Assessing Reservoir Performance and Modeling using Prosper for Idle Well Reactivation

Dissertation Report submitted in partial fulfillment of
the requirements for the
Degree in Bachelor of Petroleum Engineering (Hons)

Prepared by:
AHMAD FARIS HAFIZI BIN AHMAD PAUZI
ID: 11863

SUPERVISOR: MR. MOHD AMIN SHOUSHTARI

UniversitiTeknologi PETRONAS
Bandar Seri Iskandar,
31750 Tronoh
Perak Darul Ridzuan

CERTIFICATION OF APPROVAL

Assessing Reservoir Performance and Modeling using Prosper for Idle Well Reactivation

by,

Ahmad Faris Hafizi Bin Ahmad Pauzi

A project dissertation 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,

____
(Mr.Mohd Amin Shoushtari)

UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK
September 2012

CERTIFICATION OF APPROVAL

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.

………………………………………………

AHMAD FARIS HAFIZI BIN AHMAD PAUZI

11863

PETROLEUM ENGINEERING

ABSTRACT

Idle Wells are the wells which are inactive due to an extended close down in production or injection of fluids. The well usually shut in because of low production from the accessed reservoir. Well also will be considered idle when there is some mechanical problems like surface control subsurface safety valve problem that lead to shut-in of the well. Also, the well might be inactive when there are some facilities problems like broken gaslift flowline. But the major idle well that needs extra attention is the idle well which has possiblity to access other potential reservoir eventhough the well is considered idle previously due to depleted of current accessed reservoir.

Thus, how to reactivate the idle well? Before reviving the idle well, the factor that lead the well to be inactive should be investigated first. Is it due to some mechanical problems or because of depleted reservoir reserves? Normally, if the well is idle because of mechanical problems, the parts which are broken can easily be replaced or repaired. But, if it is because of low production rate, the approachment will be different. One of common approach is Insert String Job. But this project will focus more on the enhancement job that will reactivate the idle well.

In addition, the well needs to be reactivated because Idle well can still provide the states and nation with much needed production. For instance sidetracking a well. This is one of the methods to revive the idle well. Sidetracking is drilling a directional hole to deepen a well or to relocate the bottom of the well in a more productive zone, which is horizontally removed from the original well. Thus, by sidetracking, the idle well can accessed to the other reservoir and thus reactivate the well. The same concept is applied to the additional perforation enhancement job. It simply creates a communication between the potential reservoir with the idle well. So, the idle well can reproduce back with different reservoir from the current one.

ACKNOWLEDGEMENT

This Final Year Project involves many parties in order for the student to complete it successfully. It is a golden opportunity to learn and practice. Hence, thanks to Mr.Mohd Amin Shoushtari, UTP Supervisor for all the guidance along the journey to complete this project.

Also, special thanks to the representatives from PETRONAS for being a mentor to the student. Many lessons were learnt during the project commencement. Author also would like to express my gratitude to Ariff Shazwan B M Nazri, BWI Operation Engineers for being a great team member and guided me throughout the project. Last but not least, to all colleagues for the support and the knowledge that they have shared.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATION

DCA	Decline Curve Analysis
SGS	Static Gradient Survey
MECH	Mechanical
GL	Gas Lift
FAC	Facilities
OPNS	Operational Reasons
RMD	Remedial Works
PVT	Pressure Temperature Volume
IPR	Inflow Performance Rate
ESP	Electic Submersible Pump
PCP	Progressive Cavity Pump
AOF	Absolute Open Flow
GOR	Gas Oil Ratio
THP	Tubing Head Pressure
FTHP	Flowing Tubing Head Pressure
VLP	Vertical Lift Flow

CHAPTER 1 INTRODUCTION

1.1 Background Study

A number of oil and gas wells scattered across Malaysia are currently not producing oil or gas. Once a well has reached the end of its productive life it will be left as idle. On the other hand, as time goes, and technology emerges, reserves that were once profitable to extract become profitable and inactive wells are reactivated. To maintain the potential for future production, operating companies allow non producing wells to remain inactive and idle and do not force into the plug and abandonment process. Some of the wells however are considered to be depleted as the current reservoirs that have been accessed do not have any reserves left.

In addition, at the current level of oil and gas prices, more and more interest is falling upon mature fields and reservoirs. So, many of these mature fields and reservoirs appear to be depleted, and no commercial value. However, if takes a closer look, there is still value present. The difficulty; however is to figure out this value especially well with complex reservoirs. This value is essential and needed for the reactivation of the idle well. Thus, a team will be organized in order to consider all the uncertainties involves and formulated an optimum reactivation of idle well plan.

This project will focus on the one major technique of reviving idle well. Basically, in this project, the reservoirs that produce through this well are all depleted. So, the reservoir engineer will run reservoir modeling simulation to conclude that the reservoir already out of reserve and the well can have an access to the other reservoir. In order to evaluate the reserves from the zone reservoir, decline curve analysis (DCA) method are used. PROSPER analysis on the water cut, skin and permeability will estimate the initial production rate when the well already communicates with the newly potential reservoir.

1.2 Problem Statement

It is an obvious statement of fact that every well drilled will reach the end of its productivity live. When that occurs, plugging and abandonment are the final solution. Thus it is really important to do the reactivation job in order to avoid plugging well which still has potentials. The problem statements of this project are divided into three sections which are categorized into vision, issue statement and method.

In term of vision, what will occur if the reactivation of the idle well job is not being conducted? It might lead to abandonment or pre-maturing plug. Thus all the potential that exist at the idle well cannot be extracted. It will be a waste since that production of the well can still contribute to the total number of production.

Besides that, for the issue statement, what is the current issue which related to the implementation of the project? There are currently hundreds of thousands of oil and gas wells scattered across North America are currently not producing oil or gas. The wells are left idle for quite a some time. There are no action been taken toward these wells. Thus, it is such a waste since that the well can be reproduced if it still has potential.

Last but not least, in term of problem in method to reactivate the idle well. There are quite a number of methods to revive the idle well. The conditions of the idle well need to be investigated first in order to know which technique to be used. Thus, the reservoir and well data need to be analysed first and a team need consist of reservoir engineer, geologist, production technologies and production engineer need to be formed. Each of them has their own roles in the reactivation job.

1.3 Objectives of study

The main objective of this project is to assess and conclude the suitable approach for the reactivation job of the idle well by having the reservoir performance modelling. Reservoir performance modelling is an analysis of the reservoir potential of the idle well by applying a production optimization software tool, PROSPER. The main objective of this project can further defined to the following list below:

- To attain the well and the reservoir data from SGS (Static Gradient Survey Job) or from other well which access the same idle well reservoir.
- To evaluate the reservoir potential of the idle well
- To propose the suitable job for this idle well in order to reactivate it. (By referring the Prosper result and also by other well cases).

1.4 Scope of study

Reviving of the idle well is really a golden approach since that it can add to the total number of production. So, the study of reactivation job is conducted. This study will focus on:

- Reservoir performance modeling of the current and additional reservoir that the idle well can still accessed.
- The reservoir potential that will be indicated by having the prosper analysis.

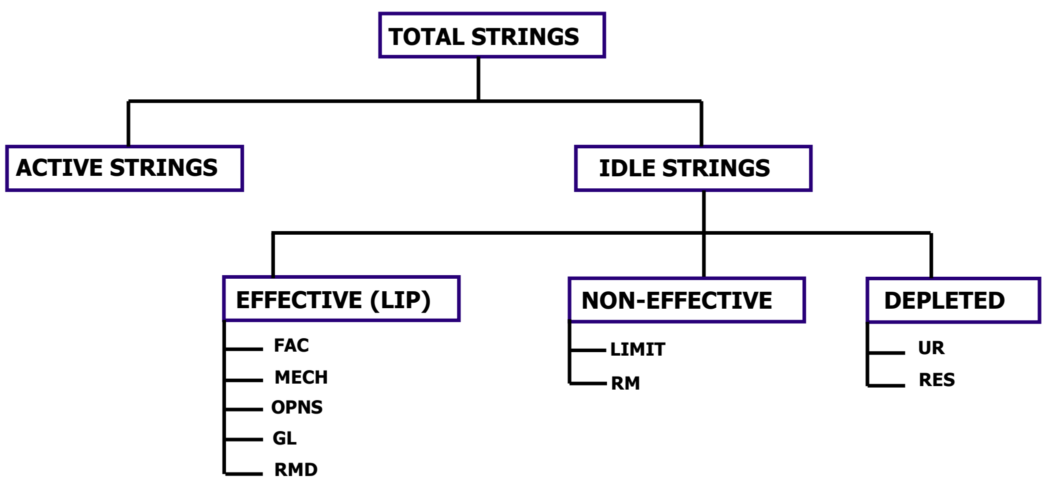
1.5 Relevancy and Feasibility of the Project

This project is relevance and feasible within the time frame provided as all the main result for this research is obtain through simulation. The data and material required to conduct this research has been prepared and the necessary party involved has agreed to provide these materials within the suggested time frame.

CHAPTER 2 LITERATURE REVIEW

THEORY

Wells are considered idle or inactive due to an extended halt in production or injection of fluids. This disruption of fluid flow is mainly result of mechanical failure, uneconomic production rate or both. The idle well are classified into three which are effective, non-effective and depleted from PETRONAS Definition. Effective idle well is well that will result in immediate net incremental production at field if it is restored. Non-effective idle well is the well that will not result in near-term production gain at field if it is restored. In addition, depleted idle well is the well that is considered depleted due to no wellbore activities.



Idle Strings Classification

EFFECTIVE - Capacity shut in from existing zones within current facilities handling constraints and with definitive short term action plans

NON-EFFECTIVE - Capacity shut in from existing zones which will not provide net production gain due to facilities constraint or reservoir

DEPLETED - Capacity shut in from existing zones in which the reserve is uneconomical to realize

Thus, once a well is reported idle, a series of evaluations are performed. It is because if the idle well falls in the effective idle well category, the well can still be revived according to its correct reviving method. The effective idle wells are branched into five which are MECH, GL, FAC, OPNS and RMD. The details of these categories are shown below.

Effective Idle String

MECH	Strings that are shut-in due to mechanical problems. The strings are waiting for X-Mas tree or downhole tubing/ completion servicing / repair (such as tubing patch, pull plug/ SCSSV problems, insert valve etc)
GL	Strings that are shut-in due to , while waiting on gaslift valve installation or gaslift valve repair
FAC	Strings that are shut-inn due to facilities related problem. Includes strings that are waiting on surface facilities repair and planned upgrade or production / injection flowline (includes gaslift flowline)
OPNS	Strings that are shut-in due to operational reasons ie emulsion, water quality problem, sand production etc
RMD	Strings that are shut-in and require remedial work at perforation/ near wellbore zone for reactivation. Includes additional perforation job, stimulation, gravel packing etc

So, an evaluation procedure taken to each idle well is taken. The first step is to identify the inactive wells and to collect the available data. A list of idle wells is recorded. The status of each well is then verified before moving forward. Some of the collected data are the production histories, reserve estimates, wellbore schematics, well logs and surrounding production rates. Data is normally available for most wells. Wells that belong to the same reservoir are grouped together.

Next, the inactive list is refined to include wells of reactivation value. Potential candidates included wells that were identified for uncompleted hydrocarbon-bearing zones, wells with no major down-hole problems, and well surrounded by economic producers. Well logs were analyzed to identify possible pay zones for recompletion.

This will be done by collaboration with geologist. Permeable and porous hydrocarbon zones were identified based on gamma ray and resistivity logs. Uncompleted zones will be verified by correlating well logs to nearby producing wells. As for mechanical problems, wellbore schematics for each well are inspected. If a problem is reported, the damage will be recorded.

