Journal of Scientific and Engineering Research, 2017, 4(4):198-207



Research Article

ISSN: 2394-2630 CODEN(USA): JSERBR

The Economics of Multiphase Flow Meters and Test Separators in Flow Testing

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Abstract To decide between Test Separators (TS) and Multi-Phase Flow Meters (MPFM), the Capital & Operating Expenditures (CAPEX and OPEX) of each facility must be compared. An economic model is developed for evaluating the economics of Multi-Phase Flow Meters, MPFM and Test Separators, TS. A comparative study was made to consider which is more economically viable to be installed between the multiphase flow meter, MPFM and test separator, TS. The NPV was evaluated and was found to be a positive value, since Present Value (PV) for Multiphase Flow Meter, (MPFM) is - \$332,618 and Present Value (PV) for Test Separator, (TS) is -\$583,648. Hence, MPFM was selected, because NPV = PV_{MPFM} - PV_{TS} = (- \$332,618) - (- \$583,648) = \$251,030. This shows that Multi-Phase Flow Meters, MPFM is a more cost-effective means of obtaining well-test data.

Keywords Test Separators, Multi-Phase Flow Meters, Multi-Phase Flow, Economic Model, Net Present Value (NPV).

Introduction

The production stream from the oil wells contains gas and water, and particulate matter in a high mixed state. The ability to control and monitor the separation process is of critical essence in the oil and gas energy industry. Multiphase flow measurement is a general term that explains multiple flow measurement in a general term. Oil and water are known to be multiphase in the energy industry. The flow is a difficult subject principally as a result of the form in which the two fluids exist inside the pipe, known as the flow regime. Until recently, large test separators that are expensive are used to separate oil, water and gas, which are measured using conventional technology. The production stream from the oil, separation and measurement approach has inaccuracies and requires operator attention and maintenance [1]. Multi-Phase Flow Meters, MFPM application has become a very promising technology nowadays. It is proven that MPFM is environment-friendly since it generates zero emission to the environment (closed loop). Despite most careful preparation of the separator metering devices, there are still limitations on the accuracy of the test separator measurements [2]. Multiphase metering delivers real-time simultaneous measurement of oil, water and gas eliminating the need for test separators. It provides instant information on reservoir production [3]. One of the problems of the multiphase measurement technology is the uncertainty of the measurement. The main source for these higher measurement uncertainties in well test data is the fact that they measure unprocessed and far more complex flows. The problem now arises as to whether the accuracy of multiphase flow meter (MPFM) compares well with that of the test separator? More so, how economically viable are the multiphase flow meters (MPFMs) when compared to test separators?

MPFM eliminates the requirement of test separators, test lines, manifold and valve system. The drawback is that it cannot be applied for offloading and well cleaning purpose [4]. Prior industry attempts to utilize the new technology of multiphase metering for production well testing in mature fields has been hampered by the high cost of multiphase meters [5].



Figure 1: Flow Chart for Economic Model Development

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Objectives of Study

To develop an economic model in order to compare the cost of expenditures on the multiphase flow meter and test separator for selecting best metering method for production operations that will bring about maximum benefit and return on investment.

Scope of Study

In terms of multiphase flow meters (MPFM), this work is limited to the measurement of the in-line meter of the multiphase flow of oil, gas and water. The profitability indicators will be limited to the Net Present value (NPV).

Materials and Methods

The profitability indicator such as NPV is used to select the economic service-producing investments, such as the Test Separator and Multiphase Meters.

Economic Model

The NPV is obtained by subtracting the present value of periodic cash-out flows from the present value of periodic cash inflows. The NPV can be calculated has follows:

$$NPV_{(MPFM-TS)} = \sum_{i=1}^{n} TC \left[\frac{(MPFM - TS)}{(1+i)^{n}} \right]$$
(1)

When the NPV is calculated, decision is made as follows:

If NPV is greater than zero, select multiphase flow meter (MPFM);

If NPV is less than zero, select Test Separator (TS);

If NPV is zero, select either of them

The following are the assumptions made in this study:

- 1. The equipment has a twelve-year service life;
- 2. There is no tax implication to the investment;
- 3. There is no salvage value;
- 4. Base case of 15% discount factor is considered.

Results and Discussion

This study gives a comparative economic evaluation of both the multiphase flow meter and the test separator. This is important, for one to decide which method to select or reject. Selecting the best equipment for production operations will bring about maximum benefit and good return on investment.

