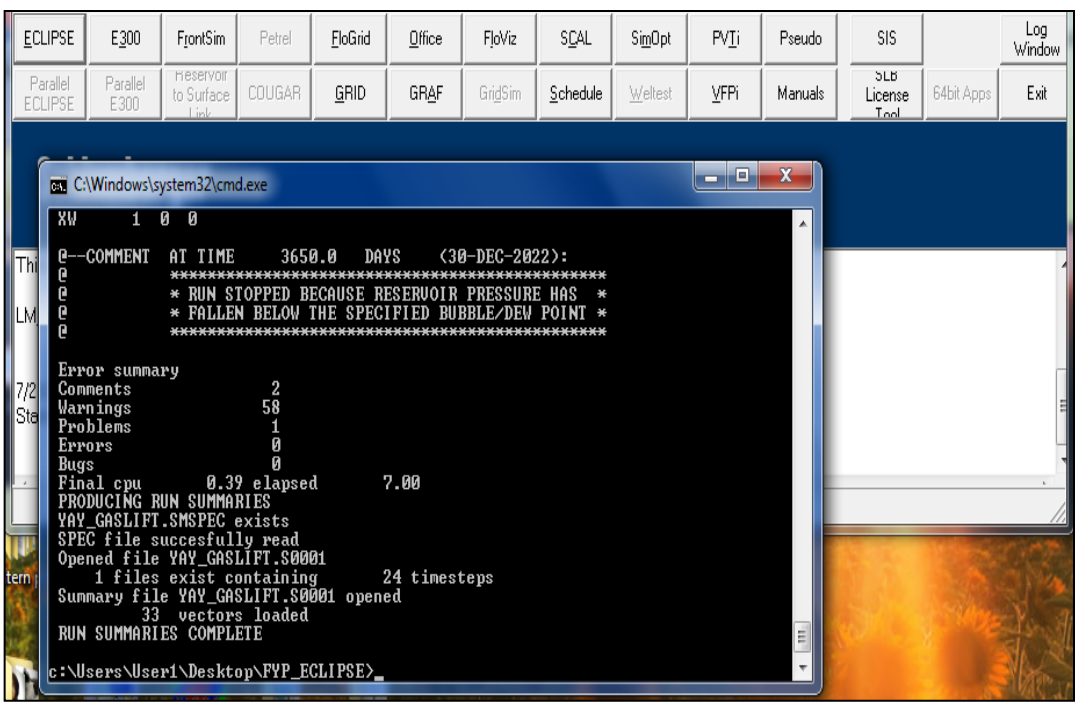


FIGURE 11. Running FILENAME.DATA file

Furthermore, through the reservoir simulations that are based on accurately developed reservoir characterisation, it will be significant in predicting the production life of the field. The production life of the field is predicted by using the timestep of 25 years which is equivalent to 9125 days to be input in the FILENAME.DATA file to be run. The result will be discussed in the next chapter.

CHAPTER 4

RESULTS

In this chapter the results of the first phase, second phase and third phase of the project that has been completed will be shown well by well.

4.1 PROSPER Modeling- Base Case

The Base Case study is the study on the wells in Platform C using PROSPER modeling without the gas lift injection. The results of eight wells in the Base Case will be shown below.

<u>Well B-301</u>

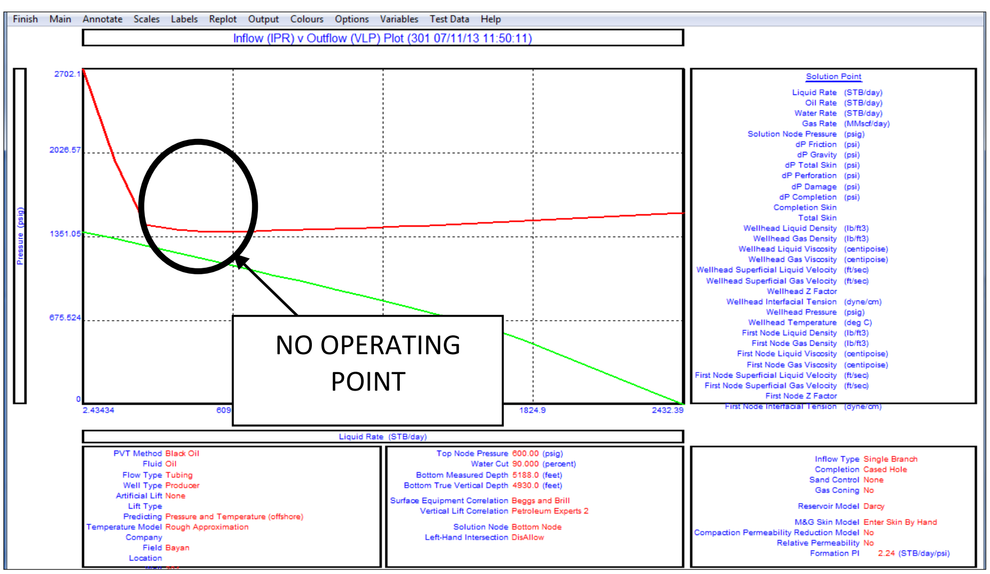


FIGURE 12. IPR/VLP curve for B-301 in Base Case.

Well B-303

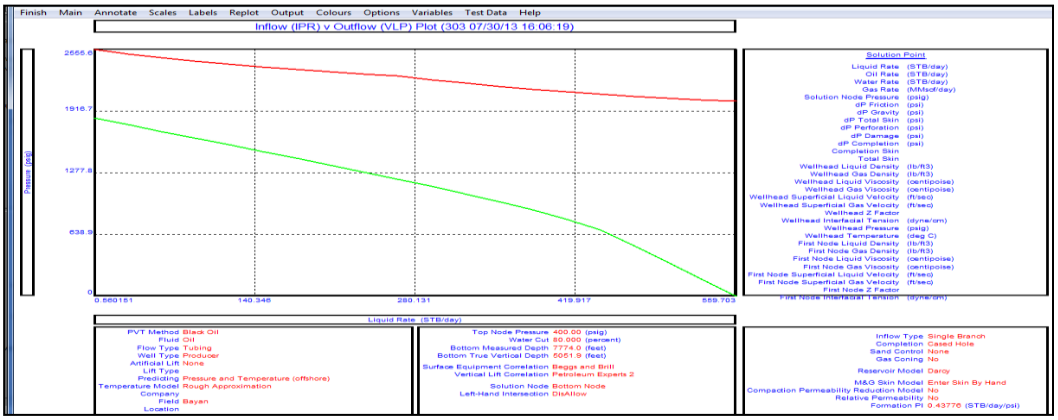


FIGURE 13. .IPR/VLP curve for B-303 in Base Case.

Well B-304

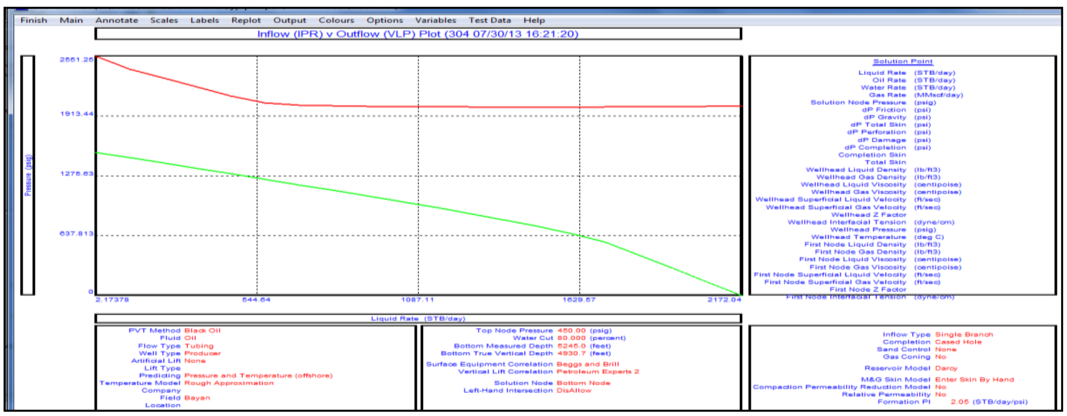


FIGURE 14. IPR/VLP curve for B-304 in Base Case.

Well B-305

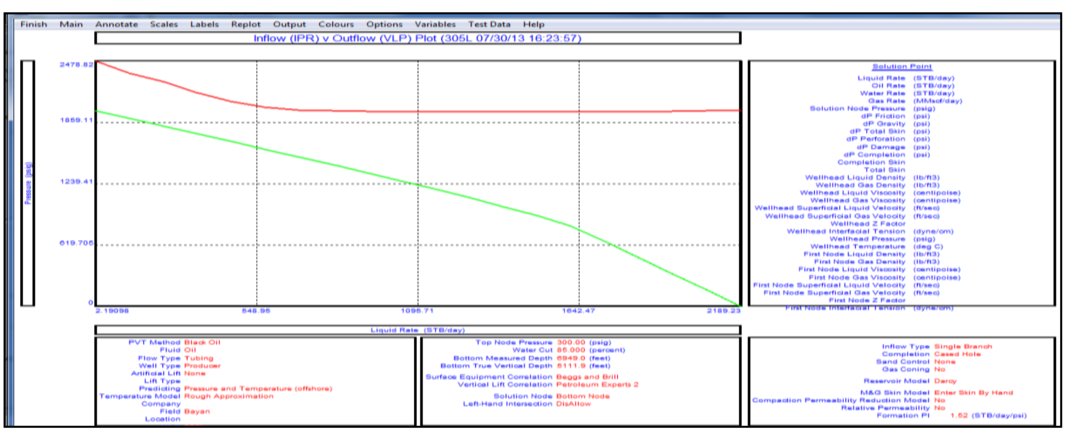


FIGURE 15. IPR/VLP curve for B-305 in Base Case.

Well B-306

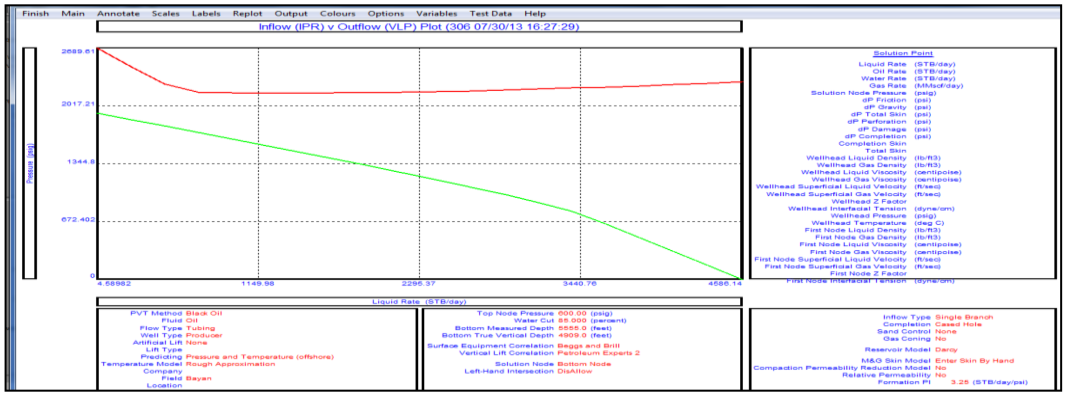


FIGURE 16. IPR/VLP curve for B-306 in Base Case.

Well B-307

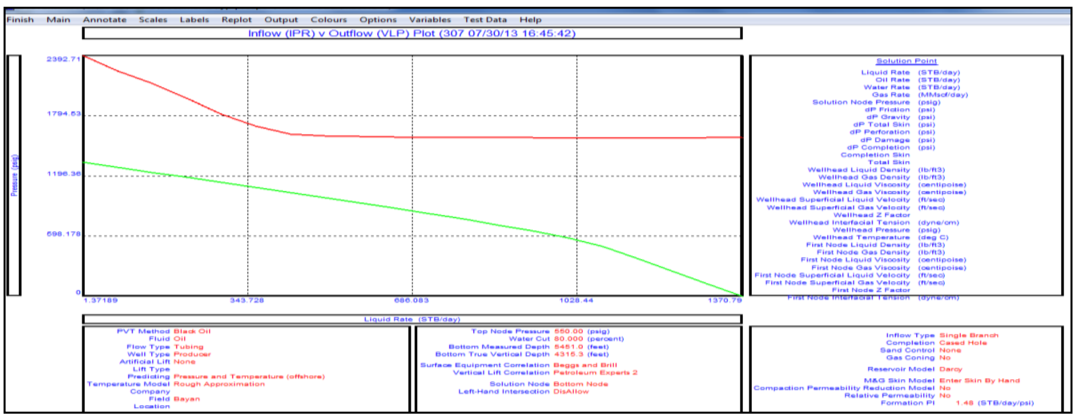


FIGURE 17. IPR/VLP curve for B-307 in Base Case.

Well B-308

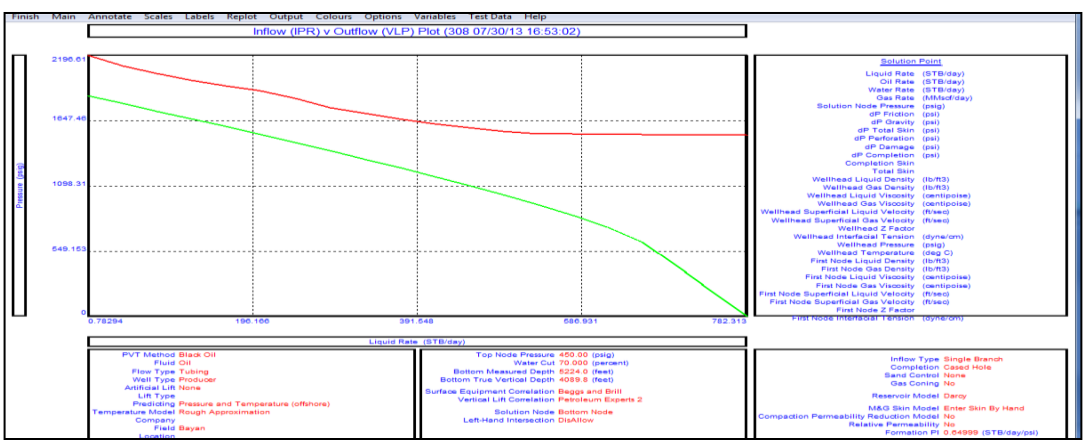


FIGURE 18. IPR/VLP curve for B-308 in Base Case.

Well B-309

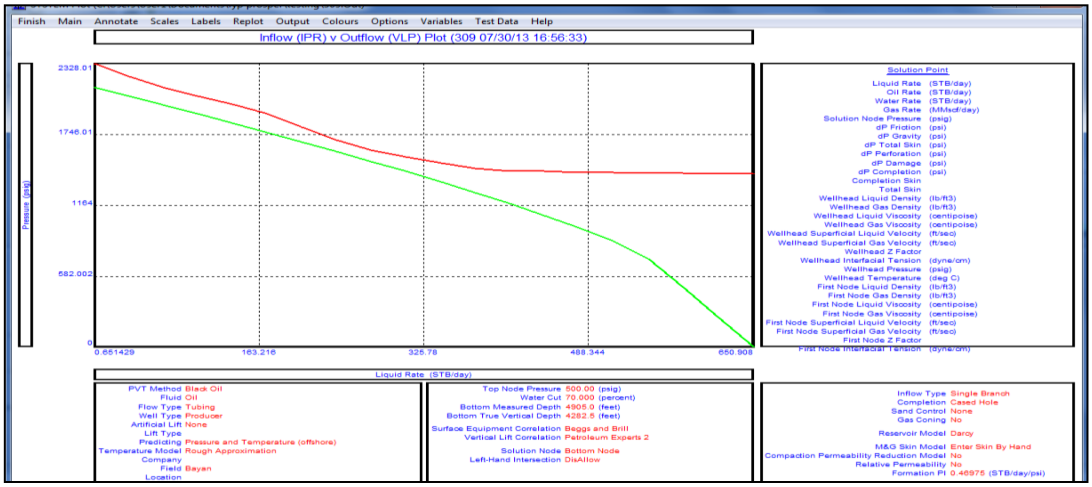


FIGURE 19. IPR/VLP curve for B-309 in Base Case.

From the PROSPER modeling, all of the wells in Platform C are showing no operating point in the Base Case, thus the flow rate is zero bbl/day for every wells in Platform C.

4.2 PROSPER Modeling- Case 2 (Gas lifted all wells with optimized gas lift parameters)

Well B-301

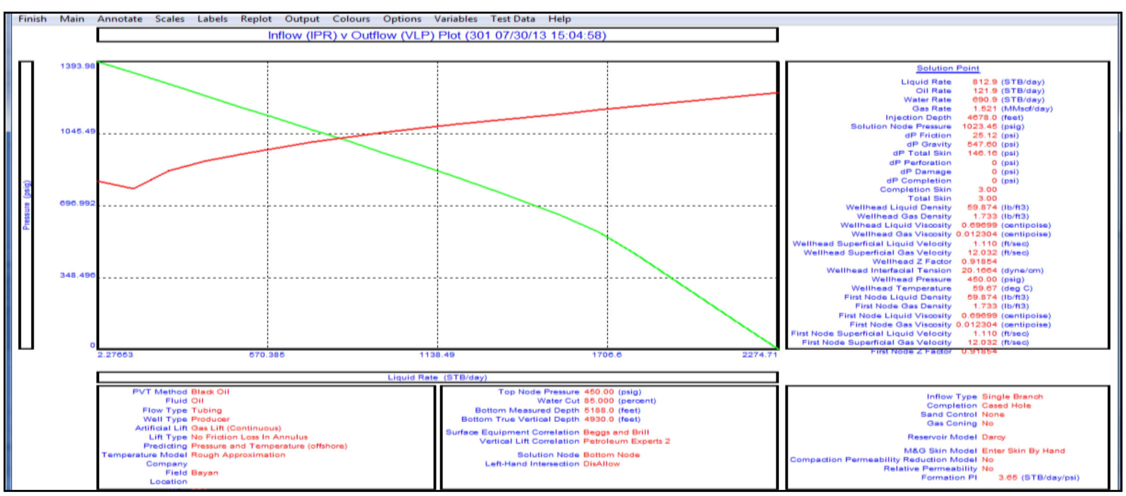


FIGURE 20. IPR/VLP curve for B-301

Figure 20 shows the IPR/VLP curve for well B-301. From the graph, the operating point can be observed and the Absolute Open Flow (AOF) can be obtained. AOF is the maximum flow rate the well can achieve when the flowing bottom hole pressure is equal to zero. In this well the AOF is 2274.71bbl/day. Moreover, the operating point is present at the rate of 812.9 bbl/day of liquid.