Next, well reserves, anticipated production and wellbore condition are evaluated. A conservative approach is applied to reserve estimation and production forecasting. Recoverable hydrocarbon reserve values are generated by software that fits decline curve based on recorded production trends and anticipated production rates. An annual decline rate is defined according to observed field performance. Average reservoir pressure and offset production rates are used to predict initial production upon reactivation.

The last factor in determining the reactivation candidates is economic. Wells where reactivation costs outweighed the expected revenue will be rejected. Revenue is calculated based on predicted initial production rates and anticipated production decline with time.

RESEARCH TABLE

Below is the comparison between different techniques of reviving the idle well. All the techniques are proven to be a success.

Name of Author	Title	Outcome
A.T. Sulai & Y. Hassan (2005)	Insert String Technique Reviving Idle Well	• Insert String is proven to be a practical technique in reviving Idle Well which quit production due to low liquid level. • Improve economics of small producing fields and prolong field life.
N.M Al-Araimi & M. Mahajan (2005)	Successful Revival of long time closed-in gas well by Matrix Stimulation Treatments	• Successfully revive idle well with coiled tubing conveyed acidizing remedial treatments. • The successful acidizing campaign has been executed to revive 10 idle wells in offshore at Brunei.
Amir H. Abuhassoun & Bernabe A. Sequera (2011)	Effective Reservoir Management Strategies to Revitalize Dead Producers Behind the Flood Front	• Dead producer well was revived and a gain of 3 MBOD was achieved. • A healthy well performance was acquired which will positively and directly influence delivery the required sustainable rates from the field if applied to other candidate.
Keith T. Thomas (2001)	Produce or Plug? A Summary of Idle and Orphan Well Statistics and Regulatory Approaches	• It is best interest of the oil and gas producing states to make sure that no well is prematurely plugged (refer to idle well). • It is in economic best interest for both operator and states to get idle wells back into production. • By returning to active status, these wells produce revenue for both operator and state.

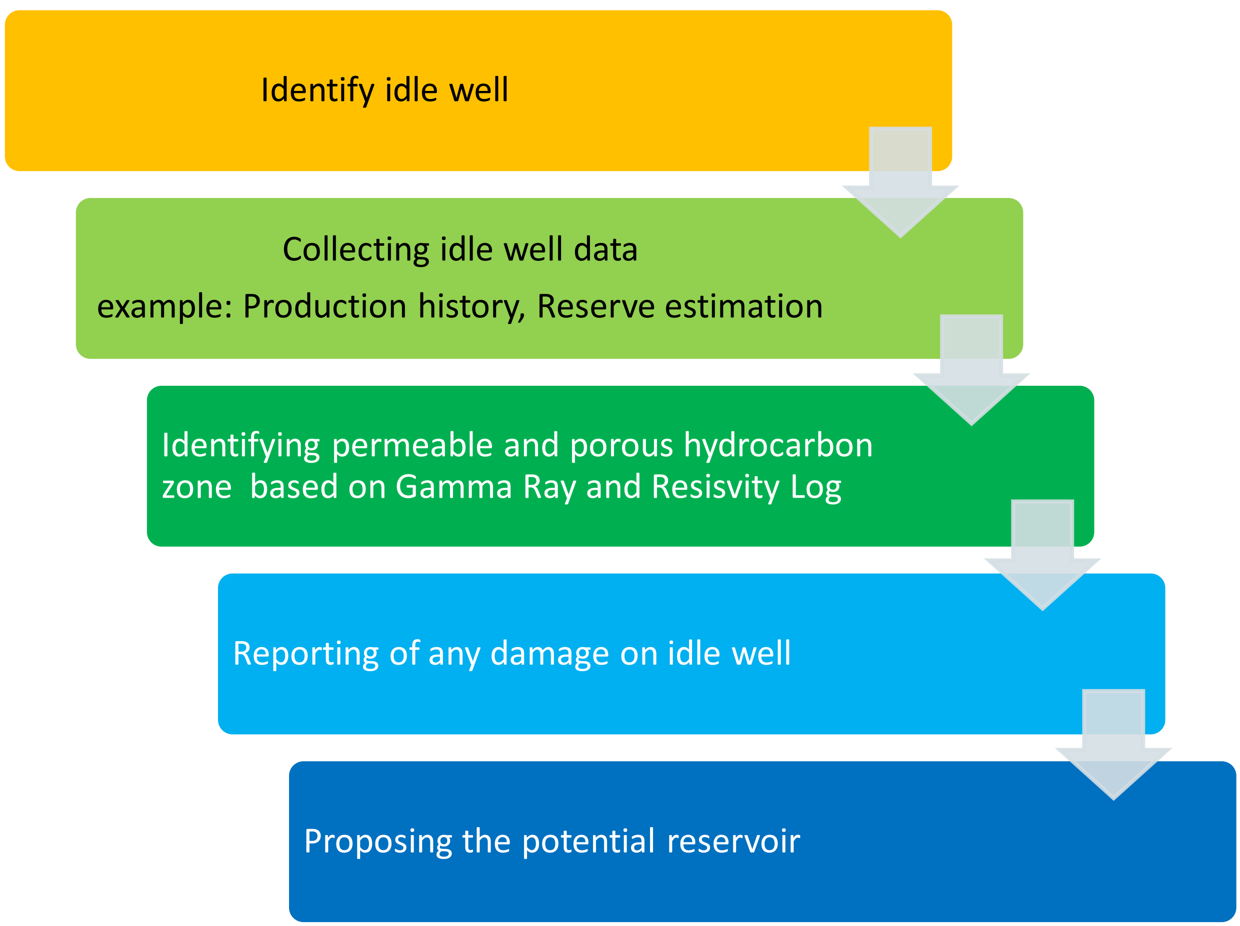
Table 2-1 Research Table

CHAPTER 3 METHODOLOGY

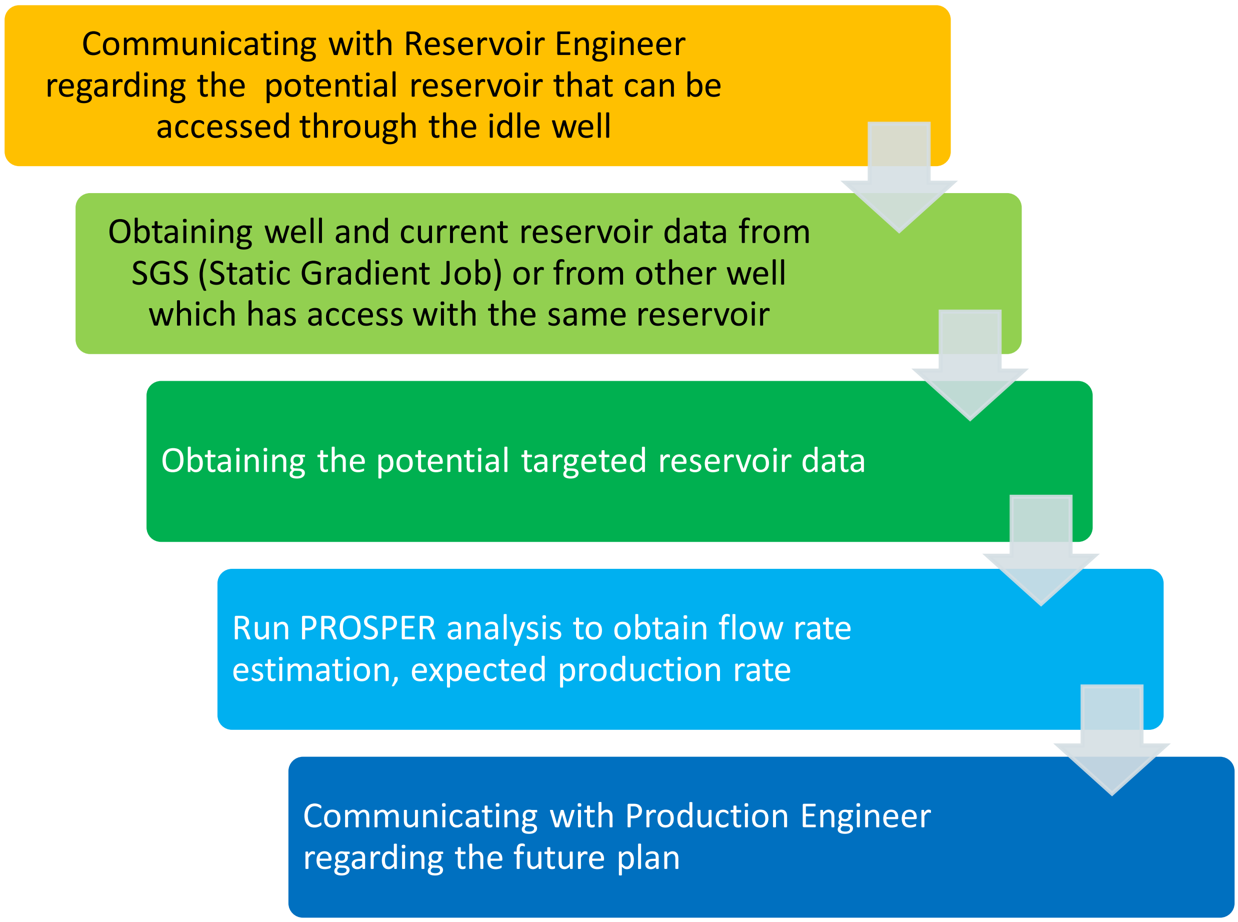
3.1 Overall Project Sequences

This project will apply a real field data and the author will work as the production technologist. The job flow will be from Reservoir Engineer and Geologist to Production Technologies and to Production Engineer.

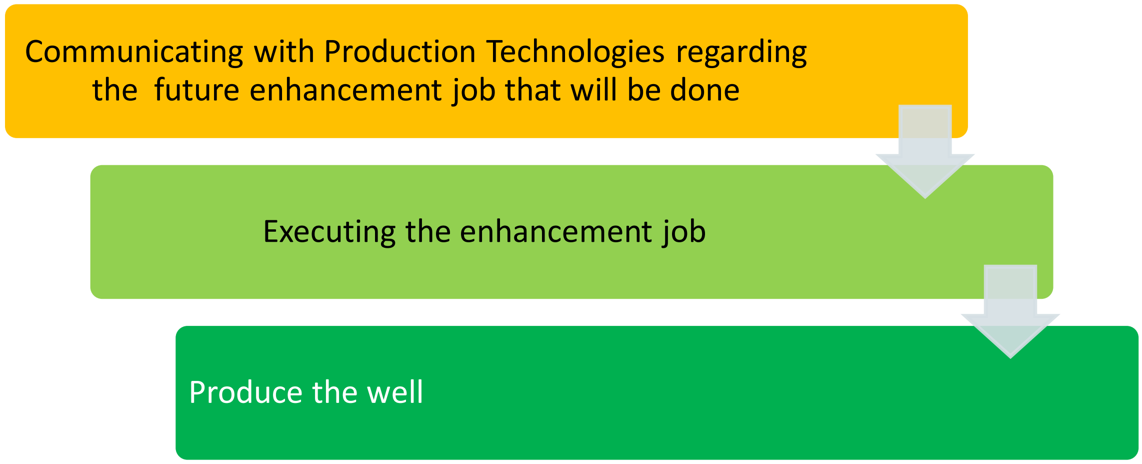
RESERVOIR ENGINEER AND GEOLOGIST ROLES



PRODUCTION TECHNOLOGIES (AUTHOR) ROLES



PRODUCTION ENGINEER ROLES



SUMMARIZE JOB SEQUENCES

1) **Reservoir Engineer** will propose that there is behind casing potential in that well. The geologist and the Reservoir Engineer already propose that the there is reservoir that can be accessed through the targeted idle well.
2) Then the well and the reservoir data from SGS (Static Gradient Survey Job) or from other well which access the same reservoir will be obtained. The author will communicate with the region petroleum engineer for the data requisition
3) Next, **prosper analysis** will be performed to see the potential of the reservoir, obtaining the flow rate estimation and how many barrels of oil we can produce and salvage. The author will familiarize with the software and input all the data in order to obtain the required result.
4) Finally, after it is concluded that the reservoir has a promising production, an enhancement job will be planned. The author will communicate with **production engineer** in order to assist in the enhancement job.