Years	Multiphase l	Flow Meter
from Start	CAPEX (\$)	OPEX (\$)
0	170,000	0
1	0	30,000
2	0	30,000
3	0	30,000
4	0	30,000
5	0	30,000
6	0	30,000
7	0	30,000
8	0	30,000
9	0	30,000
10	0	30,000
11	0	30,000
12	0	30,000

Table 1: Cost of Operation for Multiphase Flow Meter

able 2: Cost o	f Operation for	Test Separate
Years	Test Sep	parator
from Start	CAPEX (\$)	OPEX (\$)
0	150,000	0
1	0	80,000
2	0	80,000
3	0	80,000
4	0	80,000
5	0	80,000
6	0	80,000
7	0	80,000
8	0	80,000
9	0	80,000
10	0	80,000
11	0	80,000
12	0	80,000

								Granville
Period of	Investment					Cash Flow		
Enter Time Length (t,yr)	12	Ok	Close	Cancel Clea	Choose Discount Rate 0		- Plot S	ave
Input Parameters for Flow Meter			Time(year)	CAPEX_FM(\$)	OPEX_FM(\$)	TC_FM(\$)	Disc'Factor_FM(%)	PV_@_Disc'Factor_FM
Enter CAPEX(C, \$)	Engaged		.0 0	170000	0	170000	1	170000
			01	0	30000	30000	0.8696	26088
Enter OPEX(U, \$)	Engaged		0 2	0	30000	30000	0.7561	22683
DiscountRate(%)	15	ок	0 3	0	30000	30000	0.6575	19725
			<i>J</i> 4	0	30000	30000	0.5718	17154
Input Parameters	for Test Separat	or	.0 5	0	30000	30000	0.4972	14916
Enter CAPEX(C, \$)	Engaged		0 6	0	30000	30000	0.4323	12969
Enter OPEX(O_\$)	Engaged		0 7	0	30000	30000	0.3759	11277
D: (D) (0)	Lingageu		.0 8	0	30000	30000	0.3269	9807
DiscountRate(%)	15	OK	.0 9	0	30000	30000	0.2843	8529
			_Ø 10	0	30000	30000	0.2472	7416
			11	0	30000	30000	0.2149	6447
			12	0	30000	30000	0.1869	5607
			* TOTAL	XXX	XXX	TOTAL =530000	XXX	TOTAL =332618
				I	I			
				- Calar				
			Advice	e = Selec	a Multiph	ase meter		

Figure 2: Model Result for Multiphase Flow Meter of 15 % Discount

Period of	Investment		Cash Flow							
Enter Time Length (t,yr)	12	Ok	Close Cance	l Clear Cl	ioose Discount Rate	• 0 •	Plot Save			
Input Paramete	ers for Flow Met	er	c'Factor_FM(Frac)	CAPEX_TS(\$)	OPEX_TS(\$)	TC_TS(\$)	PV_@_Disc'Factor_TS(Frac			
Enter CAPEX(C, \$)	Engaged		1	150000	0	150000	150000			
Enter OPEX(O, \$)	Engaged			0	80000 80000	80000 80000	69568 60488			
DiscountRate(%)	15	01		0	80000	80000	52600			
	15	OK		0	80000	80000	45744			
Input Parameters	for Test Separ	ator		0	80000	80000	39776			
Enter CAPEX(C, \$)	Engaged			0	80000	80000	34584			
	Engrand			0	80000	80000	30072			
Enter OFEX(0, 5)	Engaged			0	80000	80000	26152			
DiscountRate(%)	15	OK		0	80000	80000	22744			
				0	80000	80000	19776			
				0	80000	80000	17192			
				0	80000	80000	14952			
			32618	XXX	XXX	TOTAL =111000	0 TOTAL =583648			
			Advice =	Select M	ultiphase N	leter				

Figure 2: Model Result for Test Separators of 15 % Discount



The NPV was evaluated based on equation (1). Here, the NPV was found to be a positive value, since Present Value (PV) for Multiphase Flow Meter (MPFM) is - 332,618 and Present Value (PV) for Test Separator is - 583,648. Hence, MPFM was selected, because NPV = PV_{MPFM} -PV_{TS} = (- 332,618) - (-583,648) = 251,030. Figure 4 below shows the relationship between the CAPEX and OPEX for both MPFM and Test Separator. It is cheaper to install a Test Separator when compared to a Multi-Phase Flow Meter (MPFM), but the cost of operating a Multi-Phase Flow Meter (MPFM) over a period of time is far lesser than that of a Test Separator.