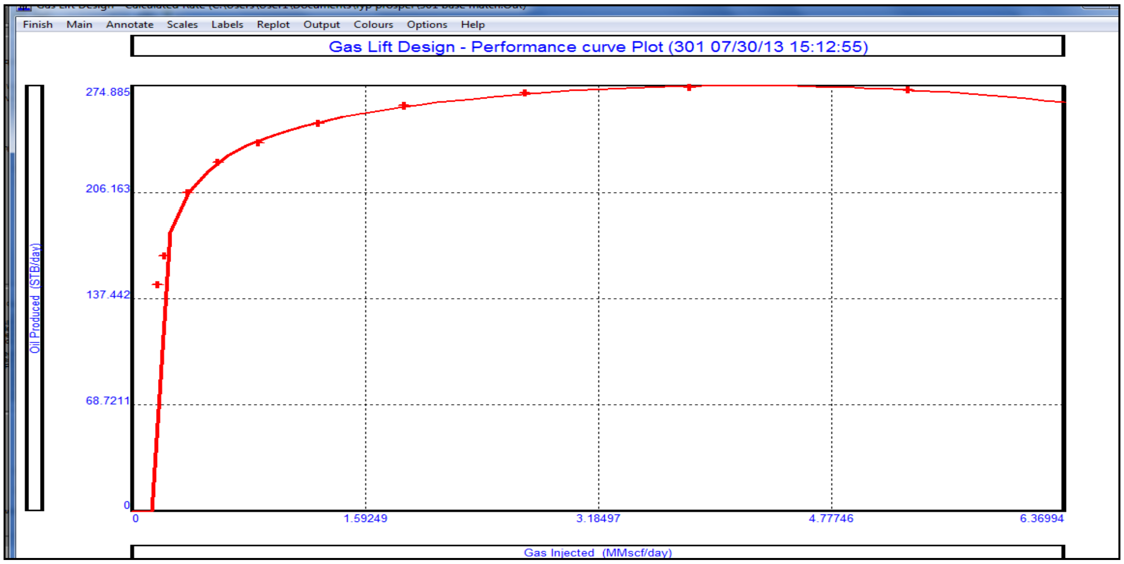


FIGURE 21. Gas Lift Design- Performance Curve Plot for B-301

The Gas Lift Design Performance Curve Plot for B-301in the Figure 21 shows the increasing oil rate with respect to the gas lift injection rate curve trend. Initially when zero injection rate is applied, the oil rate also is zero. When the gas injection rate increases, the oil gain increases. From the graph the optimum gas lift injection rate is 0.485 and the oil rate is 218.26 bbl/day.

Figure 22 shows the gas lift design which shows the injection point depth for the optimize flow in the well. For B-301, the injection point is at the depth of 4678 ft, while Figure 23shows the new setting for the gas lift valve including the Port Size, Test Rack Opening Pressure, Types of Valve and the Depth for every installed valve type.

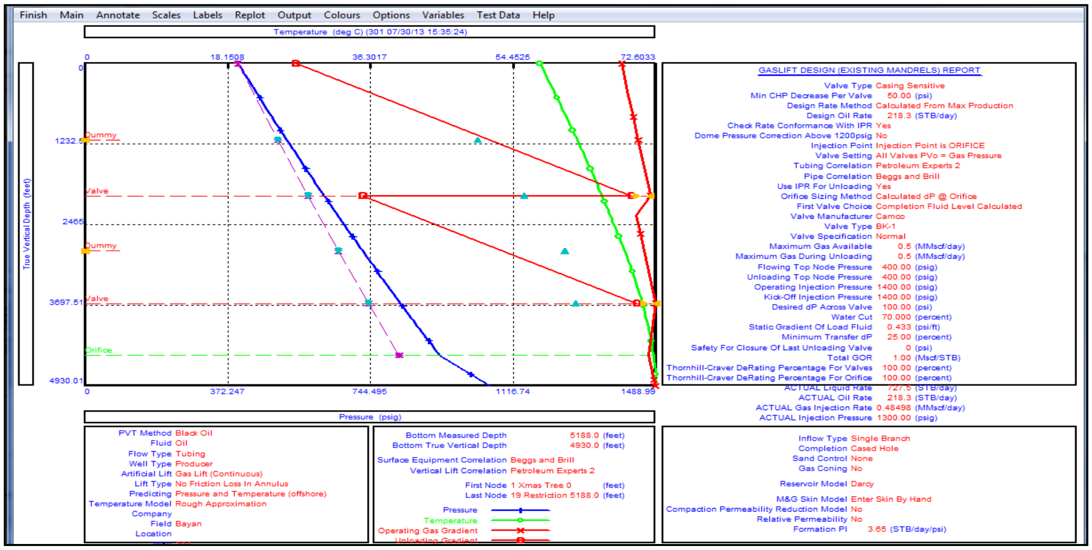
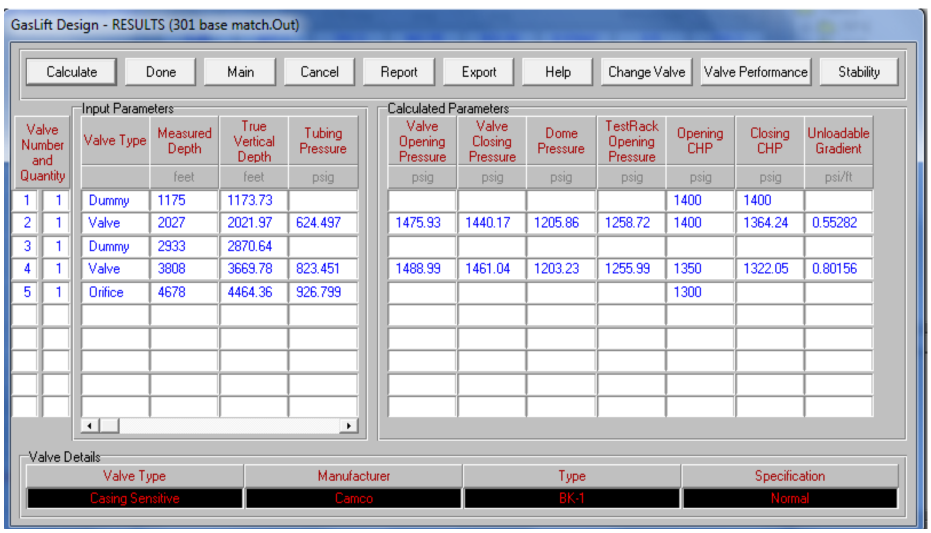


FIGURE 22. Gas Lift Design Graph for B-301



GasLift Design - RESULTS (301 base match.Out)

Calculate | Done | Main | Cancel | Report | Export | Help | Change Valve | Valve Performance | Stability

		Input Parameters				Calculated Parameters						
Valve Number and Quantity		Valve Type	Measured Depth	True Vertical Depth	Tubing Pressure	Valve Opening Pressure	Valve Closing Pressure	Dome Pressure	TestRack Opening Pressure	Opening CHP	Closing CHP	Unloadable Gradient
			feet	feet	psig	psig	psig	psig	psig	psig	psig	psi/ft
1	1	Dummy	1175	1173.73						1400	1400	
2	1	Valve	2027	2021.97	624.497	1475.93	1440.17	1205.86	1258.72	1400	1364.24	0.55282
3	1	Dummy	2933	2870.64								
4	1	Valve	3808	3669.78	823.451	1488.99	1461.04	1203.23	1255.99	1350	1322.05	0.80156
5	1	Orifice	4678	4464.36	926.799					1300		

Valve Details

Valve Type	Manufacturer	Type	Specification
Casing Sensitive	Camco	BK-1	Normal

FIGURE 23. Results of the Gas Lift Design for B-301

Well B-303

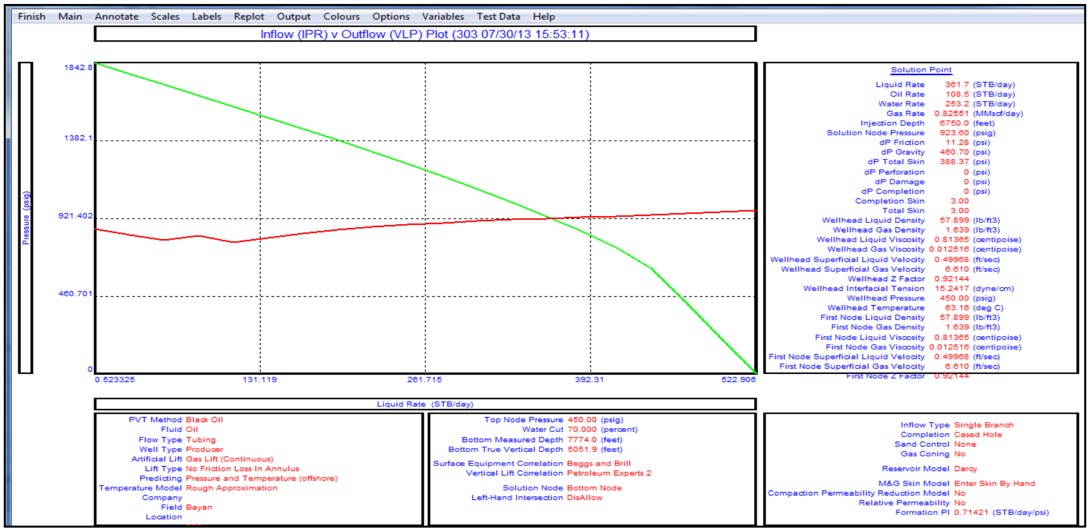


FIGURE 24. IPR/VLP curve for B-303

Figure 24 shows the IPR/VLP curve for well B-303. In this well the AOF is 522.91 bbl/day. Moreover, the operating point is present at the rate of 361.7 bbl/day of liquid.

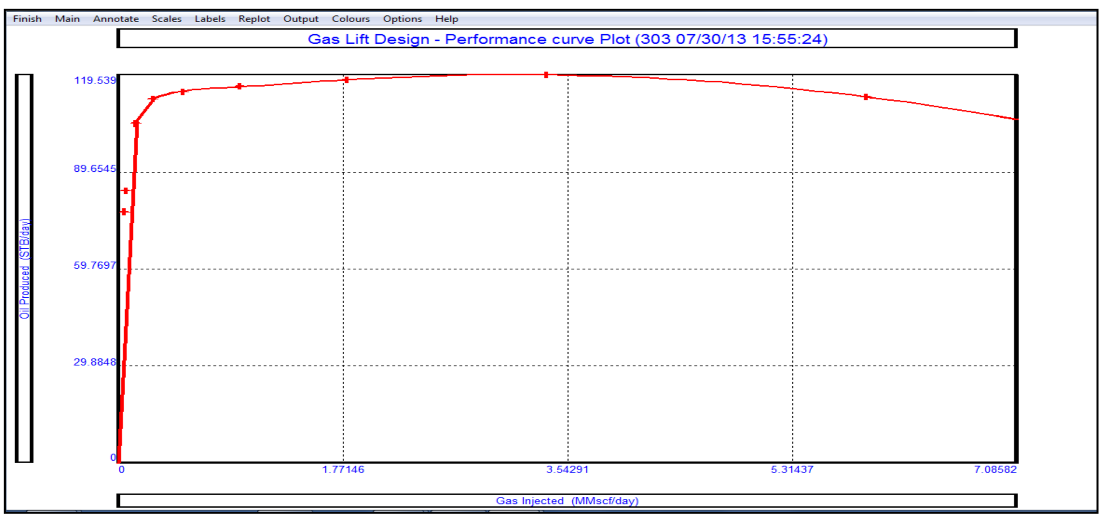


FIGURE 25. Gas Lift Design- Performance Curve Plot for B-303

The Gas Lift Design Performance Curve Plot for B-303in the Figure 25 above shows the increasing oil rate with respect to the gas lift injection rate curve trend. From the graph the optimum gas lift injection rate is 0.3394 MMscf/day and the oil rate is 115.43 bbl/day.

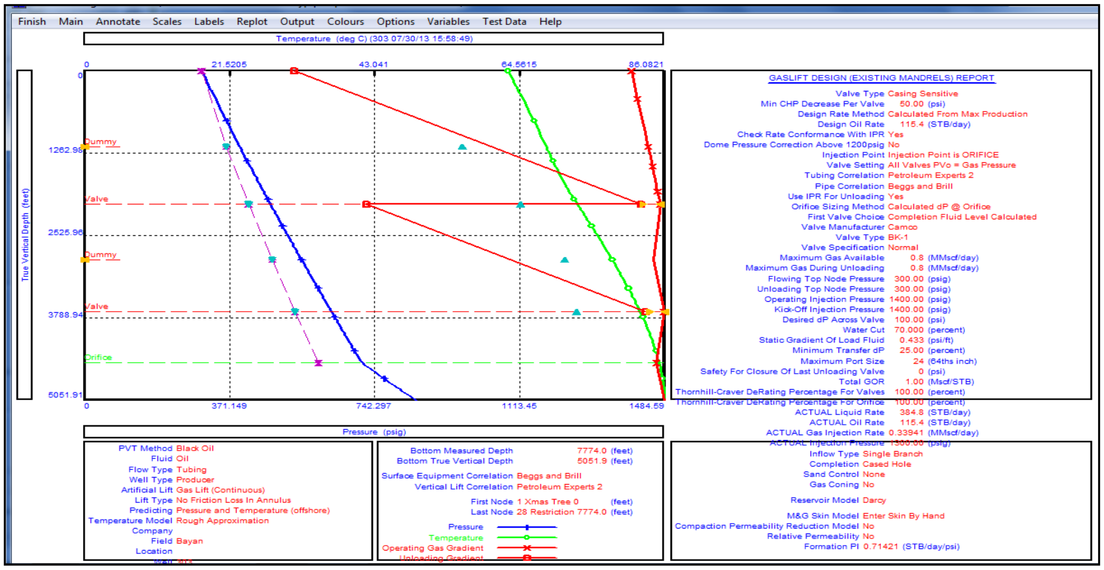
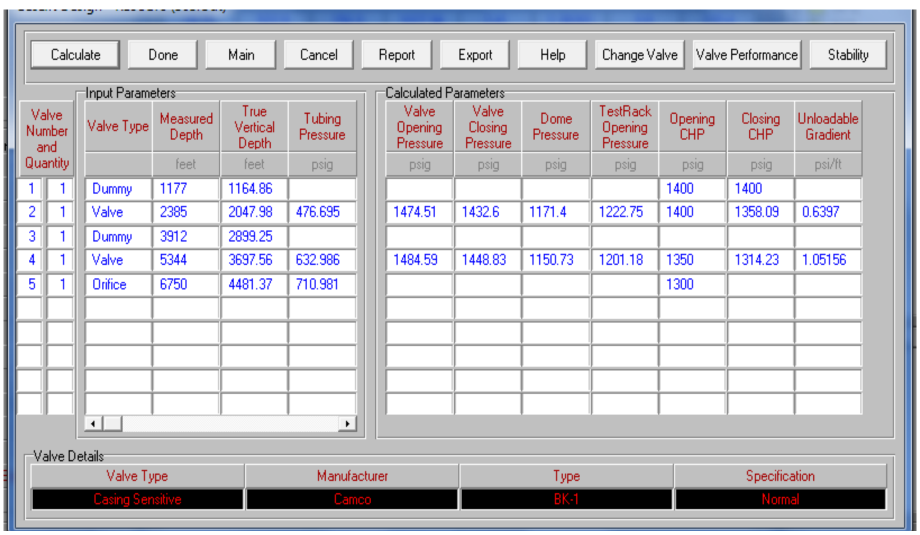


FIGURE 26. Gas Lift Design Graph for B-303



Valve Number and Quantity		Valve Type	Measured Depth (feet)	True Vertical Depth (feet)	Tubing Pressure (psig)	Valve Opening Pressure (psig)	Valve Closing Pressure (psig)	Dome Pressure (psig)	TestRack Opening Pressure (psig)	Opening CHP (psig)	Closing CHP (psig)	Unloadable Gradient (psi/ft)
1	1	Dummy	1177	1164.86						1400	1400	
2	1	Valve	2385	2047.98	476.695	1474.51	1432.6	1171.4	1222.75	1400	1358.09	0.6397
3	1	Dummy	3912	2899.25								
4	1	Valve	5344	3697.56	632.986	1484.59	1448.83	1150.73	1201.18	1350	1314.23	1.05156
5	1	Orifice	6750	4481.37	710.981					1300		

Valve Details

Valve Type	Manufacturer	Type	Specification
Casing Sensitive	Camco	BK-1	Normal

FIGURE 27. Results of the Gas Lift Design for B-303

Figure 26 above shows the gas lift design which shows the injection point depth for the optimized flow in the well. For B-301, the injection point is at the Orifice at depth of 6750 ft which is at the deepest setting of the side pocket mandrel.