3.2 PROSPER Modeling

Using PROSPER for Sidetracking of Existing Idle Well

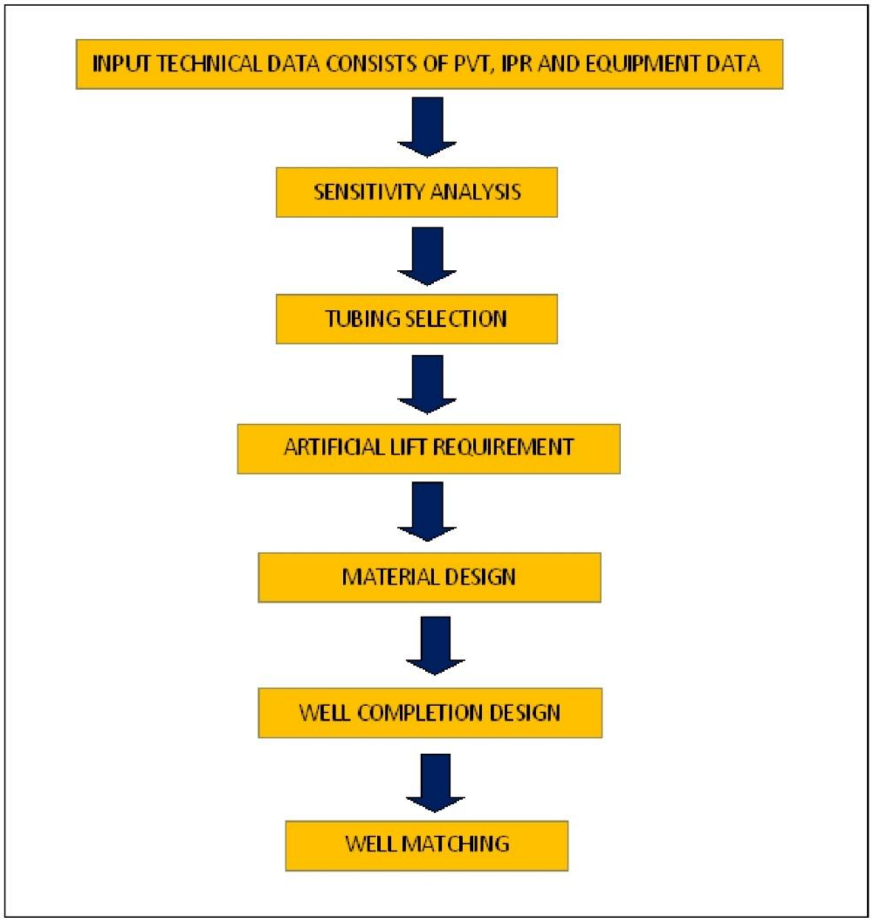


Figure 1.1: Project process flow

<u>Project activities</u>

Input technical data

In order to construct a well model, PROSPER software is used. All technical data are input into the PVT, IPR, equipment data and analysis summary section.

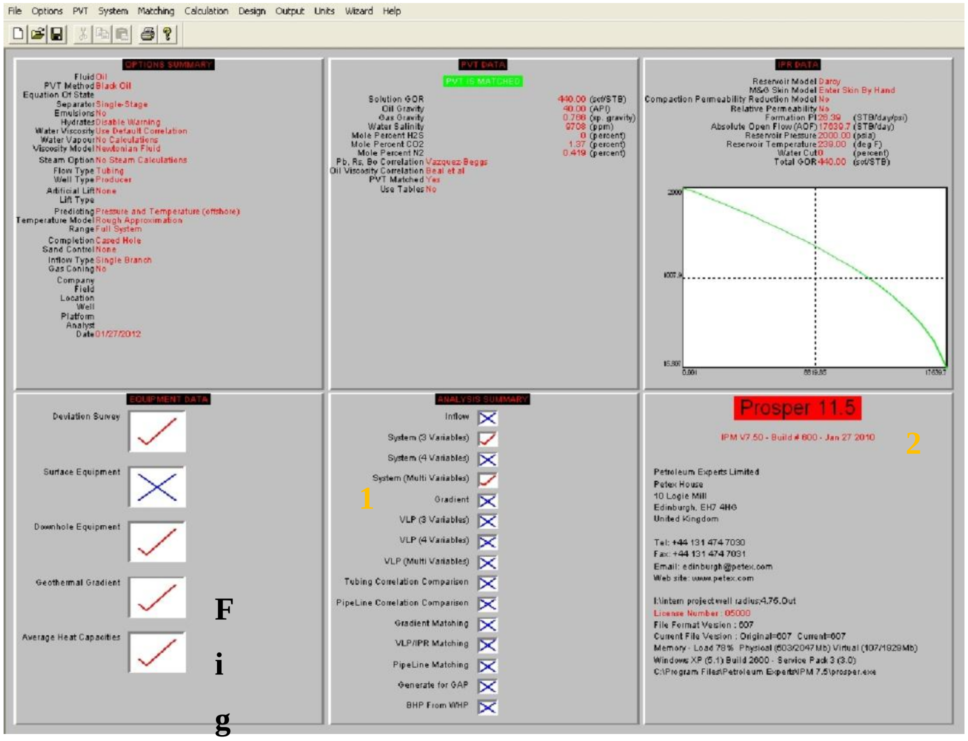


Figure 1.2: PROSPER interface

PVT and IPR data in the column number 1 & 2 were gained from the reservoir team while equipment data in the first bottom section of column number 3 were gained from the drilling and completion teams.

Sensitivity analysis

Analysis summary section which is at column number 4 is where all the sensitivity analysis is done. From the sensitivity analysis, we can choose the optimum tubing size as well as predict well performance for this new well.

Artificial lift requirement

Evaluation on various artificial lift techniques including ESP (electrical submersible pump), PCP (progressive cavity pump), gas lift and hydraulic jet pump had been carried out, and it was concluded that Gas lift will be the optimum options for this program. In addition, all of Field Y wells are using gas lift since the gas lift utilities system is already accommodated in the Field Y A platform. The gas lift is also designed by using PROSPER software.

Material selection

Selection for the suitable material to be used for the tubing and downhole accessories are done by using Wellcat software.

Well completion design

Start designing well completion diagram after selectively choose the suitable material to be used for the new well.

Well matching

Last process involved for this project is constructed well matching based on the well test results.

CHAPTER 4 RESULT AND DISCUSSION

PART A

Assessing Reservoir Performance and Modeling Using Prosper For Reactivation of the Idle Well through Sidetracking

Well Y was completed in 1987 as a single string oil producer. Currently both strings at this well are idle. So, the well will be sidetracked in order to access N27 zone. An initial anticipated rate for this zone is:

N27 zone – 1700 stb/d (oil producer) PROSPER analysis is used to predict the well performance

1) Technical data

Some of the technical data includes PVT, IPR and Equipment data.

Field	FIELD Y C
Target production	1700 stb/d
Well type	Oil producer
Measured depth (m)	4224
True vertical depth(m)	1736.35

Table 4 - 1.1: Nodal analysis input

Pressure	2300 psia
Temperature	239 F
Net sand	10 m
Permeability	500 md
Porosity	24%-30%
Tubing head pressure	550 psia

Table 4 - 1.2: Reservoir data

API	40
Gas Oil Ratio	440 scf/stb
Water cut	0 %

Table 4 - 1.3: Fluid parameters

I. PVT data

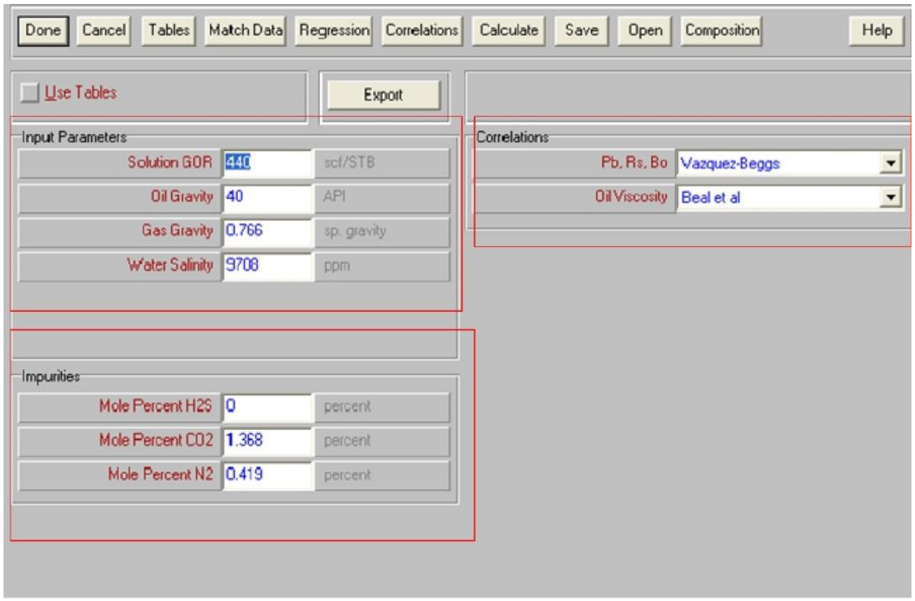


Figure 1.3: PVT data

After input all the necessary data into the required field, user can check whether the PVT is matched or not. Only if, PVT data is matched, then proceed to input data in the IPR section

Figure 1.4: Matched PVT data

II. IPR data

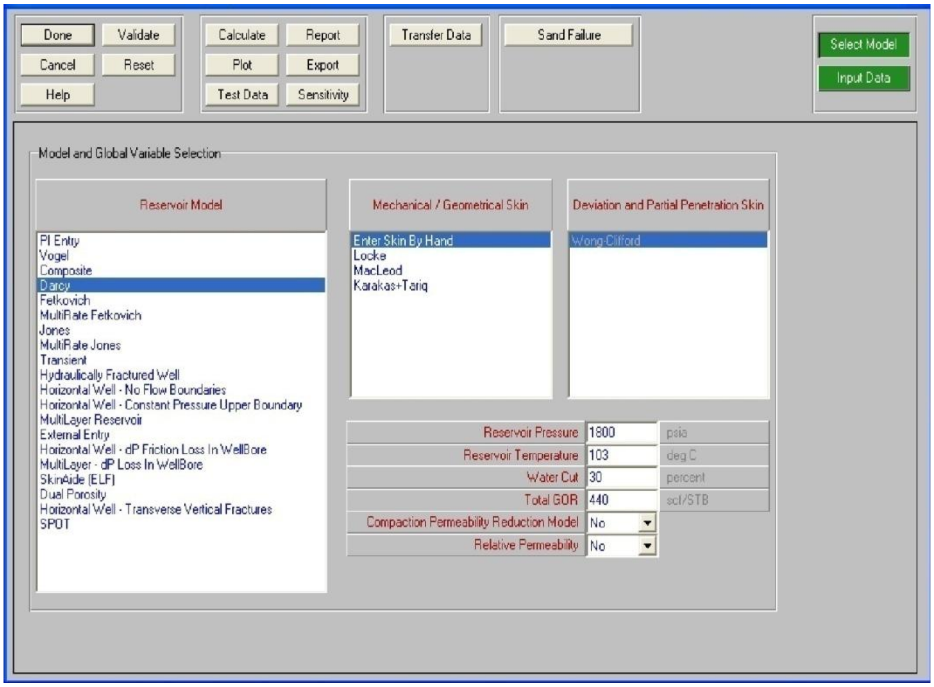


Figure 1.5: IPR data

Reservoir model: Darcy

Mechanical/ geometrical skin: Enter skin by hand

One of the reasons why user chooses this reservoir model type of Darcy is to get the plot of IPR Darcy curve.

