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Volumetric appraisal
for
Pee Jay prospect
T/ 39P

Prepared by
P J Cameron
ResourceInvest Pty Ltd
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ResourceInvest Pty Ltd ABN: 96 092 481 126
PO BOX 141, Exeter, Tasmania, 7275
email: resourceinvest@bigpond.com
Telephone 03 6394 7214
Fax 03 6394 7614

Table of Contents

1 SUMMARY 4
2 INPUT ASSUMPTIONS 7
2.1 Gross Rock Volume 7
2.2 Percentage Fill of Reservoir 8
2.3 Net to Gross 9
2.4 Porosity 9
2.5 Gas Saturation 10
2.6 Oil Saturation 10
2.7 Gas expansion factor, E 10
2.8 Oil Shrinkage Factor 11
2.9 Gas Recovery Factor 11
2.10 Oil Recovery Factor 11
2.11 Condensate Gas Ratio 12
2.12 LPG 12
2.13 Inerts 12
2.14 Volume Normalisation 12
3 RESERVE DISTRIBUTION TUEVCM - FULL TO SPILL (FTS) 13
4 RESERVE DISTRIBUTION TUEVCM – VARIABLE FILL (VF) 14
5 RESERVE DISTRIBUTION IUEVCM 1540 - FULL TO SPILL (FTS) 15
6 RESERVE DISTRIBUTION IUEVCM 1540 - VARIABLE FILL (VF) 16
7 RESERVE DISTRIBUTION BUEVCM 1710 - FULL TO SPILL (FTS) 17
8 RESERVE DISTRIBUTION BUEVCM 1710 – VARIABLE FILL (VF) 18
9 SENSITIVITIES 19

List of Tables

Table 1. Potential hydrocarbon volumes - Pee Jay Full to Spill (FTS). 5
Table 2. Potential hydrocarbon volumes - Pee Jay Variable Fill (VF). 6
Table 3. Pee Jay – Gross Rock Volume TUEVCM. 7
Table 4. Pee Jay - Gross Rock Volume IUEVCM 1540. 7
Table 5. Pee Jay - Gross Rock Volume BUEVCM 1710 8
Table 6. Estimated pressure, temperature and Gas expansion factor. 10

List of Figures

Figure 1. Pee Jay Top Upper Eastern View Depth Map. 4
Figure 2. Hydrocarbon column vs Cumulative Reserves TUEVCM. 9
Figure 3. TUEVCM Gas-in-place (FTS). 13
Figure 4. TUEVCM Recoverable Sales Gas (normalised) (FTS). 13
Figure 5. TUEVCM Recoverable Condensate (FTS). 13
Figure 6. TUEVCM Oil in place (FTS). 13
Figure 7. TUEVCM Recoverable Oil (FTS). 13
Figure 8. TUEVCM Recoverable LPG (FTS) 13
Figure 9. TUEVCM Gas-in-place (VF). 14
Figure 10. TUEVCM Recoverable Sales Gas (normalised) (VF). 14
Figure 11. TUEVCM Recoverable Condensate (VF). 14
Figure 12. TUEVCM Oil in place (VF). 14
Figure 13. TUEVCM Recoverable Oil (VF). 14
Figure 14. TUEVCM LPG (VF) 14
Figure 15. IUEVCM Gas-in-place (FTS). 15
Figure 16. IUEVCM Recoverable Sales Gas (normalised) (FTS). 15
Figure 17. IUEVCM Recoverable Condensate (FTS). 15
Figure 18. IUEVCM Oil in place (FTS). 15
Figure 19. IUEVCM Recoverable Oil (FTS). 15
Figure 20. IUEVCM LPG (FTS) 15
Figure 21. IUEVCM Gas-in-place (VF) 16
Figure 22. IUEVCM Recoverable Sales Gas (normalised) (VF). 16
Figure 23. IUEVCM Recoverable Condensate (VF). 16
Figure 24. IUEVCM Oil in place (VF). 16
Figure 25. IUEVCM Recoverable Oil (VF). 16
Figure 26. IUEVCM LPG (VF) 16
Figure 27. BUEVCM Gas-in-place (FTS). 17
Figure 28. BUEVCM Recoverable Sales Gas (normalised) (FTS) 17
Figure 29. BUEVCM Recoverable Condensate (FTS). 17
Figure 30. BUEVCM Oil in place (FTS) 17
Figure 31. BUEVCM Recoverable Oil (FTS). 17
Figure 32. BUEVCM LPG (FTS). 17
Figure 33. BUEVCM Gas-in-place (VF). 18
Figure 34. BUEVCM Recoverable Sales Gas (normalised) (VF). 18
Figure 35. BUEVCM Recoverable Condensate (VF). 18
Figure 36. BUEVCM Oil in Place (VF). 18
Figure 37. BUEVCM Recoverable Oil (VF). 18
Figure 38. BUEVCM LPG (VF) 18