Figure 4: Expenditure curves for MPFM and Test Separator

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Period of	Investment					Cash Flow		
Enter Time Length (t,yr)	Enter Time Length (t,yr) 12 Ok				ar Choose Disco	ount Rate 0	✓ Plot Save	
Input Paramete	ers for Flow Meter		Time(year)	CAPEX_FM(\$) OPEX_FM(\$)	TC_FM(\$)	Disc'Factor_FM(%)	PV_@_Disc'Fact
Enter CAPEX(C, \$)	Engaged		<i>.1</i> 0	170000	0	170000	1	170000
Enter OPEX(O, \$)	Engaged		1 2	0	30000	30000	0.9524	28572
DiscountRate(%)	5	or	J 3	0	30000	30000	0.8638	25914
	Ľ	UN	<i>J</i> 4	0	30000	30000	0.8227	24681
Input Parameters	s for Test Separator		Ø 5	0	30000	30000	0.7835	23505
Enter CAPEX(C, \$)	Engaged		J 6	0	30000	30000	0.7462	22386
Enter OPEX(O_\$)	Engaged		<i>I</i> 7	0	30000	30000	0.7107	21321
	Liigageu		J 8	0	30000	30000	0.6768	20304
DiscountRate(%)	5	ОК	Ø 9	0	30000	30000	0.6446	19338
L			<i>.≬</i> 10	0	30000	30000	0.6139	18417
			11	0	30000	30000	0.5847	17541
			12	0	30000	30000	0.5568	16704
			* TOTAL	XXX	XXX	TOTAL =530000) XXX	TOTAL =435893
			•		11			
			Advice	e = Sele	ect Multipha	se Meter		

Figure 5: Model Result for Multiphase Flow Meter of 5 % Discount

					Gr	anville	-		
Period of	f Investment				Cr	ash Flow			
Enter Time Length (t,yr)	12	Ok	Close	Cancel Clear	Choose Discount F	Rate 0 👻	Plot Save		
Input Paramete	ers for Flow Mete	ar	tor_FM(Frac)) CAPEX_TS(\$)	OPEX_TS(\$)	TC_TS(\$)	PV_@_Disc'Factor_TS((Frac)	4
Enter CAPEX(C, \$)	Engaged		1	0	80000	80000	76192		
	Lingugou			0	80000	80000	72560		
Enter OPEX(U, \$)	Engaged			0	80000	80000	69104		
DiscountRate(%)	5	ок		0	80000	80000	65816		
			_	0	80000	80000	62680		
Input Parameters	s for Test Separa	tor		0	80000	80000	59696		
Enter CAPEX(C, \$)	Engaged			0	80000	80000	56856		
Enter OPEV(O_6)	Engaged			0	80000	80000	54144		
	Engageu			0	80000	80000	51568	1	
DiscountRate(%)	5	OK		0	80000	80000	49112	1	
L				0	80000	80000	46776		
				0	80000	80000	44544	1	
				0	80000	80000	42424		
				XXX	XXX	0	0	1	
				XXX	XXX	0	0		
				XXX	XXX	TOTAL =11900	000 TOTAL =901472	F	÷
									7
			Advice) = Select	Multiphase	Meter			