Well B-304

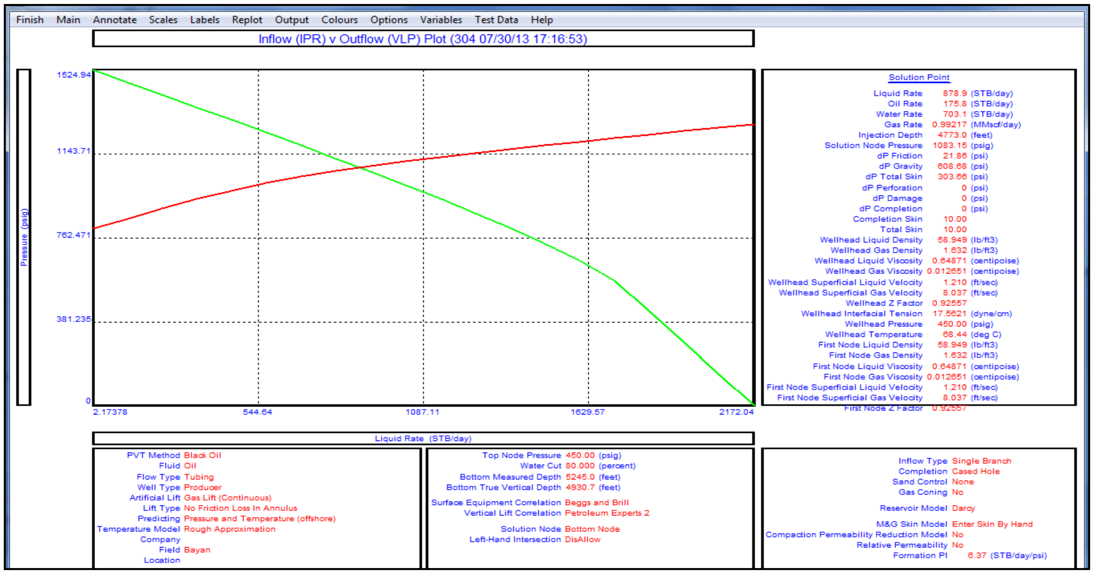


FIGURE 28. IPR/VLP curve for B-304

Figure 28 shows the IPR/VLP curve for well B-304. In this well the AOF is observed to be 2172.04 bbl/day. Moreover, the operating point is present at the rate of 878.9 bbl/day of liquid.

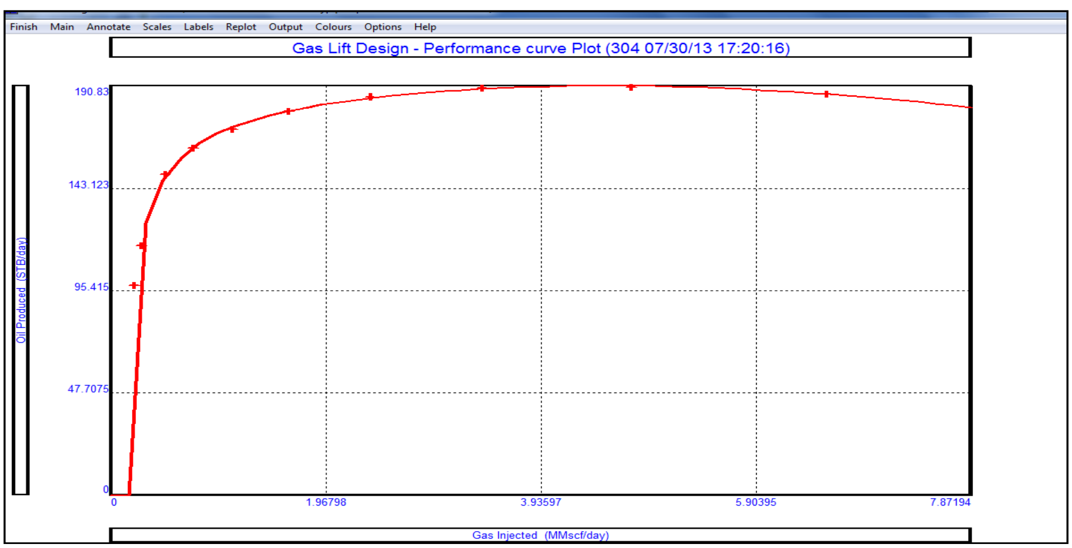


FIGURE 29. Gas Lift Design- Performance Curve Plot for B-304

Figure 29 shows the Gas Lift Design Performance Curve Plot for B-304 which has an increasing oil rate with respect to the gas lift injection rate curve trend. From the graph the optimum gas lift injection rate is 0.483 MMscf/day and the oil rate is 148.17 bbl/day.

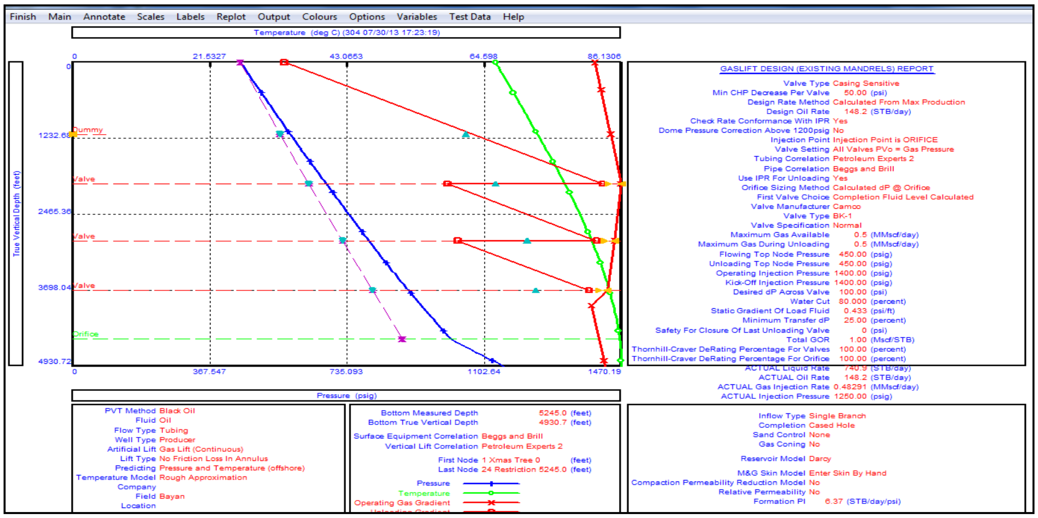
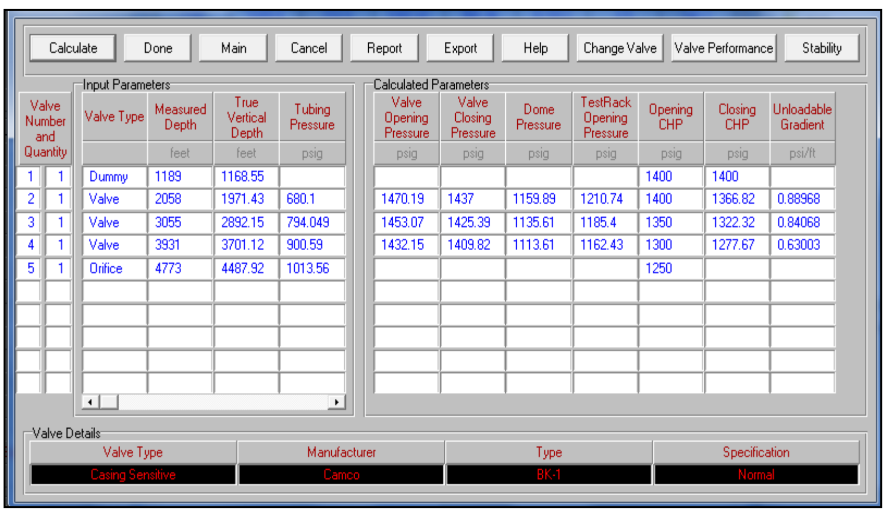


FIGURE 30. Gas Lift Design Graph for B-304



Calculate | Done | Main | Cancel | Report | Export | Help | Change Valve | Valve Performance | Stability

Valve Number and Quantity		Valve Type	Measured Depth (feet)	True Vertical Depth (feet)	Tubing Pressure (psig)	Valve Opening Pressure (psig)	Valve Closing Pressure (psig)	Dome Pressure (psig)	TestRack Opening Pressure (psig)	Opening CHP (psig)	Closing CHP (psig)	Unloadable Gradient (psi/ft)
1	1	Dummy	1189	1168.55						1400	1400	
2	1	Valve	2058	1971.43	680.1	1470.19	1437	1159.89	1210.74	1400	1366.82	0.88968
3	1	Valve	3055	2892.15	794.049	1453.07	1425.39	1135.61	1185.4	1350	1322.32	0.84068
4	1	Valve	3931	3701.12	900.59	1432.15	1409.82	1113.61	1162.43	1300	1277.67	0.63003
5	1	Orifice	4773	4487.92	1013.56					1250		

Valve Details

Valve Type	Manufacturer	Type	Specification
Casing Sensitive	Camco	BK-1	Normal

FIGURE 31. Results of the Gas Lift Design for B-304

Based on the results from the gas lift design in the Figure 30 and Figure 31, the optimum injection depth for B-304 is at 4773 ft.

Well B-305

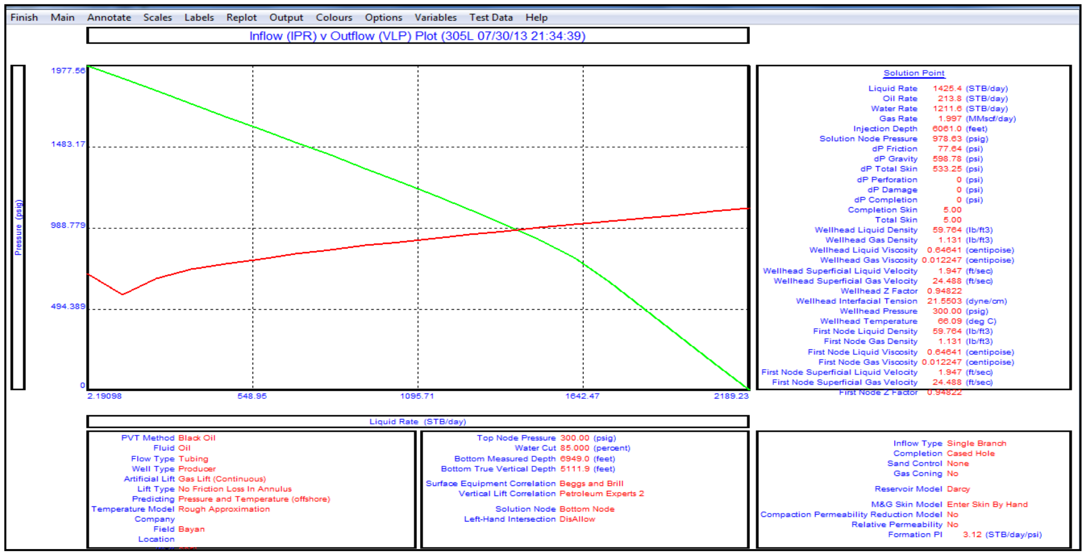


FIGURE 32. IPR/VLP curve for B-305

Figure 32 shows the result on the IPR/VLP curve for well B-305. In this well the AOF is 2189.23 bbl/day. Tithe operating point is observed to be present at the rate of 1425.4 bbl/day of liquid.

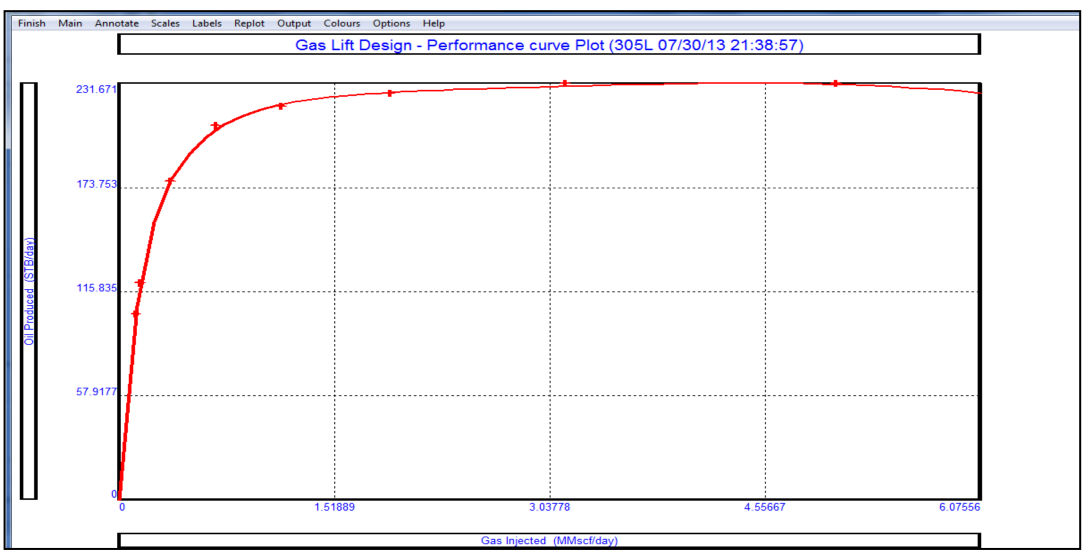


FIGURE 33. Gas Lift Design- Performance Curve Plot for B-305

The Gas Lift Design Performance Curve Plot for B-305 in the Figure 33 shows the increasing oil rate with respect to the gas lift injection rate curve trend. From the graph the optimum gas lift injection rate is 0.473 MMscf/day and the oil rate is 192.18 bbl/day.

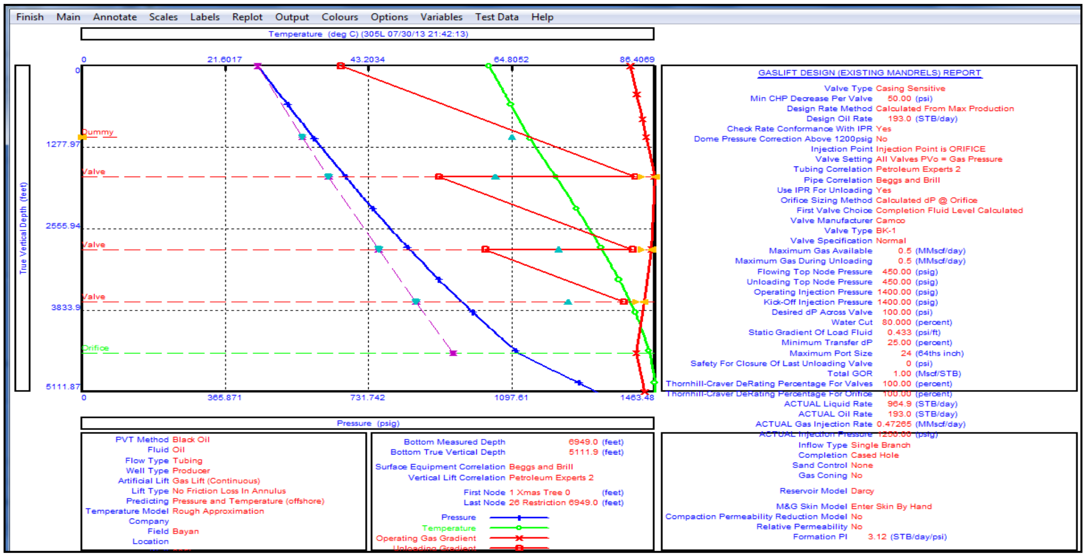
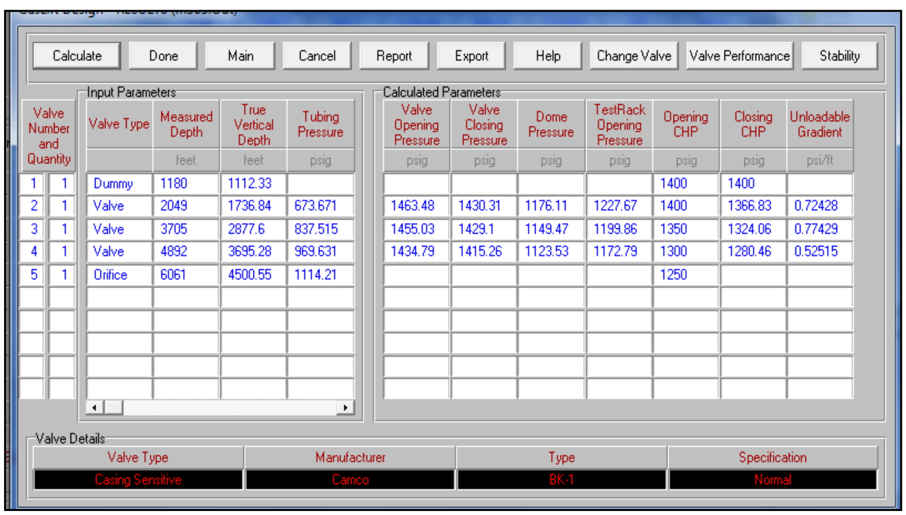


FIGURE 34. Gas Lift Design Graph for B-305



Valve Number and Quantity		Valve Type	Measured Depth (feet)	True Vertical Depth (feet)	Tubing Pressure (psig)	Valve Opening Pressure (psig)	Valve Closing Pressure (psig)	Dome Pressure (psig)	TestRack Opening Pressure (psig)	Opening CHP (psig)	Closing CHP (psig)	Unloadable Gradient (psi/ft)
1	1	Dummy	1180	1112.33						1400	1400	
2	1	Valve	2049	1736.84	673.671	1463.48	1430.31	1176.11	1227.67	1400	1366.83	0.72428
3	1	Valve	3705	2877.6	837.515	1455.03	1429.1	1149.47	1199.86	1350	1324.06	0.77429
4	1	Valve	4892	3695.28	969.631	1434.79	1415.26	1123.53	1172.79	1300	1280.46	0.52515
5	1	Orifice	6061	4500.55	1114.21					1250		

Valve Type	Manufacturer	Type	Specification
Casing Sensitive	Camco	BK-1	Normal

FIGURE 35. Results of the Gas Lift Design for B-305

Based on the results from the gas lift design, the optimum injection depth for B-305 is at 6061 ft which is at the deepest side pocket mandrel that has been already installed in the well B-305.