1 Summary

The Pee Jay prospect is a faulted four way dip closure at the top of the Eastern View Coal Measures (EVCM) in permit T/39P in the Bass Basin. Seismic mapping has been undertaken by Jennifer Baird and depth conversion by Ian Ward. ResourceInvest Pty Ltd has used depth and area determinations from the seismic mapping to calculate gross rock volume and potential hydrocarbon volumes.

Three reservoir sections are considered – one at the top of the Upper Eastern View Coal Measures (TUEVCM), and two within the EVCM – Intra Eastern View Coal Measures (IUEVCM 1540) and the Base Upper Eastern View Coal Measures (BUEVCM 1710).

Gas and oil volumes are calculated for all reservoirs, but by analogy with Yolla, the expected case could be gas with a small oil leg in the TUEVCM, gas in the IUEVCM, and oil in the BUEVCM (Yolla-4 2458 sand).

We present a base case assuming reservoirs are 'full to spill', as well as a second case where we vary the percentage fill.

A probabilistic approach is taken with P90, P50, Mean and P10 results presented in

Table 1 and Table 2.

Figure 1. Pee Jay Top Upper Eastern View Depth Map.

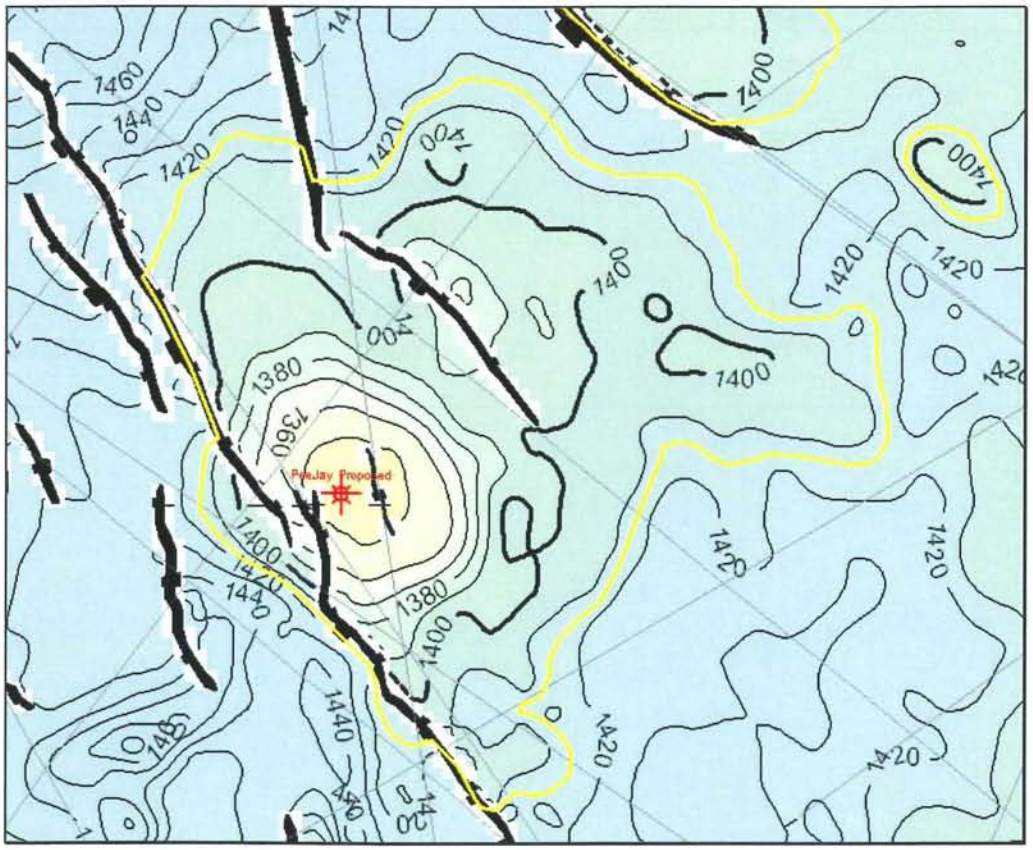


Table 1. Potential hydrocarbon volumes - Pee Jay Full to Spill (FTS).

TUEVCM		**P90**	**P50**	**Mean**	**P10**
Gas Case					
Gas in place	BCF	366	440	443	521
Sales Gas recoverable (normalised)	BCF	245	298	301	360
Condensate	mmbbls	11	15	15	20
LPG	mmbbls	11	14	15	19
Oil Case					
Oil in place	mmbbls	207	251	253	301
Oil recoverable	mmbbls	90	112	114	140
IUEVCM 1540		**P90**	**P50**	**Mean**	**P10**
Gas Case					
Gas in place	BCF	216	253	254	294
Sales Gas recoverable (normalised)	BCF	143	172	173	204
Condensate	mmbbls	4	6	6	7