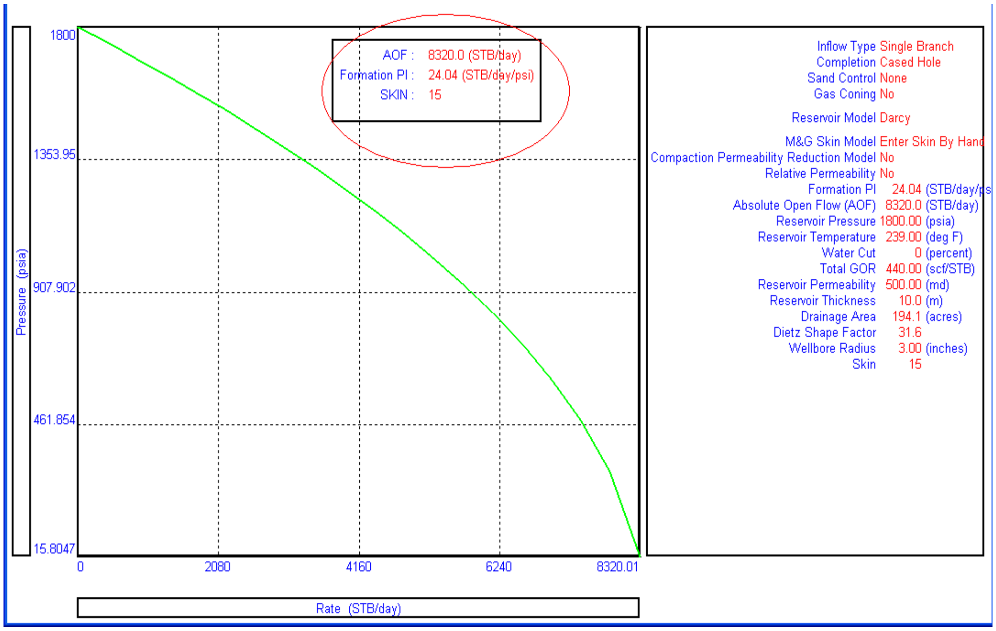


Figure 1.6: IPR darcy plot

From this Darcy plot, user can predict the well performance by looking at the value of absolute open flow potential (AOF), formation productivity index (PI) as well as skin produced.

AOF is the maximum oil rate produced from the well when the bottomhole pressure is zero.

$$PI = Q/_{(Pr - Pwf)}$$

From the AOF value obtained, it shows that this well can produces up to a maximum of 8320 stb/d when the bottomhole pressure is zero. Skin value produces also will determine whether this well is damaged or simulated.

III. Equipment data

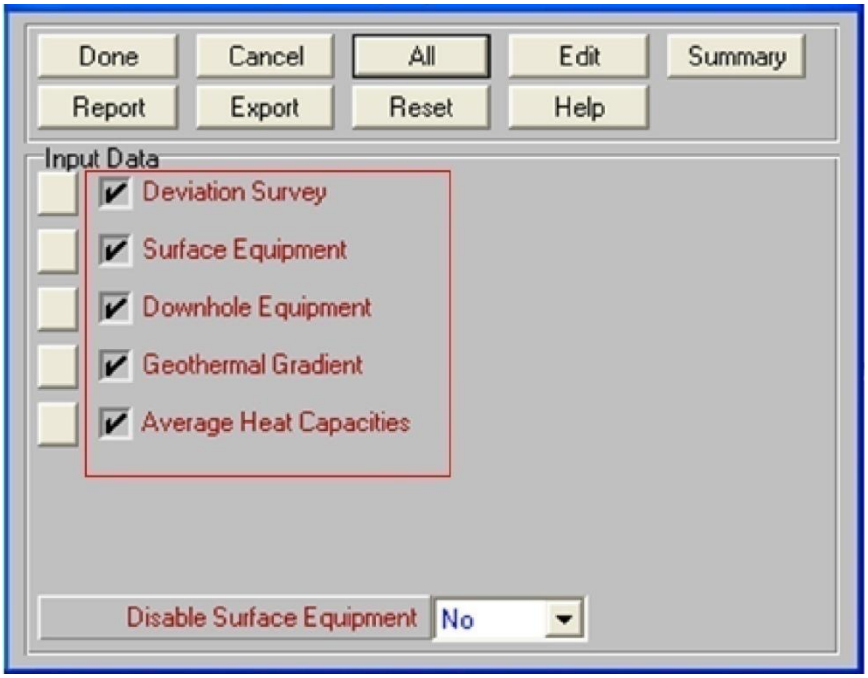
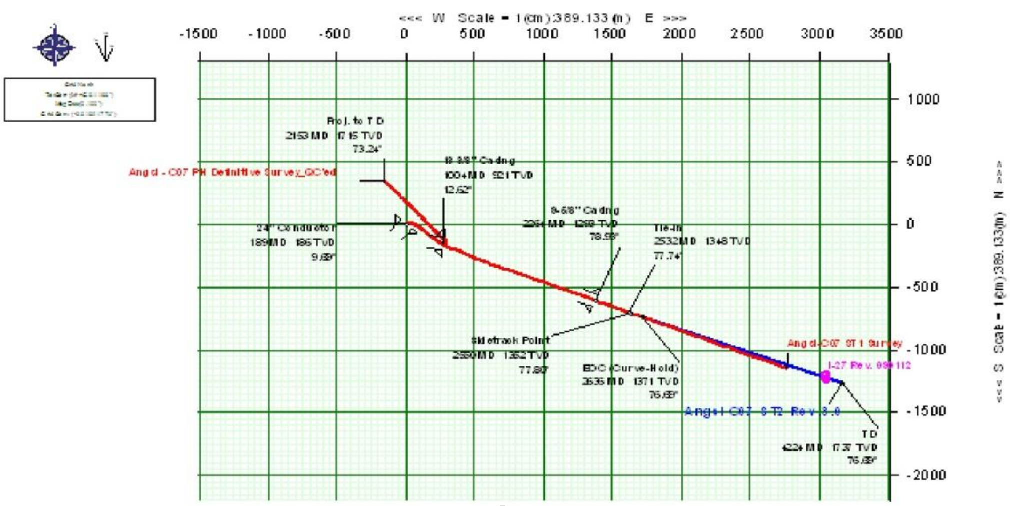
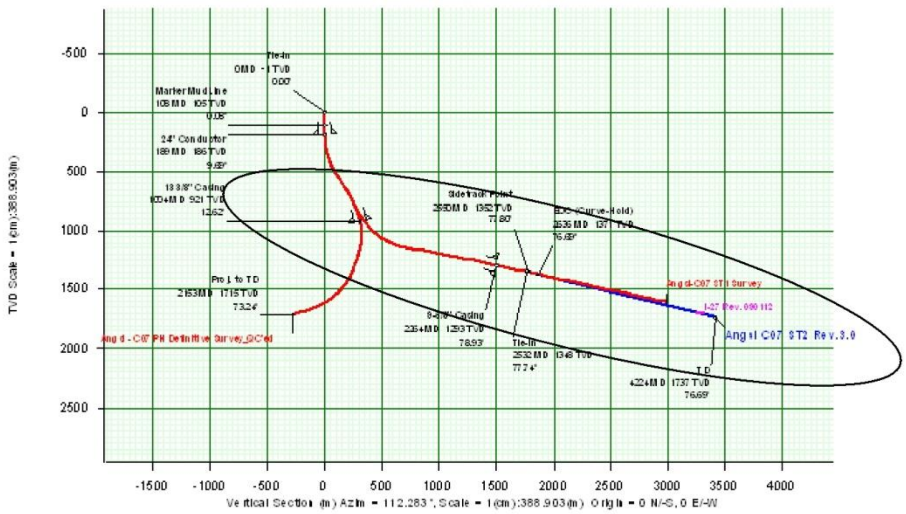


Figure 1.7: Equipment data



Plan view



Side view

Figure 1.8: Well trajectory

From the trajectory data obtained, it shows that this new well is deviated around 77 degree angle. This new well can be considered as quite high angle since all of the wells which deviated greater than 70 degree can be classified as high angle well.

In addition, this new well in Field Y C is sidetracked from the existing well. The purpose of sidetracked this new well is because there is no more available slot in Field Y C. Also, the existing well is no longer can produces at its maximum rate.

2) Sensitivity analysis

Sensitivity analysis was done using various parameters including:

Tubing size	2-7/8’’, 3-1/2’’ & 4-1/2’’
Reservoir pressure (psia)	2300 , 2000
Water cut (%)	0, 20
GOR (scf/stb)	440, 600 & 800
Skin	0 , 15

Table 4 - 1.4: Sensitivity analysis

The first sensitivity analysis was done on the tubing size purposely to choose the most optimum tubing size to be used for this X well.

Sensitivity on tubing size

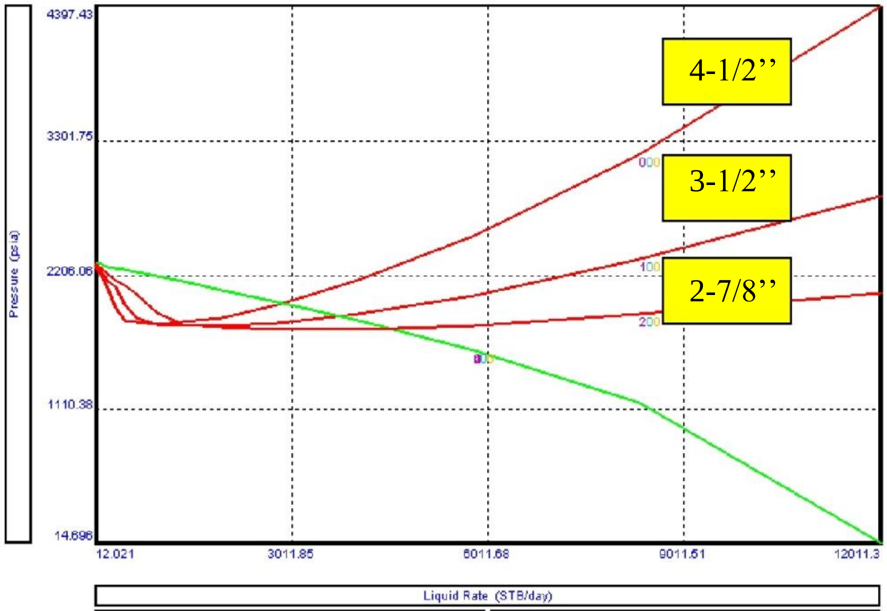


Figure 1.9: Sensitivity on tubing size

Tubing size	Production rate
2-7/8''	2888
3-1/2''	3738
4-1/2''	4457

Table 4 - 1.5: Oil production rate

Note that the anticipated target rate for this well is 1700 stb/d. From the result obtained, 4-1/2'' can be excluded from our selection since it produces a very high oil production rate. The remaining candidates left for the tubing size are 2-7/8'' and 3-1/2''.

The next tubing performance analysis was done on the 3-1/2'' and 2-7/8'' tubing sizes.

a) Tubing performance analysis: Operating rate vs. GOR as reservoir pressure depleted.