ment						Cash Flow		
Enter Time Length (t.yr) 12 Ok		ose	Cancel	Clear	Choose Discour	nt Rate 0 👻	Plot Save	J
Flow Meter	Time	(year)	CAPEX_	FM(\$)	OPEX_FM(\$)	TC_FM(\$)	Disc'Factor_FM(%)	PV_@_Disc'Facto
jaged	10		170000		0	170000	1	170000
aged	1 1 2		0		30000	30000	0.9091	2/2/3
	1 3		0		30000	30000	0.7513	22539
ОК	04		0		30000	30000	0.683	20490
est Separator	0 5		0		30000	30000	0.6209	18627
aged	06		0		30000	30000	0.5645	16935
	07		0		30000	30000	0.5132	15396
Jageu	0 8		0		30000	30000	0.4665	13995
OK	.0 9		0		30000	30000	0.4241	12723
	0 1	0	0		30000	30000	0.3855	11565
	01	1	0		30000	30000	0.3505	10515
	1 1	2	0		30000	30000	0.3186	9558
	T	OTAL	XXX		XXX	0	0.2897	0
	* 🔳	OTAL	XXXX		XXXX	TOTAL =530000	XXX	TOTAL =374408
				111				
	Ad	vice	= S	elect	Multiphas	se Meter		
	ment Dok Flow Meter Haged Dok St Separator Haged Dok OK	ment isged in a isged isged is isged isged isged isged isged isged isged is isged isged isged isged isged isged is isged isged isged isged isged isged isged is isged isged isged isged isged isged is isged isged isged isged isged is isged isged	Ok Time(year) Jaged J Jaged J OK J St Separator J Jaged J Jaged J OK J J <t< th=""><td>Ok Close Cancel Time(year) CAPEX, laged 0 170000 aged 0 170000 y 0 170000 jaged 0 1 ox 4 0 stSeparator 9 5 jaged 0 7 jaged 0 10 j 0 10 j 10 0 j 12 0 TOTAL<xxx< td=""> * TOTAL<xxx< td=""></xxx<></xxx<></td><td>Imment Close Cancel Clear Flow Meter # 0 170000 iaged # 0 1 0 iaged # 0 1 0 ist Separator # 5 0 # 4 0 iaged # # 0 # 7 0 # # 0 # # 0 # # 0 # # 0 # # 0 # # 0 # # 0 # # 0 # # 0 # # 0 # # 0 # # 0 # # 0 # # 0 # # 0 # # 0 # # 0 # # 10 0 # # 10 # # 10 # # 10 # # #</td><td>Imment Close Cancel Clear Choose Discour Time(year) CAPEX_FM(S) OPEX_FM(S) OPEX_FM(S) laged 0 170000 0 aged 0 170000 0 V 1 0 30000 y 2 0 30000 y 3 0 30000 y 4 0 30000 y 5 0 30000 y 5 0 30000 y 6 0 30000 y 8 0 30000 y 9 0 30000 y 9 0 30000 y 10 0 30000 y 11 0 30000 y 12 0 30000 y 12 0 30000 x TOTAL XXX XXX Advice = Selecct Multiphas</td></t<> <td>ment Cash Flow Image <thimage< th=""> <thimage< th=""> Image</thimage<></thimage<></td> <td>Image Cash Flow Image Image Image Plot Save Time(year) CAPEX_FM(S) OPEX_FM(S) TC_FM(S) DiscFactor_FM(%) aged 0 1 0 30000 30000 0 9991 aged 0 1 0 30000 30000 0 8264 // 3 0 30000 30000 0.6833 1 0 30000 0.6633 st Separator // 5 0 30000 30000 0.6645 // // 1 0 30000 0.6645 // // // 1 0 30000 0.6209 // // // 1 0 30000 0.6209 // // // // 0 30000 0.6209 //</td>	Ok Close Cancel Time(year) CAPEX, laged 0 170000 aged 0 170000 y 0 170000 jaged 0 1 ox 4 0 stSeparator 9 5 jaged 0 7 jaged 0 10 j 0 10 j 10 0 j 12 0 TOTAL <xxx< td=""> * TOTAL<xxx< td=""></xxx<></xxx<>	Imment Close Cancel Clear Flow Meter # 0 170000 iaged # 0 1 0 iaged # 0 1 0 ist Separator # 5 0 # 4 0 iaged # # 0 # 7 0 # # 0 # # 0 # # 0 # # 0 # # 0 # # 0 # # 0 # # 0 # # 0 # # 0 # # 0 # # 0 # # 0 # # 0 # # 0 # # 0 # # 0 # # 10 0 # # 10 # # 10 # # 10 # # #	Imment Close Cancel Clear Choose Discour Time(year) CAPEX_FM(S) OPEX_FM(S) OPEX_FM(S) laged 0 170000 0 aged 0 170000 0 V 1 0 30000 y 2 0 30000 y 3 0 30000 y 4 0 30000 y 5 0 30000 y 5 0 30000 y 6 0 30000 y 8 0 30000 y 9 0 30000 y 9 0 30000 y 10 0 30000 y 11 0 30000 y 12 0 30000 y 12 0 30000 x TOTAL XXX XXX Advice = Selecct Multiphas	ment Cash Flow Image Image <thimage< th=""> <thimage< th=""> Image</thimage<></thimage<>	Image Cash Flow Image Image Image Plot Save Time(year) CAPEX_FM(S) OPEX_FM(S) TC_FM(S) DiscFactor_FM(%) aged 0 1 0 30000 30000 0 9991 aged 0 1 0 30000 30000 0 8264 // 3 0 30000 30000 0.6833 1 0 30000 0.6633 st Separator // 5 0 30000 30000 0.6645 // // 1 0 30000 0.6645 // // // 1 0 30000 0.6209 // // // 1 0 30000 0.6209 // // // // 0 30000 0.6209 //