LPG		4	5	5	7
Oil Case					
Oil in place	mmbbls	117	138	139	161
Oil recoverable	mmbbls	50	62	62	75
BUEVCM 1710		**P90**	**P50**	**Mean**	**P10**
Gas Case					
Gas in place	BCF	110	142	143	176
Sales Gas recoverable (normalised)	BCF	69	90	90	113
Condensate	mmbbls	2	3	3	4
LPG	mmbbls	2	3	3	4
Oil Case					
Oil in place	mmbbls	59	76	77	95
Oil recoverable	mmbbls	23	30	31	39

Table 2. Potential hydrocarbon volumes - Pee Jay Variable Fill (VF).

TUEVCM		**P90**	**P50**	**Mean**	**P10**
Gas Case					
Gas in place	BCF	209	258	267	345
Sales Gas recoverable (normalised)	BCF	139	175	182	235
Condensate	mmbbls	6	9	9	13
LPG	mmbbls	6	9	9	12
Oil Case					
Oil in place	mmbbls	118	147	153	198
Oil recoverable	mmbbls	51	66	69	90
IUEVCM 1540		**P90**	**P50**	**Mean**	**P10**
Gas Case					
Gas in place	BCF	74	93	109	158
Sales Gas recoverable (normalised)	BCF	50	67	74	108
Condensate	mmbbls	2	2	2	4
LPG	mmbbls	1	2	2	3
Oil Case					
Oil in place	mmbbls	40	54	59	86
Oil recoverable	mmbbls	18	24	27	39
BUEVCM 1710		**P90**	**P50**	**Mean**	**P10**
Gas Case					
Gas in place	BCF	55	77	83	121
Sales Gas recoverable (normalised)	BCF	35	49	53	77
Condensate	mmbbls	1	2	2	3
LPG		1	2	2	2
Oil Case					
Oil in place	mmbbls	30	42	45	65
Oil recoverable	mmbbls	11	17	18	26

2 Input Assumptions

2.1 Gross Rock Volume

Gross Rock Volumes are calculated from depth - area inputs at 5 metre depth intervals as provided from seismic mapping. Volumes for the TUEVCM were provided by Ian Ward (Table 3). Volumes for the IUEVCM 1540 & BUEVCM 1710 reservoirs were taken from the Petrosys output (Table 4 and Table 5).

We have allowed a +/-10% variation in gross rock volume for volumetric calculations.

Table 3. Pee Jay – Gross Rock Volume TUEVCM.