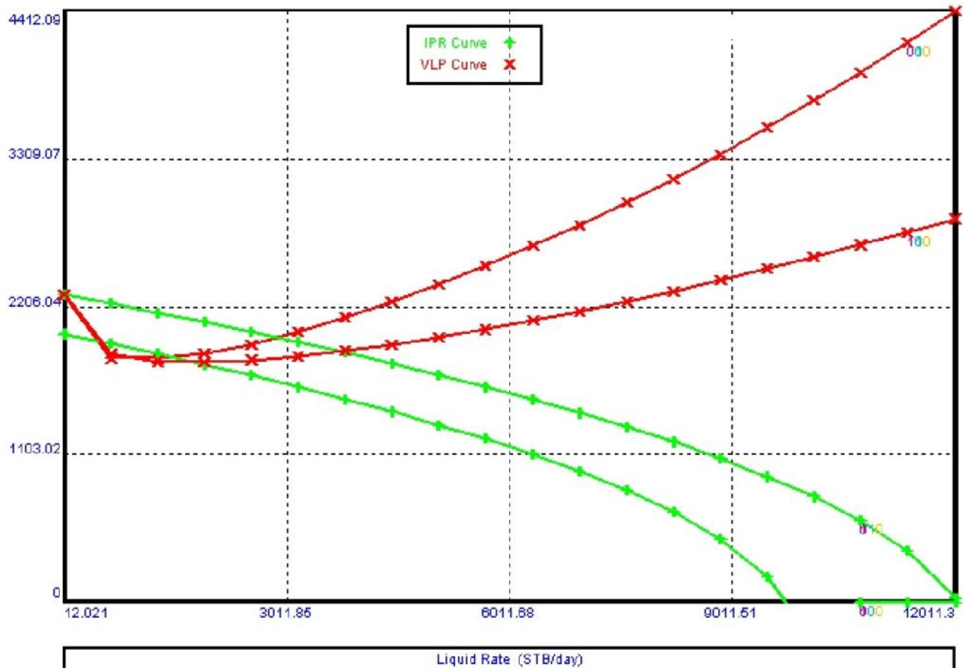


Figure 1.10: Tubing performance analysis for operating rate versus GOR as reservoir pressure depleted

GOR	Pres	Prod rate		Diff	(%)
		2-7/8	3-1/2		
440	2300	2888	3738	850	**29**
	2000	1469	1742	273	**19**
600	2300	3320	4534	1214	**37**
	2000	2309	3070	761	**33**
800	2300	3463	4818	1355	**39**
	2000	2602	3552	950	**37**

Table 4 - 1.6: Oil production rate for operating rate versus GOR as reservoir pressure depleted

Percentage differences for the production rate produced for these two tubing sizes are high even GOR value is high and reservoir pressure is depleted.

b) Tubing performance analysis: Operating rate vs. GOR as water cut increase

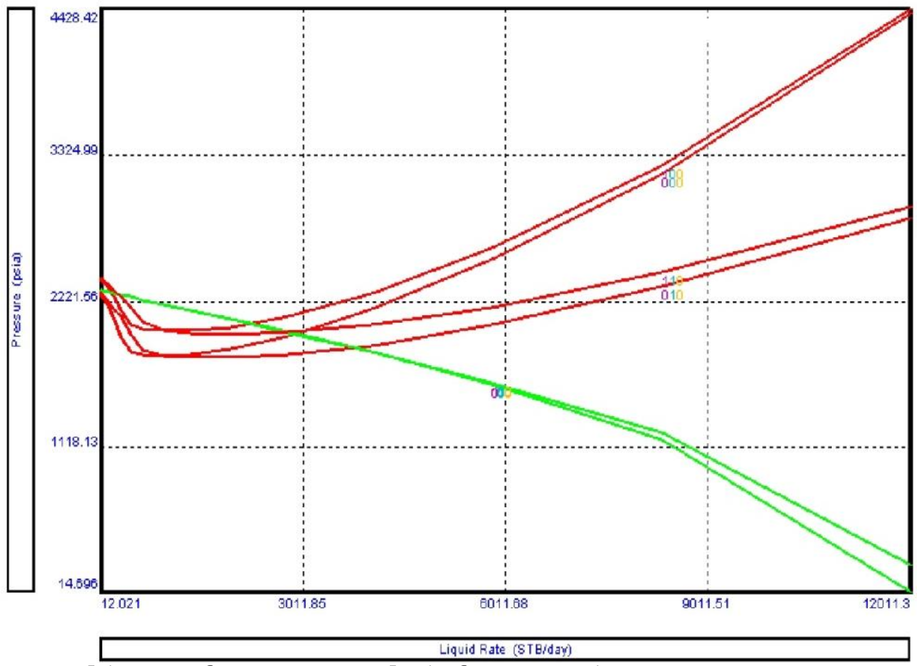


Figure 1.11: Tubing performance analysis for operating rate versus GOR as water cut increase

GOR	WC	Prod rate		Diff	(%)
		2-7/8	3-1/2		
440	0	2888	3738	850	29
	20	1796	2251	455	25
600	0	3320	4534	1214	37
	20	2398	3218	820	34
800	0	3463	4818	1355	39
	20	2651	3660	1009	38

Table 4 - 1.7: Oil production rate for operating rate versus GOR as water cut increase

- At 0% water cut, 3-1/2’’ tubing produces higher oil rate compared to the 2-7/8’’ tubing size.
- At 20% water cut, 3-1/2’’ tubing also produces higher oil rate compared to the 2-7/8’’ tubing size.

c) Tubing performance analysis: Operating rate vs. skin as reservoir pressure depleted

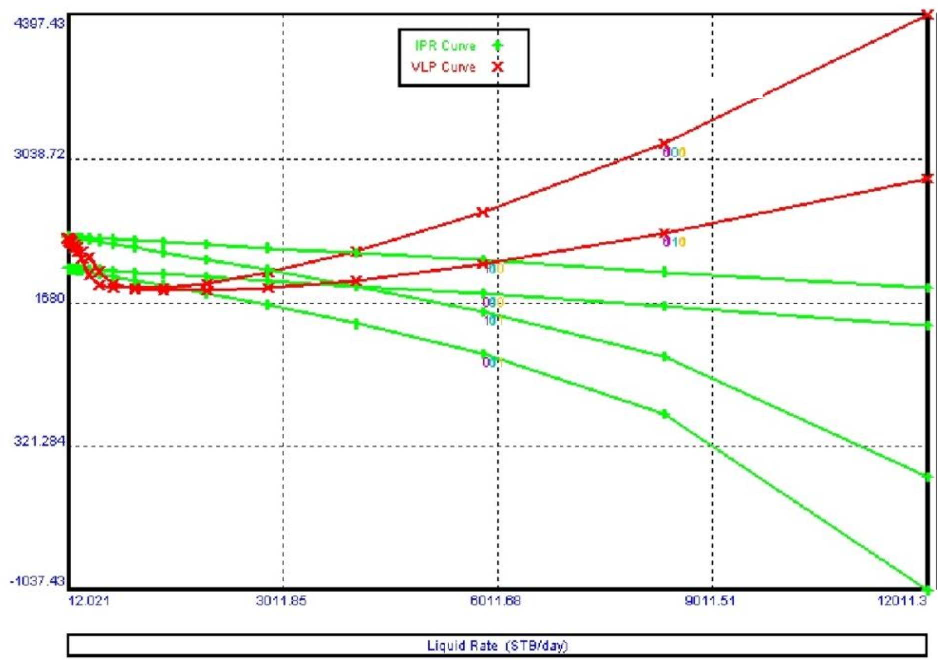


Figure 1.12: Tubing performance analysis for operating rate versus skin as reservoir pressure depleted

skin	Pressure	Prod rate		Diff	(%)
		2-7/8	3-1/2		
0	2300	3954	6038	2084	**53**
	2000	2340	3518	1178	**50**
15	2300	2888	3738	850	**29**
	2000	1469	1742	273	**19**

Table 4 - 1.8: Oil production rate for operating rate versus skin as reservoir pressure depleted

The above result also shows that the percentage differences for the production rate between these two tubing size are high even reservoir pressure is depleted and skin builds up.

From all these three tubing performance analysis, the optimum tubing size to be used for this well is 3-1/2’’. This is based on the few reasons;

- Percentage differences for the production rate which is greater than 20% can be considered high. From all the graphs above, mostly all of the percentage differences produced is high which clearly means that the 3-1/2’’ tubing is very significant to be used for this Y well.
- Oil produced by the 2-7/8’’ is lower than the anticipated rate when the reservoir pressure is 2000 psi and GOR value is 440 scf/stb.
- Mostly all of the Field Y wells are using 3-1/2’’ tubing size since all of the tools needed for the well intervention purposes in Field Y is available for this tubing size.

Next sensitivity analysis is done to estimate the well potential by using minimum tubing head pressure (THP) and minimum skin.

Well potential @ minimum THP using minimum skin

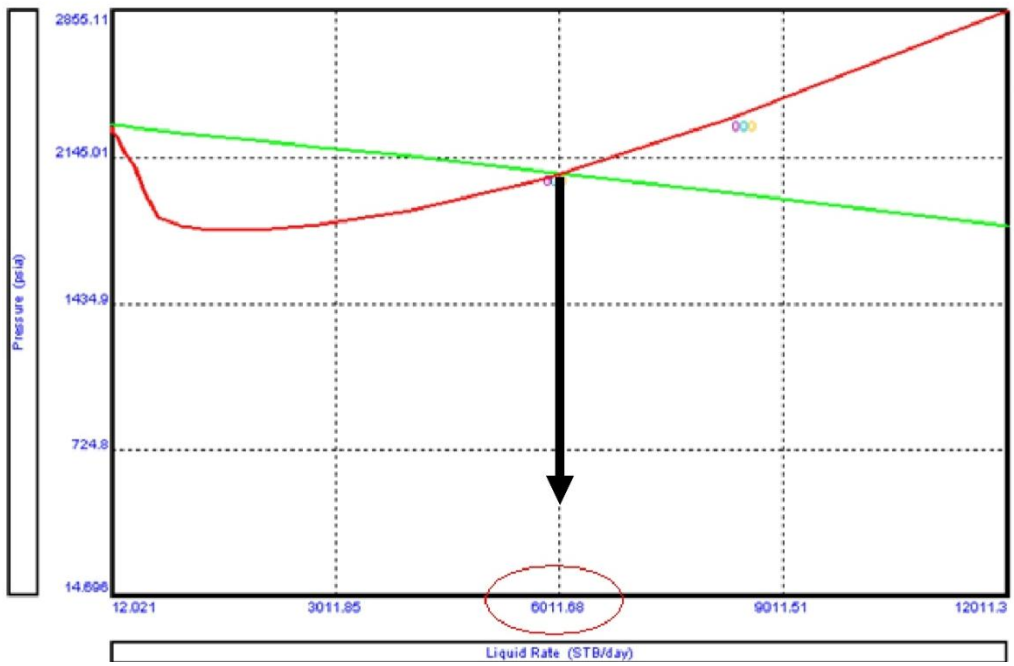


Figure 1.13: Well potential

Skin	Oil rate (bopd)
0	6011
15	3738

Table 4 - 1.9: Well potential using various skins

The original skin for this well is 15, and the oil rate produced is 3738 bopd. From the above sensitivity graph which is done by using original THP @ 550 psia and skin of zero, this well can produces up to 6011 stb/d which is greater than our initial target rate. In order to increase the oil rate, we have to reduce the skin. To cater this problem, both drilling and completion teams are now agreed to use the dynamic underbalanced perforating techniques.

Dynamic underbalanced perforating technique is basically a perforating technique which is done in underbalanced condition to remove all of the damages in the well up to the surface. This technique will reduce the skin and automatically will increase the flow efficiency of this well.