Figure 7: Model Result for Multiphase Flow Meter of 10 % Discount

					Gran	ville	
Period o	f Investment				Cash	Flow	
Enter Time Length (t.yr)	12	Ok	Close Can	cel Clear Cl	noose Discount Rate	e 0 👻 F	1ot Save
Input Paramet	ers for Flow Mete	er	Factor_FM(Frac)	CAPEX_TS(\$)	OPEX_TS(\$)	TC_TS(\$)	PV_@_Disc'Factor_TS(Frac)
Enter CAPEX(C s)	Engrand			150000	0	150000	150000
Enter CALEX(C, V)	Lingageu			0	80000	80000	72728
Enter OPEX(O, \$)	Engaged			0	80000	80000	66112
DiscountRate(%)	10	ОК		0	80000	80000	60104
				0	80000	80000	54640
Input Parameter	s for Test Separa	ator		0	80000	80000	49672
Enter CAPEX(C, \$)	Engaged			0	80000	80000	45160
Enter OPEX(O_\$)	Engrand			0	80000	80000	41056
	chigageu			0	80000	80000	37320
DiscountRate(%)	10	ОК		0	80000	80000	33928
				0	80000	80000	30840
				0	80000	80000	28040
				0	80000	80000	25488
				XXX	XXX	0	0
			408	XXX	XXX	TOTAL =1110000	TOTAL =695088
			•				III
			Advice =	Select M	ultiphase N	leter	

Figure 8: Model Result for Test Separator of 10 % Discount



					(Granville		×				
Period o	f Investment		Cash Flow									
Enter Time Length (t.yr)	12	Ok	Close	Close Cancel Clear Choose Discount Rate 0 - Plot Sa								
Input Paramet	ers for Flow Met	er	Time(year)	CAPEX_FM(\$)	OPEX_FM(\$)	TC_FM(\$)	Disc'Factor_FM(%)	PV_@_Disc'Fa				
Enter CAPEX(C_\$)	Engaged		<i>I</i> 0	170000	0	170000	1	170000				
	Lingageo		1	0	30000	30000	0.8333	24999				
Enter OPEX(O, \$)	Engaged		0 2	0	30000	30000	0.6944	20832				
DiscountRate(%)	20	ОК	0 3	0	30000	30000	0.5787	17361				
			.0 4	0	30000	30000	0.4823	14469				
Input Parameter	s for Test Separ	ator	.0 5	0	30000	30000	0.4019	12057				
Enter CAPEX(C, \$)	Engaged		0 6	0	30000	30000	0.3349	10047				
			07	0	30000	30000	0.2791	8373				
Enter OFEX(0, \$)	Engaged		0 8	0	30000	30000	0.2326	6978				
DiscountRate(%)	20	ОК	0 9	0	30000	30000	0.1938	5814				
	-		0 10	0	30000	30000	0.1615	4845				
			0 11	0	30000	30000	0.1346	4038				
			0 12	0	30000	30000	0.1122	3366				
			► TOTAL	XXXX	XXX	TOTAL =530000	XXX	TOTAL =3031				
			Advice	= Select	Multiphas	e Meter						