Depth m	Area km^2	Average area km^2	GRV m^3
1343	0.000		
1345	0.200	0.10	200,000
1350	0.600	0.40	2,000,000
1355	1.100	0.85	4,250,000
1360	1.600	1.35	6,750,000
1365	2.100	1.85	9,250,000
1370	2.500	2.30	11,500,000
1375	2.900	2.70	13,500,000
1380	3.500	3.20	16,000,000
1385	4.100	3.80	19,000,000
1390	5.100	4.60	23,000,000
1395	7.300	6.20	31,000,000
1400	10.600	8.95	44,750,000
1405	16.000	13.30	66,500,000
1410	19.800	17.90	89,500,000
1415	23.900	21.85	109,250,000
			446,450,000

Table 4. Pee Jay - Gross Rock Volume IUEVCM 1540.

Depth m	Area km^2	GRV m^3
1465		
1470	0.27	605,000
1475	0.88	2,894,000
1480	1.29	5,424,000
1485	1.73	7,598,000
1490	2.19	9,954,000
1495	2.60	12,141,000
1500	3.06	14,307,000
1505	3.50	16,496,000
1510	4.21	19,201,000
1515	5.58	24,197,000
1520	7.73	32,842,000
1525	10.47	45,690,000
1530	15.51	65,083,000
1535	19.51	87,689,500
1540	23.26	107,591,250
		451,712,750

Table 5. Pee Jay - Gross Rock Volume BUEVCM 1710.

Depth m	Area km^2	GRV m^3
1635	0.000	
1640	0.040	31,000
1645	0.440	1,169,000
1650	1.050	3,525,000
1655	1.520	6,548,000
1660	1.840	8,495,000
1665	2.270	10,321,000
1670	2.620	12,245,000
1675	3.030	14,128,000
1680	3.510	16,381,000
1685	4.080	19,055,000
1690	5.135	22,975,250
1695	6.598	29,111,000
1700	9.100	38,722,750
1705	13.365	56,463,250
1710	16.990	77,359,750
		316,530,000

2.2 Percentage Fill of Reservoir

It is not clear at this stage whether Yolla is full to spill or only partly full. On published depth maps, the initial impression is that the structure is not full to spill, but a closer examination of these maps may indicate a residual velocity effect due to volcanics, that fails to adequately correct the closing depth contour. If this is the case, Yolla may be full to spill.

We have a run a 'full to spill' case as the base case for Pee Jay as this is the simplest.

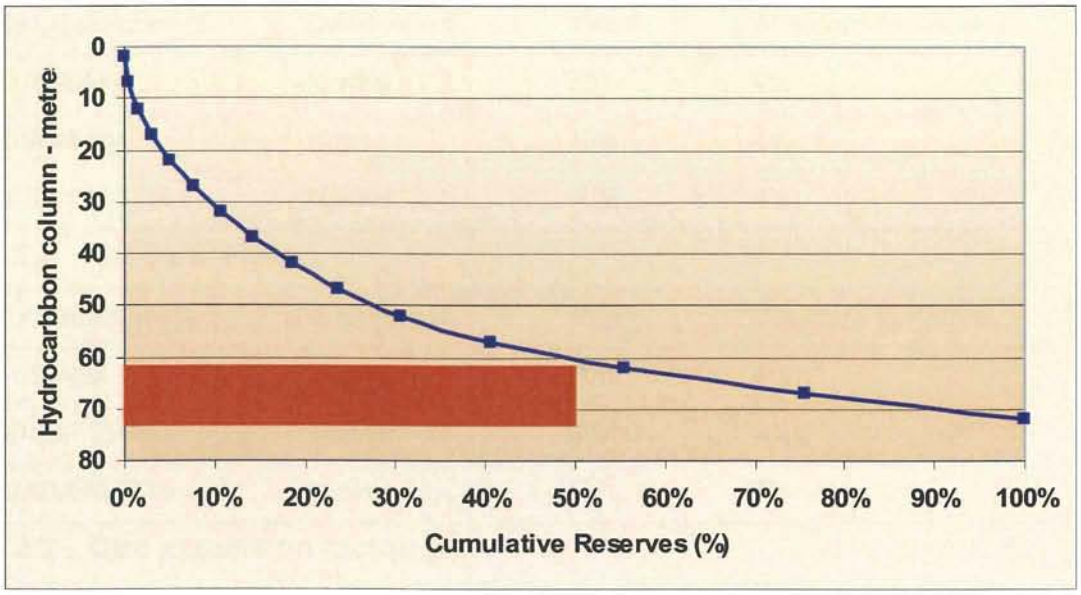
We have then considered cases not full to spill by varying the height of the hydrocarbon column over the base 25% of the column.