3) Gas lift design

The parameters used to design gas lift valve setting depths are in the table

Brine weight	0.45 psi/ft
Optimum gas lift injection rate	0.55 MMSCF/d- 1.0 MMSCF/d
Minimum FTHP	550 psia
Casing pressure	1300 psia

Table 4 - 1.10: Gas lift parameters

In order to design gas lift for the unloading purpose, consider no flow at;

Reservoir pressure	2300 psi
Water cut	40%
GOR	440 scf/stb
Reservoir permeability	100 md

Table 4 - 1.11: Gas lift design data

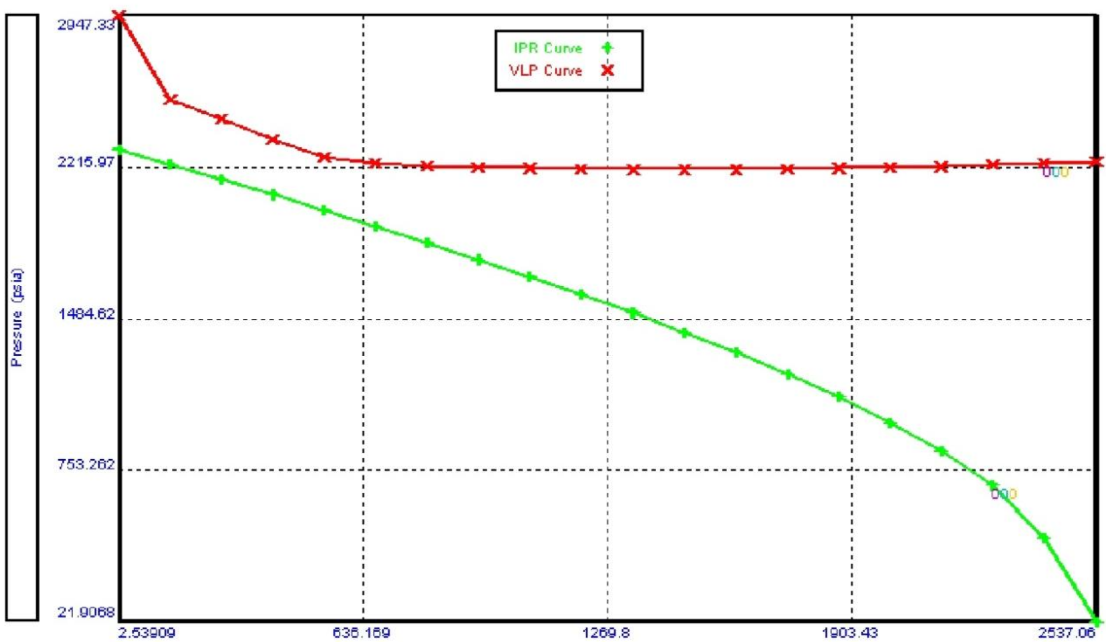


Figure 1.14: IPR versus VLP before using gas lift

From the Inflow Performance Relationship (IPR) versus Vertical Lift Performance (VLP) plot above, these two lines are not intersecting between each other which clearly indicate that this well is not flowing.

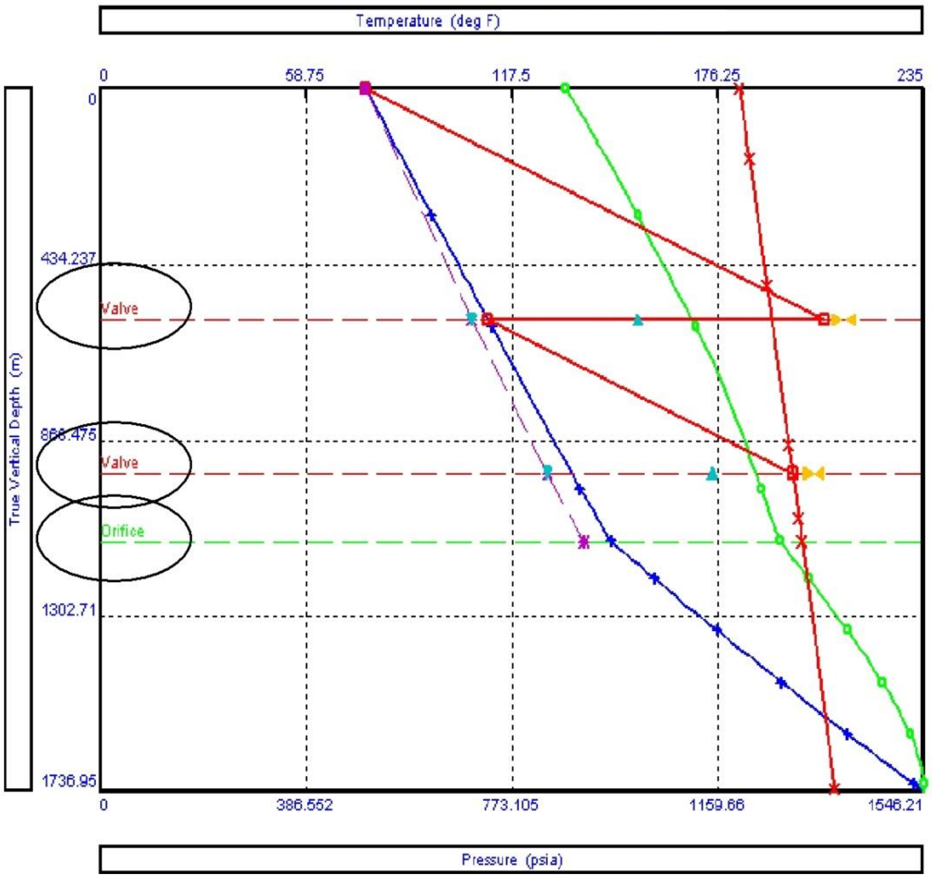
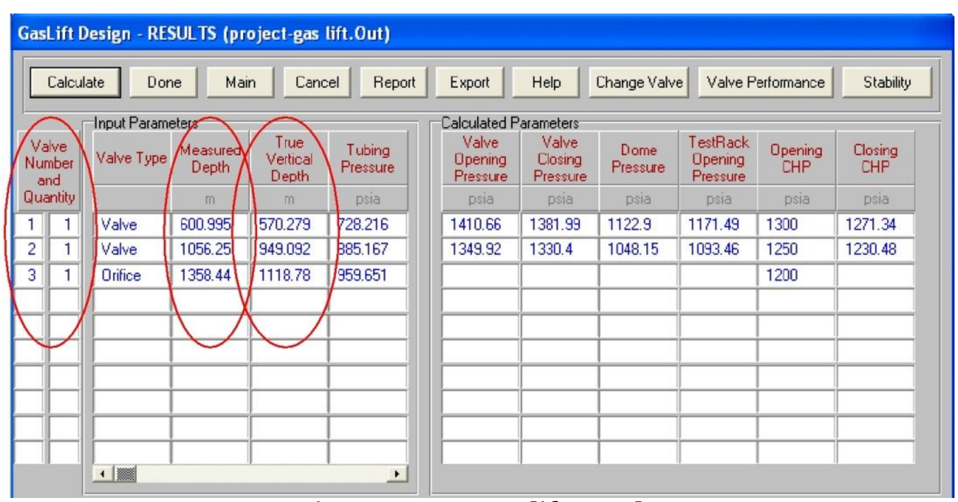


Figure 1.15: Gas lift design

From the above gas lift design, it is indicated that three valves need to be installed at their respective depths in the completion design later on.



Valve Number and Quantity		Valve Type	Measured Depth (m)	True Vertical Depth (m)	Tubing Pressure (psia)	Valve Opening Pressure (psia)	Valve Closing Pressure (psia)	Dome Pressure (psia)	TestRack Opening Pressure (psia)	Opening CHP (psia)	Closing CHP (psia)
1	1	Valve	600.995	570.279	728.216	1410.66	1381.99	1122.9	1171.49	1300	1271.34
2	1	Valve	1056.25	949.092	885.167	1349.92	1330.4	1048.15	1093.46	1250	1230.48
3	1	Orifice	1358.44	1118.78	959.651					1200	

Figure 1.16: Gas lift results

IPR VERSUS VLP PLOT AFTER USING GAS LIFT DESIGN

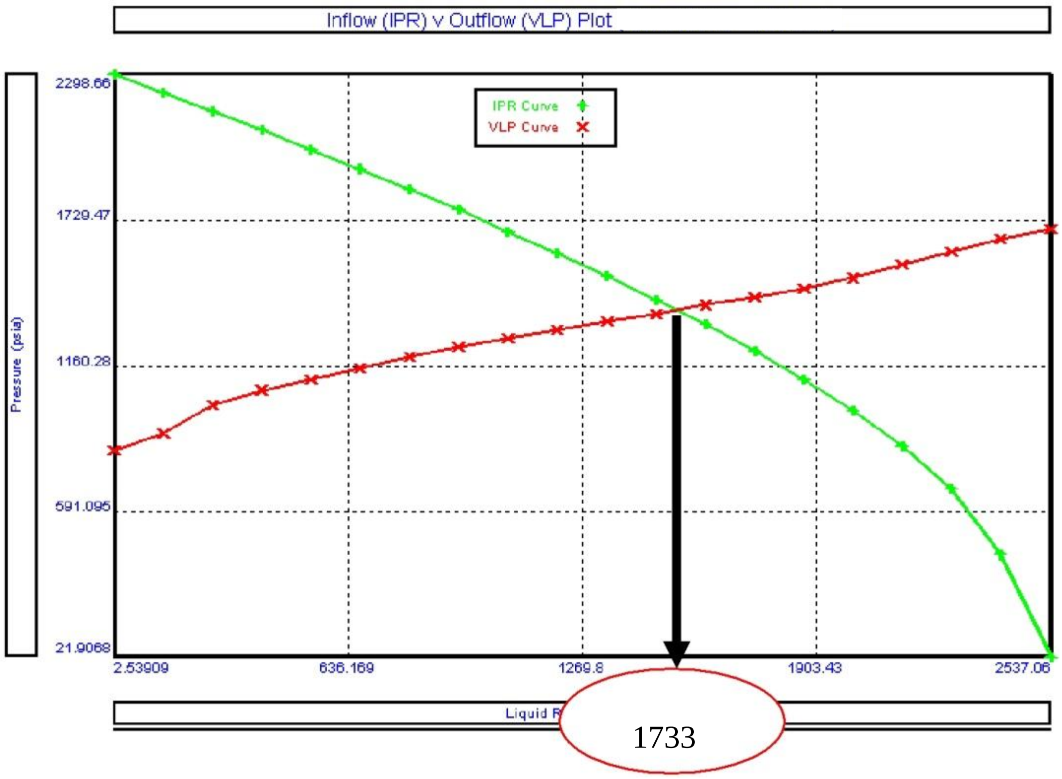


Figure 1.17: IPR versus VLP after using gas lift

The above graph shows the IPR versus VLP plot after using gas lift valve. Notice that this well is now starting to flow at 1733 stb/d since these two lines are intersecting between each other.