Well B-306

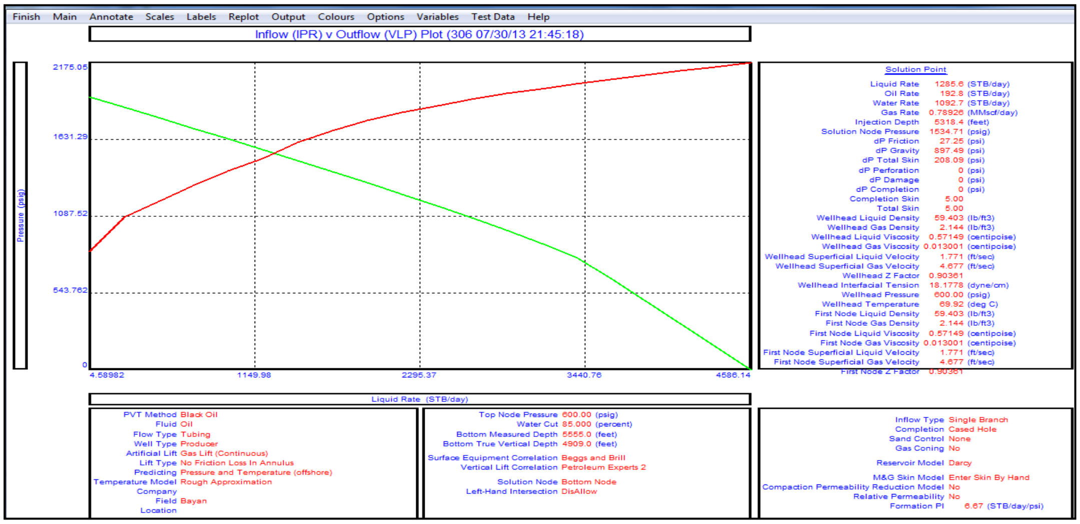


FIGURE 36. IPR/VLP curve for B-306

Figure 36 shows the IPR/VLP curve for well B-306. In this well the AOF is 4585.1 bbl/day. Moreover, the operating point is present at the rate of 1285.6 bbl/day of liquid.

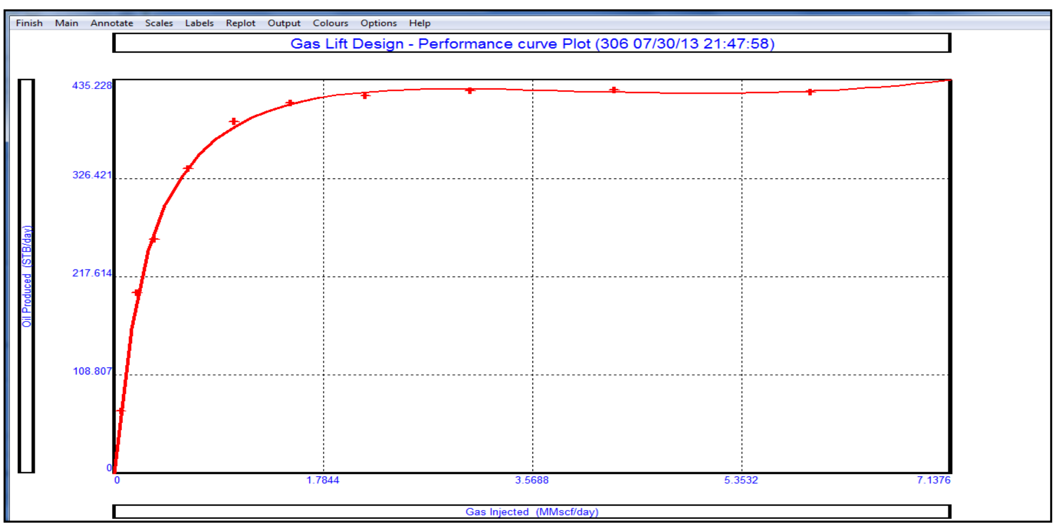


FIGURE 37. Gas Lift Design- Performance Curve Plot for B-306

The Gas Lift Design Performance Curve Plot for B-306 in the Figure 37above shows the increasing oil rate with respect to the gas lift injection rate curve trend. From the graph the optimum gas lift injection rate is 0.490 MMscf/day and the oil rate is 290.58 bbl/day.

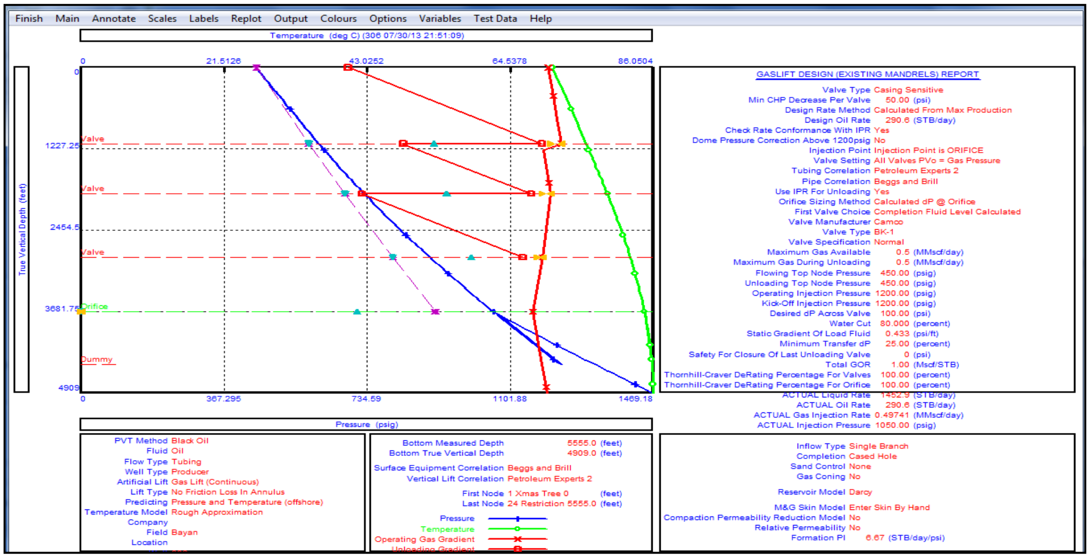
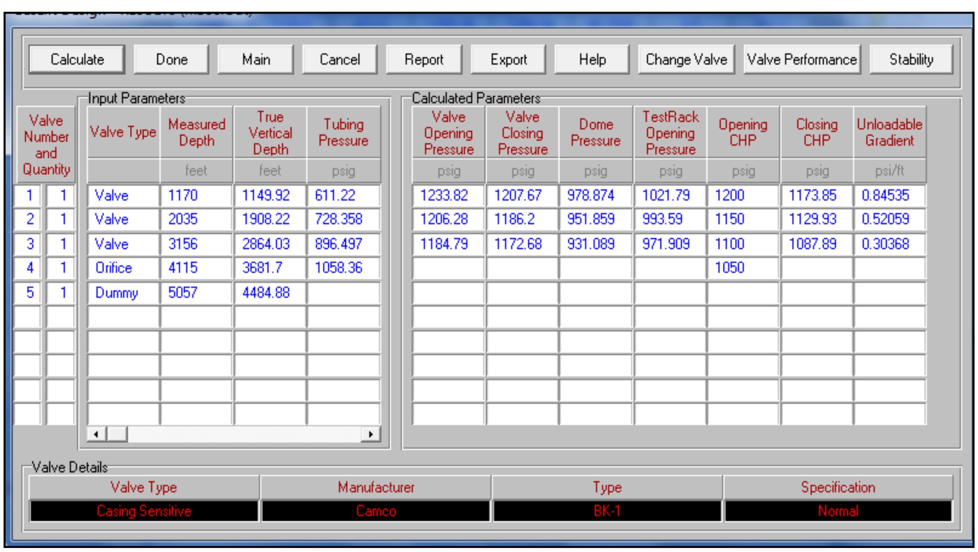


FIGURE 38.   Gas Lift Design Graph for B-306



Valve Number and Quantity		Valve Type	Measured Depth	True Vertical Depth	Tubing Pressure	Valve Opening Pressure	Valve Closing Pressure	Dome Pressure	TestRack Opening Pressure	Opening CHP	Closing CHP	Unloadable Gradient
			feet	feet	psig	psig	psig	psig	psig	psig	psig	psi/ft
1	1	Valve	1170	1149.92	611.22	1233.82	1207.67	978.874	1021.79	1200	1173.85	0.84535
2	1	Valve	2035	1908.22	728.358	1206.28	1186.2	951.859	993.59	1150	1129.93	0.52059
3	1	Valve	3156	2864.03	896.497	1184.79	1172.68	931.089	971.909	1100	1087.89	0.30368
4	1	Orifice	4115	3681.7	1058.36					1050		
5	1	Dummy	5057	4484.88								

Valve Details

Valve Type	Manufacturer	Type	Specification
Casing Sensitive	Camco	BK-1	Normal

FIGURE 39.   Results of the Gas Lift Design for B-306

Figure 38 shows the gas lift design which shows the injection point depth for the optimize flow in the well. For B-306, the injection point is at the depth of 5057 ft, while Figure 39 shows the new setting for the gas lift valve including the Port Size, Test Rack Opening Pressure, Types of Valve and the Depth for every installed valve type.

Well B-307

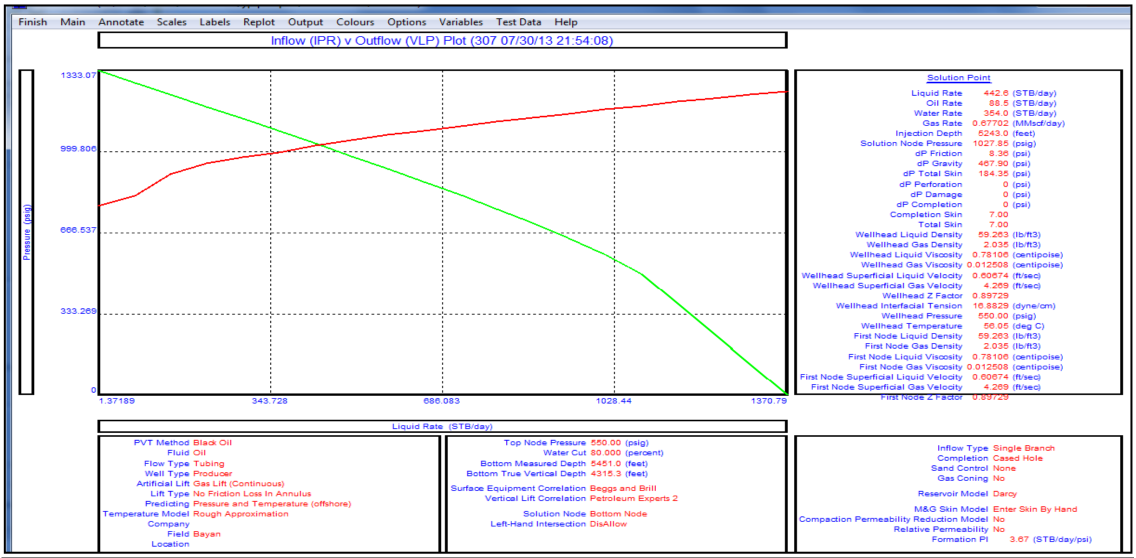


FIGURE 40. IPR/VLP curve for B-307

Figure 40 shows the IPR/VLP curve for well B-307. In this well the AOF is 1370.79 bbl/day. Moreover, the operating point is present at the rate of 442.6 bbl/day of liquid.

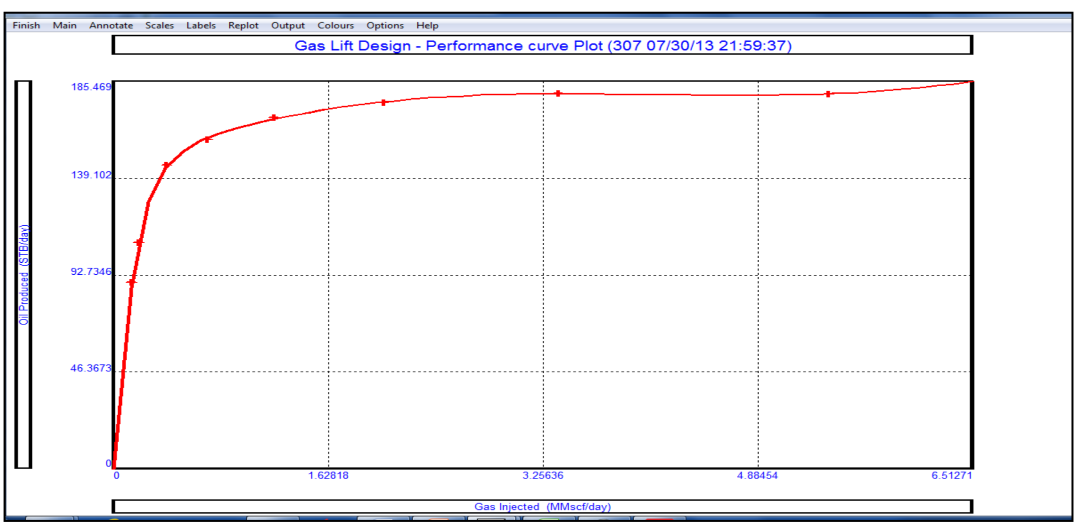


FIGURE 41. Gas Lift Design- Performance Curve Plot for B-307

The Gas Lift Design Performance Curve Plot for B-307 above shows the increasing oil rate with respect to the gas lift injection rate curve trend. From the graph the optimum gas lift injection rate is 0.446 MMscf/day and the oil rate is 147.63 bbl/day.

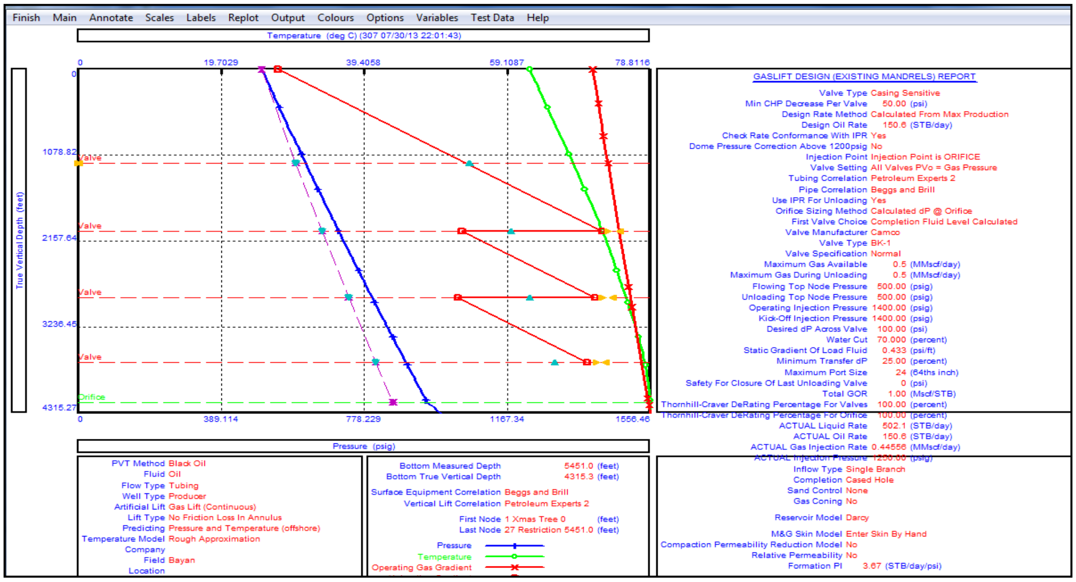
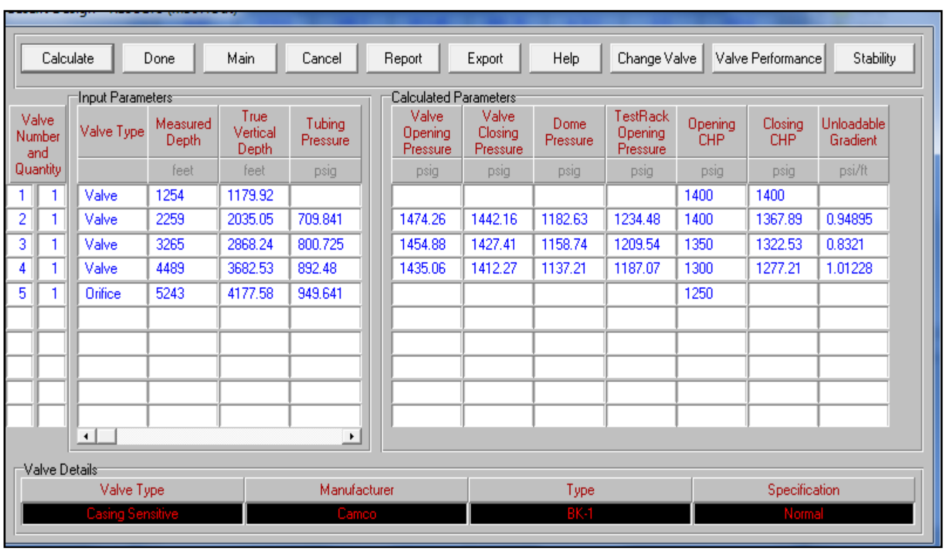


FIGURE 42. Gas Lift Design Graph for B-307



Valve Number and Quantity		Valve Type	Measured Depth (feet)	True Vertical Depth (feet)	Tubing Pressure (psig)	Valve Opening Pressure (psig)	Valve Closing Pressure (psig)	Dome Pressure (psig)	TestRack Opening Pressure (psig)	Opening CHP (psig)	Closing CHP (psig)	Unloadable Gradient (psi/ft)
1	1	Valve	1254	1179.92						1400	1400	
2	1	Valve	2259	2035.05	709.841	1474.26	1442.16	1182.63	1234.48	1400	1367.89	0.94895
3	1	Valve	3265	2868.24	800.725	1454.88	1427.41	1158.74	1209.54	1350	1322.53	0.8321
4	1	Valve	4489	3682.53	892.48	1435.06	1412.27	1137.21	1187.07	1300	1277.21	1.01228
5	1	Orifice	5243	4177.58	949.641					1250		

Valve Details

Valve Type	Manufacturer	Type	Specification
Casing Sensitive	Camco	BK-1	Normal

FIGURE 43. Results of the Gas Lift Design for B-307

Based on the results from the gas lift design in the Figure 42 and Figure 43, the optimum injection depth for B-307 is at 5243 ft.