						Gran	ville	-	
Period of	Investment					Cash	Flow		
Enter Time Length (t,yr)	12	Ok	Close	Cancel	Clear	Choose Discount Rate	0 -	Plot Save	
Input Paramete	ers for Flow Met	er	Factor_FM(F	rac) (CAPEX_TS(\$) OPEX_TS(\$)	TC_TS(\$)	PV_@_Disc'Factor_	TS(Frac)
Enter CAPEX(C. \$)	Engaged		1	•	150000	0	150000	150000	
					D	80000	80000	66664	
Enter OPEX(0, \$)	Engaged				D	80000	80000	55552	
DiscountRate(%)	20	ок			D	80000	80000	46296	
			-		D	80000	80000	38584	
Input Parameters	for Test Separ	ator		(D	80000	80000	32152	
Enter CAPEX(C, \$)	Engaged			(D	80000	80000	26792	
Enter OPEX(O_\$)	Engaged			(D	80000	80000	22328	
	Engaged			(D	80000	80000	18608	
DiscountRate(%)	20	OK		(D	80000	80000	15504	
L			-	(D	80000	80000	12920	
				(D	80000	80000	10768	
				(D	80000	80000	8976	
			179)	XXX	XXX	TOTAL =111	0000 TOTAL =505144	
								III	
		Advice	e = ;	Select	Multiphase N	leter			

Figure 10: Model Result for Test Separator of 20 % Discount

						Granville		- 🗆 🗙	
Period of I	nvestment					Cash Flow			
Enter Time Length (t,yr)	Close	Close Cancel Clear Choose Discount Rate 0 - Plot Save							
Input Parameter	Input Parameters for Flow Meter				OPEX_FM(\$)	TC_FM(\$)	Disc'Factor_FM(%)	PV_@_Disc'Facto	
Enter CAPEX(C_\$)	Engaged		0	170000	0	170000	1	170000	
	Engagoa		0 1	0	30000	30000	0.8	24000	
Enter OPEX(O, \$)	Engaged		0 2	0	30000	30000	0.64	19200	
DiscountRate(%)	25	ок	0 3	0	30000	30000	0.512	15360	
			0 4	0	30000	30000	0.4096	12288	
Input Parameters	for Test Separate	or	0 5	0	30000	30000	0.3277	9831	
Enter CAPEX(C, \$)	Engaged		0 6	0	30000	30000	0.2621	7863	
Enter OPEX(O_S)	Engaged		07	0	30000	30000	0.2097	6291	
Enter OFEX(0, 3)	Engaged		0 8	0	30000	30000	0.1678	5034	
DiscountRate(%)	25	ОК	0 9	0	30000	30000	0.1342	4026	
			0 10	0	30000	30000	0.1074	3222	
			0 11	0	30000	30000	0.0859	2577	
			0 12	0	30000	30000	0.0687	2061	
			TOTAL	XXX	XXX	0	0.055	0	
			* TOTAL	XXXX	XXXX	TOTAL =530000	XXXX	TOTAL =281753	
				1	II.				
			Advice	e = Seleo	ct Multipha	ase Meter			
					-				

Figure 11: Model Result for Multiphase Flow Meter of 25 % Discount



						Gran	ville	-	□ ×
Period o	Cash Flow								
Enter Time Length (t.yr)	12	Ok	Close	Cancel	Clear	Choose Discount Rate	• 0 •	Plot Save	
Input Parameters for Flow Meter			Factor_FM(F	Frac) C	APEX_TS(\$) OPEX_TS(\$)	TC_TS(\$)	PV_@_Disc'Factor_T	S(Frac)
Enter CAPEX(C, \$)	Engaged		-	1	50000	0	150000	150000	
Enter OPEX(0_\$)	Engaged			0		80000	80000	64000	
Discourt Data (%)	Engaged			0		80000	80000	51200	
DiscountRate(%)	25	OK		0		80000	80000	22762	
Input Parameter	s for Test Separa	ator	1	0		80000	80000	26216	
Enter CAPEX(C_\$)	Engaged			0		80000	80000	20968	
	Engaged			0		80000	80000	16776	
Enter OPEX(0, \$)	Engaged			0		80000	80000	13424	
DiscountRate(%)	25	OK		0		80000	80000	10736	
				0		80000	80000	8592	
				0		80000	80000	6872	
				0		80000	80000	5496	
				0		80000	80000	4400	
			753	X	××	XXX	TOTAL =1190	0000 TOTAL =452408	
								III	
	Advice = Select Multiphase Meter								