4) Material selection

CO2	H2S	CO2 partial pressure	H2S partial pressure
mole %	ppm	atm	atm
2.3	0	2.8	0

Table 4 - 4.1: Material selection

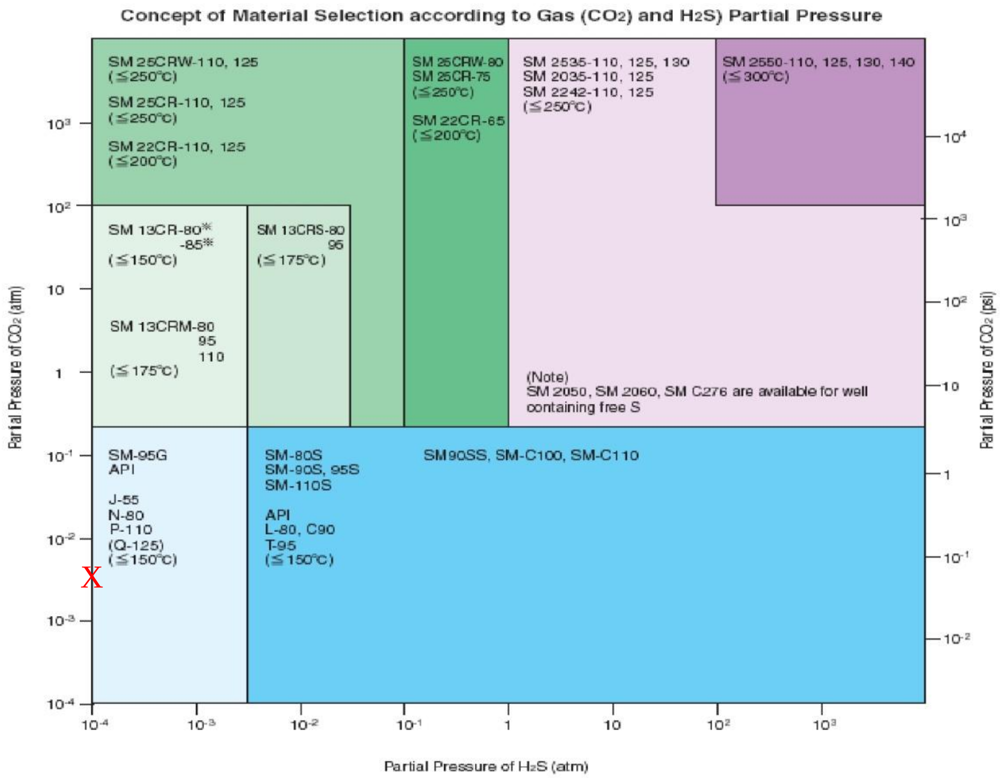


Figure 1.18: Material selection chart

From the chart above, it shows that the required material to be used for this new well is 13Cr. However, the entire existing oil producer wells in Field Y which are using L-80 Carbon steel show no indication for the downhole corrosion even without injecting any corrosion inhibitor. Hence, it is proposed that Carbon steel will be used instead of 13 Cr. To add, carbon steel is far more cheaper compared to the 13 Cr material.

5) Well completion design

After chose suitable material to be used for this new well, start designed well completion diagram by using Microsoft Excel.

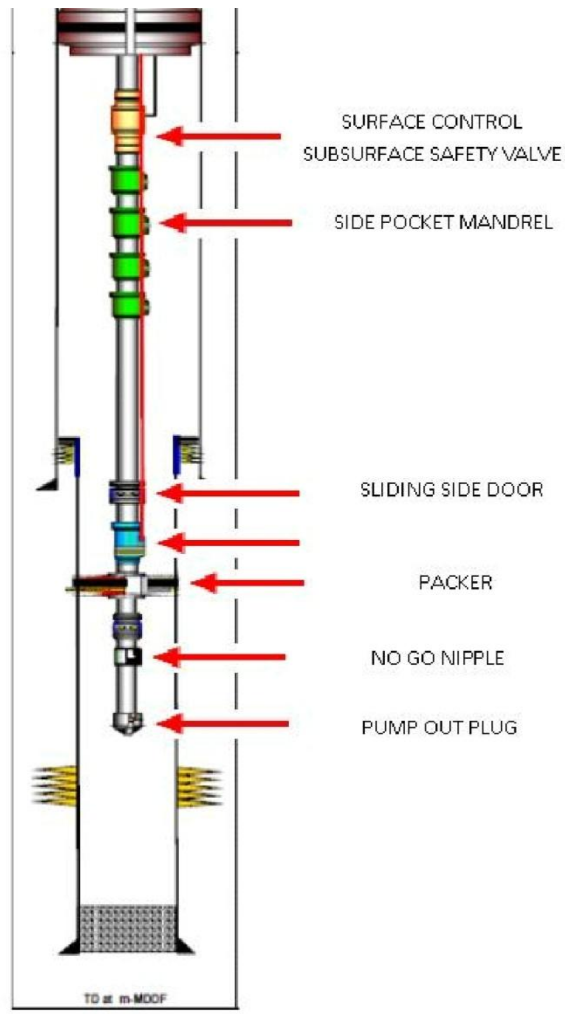


Figure 1.19: Well completion design (Early design)

Well completion operation summary

This procedure is designed to cover the completion operations for the Field Y well Y oil producer with a maximum inclination of 77 degree. This well has been directionally drilled to the N27 reservoir, building angle in the 12-1/4’’ section to encounter the reservoir top at approximately 77 degree inclination. 7’’ liner will be cemented across the reservoir N27. After performing wellbore clean up with scrapper and clean up pills, hydroxyl ethyl cellulose (HEC) will be displaced at the perforated zone depth to reduce losses after the perforation. Gun system will be run into this well on wireline.

3-1/2’’ single completion string with hydraulic set packer and permanent downhole gauge (PDG) will be run into the well until land tubing hanger. After setting and testing the tubing hanger, blowout preventer (BOP) will be nipple down and Christmas tree installed and tested. After flowed line installed, the well will be flowed back and handed over to production.

6) Well matching

Well matching is the last step involved to validate the well model by using well test data. This well matching is done on the PVT and IPR data. Below summarizes the results obtained for both data.

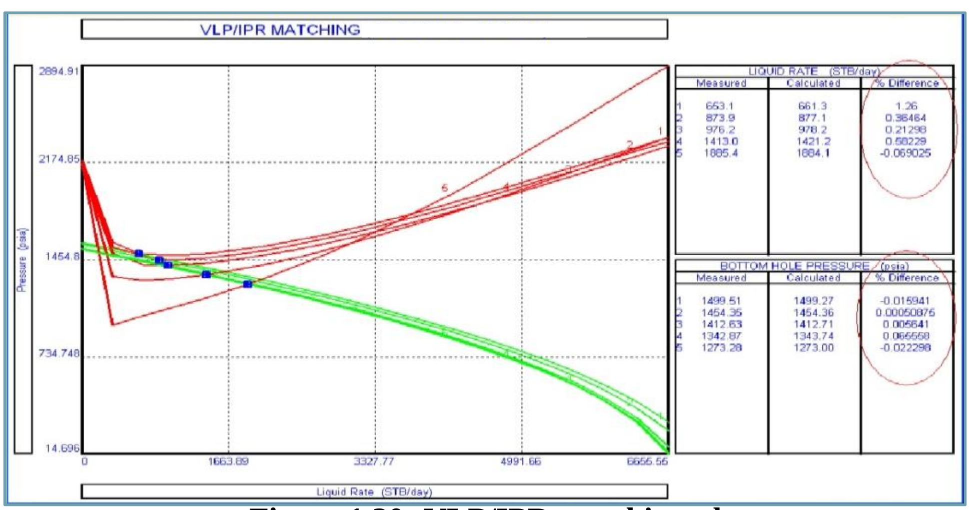


Figure 1.20: VLP/IPR matching plot

From the above PVT matching, the percentage difference for the liquid rate and bottomhole pressure between the measured and calculated value are small.

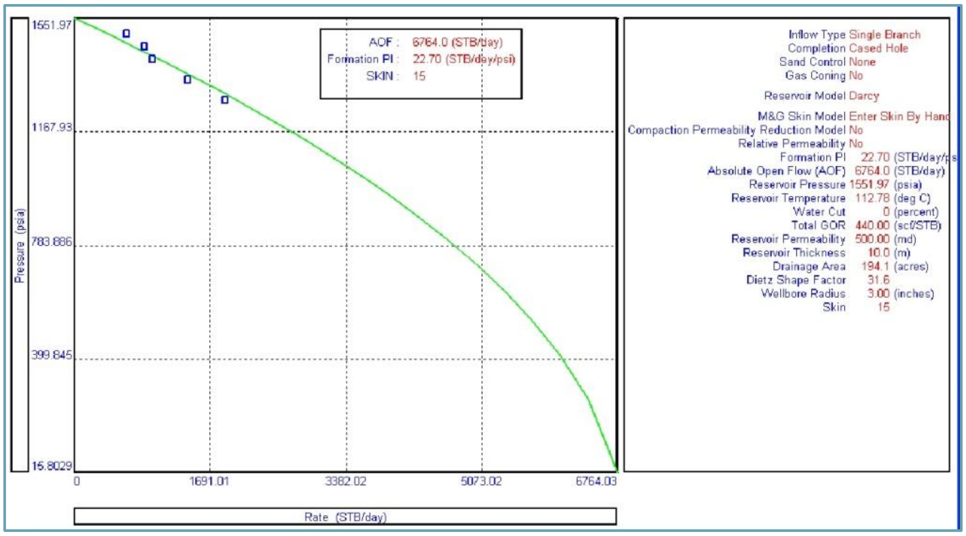


Figure 1.21: IPR matching plot

For the IPR matching above, it shows that all five well test results are plotted quite similar to the original IPR curve produced from the well model.

Based on these two PVT and IPR matching, we can considered that our well model is matched and it can be used for further analysis as tubing design and others.

Conclusion and Recommendation for Part A

For this project, a few production technology aspects which include designing well model, sensitivity analysis, material selection, designing well completion diagram, artificial lift requirement and also well matching are already completed. There are a few suggestions and recommendations that are very suitable and useful to be used in the near future in order to improve the well performance. For the well design, the further analysis should be done for the SMART well design which includes Inflow control device (ICD) and inflow control valve (ICV). So-called ‘smart’ or ‘intelligent’ wells are equipped with downhole sensors to monitor well and reservoir conditions, and valves to control the inflow of fluids from the reservoir to the well. This combination of monitoring and control technology has the potential to significantly improve oil and gas recovery.

For the perforation, this X well is perforated using PowerJet Omega type of charges. New technology has introduced PowerJet Nova where this charge could actually provide an extra deep penetration into the formation and dramatically will optimize the well productivity. For the well stimulation, this X well is currently not using any well stimulation techniques as it is already performed the dynamic underbalanced perforating job. However, to further increase the flow efficiency as well as reduce the damage in the well, I would like to suggest both of the completion and production teams to use StimGun to stimulate this well. The StimGun assembly has two major components which consist of perforating gun and the special propellant sleeve surrounding the gun where the usage of propellant itself will dynamically clean and stimulate the near-wellbore area. By using this StimGun, it will efficiently stimulate wells that have existing perforations or openhole completions, thus offering economical alternatives to recompletion and remediation.

PART B

ADDITIONAL PERFORATION JOB FOR REACTIVATION OF IDLE WELL X

Additional perforation creates a communication between the potential reservoirs with the idle well. So, the idle well can reproduce back with different reservoir from the current one. Additional perforation simply increases the production via adding new zone based on behind casing opportunities for the well. A perforation in this context refers to a hole punched in the casing, or liner of the well to connect it to the reservoir.

Activity	Reservoir	Interval		
		(ft BDF)	(ft BTHF)	(ft TVDSS)
Add perforation	RM3.1	6870-6890	6799-6819	5689.1-5702.4

Reserves and Potential

In order to evaluate the reserves from this zone, decline curve analysis (DCA) method were used. DCA using initial rate of 600 bopd and an annual decline rate of 30% yields a reserves number of 0.66 MMstb.