Well B-308

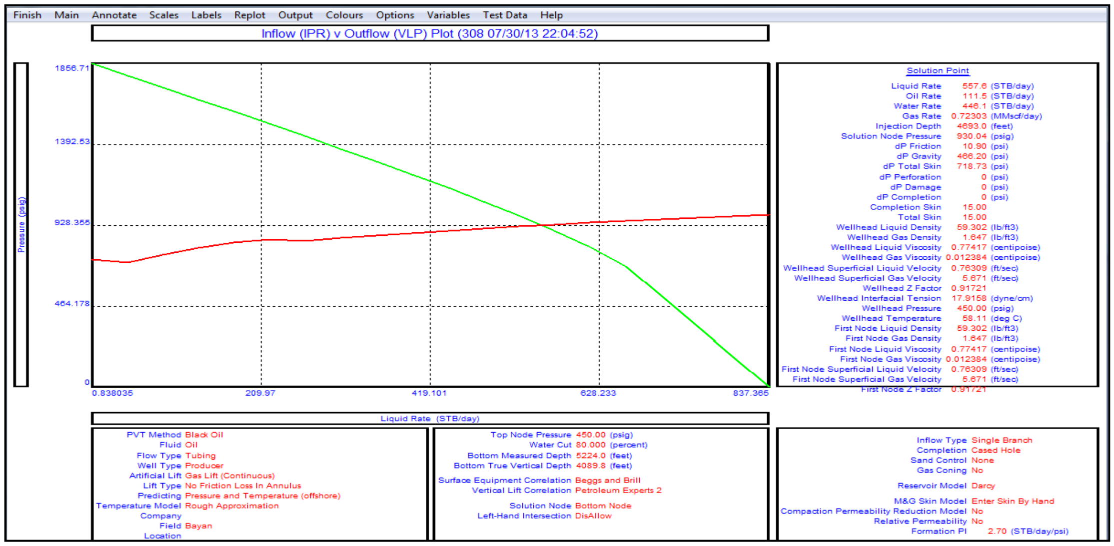


FIGURE 44. IPR/VLP curve for B-308

Figure 44 shows the IPR/VLP curve for well B-308.The AOF is observed to be 837.37 bbl/day. Moreover, the intersection of the IPR and the VLP curves which is the operating point is present at the rate of 557.6 bbl/day of liquid.

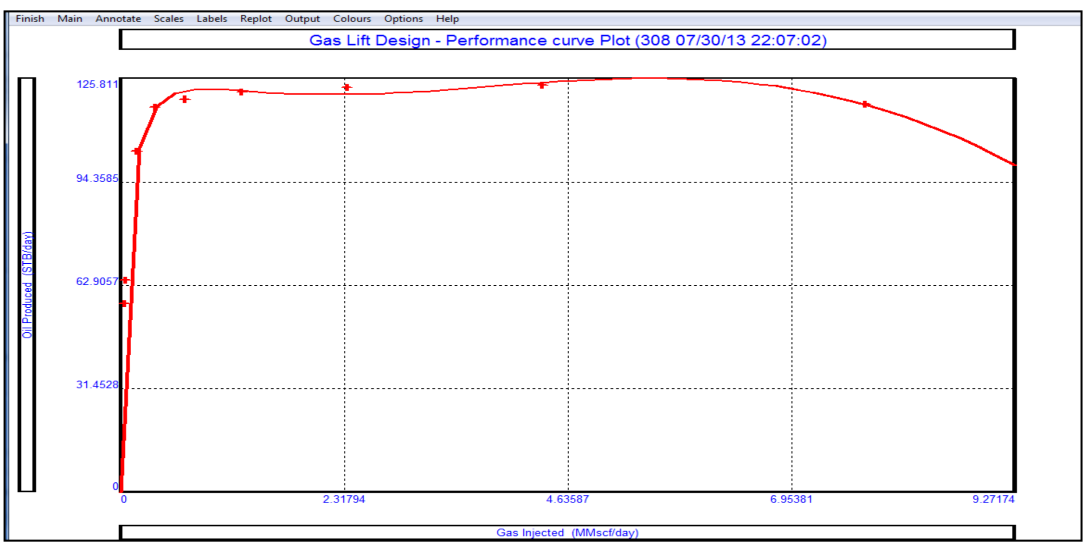


FIGURE 45. Gas Lift Design- Performance Curve Plot for B-308

The Gas Lift Design Performance Curve Plot for B-308 in the Figure 45 shows the increasing oil rate with respect to the gas lift injection rate curve trend. From the graph the optimum gas lift injection rate is 0.384 MMscf/day and the oil rate is 117.68 bbl/day.

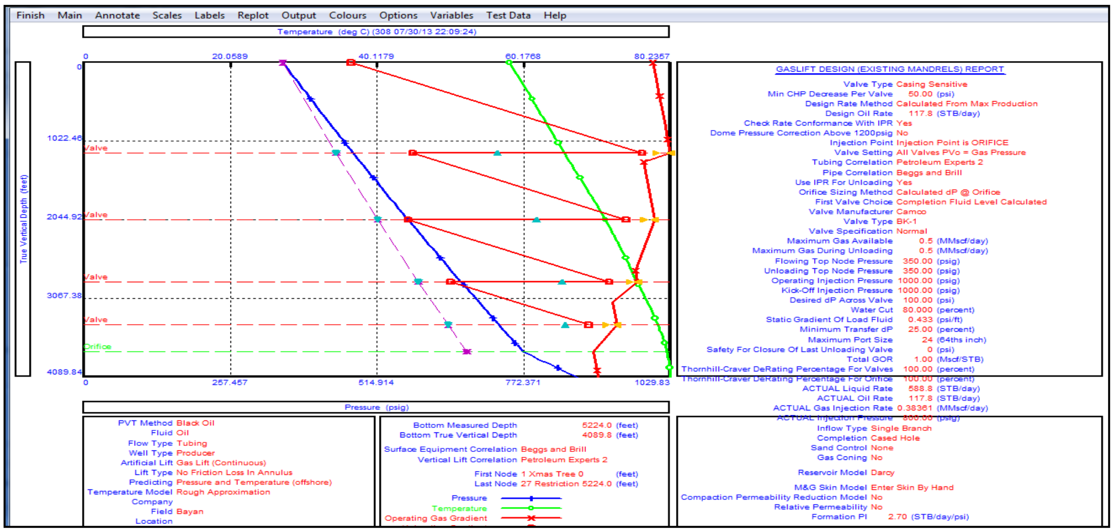
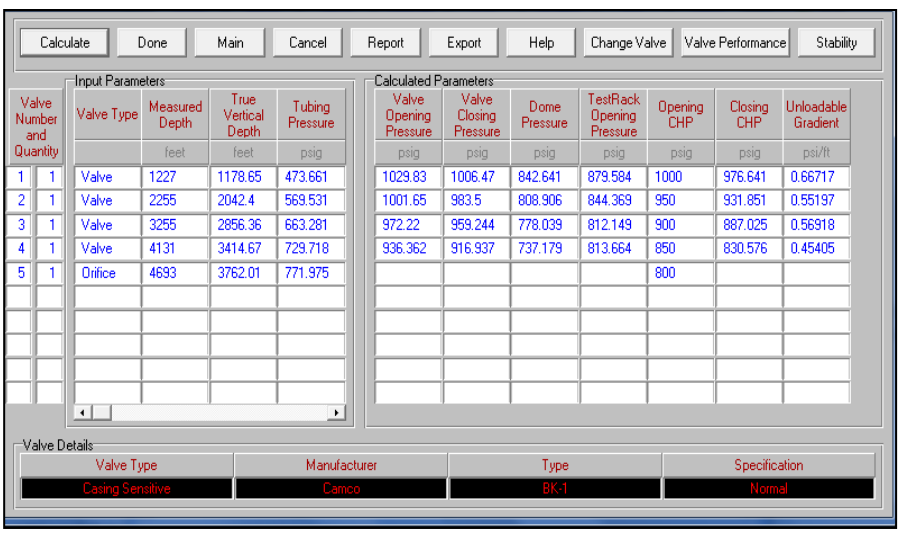


FIGURE 46. Gas Lift Design Graph for B-308



Valve Number and Quantity		Valve Type	Measured Depth (feet)	True Vertical Depth (feet)	Tubing Pressure (psig)	Valve Opening Pressure (psig)	Valve Closing Pressure (psig)	Dome Pressure (psig)	TestRack Opening Pressure (psig)	Opening CHP (psig)	Closing CHP (psig)	Unloadable Gradient (psi/ft)
1	1	Valve	1227	1178.65	473.661	1029.83	1006.47	842.641	879.584	1000	976.641	0.66717
2	1	Valve	2255	2042.4	569.531	1001.65	983.5	808.906	844.369	950	931.851	0.55197
3	1	Valve	3255	2856.36	663.281	972.22	959.244	778.039	812.149	900	887.025	0.56918
4	1	Valve	4131	3414.67	729.718	936.362	916.937	737.179	813.664	850	830.576	0.45405
5	1	Orifice	4693	3762.01	771.975					800		

Valve Details

Valve Type	Manufacturer	Type	Specification
Casing Sensitive	Camco	BK-1	Normal

FIGURE 47. Results of the Gas Lift Design for B-308

Based on the results from the gas lift design in the Figure 46, the optimum injection depth for B-308 is at 4693 ft. In addition, the new gas live valve setting is proposed from the gas lift design in the Figure 47.

Well B-309

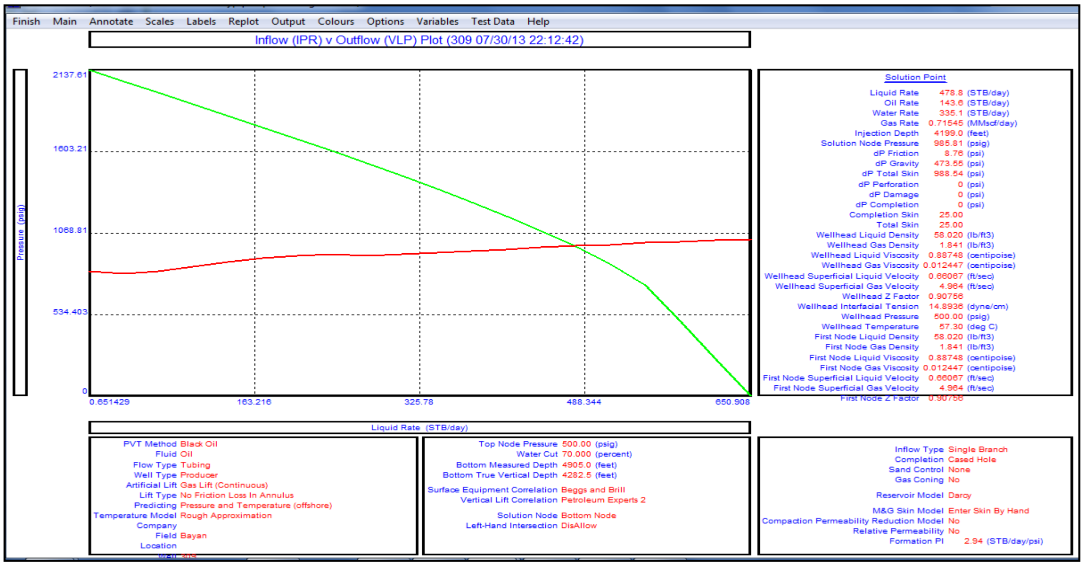


FIGURE 48. IPR/VLP curve for B-309

Figure 48 shows the IPR/VLP curve for well B-309. From the graph, the operating point can be observed and the Absolute Open Flow (AOF) can be obtained. In this well the AOF is 650.91. Moreover, the operating point is present at the rate of 478.8 bbl/day of liquid.

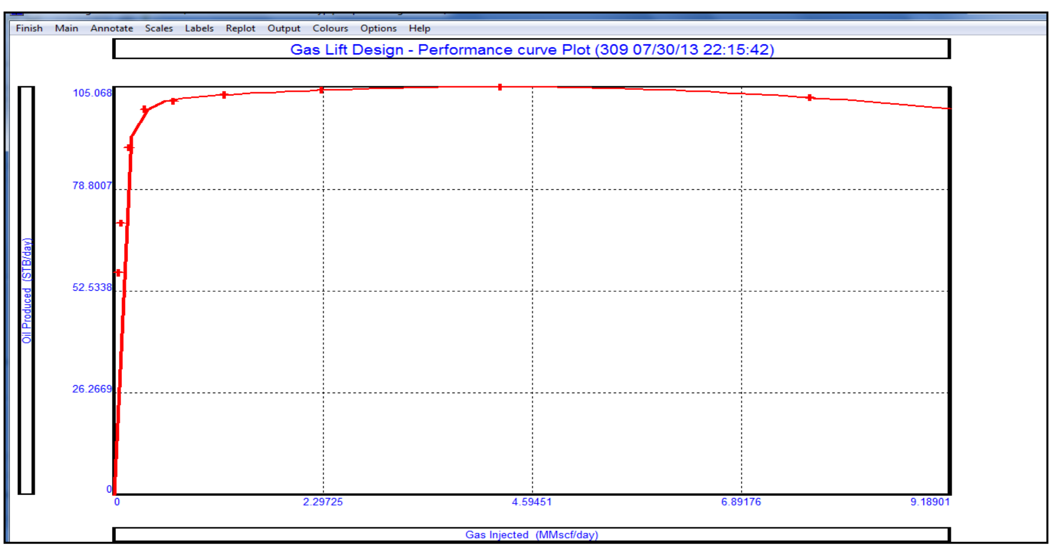


FIGURE 49. Gas Lift Design- Performance Curve Plot for B-309

The Gas Lift Design Performance Curve Plot for B-309 above shows the increasing oil rate with respect to the gas lift injection rate curve trend. From the graph the optimum gas lift injection rate is 0.344 MMscf/day and the oil rate is 100.88 bbl/day.

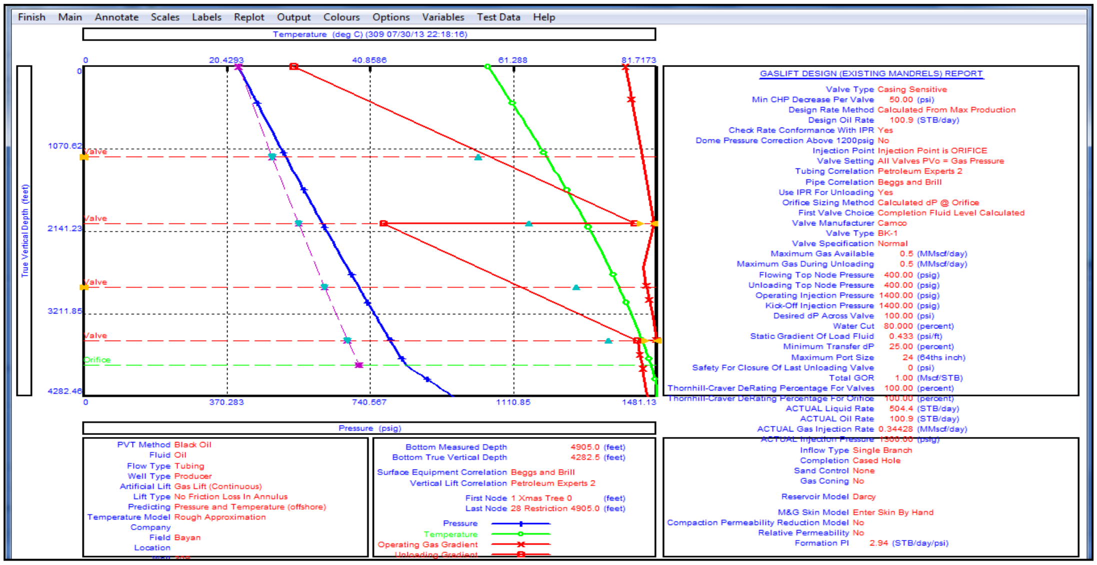
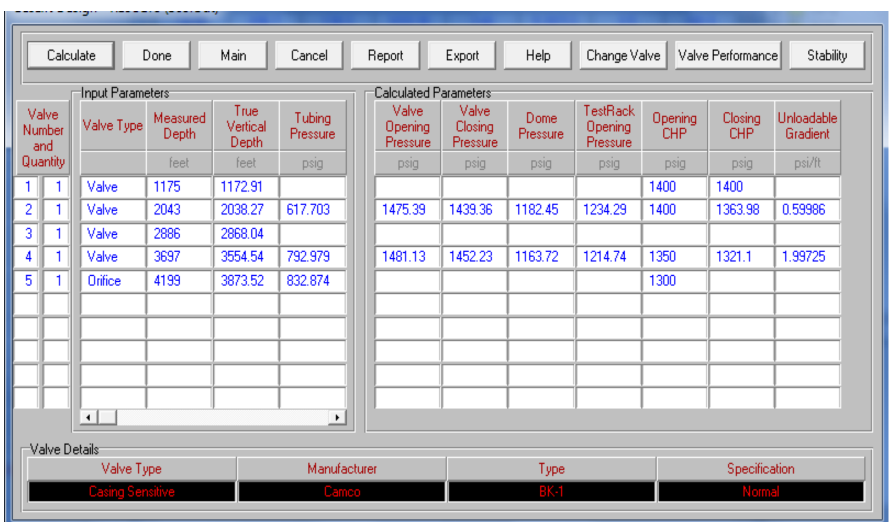


FIGURE 50. Gas Lift Design Graph for B-309



Valve Number and Quantity		Valve Type	Measured Depth (feet)	True Vertical Depth (feet)	Tubing Pressure (psig)	Valve Opening Pressure (psig)	Valve Closing Pressure (psig)	Dome Pressure (psig)	TestRack Opening Pressure (psig)	Opening CHP (psig)	Closing CHP (psig)	Unloadable Gradient (psi/ft)
1	1	Valve	1175	1172.91						1400	1400	
2	1	Valve	2043	2038.27	617.703	1475.39	1439.36	1182.45	1234.29	1400	1363.98	0.59986
3	1	Valve	2886	2868.04								
4	1	Valve	3697	3554.54	792.979	1481.13	1452.23	1163.72	1214.74	1350	1321.1	1.99725
5	1	Orifice	4199	3873.52	832.874					1300		

Valve Details

Valve Type	Manufacturer	Type	Specification
Casing Sensitive	Camco	BK-1	Normal

FIGURE 51. Results of the Gas Lift Design for B-309

Based on the results from the gas lift design, the optimum injection depth for B-309 is at 4199 ft.