The chart below (Figure 2) shows the hydrocarbon column (72 metres) for the TUEVCM plotted against cumulative reserves. Almost 50% of the reserves are contained in the base 20 metres of the reservoir. We apply a straight line sloping probability distribution for the base 20 metres of the reservoir that decreases to zero probability at the total column depth.

We similarly vary the base 20 metres of the IUEVCM 1540 & BUEVCM 1710 reservoirs.

The effect of this on the reserve distribution is to 'stretch out' the distribution over the P50 to P0 range, and increase the separation of the P50 and Mean cases.

Figure 2. Hydrocarbon column vs Cumulative Reserves TUEVCM.



2.3 Net to Gross

Net to Gross %	Distribution	Minimum	Most likely	Maximum
TUEVCM	Triangular	60	80	100
IEVCM 1540	Triangular	40	50	60
BUEVCM 1710	Triangular	25	40	55

This data reflects the top EVCM net to gross from Yolla 2 and Squid 1, and the intra EVCM data from Yolla 2, and Pelican 3.

2.4 Porosity

Porosity %	Distribution	Minimum	Most likely	Maximum
TUEVCM	Triangular	28	30	32
IEVCM 1540	Triangular	24	26	28
BUEVCM 1710	Triangular	22	24	26

The high TUEVCM porosity is guided by Yolla 2 which has a reported top UEVCM porosity of 32.5%. EVCM porosities from other wells are as follows:

Yolla 1 average 26%

Chat 1 average 24%

Narimba 1 > 20%

Pipipa 1 average 24%

Squid 1 23 – 27%

2.5 Gas Saturation

Gas Saturation %	Distribution	Mean	Standard deviation
TUEVCM	Normal	70%	4%
IEVCM 1540	Normal	70%	4%
BUEVCM 1710	Normal	70%	4%

2.6 Oil Saturation

Oil Saturation %	Distribution	Mean	Standard deviation
TUEVCM	Normal	60%	4%
IEVCM 1540	Normal	60%	4%
BUEVCM 1710	Normal	60%	4%

2.7 Gas expansion factor, E

We have considered pressure gradients from Yolla 1, Yolla 2, and Pelican 3 and estimated reservoir pressures at the Pee Jay reservoir depths from these data as shown in Table 6.

Expected reservoir temperatures at Pee Jay have been provided by Victoria Fitzgerald based on a temperature gradient of 3.6^0C/100m derived from well information, and a sea floor temperature of 13^0C.

For a gas of ~85% methane at the above conditions we have estimated Z factors as shown, and calculated E = 35.37*p/Z*T.

Table 6. Estimated pressure, temperature and Gas expansion factor.

	Depth (m)	Input Value
Pressures psi		
TUEVCM	1400	**2300**
IUEVCM	1540	**2500**
BUEVCM	1710	**2800**
Temperature ^{0}C		
TUEVCM	1400	**58.8**
IUEVCM	1540	**65.6**
BUEVCM	1710	**71.8**
Z factor		
TUEVCM	1400	**0.815**
IUEVCM	1540	**0.830**
BUEVCM	1710	**0.840**
Gas expansion factor		
TUEVCM	1400	**167.0**
IUEVCM	1540	**175.0**
BUEVCM	1710	**190.0**

Gas expansion %	Distribution	Minimum	Most likely	Maximum
TUEVCM	Triangular	150	167	184
IEVCM 1540	Triangular	158	175	193
BUEVCM 1710	Triangular	171	190	209

2.8 Oil Shrinkage Factor

For our most likely estimate we have used oil Formation Volume Factors (Bo) as derived for Yolla from analysis of fluid samples in Yolla 3 and Yolla 4. These were 1.6 and 1.49 for the oil leg in top UEVCM, and 1.49 for the 2458 sand in Yolla, equivalent to the BUEVCM.