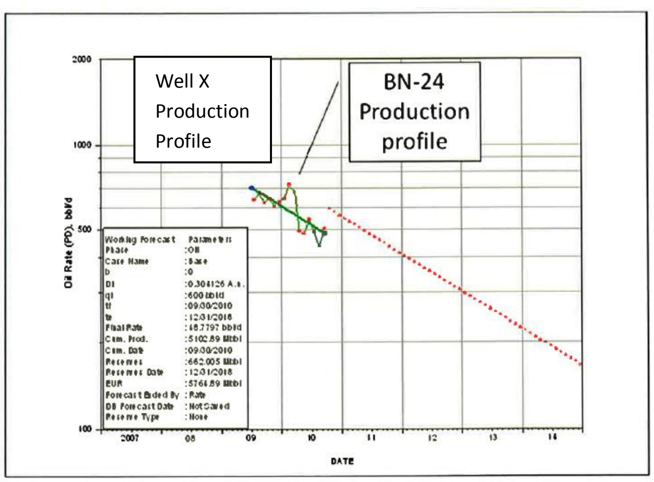
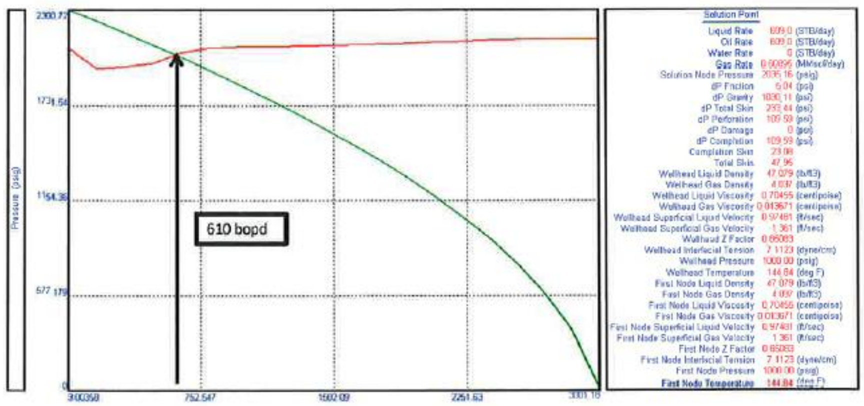


Figure 2 Reservoir Analysis DCA

Based on PROSPER analysis with sensitivities being carried out on watercut, skin and permeability the initial production rate estimated to be 600 bopd.

At 0% WC

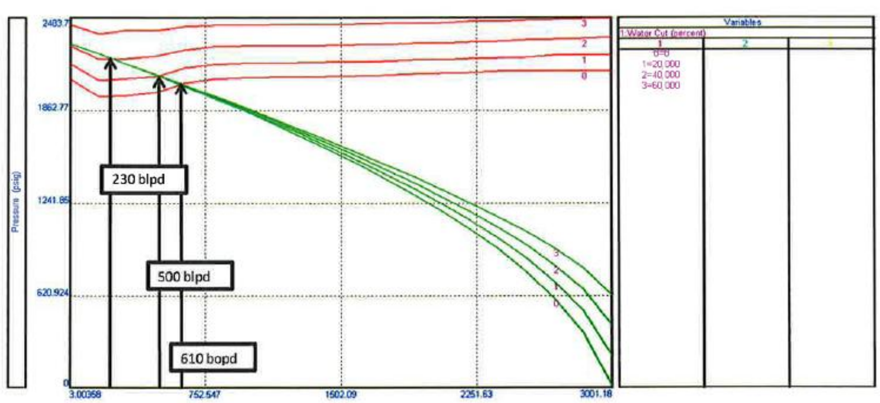


At 0% WC the well able to produce up to 600 bopd oil.

Sensitivity to WC

Figure 3 Oil Rate Sensitivities toward 0% Watercut

Sensitivity to WC



WC	Gross	Net
0	610	610
20	500	400
40	230	140

The well able to flow naturally up to 40% WC and still produce 140 bopd oil.

Figure 4 Oil Rate Sensitivities toward 0, 20 and 40% Watercut

Well X Additional Perforation Future Job

Well X has potential oil production from new zone RM3.1. X was completed in 1987 as a dual string oil producer. Currently both strings at this well are idle. The new perforation interval will be perforated (RM3.1 zone). This idle well is currently perforated in RM3.2. The RM3.2 zone has low productivity due to high water cut while RM3.1 still has oil reserves to be drained. The well was closed in year 2000. The well consider depleted. It gives opportunity to explore the new potential reservoir, RM3.1.

The estimated total potential gain of 600 BOPD and a total of 0.66 MMstb of reserves are expected to be recovered from this new zone. Refer to the **APPENDIX for** the wellbore diagram which shows the depth of the new zone.

Conclusion and Recommendation for Part B

Additional Perforation job at Well X has already successfully completed. The Idle well which previously shut in due to high water cut at RM3.2 zone has already revive back through RM3.1 zone. Well X currently can produce through this RM3.1 zone and achieved the targeted value of production. Thus, the idle well indeed can be revived by conducting the additional perforation to create channel of communication between the potential reservoir and the idle well.

CHAPTER 5 CONCLUSION

1) From all the research paper, it is proven that the reactivation of idle well job is a success. All the wells are already been reproduced.

2) The idle well need to be reactivated since that it still can contribute to the total number of production. It will be a waste if the well is abandoned or plugged if it still has the potential that can be extracted.

3) The reservoir potential need to be evaluated to plan the future reactivation job. Each condition of the idle well need to be analyzed first before applying any technique of reviving the idle well.

4) Sidetracking the existing idle well can enhance well productivity and thus reactivate the idle well.

5) Implementing sidetracking well technique will help produce from the targeted reservoir without the need to drill new wells. (Minimize cost and improve total number of production for the operating company.

6) The idle well can also be revived by conducting the additional perforation to create channel of communication between the potential reservoir and the idle well.

Ahmad Faris Hafizi Bin Ahmad Pauzi

Author

RECOMMENDATIONS

1) Communicating with well completion and drilling team in order to proceed with the sidetracking job.

2) Communicating with production team for the additional perforation job.

3) Attend all the meeting regarding the reviving idle job and presenting the current finding to the team.

REFERENCES

1. Kimbrell C.W. & Wojtanowicz K.A.,(2006). *Enhancing Inactive Well Recovery Potential –A Case History*. Available from www.onepetro.org PAPER 2006-177

2. Sulai T.A. & Hassan Y., (2005). *Insert String Technique Reviving Idle Well*. Available from www.onepetro.org. SPE NO: 93848

3. Al-Araimi M.N. & Mahajan M., (2005*) Successful Revival of Long-Time Closed-In Gas Wells by Right Matrix Stimulation Treatments*. Available from www.onepetro.org. SPE NO: 96735

4. Thomas T.K., (2001). Produce or Plug? *A Summary of Idle and Orphan Well Statics and Regulatory Approaches*. Available from www.onepetro.org. SPE NO: 68695

5. Borkhoche R., (2010). *Reactivation Project.* Available from www.onepetro.org. SPE 141245-STU

6. Abuhassoun H.A, & Sequera A.B., (2011). *Effective Reservoir Management Strategies to Revitalize Dead Producers Behind the Flood Front*. Available from www.onepetro.org. SPE NO: 149101

7. Manapov T., Alekseeva V., Zhigalov V. & Aksenov M., (2008). *TNK-BP Idle Well Stock Reactivation Program*. Available from www.opetro.org. SPE NO: 117397

8. M Latif M.A, A Aziz M., Latif N., Ibrahim Z., Mohamed N.A. & Jackson N., (2009). *Low Pressure System : A Production Enhancement Initiative*. Available from www.onepetro.org. SPE NO: 124276

9. Kamkum R & Zhu D. (2006). *Generalized Horizontal Well Inflow Relationship for Liquid Gas or Two-Phase Flow.* Available from www.onepetro.org. SPE NO: 99712

10. ***Well X – Additional Perforation Proposal"*** GhazalyBakar, YY Production Technologist/SSI, PCSB-KLCC
Date Prepared : 3rd of November 2011

11. ***"Wireline Oriented Perforation : Well X"*** ShafieJumaat, Wireline Customer Support, Schlumberger (M) Sdn. Bhd
Date Prepared: 13th of October 2011

12. ***"Site Visit Report Well X : Customer's Copy"***Sylvia Wong, Thundercranes
Date Prepared : 22nd of August 2011

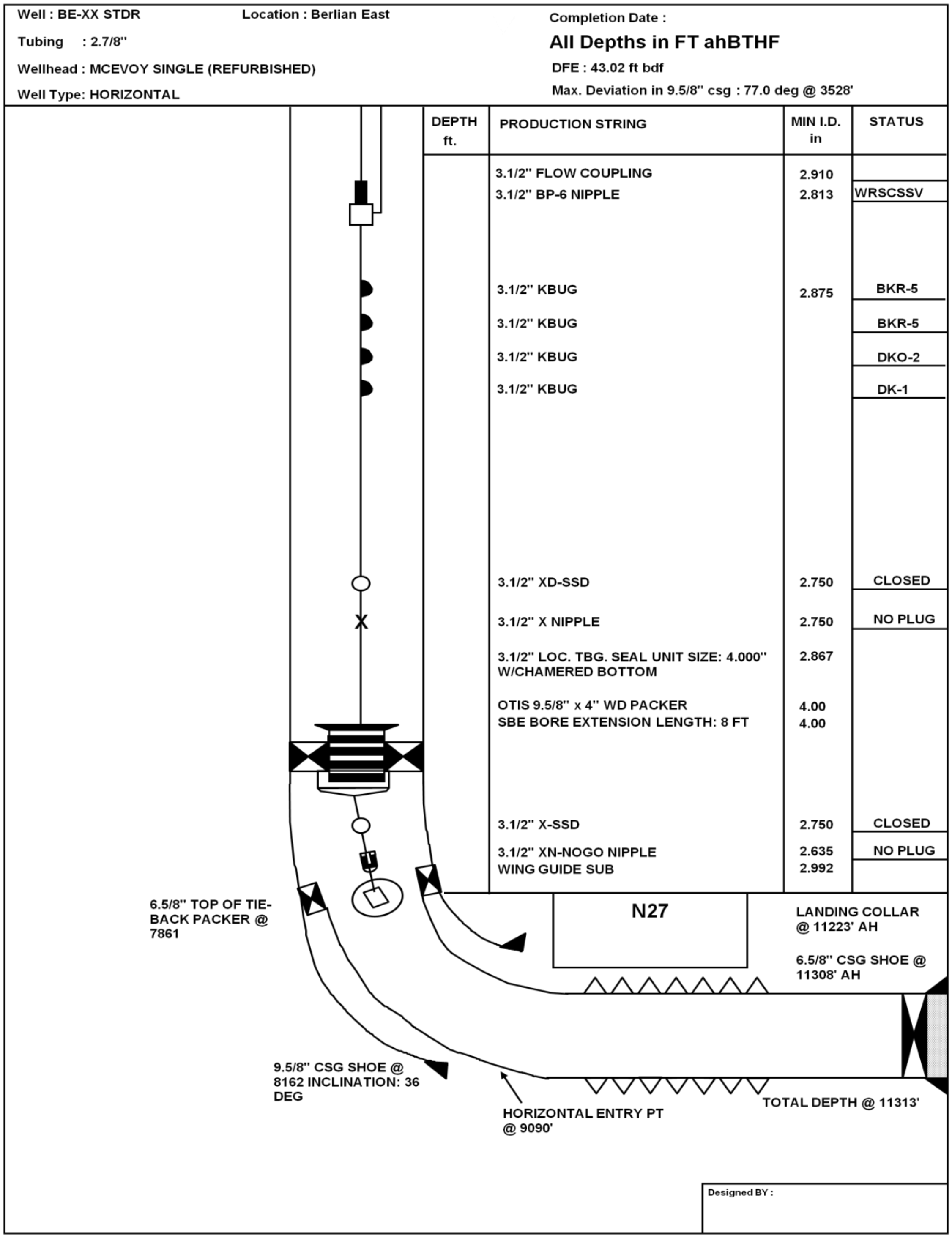
13. ***"General Overview of Field YY : Site Visit"*** Roland Bail, BJ Services (M) SdnBhd
Date Prepared : 22nd of August 2011

14. ***"Platform Inspection Report - Platform Well X"*** Abdul Karim Sainuddin, Field Specialist, Schlumberger WTA (M) Sdn. Bhd
Date Prepared: 9thof September 2011

15. ***"Well X : Final Job Report for Well Leak Detector"***Ahmad Fitri Mahmud, Senior Operations Engineer, TecWel™

APPENDIX A Wellbore Digram Well Y

Proposed Well



APPENDIX B Wellbore Digram Well X