TABLE 6. Result of Gas Lift Design for Eight Wells in Platform C, B-1 Field.

Well	Gas Lift Injection Rate (MMscf/day)	Point of Injection (MD-ft-THF)	Oil Rate (bbl/day)
B-301	0.49	4678	218.26
B-303	0.34	6750	115.43
B-304	0.48	4773	148.17
B-305	0.47	6061	192.18
B-306	0.49	5057	290.58
B-307	0.44	5242	147.63
B-308	0.38	4693	117.68
B-309	0.34	4199	100.88
TOTAL			1330.81

From the TABLE 6, the total oil production rate after the gas lift optimization is 1330.81 bbl/day showing that it is possible for the wells in Platform C to flow with the gas lift aid. Moreover, the oil production rate shown is the optimize rate from the gas lift design done in the PROSPER software with respect to the optimum injection gas rate and depth of injection point.

4.3 ECLIPSE100 Modeling- Reservoir Modeling and Prediction of Production Life of B-1 Field

After the results from the PROSPER modeling is obtained, the simulation continues with the ECLIPSE100 reservoir static and dynamic modeling. The modeling is done by running the Eclipse Data file with the parameter needed in the reservoir properties. The reservoir model is shown in the Figure 52, Figure 53and Figure 54.

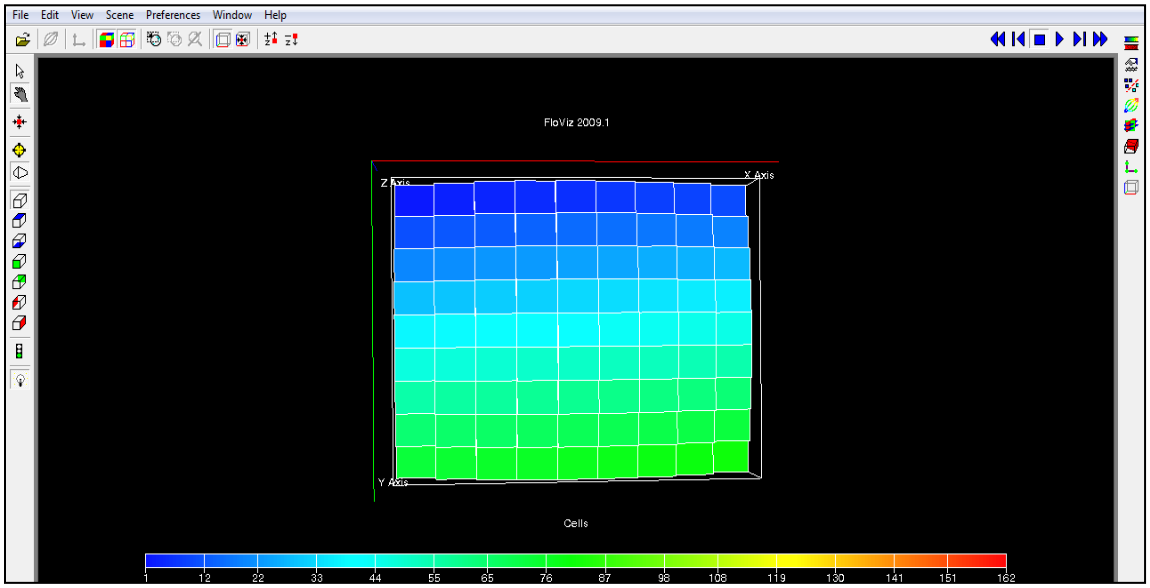


FIGURE 52. Top View of Reservoir Model

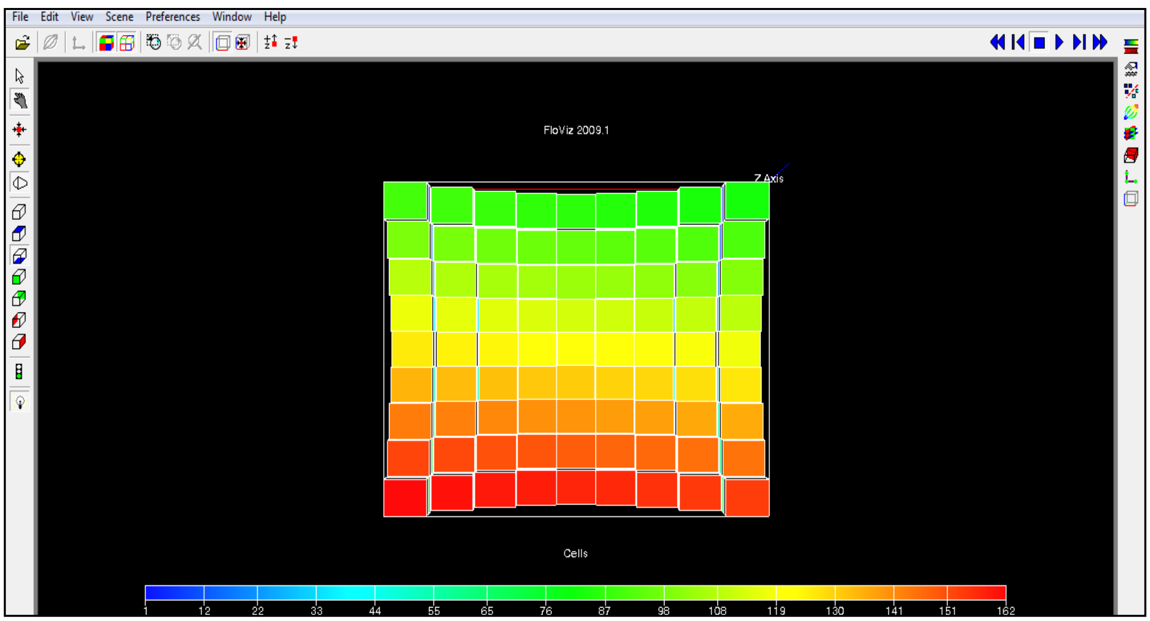


FIGURE 53. Bottom View of Reservoir Model

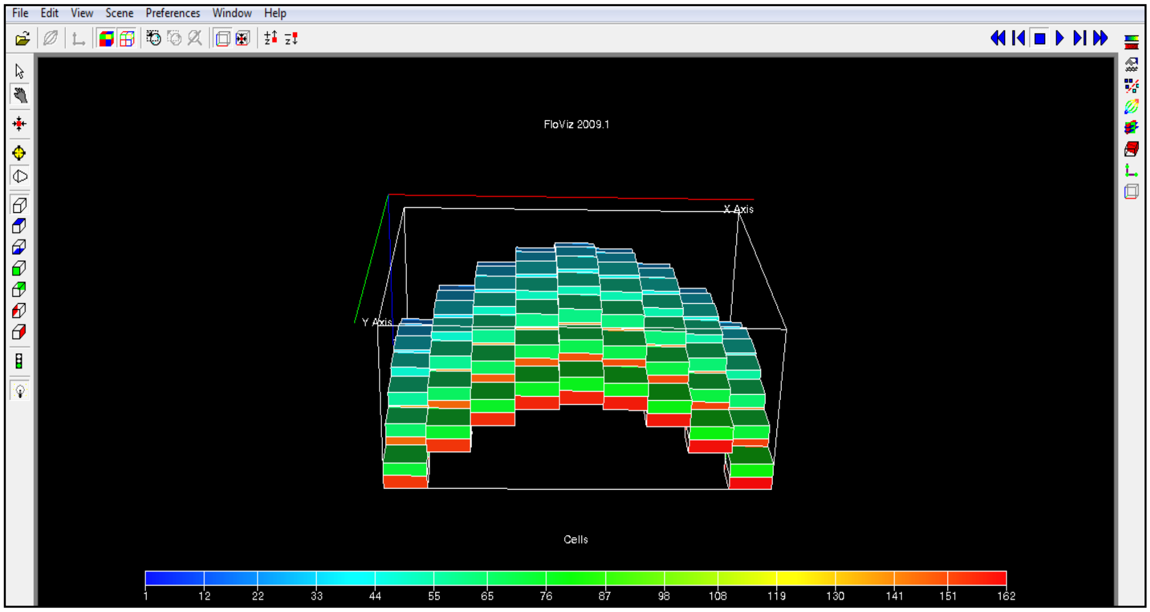


FIGURE 54. Front View of Reservoir Model

Besides that, from the reservoir modeling, the Field Oil Production Rate and Field Oil Production Total is obtained by running the prediction case study of 9125 days (25 years). The result is shown in the Figure 55 and Figure 56. The Field Oil Production Rate graph shows that the field production can sustain up to 25 years based on the prediction period of the production of the wells in Platform C. Although the graph shows decreasing trend curve, the rate of production is still high approximately 1000 stb/day up to 25 years of production.

Figure 56 shows the Field Oil Production Total of Platform C production rate up to 9125 days (25 years). The graph shows a linear increasing trend proving that the well will have increasing production rates in the 25 years production time.

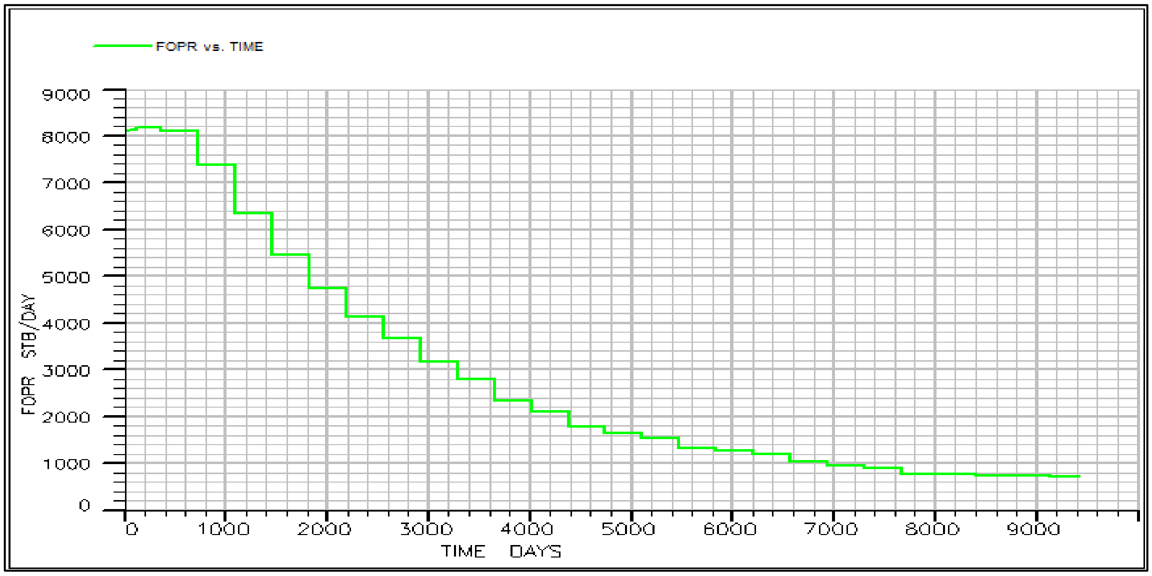


FIGURE 55. Field Oil Production Rate

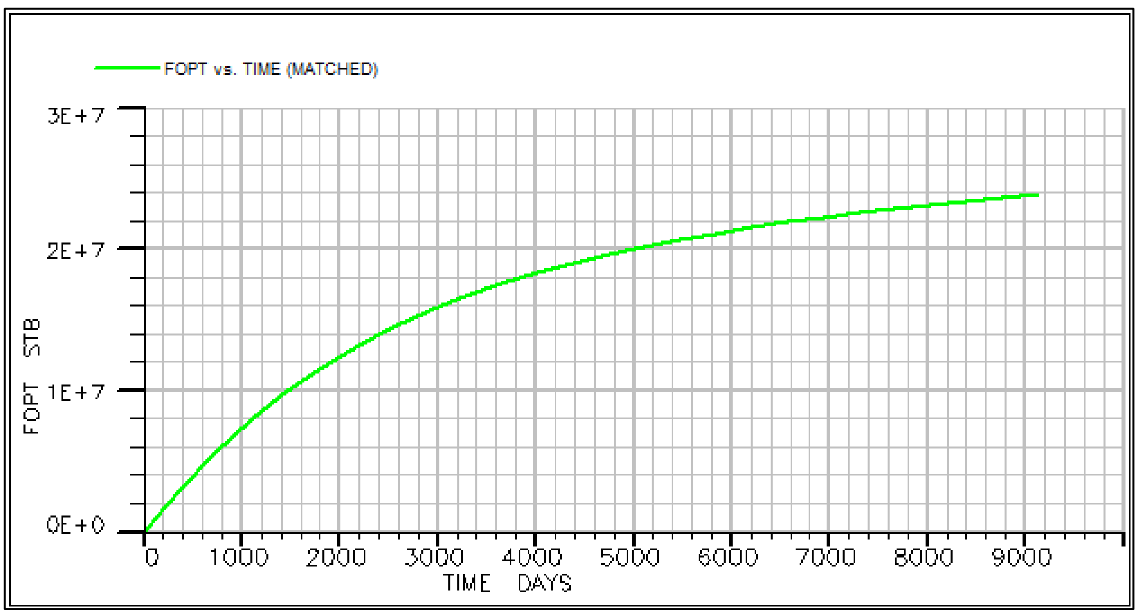


FIGURE 56. Field Oil Production Total

CHAPTER 5

DISCUSSIONS

5.1 PROSPER Modeling

In this project, the experimentation and modeling will be done by using the PROSPER software in the first and second phase. While in the third phase, the modeling will be done in ECLIPSE 100.By using the software, the performance of the wells in Platform C can be observed. The observation of the well performances is very crucial because it relates to the production and gain of the reservoir daily. Moreover by modeling, performance of the well can be optimized and optimum oil gain can be produced.

In this project, the well models for eight wells in PROSPER is first generated without the gas lift facilities which is for the Base Case. This is to prove that there is no production in Platform C in the early years because of the high water cut percentage in the reservoir in Platform C. This is done by using the relevant data from the field to do the comparison of the PROSPER model. From the modeling, the production rate is zero bbl/day which shows that the wells in the field need an aid to flow.

The reason for the well cannot flow is because there is no intersection between the Inflow Performance and Vertical Lift Performance. In other word, the well has no operating point and thus cannot flow. Therefore, to flow the wells and to optimize the production of the wells in Platform C, this project is proposed. Gas lift is chosen because one of the well in Platform C which is B-310 has been identified as a natural gas reservoir and thus is very suitable to be the gas lift source for the project and on the other hand known as one of the efficient artificial lift method. The result of the project which is modeling the well and optimizing the production with the aid of gas lift is discussed in this chapter.

By using the data from the well, the modeling is done is done in the PROSPER software and it is proven that the well cannot flow in the early years due to the high water cut, thus this project will apply the gas lift optimization to allow the wells to produce. The gas lift design is done to obtain the optimized injection gas lift rate and the best injection depth for every well. In the gas lift principle, the deeper the injection depth, the higher the oil rate produced. Therefore in this project, the principle is used as the guidance in the gas lift design. Currently there are 8 wells in Platform C, which are B-301, B-303, B-304, B-305, B-306, B-307, B-308 and B-309.

The production rate is analyzed from the IPR/VLP generated. From the IPR/VLP curve, the liquid rate and oil rate is known thus showing that there is increase in production for every well when gas lift is applied in the well to assist the production. Moreover, the production rate is basically known from the intersection point of the IPR and VLP, and in the other hand showing the relationship of the flow from the reservoir and the flow through the tubing up to the surface. Furthermore, the value of AOF is also known from the IPR/VLP curve which shows the maximum flow rate that can be obtained when the bottom hole flowing pressure is equal to zero. The production rate is the highest the well can achieve with the minimum rate of injection. Thus, the cost in gas lift injection can be reduced when the optimum volume of gas injection rate is known based on the gas lift design.

Furthermore, from the gas lift design, the new setting of the gas lift will be shown in the results table. The information given in the result table are the gas lift valve types with respect to its depth setting, transfer pressure, gas lift gas rate, port size, tubing head pressure and casing pressure. This information is very useful in the gas lift design so that the proper well accessories can be installed and thus gas lift system can work properly in the well. Table 7shows the example of comparison of the well's Existing Valve and the Proposed Design that can be done from the gas lift design results.