Oil shrinkage % (1/Bo)	Distribution	Minimum	Most likely	Maximum
TUEVCM	Triangular	56	62.5	69
IEVCM 1540	Triangular	56	62.5	69
BUEVCM 1710	Triangular	60	67	74

2.9 Gas Recovery Factor

Gas recovery %	Distribution	Minimum	Most likely	Maximum
TUEVCM	Triangular	65	75	85
IEVCM 1540	Triangular	65	75	85
BUEVCM 1710	Triangular	60	70	80

2.10 Oil Recovery Factor

Oil recovery %	Distribution	Minimum	Most likely	Maximum
TUEVCM	Triangular	35	45	55
IEVCM 1540	Triangular	35	45	55
BUEVCM 1710	Triangular	30	40	50

2.11 Condensate Gas Ratio

Publicly available information for CGR is inconsistent, and this input is based on data provided by Leigh Yaxley.

CGR bbls/mmcf	Distribution	Minimum	Most likely	Maximum
TUEVCM	Triangular	30	45	80
IEVCM 1540	Triangular	20	35	45
BUEVCM 1710	Triangular	20	35	45

2.12 LPG

This input is also based on data provided by Leigh Yaxley.

LPG bbls/mmcf	Distribution	Minimum	Most likely	Maximum
TUEVCM	Triangular	30	50	70
IEVCM 1540	Triangular	25	30	40
BUEVCM 1710	Triangular	25	30	40

2.13 Inerts

We have assumed that Pee Jay will have an inerts component (largely CO_2) and have assumed a most likely 10% by volume.

Inerts %	Distribution	Minimum	Most likely	Maximum
All gas	Triangular	5	10	20

2.14 Volume Normalisation

We have assumed all sales gas has a GHV of 1025 Btu/scf (an approximate average from Yolla gas per Leigh Yaxley) and normalised the sales gas volume to a GHV of 1000 Btu/scf.

3 Reserve Distribution TUEVCM - Full to Spill (FTS)

Figure 3. TUEVCM Gas-in-place (FTS).

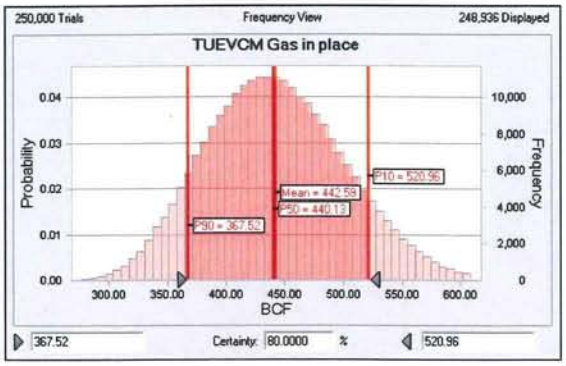


Figure 6. TUEVCM Oil in place (FTS).

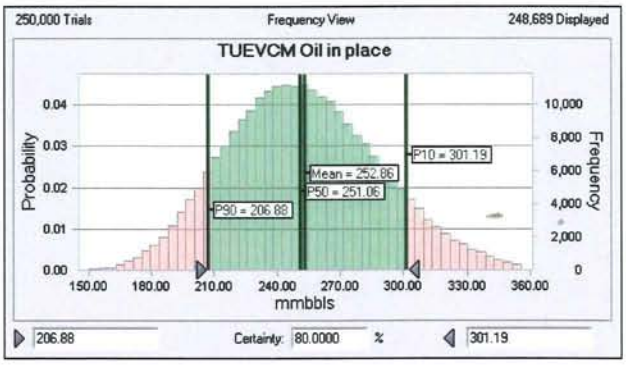


Figure 4. TUEVCM Recoverable Sales Gas (normalised) (FTS).