Figure 12: Model Result for Test Separator of 25 % Discount

							Granvine			
Period of Investment				Cash Flow						
Enter Time Length (t,yr)	12	Ok	Clo	ose Cance	l Clear	Choose Disco	ount Rate 0	Plot Save	J	
Input Parameters for Flow Meter			Time((year) CAF	PEX_FM(\$)	OPEX_FM(\$)	TC_FM(\$)	Disc'Factor_FM(%)	PV_@_Disc'Fact	
Enter CAPEX(C_S)	Engaged		.0 0	170	000	0	170000	1	170000	
	Engagea		01	0		30000	30000	0.7692	23076	
Enter OPEX(O, \$)	Engaged		.0 2	0		30000	30000	0.5917	17751	
DiscountRate(%)	30	ок	.0 3	0		30000	30000	0.4552	13656	
			.0 4	0		30000	30000	0.3501	10503	
Input Parameters for Test Separator			0 5	0		30000	30000	0.2693	8079	
Enter CAPEX(C, \$)	Engaged		0 6	0		30000	30000	0.2072	6216	
Enter OPEY(O_6)	Farmer d		07	0		30000	30000	0.1594	4782	
	Engageo		0 8	0		30000	30000	0.1226	3678	
DiscountRate(%)	30	OK	0 9	0		30000	30000	0.0943	2829	
L			0 10	0 (30000	30000	0.0725	2175	
			0 11	1 0		30000	30000	0.0558	1674	
			0 12	2 0		30000	30000	0.0429	1287	
			0 T(DTAL XXX	(XXX	0	0.033	0	
			T	DTAL XXX	(XXX	0	0.0254	0	
			' ₩ 🔽	DTAL XXX	(XXXX	TOTAL =530000	XXXX	TOTAL =265706	
			Ad	vice =	Select	Multipha	ise Meter			
						-				

Figure 13: Model Result for Multiphase Flow Meter of 30 % Discount

					Granv	ville	- 🗆 🗙	
Period of Investment			Cash Flow					
Enter Time Length (t,yr)	12	Ok	Close Cano	el Clear	Choose Discount Rate	0 -	Plot Save	
Input Parameters for Flow Meter			Factor_FM(Frac)	CAPEX_TS(\$) OPEX_TS(\$)	TC_TS(\$)	PV_@_Disc'Factor_TS(Frac)	
Enter CAPEX(C, \$)	Engaged			150000	0	150000	150000	
Enter OPEX(O, \$)	Engaged			0	80000	80000	47336	
DiscountRate(%)	30			0	80000	80000	36416	
	30	OK		0	80000	80000	28008	
Input Parameters for Test Separator				0	80000	80000	21544	
Enter CAPEX(C, \$)	Engaged			0	80000	80000	16576	
Enter OPEX(O_s)	Engrand			0	80000	80000	12752	
Enter OFEA(0, 3)	Engaged			0	80000	80000	9808	
DiscountRate(%)	30	OK		0	80000	80000	7544	
				0	80000	80000	5800	
				0	80000	80000	4464	
				0	80000	80000	3432	
				0	80000	80000	2640	
				XXX	XXX	0	0	
			706	XXXX	XXX	TOTAL =11900	00 TOTAL =407856	
							III 💽	
			Advice =	Select	Multiphase M	leter		

Figure 14: Model Result for Test Separator of 30 % Discount

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Discount	NPV (\$)					
Factor (%)	MPFM	Test Separator				
5	435,893	901,472				
10	374,408	695,088				
15	332,618	583,648				
20	303,179	505,144				
25	281,753	452,408				
30	265,706	407,856				

Table 3: NPV at Various Discount Factors





Figure 15 above shows the relationship between NPV and discount factors of 5% to 35%. To obtain the breakeven point, the total cost of both MPFM and Test Separator were discounted at various discount rate and the present value (NPV) obtained were used to generate Figure 15 above. From the trend, it shows that it will get to 80% to 90% for breakeven to occur. i.e when NPV for MPFM is equal to that of the Test Separator. MPFM gives a better investment proposal than the Test Separator which will give a better investment proposal if the discount factors continue to increase.

Conclusion

- 1. An economic model was developed for evaluating the economics of MPFM and Test Separators.
- 2. MPFM is more economically viable to install than the Test Separators. This means that MPFM is a more costeffective means of obtaining well-test data.
- 3. Further study should be considered whether it will be more economical to replace a test separator with a multiphase flow meter when the test separator is already in place.
- 4. In order to enjoy the benefits of multiphase metering, companies will have to provide the financial support to the development of higher performance meters.

Acknowledgement

We would like to appreciate every member of staff of Petroleum and Gas Engineering Department, for their individual contributions that keeps the Department working. God bless you all.

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