TABLE 7. Comparison on the Existing Valve and the Proposed Design for B-301

EXISTING VALVE				PROPOSED DESIGN			
VALVE TYPE	**DEPTH**	**TEST RACK OPENING**	**PORT SIZE**	**VALVE TYPE**	**DEPTH**	**TEST RACK OPENING**	**PORT SIZE**
Dummy	1175	N/A	N/A	Dummy	1175	N/A	N/A
Dummy	2027	N/A	N/A	Valve	2027	1263.3	8/64"
Dummy	2933	N/A	N/A	Dummy	2933	N/A	N/A
Orifice	3808	N/A	12/64 "	Valve	3808	1258.11	8//64"
Dummy	4678	N/A	N/A	Orifice	4678	N/A	9/64"

The existing valve is based on the wellbore diagram of well B-301. Based on the table it is observed that the new proposed design gives more information than the existing design. Moreover, the injection point which is the Orifice is changing from the depth of 3808 ft in the existing valve to the deepest point 4678 ft in the new propose design. The changes are made in order to optimize the production of the well based on the data input. The change of the gas lift injection point will require the Gas Lift Change Valve (GLVC) operation, where the type of valve is change. For example, a dummy is changed to the gas lift valve so that the gas lift injection operation can be done at the selected depth.

5.2 ECLIPSE100 Modeling

After the first and second phase of the project is completed in the PROSPER software, the project continues with the third phase which is the reservoir modeling and prediction of production life of the eight wells in the Platform C, B-1 Field. The reservoir static and dynamic model is created using suitable keywords for the gas lifted wells. Then the reservoir model is run and the time step is set to be 9125 days to observe the production of the well in 25 years. Based on the graph in the Figure 55 and Figure 56 in the Results chapter, it is shown that the wells in Platform C will be able to produce up to 25 years. This prediction result is very useful because it gives the insight of the reservoir ability to produce in a long time for the economic benefits in the future.

CHAPTER 6

CONCLUSION AND RECOMMENDATION

4.1 Conclusion

As the conclusion, the objectives of this project are successfully achieved. The first objective which is to remodel the wells in Platform C, B-1 Field using relevant data is accomplished by modeling the eight wells in the PROSPER software. For every well matching is done and IPR/VLP curve is generated. Moreover, the second objective, which is to optimize the production of the wells in B-1 Field is achieved by adding the gas lift facility in every well. By designing the gas lift, the injection depth and injection gas rate is proposed to have the optimum oil production rates from the eight wells in Platform C, B-1 Field. Furthermore, the third objective is also successfully achieved which is to predict the production life of the wells in B-1 Field by modeling the dynamic reservoir with the case study of time step of 25 years in the ECLIPSE100 software.

TABLE 8 Results of the Case Studies of PROSPER modeling

Case Study	Estimated Gain(bopd)
Base Case(without Gas lift)	0
Case 2 (Gas lift all wells with optimized gas lift parameters)	1330.81

Based on the two cases that have been completed in the first phase and second phase of this project, Base Case shows that the production rate is zero. Therefore, wells in Platform C is proven cannot flow without artificial lift aid. For the Case 2, where all the wells are gas lifted, the total flowing rate is 1330.81 STB/day of oil.

Using the main tools which are the PROSPER software and ECLIPSE 100 software; the project can be done smoothly. In PROSPER; optimization will be done to all the wells with the concept of Nodal Analysis. Furthermore, using PROSPER, graph of IPR and VLP will be generated in order to identify the operating point, thus giving the well's production rate daily. Then, the process will be followed by the gas lift optimization. Next, the project progress will be followed by the dynamic reservoir modeling in ECLIPSE 100 software in order to complete the objectives of this project.

Furthermore, relevant data is gathered for every well in Platform C be the input in the software which will be used. The project activities are referred to the Gantt Chart and Key Milestone to make sure that the project runs smoothly within the time given.

4.2 Recommendations

There are some recommendations to improve the project in the future which are; firstly the data for every well can be improved by sorting out the relevant data by choosing the latest data available so that the results of the study will be more accurate. Moreover, the software which is PROSPER software and ECLIPSE 100 software must be in the latest version so that more option is available in doing the simulation. Furthermore, the license of the software shall be keep in view to be available at all times in the university facility so that students can proceed with the project without any delay.

4.3 Future Plans

In the future the project research can be extended into broader study by adding more case studies to compare and have more accurate results. Moreover, more parameters should be used for the comparison of the results of the case studies. Furthermore, for the dynamic reservoir modeling, the studies should be extended to the whole field production prediction and larger reservoir model in order to maximize the oil production rate with the information on the production life of the field.

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APPENDICES

APPENDIX 1- NOMENCLATURE

1. *GOR* - Gas Oil Ratio
2. *IPR* - Inflow Performance Relationship
3. *PVT* - Pressure Volume Temperature
4. *THP* - Tubing Head Pressure
5. *TRO* - Test Rack Opening
6. *VLP* - Vertical Lift Performance
7. *WC* - Water Cut

APPENDIX 2-ECLIPSE FILENAME.DATA FILE

ECLIPSE100 FILENAME.DATA file

```
RUNSPEC
TITLE
  GAS LIFT OPTIMISATION TEST 9 X 9 X 2 - NO NETWORK

DIMENS
   9    9    2  /

OIL

WATER

FIELD

TABDIMS
   1    1   20    4    1    2 /

WELLDIMS
  12    12    4    12 /

VFPPDIMS
   20    10    10    10    2    50 /

START
  1 'JAN' 2013  /

NSTACK
   4 /

GRID        ==================================================

INIT

GRIDFILE
2  1 /
```

```
EQUALS
    'DX'     400     /
    'DY'     300     /
    'DZ'     200    /
    'PORO'   0.22    /
    'PERMX'  1573    /
    'PERMY'  1573    /
    'PERMZ'  100     /
/

BOX

 1  9  1  9  1  1 /

TOPS

 2202  2145  2105  2080  2072  2080  2105  2145  2202
 2170  2113  2073  2049  2041  2049  2073  2113  2170
 2147  2090  2050  2026  2018  2026  2050  2090  2147
 2133  2077  2037  2013  2005  2013  2037  2077  2133
 2129  2072  2032  2008  2000  2008  2032  2072  2129
 2133  2077  2037  2013  2005  2013  2037  2077  2133
 2147  2090  2050  2026  2018  2026  2050  2090  2147
 2170  2113  2073  2049  2041  2049  2073  2113  2170
 2202  2145  2105  2080  2072  2080  2105  2145  2202  /

ENDBOX

RPTGRID
   -- Report Levels for Grid Section Data
   --
   'DEPTH'
 /

PROPS    ============================================================

SWFN
0.22   0.0   0.48
0.3    0.07  0.27
0.4    0.15  0.21
0.5    0.24  0.17
0.6    0.33  0.14
0.8    0.65  0.07
0.9    0.83  0.03
1.0    1.0   0.0   /

SOF2
0.04   0.0
0.1    0.022
0.2    0.1
0.3    0.24
0.4    0.34
0.5    0.42
0.6    0.5
0.7    0.8125
0.78   1.0    /

PVTW
0           1.0356    3.2002E-06    0.3133  0  /

ROCK
```

```
2144.00    3.25e-6   /

DENSITY
52.407   62.634   0.0607   /

PVDO
2144.00            1.4281       0.4784
2214.70            1.4261       0.4815
 /

RSCONST
 1.253     2144  /

RPTPROPS

SOLUTION   ============================================================

EQUIL
 3896.00 2143.00 4928.00  .00000 1000.00  .00000     0      0      0 /

RPTSOL
   --
   -- Initialisation Print Output
   --
'PRES' 'SWAT' 'FIP=1' /

SUMMARY   =========================================================

FOPR

FOPT

FWCT

FGOR

FGLIR

WOPR
'PA301'  'PA303'  'PA304'  'PA305'  'PA306'  'PA307'  'PA308'  'PA309'  /

WWCT
'PA301'  'PA303'  'PA304'  'PA305'  'PA306'  'PA307'  'PA308'  'PA309'  /

WGLIR
'PA301'  'PA303'  'PA304'  'PA305'  'PA306'  'PA307'  'PA308'  'PA309'  /

RUNSUM

SCHEDULE  =========================================================

RPTSCHED
   'PRES' 'SWAT' 'FIP=1' 'WELLS=2' 'SUMMARY=2' 'CPU=2' 'WELSPECS' 'NEWTON=2'
/

NOECHO

--PRODUCTION WELL VFP TABLE   1

VFPPROD
-- Table   Datum Depth   Rate Type   WFR Type   GFR Type   THP Type   ALQ Type    UNITS     TAB Type
-- -----   -----------   ---------   --------   --------   --------   --------   --------   --------
```

```
     1      4930.01        LIQ       WCT       GOR       THP       ' '     FIELD       BHP /
-- LIQ units - stb/day
   2.3   121.9   241.5   361.1   480.7
  600.3   719.9   839.5   959.1  1078.7
 1198.3  1317.9  1437.5  1557.1  1676.7
 1796.3  1915.9  2035.5  2155.1  2274.7 /

-- THP units - Psia
  464.7 /

-- WCT units - stb/stb
 0.85 /

-- GOR units - Mscf/stb
     0 /

-- ' ' units -
     0.5 /

 1  1  1  1   833.5   793.7   882.4   926.2   959.5
            990.7  1018.9  1043.7  1065.8  1086.4
           1105.7  1124.1  1142.0  1159.4  1176.5
           1193.5  1210.3  1227.1  1243.9  1260.7
/
VFPPROD
-- Table   Datum Depth   Rate Type   WFR Type   GFR Type   THP Type   ALQ Type    UNITS     TAB Type
-- -----   -----------   ---------   --------   --------   --------   --------   --------   --------
     2      5051.91        LIQ       WCT       GOR       THP       ' '     FIELD       BHP /

-- LIQ units - stb/day
   0.5    27.3    54.2    81.0   107.8
  134.7   161.5   188.3   215.2   242.0
  268.8   295.6   322.5   349.3   376.1
  403.0   429.8   456.6   483.5   510.3 /

-- THP units - Psia
  464.7 /

-- WCT units - stb/stb
 0.65 /

-- GOR units - Mscf/stb
     0 /

-- ' ' units -
     0.5 /

 1  1  1  1   872.5   832.3   797.8   782.9   778.3
            807.2   833.0   854.7   867.7   879.1
            890.4   900.6   909.9   918.5   926.5
            934.0   941.1   948.2   955.5   962.7
/

VFPPROD
-- Table   Datum Depth   Rate Type   WFR Type   GFR Type   THP Type   ALQ Type    UNITS     TAB Type
-- -----   -----------   ---------   --------   --------   --------   --------   --------   --------
     3      4930.72        LIQ       WCT       GOR       THP       ' '     FIELD       BHP /

-- LIQ units - stb/day
   2.2   116.4   230.6   344.8   459.0
  573.2   687.4   801.6   915.8  1030.0
 1144.2  1258.4  1372.6  1486.8  1601.0
```

```
 1715.2  1829.4  1943.6  2057.8  2172.0 /

-- THP units - Psia
  464.7 /

-- WCT units - stb/stb
  0.8 /

-- GOR units - Mscf/stb
     0.5 /

-- ' ' units -
     0 /

 1  1  1  1   821.8   866.5   911.5   955.2   992.6
            1028.1  1057.6  1082.8  1105.0  1125.2
            1144.1  1162.5  1180.3  1197.7  1214.6
            1231.0  1247.4  1263.4  1279.3  1295.1
/


VFPPROD
-- Table   Datum Depth   Rate Type   WFR Type   GFR Type   THP Type   ALQ Type    UNITS     TAB Type
-- -----   -----------   ---------   --------   --------   --------   --------   --------   --------
      4       5111.87        LIQ       WCT       GOR       THP       ' '     FIELD       BHP /

-- LIQ units - stb/day
    2.2   117.3   232.4   347.5   462.6
  577.7   692.8   807.9   923.0  1038.2
 1153.3  1268.4  1383.5  1498.6  1613.7
 1728.8  1843.9  1959.0  2074.1  2189.2 /

-- THP units - Psia
  314.7 /

-- WCT units - stb/stb
 0.85 /

-- GOR units - Mscf/stb
     0 /

-- ' ' units -
     0.5 /

 1  1  1  1   725.9   598.3   699.0   752.3   787.4
             817.5   846.3   873.1   898.2   921.7
             943.9   965.3   985.9  1006.2  1026.2
            1045.9  1065.7  1085.4  1105.2  1125.0
/
VFPPROD
-- Table   Datum Depth   Rate Type   WFR Type   GFR Type   THP Type   ALQ Type    UNITS     TAB Type
-- -----   -----------   ---------   --------   --------   --------   --------   --------   --------
      5         4909        LIQ       WCT       GOR       THP       ' '     FIELD       BHP /

-- LIQ units - stb/day
    4.6   245.7   486.9   728.0   969.1
 1210.3  1451.4  1692.5  1933.7  2174.8
 2415.9  2657.1  2898.2  3139.3  3380.5
 3621.6  3862.7  4103.9  4345.0  4586.1 /

-- THP units - Psia
  614.7 /
```

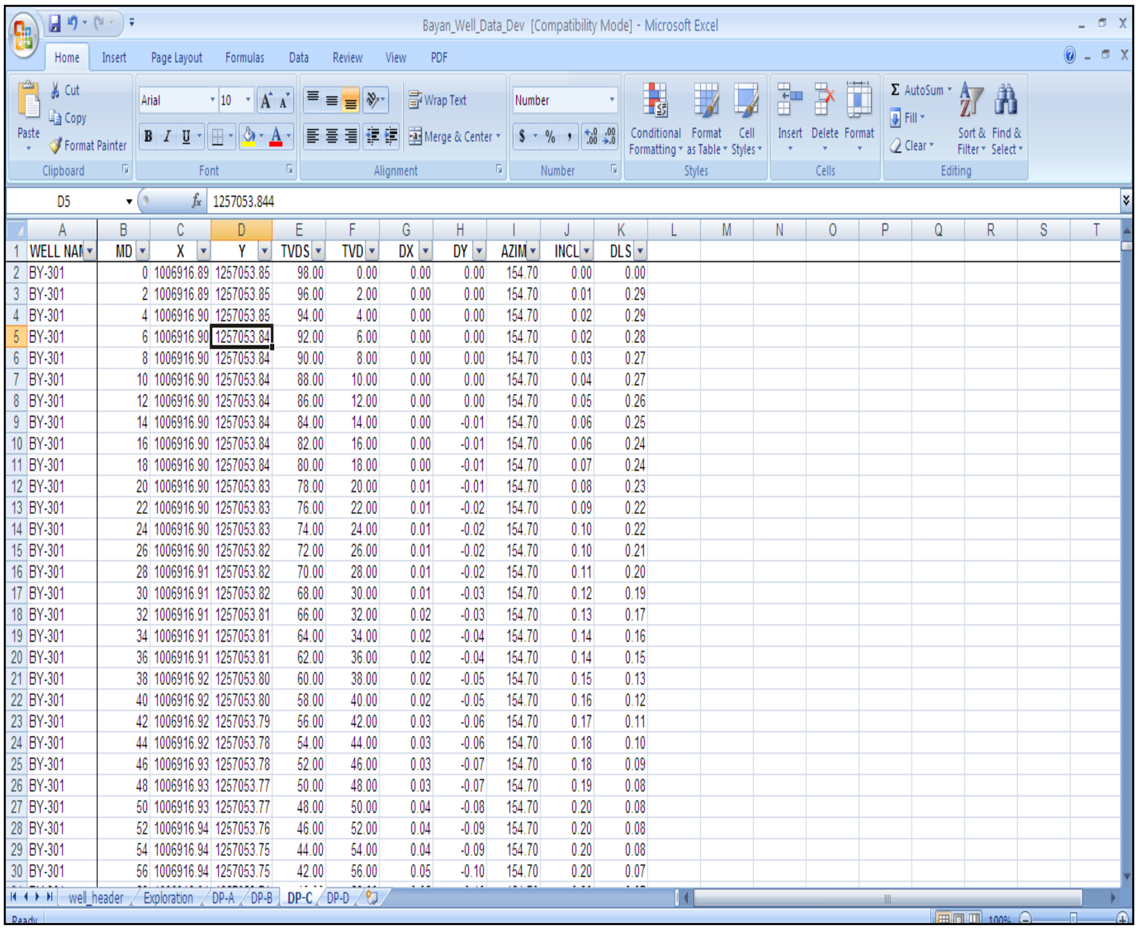
```
-- WCT units - stb/stb
 0.85 /

-- GOR units - Mscf/stb
     0 /

-- ' ' units -
     0.5 /

 1  1  1  1   856.9  1095.3  1206.1  1318.1  1424.7
            1514.9  1625.3  1711.1  1780.8  1838.0
            1887.8  1930.7  1970.3  2006.4  2040.3
            2073.3  2104.2  2133.2  2161.5  2189.7
/

VFPPROD
-- Table   Datum Depth   Rate Type   WFR Type   GFR Type   THP Type   ALQ Type    UNITS     TAB Type
-- -----   -----------   ---------   --------   --------   --------   --------   --------   --------
      6       4315.27        LIQ       WCT       GOR       THP       ' '     FIELD       BHP /

-- LIQ units - stb/day
    1.4    73.4   145.5   217.6   289.7
  361.7   433.8   505.9   578.0   650.0
  722.1   794.2   866.3   938.3  1010.4
 1082.5  1154.6  1226.6  1298.7  1370.8 /

-- THP units - Psia
  564.7 /

-- WCT units - stb/stb
  0.8 /

-- GOR units - Mscf/stb
     0 /

-- ' ' units -
     0.5 /

 1  1  1  1   793.3   834.6   922.8   966.7   994.5
            1012.2  1039.7  1063.2  1083.6  1102.2
            1120.5  1138.2  1155.5  1172.2  1188.4
            1204.1  1219.7  1235.4  1249.9  1264.0
/

VFPPROD
-- Table   Datum Depth   Rate Type   WFR Type   GFR Type   THP Type   ALQ Type    UNITS     TAB Type
-- -----   -----------   ---------   --------   --------   --------   --------   --------   --------
      7       4089.84        LIQ       WCT       GOR       THP       ' '     FIELD       BHP /

-- LIQ units - stb/day
    0.8    44.9    88.9   132.9   176.9
  221.0   265.0   309.0   353.1   397.1
  441.1   485.1   529.2   573.2   617.2
  661.3   705.3   749.3   793.3   837.4 /

-- THP units - Psia
  464.7 /

-- WCT units - stb/stb
  0.8 /
```

```
-- GOR units - Mscf/stb
     0 /

-- ' ' units -
     0.5 /

 1  1  1  1   746.7   732.8   773.9   815.2   847.5
             866.2   856.9   871.5   884.3   897.7
             911.6   925.1   937.4   948.8   959.3
             969.2   978.4   987.2   995.5  1003.4
/

VFPPROD
-- Table   Datum Depth   Rate Type   WFR Type   GFR Type   THP Type   ALQ Type    UNITS     TAB Type
-- -----   -----------   ---------   --------   --------   --------   --------   --------   --------
      8       4282.46         LIQ        WCT         GOR         THP         ' '      FIELD        BHP /

-- LIQ units - stb/day
    0.7    34.9    69.1   103.3   137.5
  171.8   206.0   240.2   274.4   308.7
  342.9   377.1   411.3   445.6   479.8
  514.0   548.2   582.5   616.7   650.9 /

-- THP units - Psia
  514.7 /

-- WCT units - stb/stb
  0.7 /

-- GOR units - Mscf/stb
     0 /

-- ' ' units -
     0.5 /

 1  1  1  1   837.5   820.0   835.7   864.9   896.9
             921.7   936.9   948.6   936.6   947.7
             957.7   968.2   979.3   990.4  1000.8
            1010.5  1019.6  1028.2  1036.2  1043.9
/

ECHO
--

WELSPECS
'PA301'  'A'  1  7   5259  'OIL'        1489   'STD'   'SHUT' /
'PA303'  'A'  1  3   7755  'OIL'        1489   'STD'   'SHUT' /
'PA304'  'A'  4  7   5295  'OIL'        1489   'STD'   'SHUT' /
'PA305'  'A'  1  5   6869  'OIL'        1489   'STD'   'SHUT' /
'PA306'  'A'  7  2   5629  'OIL'        1489   'STD'   'SHUT' /
'PA307'  'A'  8  4   6290  'OIL'        1489   'STD'   'SHUT' /
'PA308'  'A'  6  6   6037  'OIL'        1489   'STD'   'SHUT' /
'PA309'  'A'  5  3   5569  'OIL'        1489   'STD'   'SHUT' /

/

COMPDAT
'PA301'  1  7  1  2  OPEN  1          1   1 /
'PA303'  1  3  1  2  OPEN  1          1   1 /
'PA304'  4  7  1  2  OPEN  1          1   1 /
'PA305'  1  5  1  2  OPEN  1          1   1 /
'PA306'  7  2  1  2  OPEN  1          1   1 /
```

```
'PA307'  8  4  1  2  OPEN  1          1   1 /
'PA308'  6  6  1  2  OPEN  1          1   1 /
'PA309'  5  3  1  2  OPEN  1          1   1 /
/

WCONPROD
'PA301'  'OPEN'  'THP'   5000  3*  1*  1395   464.7   1  /
'PA303'  'OPEN'  'THP'   5000  3*  1*  1844   463.7   2  /
'PA304'  'OPEN'  'THP'   5000  3*  1*  1526   464.7   3  /
'PA305'  'OPEN'  'THP'   5000  3*  1*  1979   314.7   4  /
'PA306'  'OPEN'  'THP'   5000  3*  1*  1937   614.7   5  /
'PA307'  'OPEN'  'THP'   5000  3*  1*  1334   564.7   6  /
'PA308'  'OPEN'  'THP'   5000  3*  1*  1858   464.7   7  /
'PA309'  'OPEN'  'THP'   5000  3*  1*  2139   514.7   8  /

WEFAC
'PA301'  0.8  /
'PA303'  0.8  /
'PA304'  0.8  /
'PA305'  0.8  /
'PA306'  0.8  /
'PA307'  0.8  /
'PA308'  0.8  /
'PA309'  0.8  /
/
LIFTOPT
-- increment    minimum    optimisation    opt in 1st
--   size       gradient     interval       NUPCOL its?
     0.2         0.1          0.5  /

WLIFTOPT
-- well  optimise   max lift   weighting
-- name    lift?    gas rate    factor
'PA301'   'NO'    0.5   1    0.1 /
'PA303'   'NO'    0.5   1    0.1 /
'PA304'   'NO'    0.5   1    0.1 /
'PA305'   'NO'    0.5   1    0.1 /
'PA306'   'NO'    0.5   1    0.1 /
'PA307'   'NO'    0.5   1    0.1 /
'PA308'   'NO'    0.5   1    0.1 /
'PA309'   'NO'    0.5   1    0.1 /

/

WTEST
'PA301'  49.0  'P' /
'PA303'  49.0  'P' /
'PA304'  49.0  'P' /
'PA305'  49.0  'P' /
'PA306'  49.0  'P' /
'PA307'  49.0  'P' /
'PA308'  49.0  'P' /
'PA309'  49.0  'P' /
/

DEBUG
 1 0 34*0 3 /

TSTEP
9125 /

RPTSCHED
```

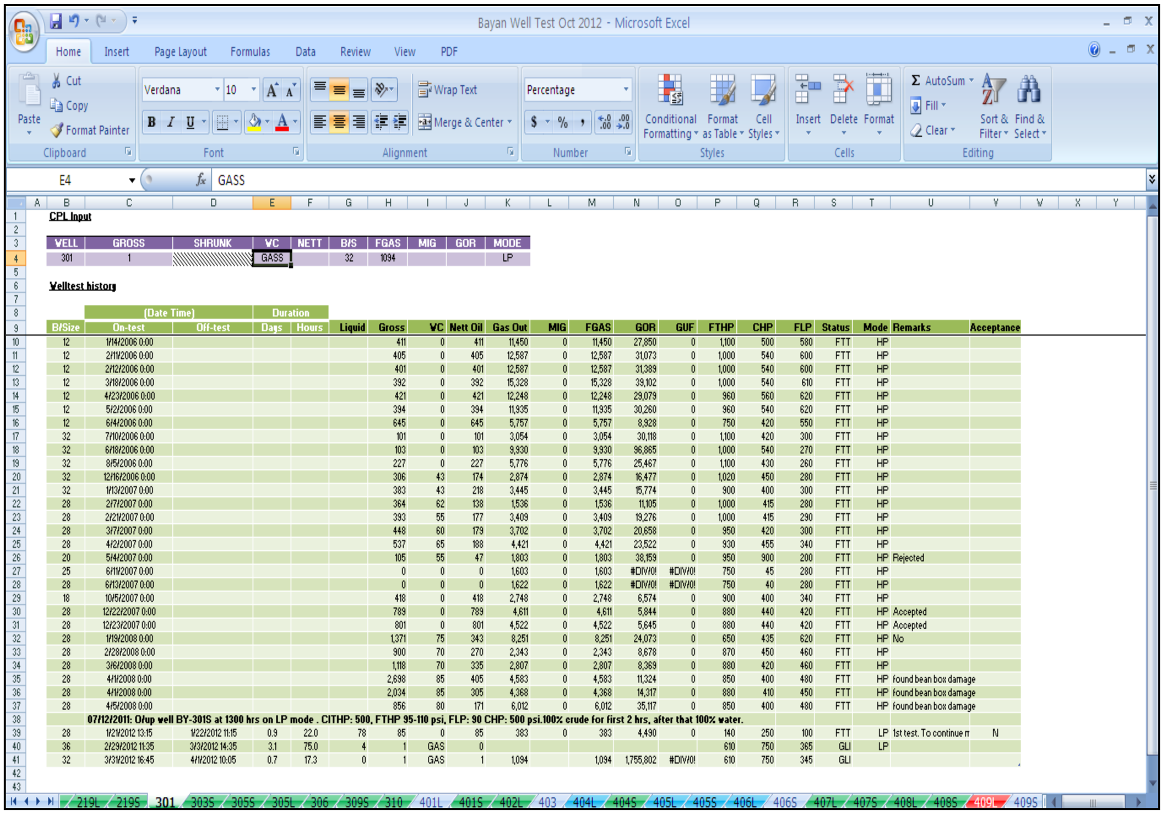
```
  'WELLS=2' 'SUMMARY=2' 'CPU=2' 'WELSPECS' 'NEWTON=2' /

--GLIFTOPT
--group   max lift
--name    gas rate
--'A'     0.5  /


RPTSCHED
  'PRES' 'SWAT' 'FIP=1' 'WELLS=2' 'SUMMARY=2' 'CPU=2' 'WELSPECS' 'NEWTON=2'
/

-- End simulation at 450 days

END
```

APPENDIX 3- EXAMPLE OF DEVIATION DATA FOR WELL B-301



	WELL NAM	MD	X	Y	TVDS	TVD	DX	DY	AZIM	INCL	DLS
2	BY-301	0	1006916.89	1257053.85	98.00	0.00	0.00	0.00	154.70	0.00	0.00
3	BY-301	2	1006916.89	1257053.85	96.00	2.00	0.00	0.00	154.70	0.01	0.29
4	BY-301	4	1006916.90	1257053.85	94.00	4.00	0.00	0.00	154.70	0.02	0.29
5	BY-301	6	1006916.90	1257053.84	92.00	6.00	0.00	0.00	154.70	0.02	0.28
6	BY-301	8	1006916.90	1257053.84	90.00	8.00	0.00	0.00	154.70	0.03	0.27
7	BY-301	10	1006916.90	1257053.84	88.00	10.00	0.00	0.00	154.70	0.04	0.27
8	BY-301	12	1006916.90	1257053.84	86.00	12.00	0.00	0.00	154.70	0.05	0.26
9	BY-301	14	1006916.90	1257053.84	84.00	14.00	0.00	-0.01	154.70	0.06	0.25
10	BY-301	16	1006916.90	1257053.84	82.00	16.00	0.00	-0.01	154.70	0.06	0.24
11	BY-301	18	1006916.90	1257053.84	80.00	18.00	0.00	-0.01	154.70	0.07	0.24
12	BY-301	20	1006916.90	1257053.83	78.00	20.00	0.01	-0.01	154.70	0.08	0.23
13	BY-301	22	1006916.90	1257053.83	76.00	22.00	0.01	-0.02	154.70	0.09	0.22
14	BY-301	24	1006916.90	1257053.83	74.00	24.00	0.01	-0.02	154.70	0.10	0.22
15	BY-301	26	1006916.90	1257053.82	72.00	26.00	0.01	-0.02	154.70	0.10	0.21
16	BY-301	28	1006916.91	1257053.82	70.00	28.00	0.01	-0.02	154.70	0.11	0.20
17	BY-301	30	1006916.91	1257053.82	68.00	30.00	0.01	-0.03	154.70	0.12	0.19
18	BY-301	32	1006916.91	1257053.81	66.00	32.00	0.02	-0.03	154.70	0.13	0.17
19	BY-301	34	1006916.91	1257053.81	64.00	34.00	0.02	-0.04	154.70	0.14	0.16
20	BY-301	36	1006916.91	1257053.81	62.00	36.00	0.02	-0.04	154.70	0.14	0.15
21	BY-301	38	1006916.92	1257053.80	60.00	38.00	0.02	-0.05	154.70	0.15	0.13
22	BY-301	40	1006916.92	1257053.80	58.00	40.00	0.02	-0.05	154.70	0.16	0.12
23	BY-301	42	1006916.92	1257053.79	56.00	42.00	0.03	-0.06	154.70	0.17	0.11
24	BY-301	44	1006916.92	1257053.78	54.00	44.00	0.03	-0.06	154.70	0.18	0.10
25	BY-301	46	1006916.93	1257053.78	52.00	46.00	0.03	-0.07	154.70	0.18	0.09
26	BY-301	48	1006916.93	1257053.77	50.00	48.00	0.03	-0.07	154.70	0.19	0.08
27	BY-301	50	1006916.93	1257053.77	48.00	50.00	0.04	-0.08	154.70	0.20	0.08
28	BY-301	52	1006916.94	1257053.76	46.00	52.00	0.04	-0.09	154.70	0.20	0.08
29	BY-301	54	1006916.94	1257053.75	44.00	54.00	0.04	-0.09	154.70	0.20	0.08
30	BY-301	56	1006916.94	1257053.75	42.00	56.00	0.05	-0.10	154.70	0.20	0.07

APPENDIX 4- EXAMPLE OF WELLTEST DATA FOR WELL B-301



CPL Input

WELL	GROSS	SHRUNK	WC	NETT	B/S	FGAS	MIG	GOR	MODE
301	1		GASS		32	1094			LP

Welltest history

B/Size	(Date Time) On-test	Off-test	Duration Days	Hours	Liquid	Gross	WC	Nett Oil	Gas Out	MIG	FGAS	GOR	GUF	FTHP	CHP	FLP	Status	Mode	Remarks	Acceptance
12	1/14/2006 0:00					411	0	411	11,450	0	11,450	27,850	0	1,100	500	580	FTT	HP		
12	2/11/2006 0:00					405	0	405	12,587	0	12,587	31,073	0	1,000	540	600	FTT	HP		
12	2/12/2006 0:00					401	0	401	12,587	0	12,587	31,389	0	1,000	540	600	FTT	HP		
12	3/18/2006 0:00					392	0	392	15,328	0	15,328	39,102	0	1,000	540	610	FTT	HP		
12	4/23/2006 0:00					421	0	421	12,248	0	12,248	29,079	0	960	560	620	FTT	HP		
12	5/2/2006 0:00					394	0	394	11,935	0	11,935	30,260	0	960	540	620	FTT	HP		
12	6/4/2006 0:00					645	0	645	5,757	0	5,757	8,928	0	750	420	550	FTT	HP		
32	7/10/2006 0:00					101	0	101	3,054	0	3,054	30,118	0	1,100	420	300	FTT	HP		
32	6/18/2006 0:00					103	0	103	9,930	0	9,930	96,865	0	1,000	540	270	FTT	HP		
32	8/5/2006 0:00					227	0	227	5,776	0	5,776	25,467	0	1,100	430	260	FTT	HP		
32	12/16/2006 0:00					306	43	174	2,874	0	2,874	16,477	0	1,020	450	280	FTT	HP		
32	1/13/2007 0:00					383	43	218	3,445	0	3,445	15,774	0	900	400	300	FTT	HP		
28	2/7/2007 0:00					364	62	138	1,536	0	1,536	11,105	0	1,000	415	280	FTT	HP		
28	2/21/2007 0:00					393	55	177	3,409	0	3,409	19,276	0	1,000	415	290	FTT	HP		
28	3/7/2007 0:00					448	60	179	3,702	0	3,702	20,658	0	950	420	300	FTT	HP		
28	4/2/2007 0:00					537	65	188	4,421	0	4,421	23,522	0	930	455	340	FTT	HP		
20	5/4/2007 0:00					105	55	47	1,803	0	1,803	38,159	0	950	900	200	FTT	HP	Rejected	
25	6/11/2007 0:00					0	0	0	1,603	0	1,603	#DIV/0!	#DIV/0!	750	45	280	FTT	HP		
28	6/13/2007 0:00					0	0	0	1,622	0	1,622	#DIV/0!	#DIV/0!	750	40	280	FTT	HP		
18	10/5/2007 0:00					418	0	418	2,748	0	2,748	6,574	0	900	400	340	FTT	HP		
28	12/22/2007 0:00					789	0	789	4,611	0	4,611	5,844	0	880	440	420	FTT	HP	Accepted	
28	12/23/2007 0:00					801	0	801	4,522	0	4,522	5,645	0	880	440	420	FTT	HP	Accepted	
28	1/19/2008 0:00					1,371	75	343	8,251	0	8,251	24,073	0	650	435	620	FTT	HP	No	
28	2/28/2008 0:00					900	70	270	2,343	0	2,343	8,678	0	870	450	460	FTT	HP		
28	3/6/2008 0:00					1,118	70	335	2,807	0	2,807	8,369	0	880	420	460	FTT	HP		
28	4/1/2008 0:00					2,698	85	405	4,583	0	4,583	11,324	0	850	400	480	FTT	HP	found bean box damage	
28	4/1/2008 0:00					2,034	85	305	4,368	0	4,368	14,317	0	880	410	450	FTT	HP	found bean box damage	
28	4/5/2008 0:00					856	80	171	6,012	0	6,012	35,117	0	850	400	480	FTT	HP	found bean box damage	
	07/12/2011: O/up well BY-301S at 1300 hrs on LP mode . CITHP: 500, FTHP 95-110 psi, FLP: 90 CHP: 500 psi.100% crude for first 2 hrs, after that 100% water.																			
28	1/21/2012 13:15	1/22/2012 11:15	0.9	22.0	78	85	0	85	383	0	383	4,490	0	140	250	100	FTT	LP	1st test. To continue m	N
36	2/29/2012 11:35	3/3/2012 14:35	3.1	75.0	4	1	GAS	0						610	750	365	GLI	LP		
32	3/31/2012 16:45	4/1/2012 10:05	0.7	17.3	0	1	GAS	1	1,094		1,094	1,755,802	#DIV/0!	610	750	345	GLI			