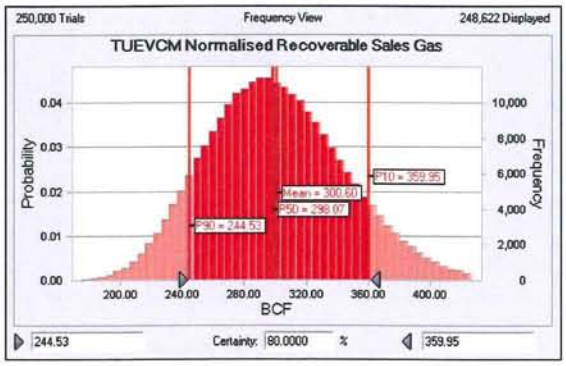


Figure 7. TUEVCM Recoverable Oil (FTS).

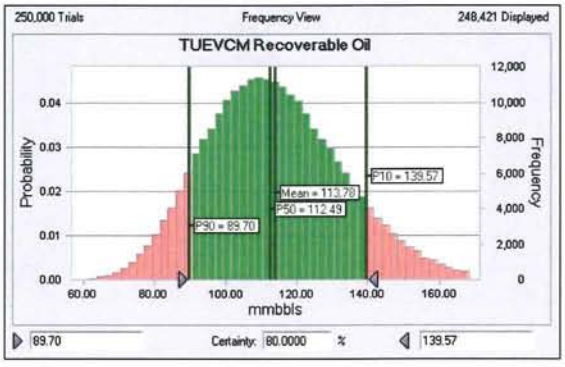


Figure 5. TUEVCM Recoverable Condensate (FTS).

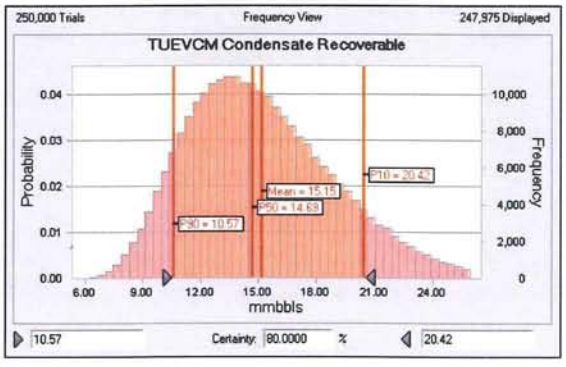
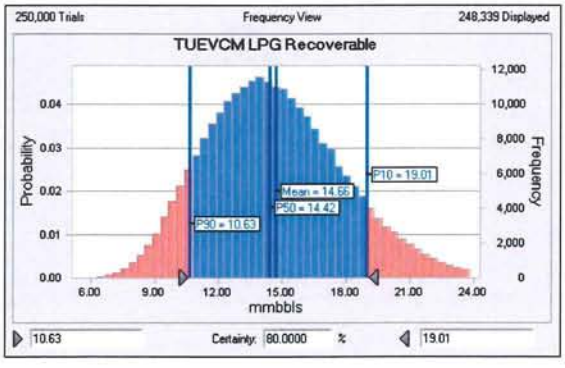


Figure 8. TUEVCM Recoverable LPG (FTS)



4 Reserve Distribution TUEVCM – Variable Fill (VF)

Figure 9. TUEVCM Gas-in-place (VF).

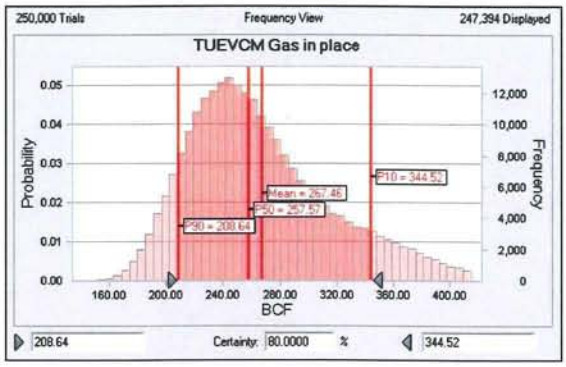


Figure 10. TUEVCM Recoverable Sales Gas (normalised) (VF).

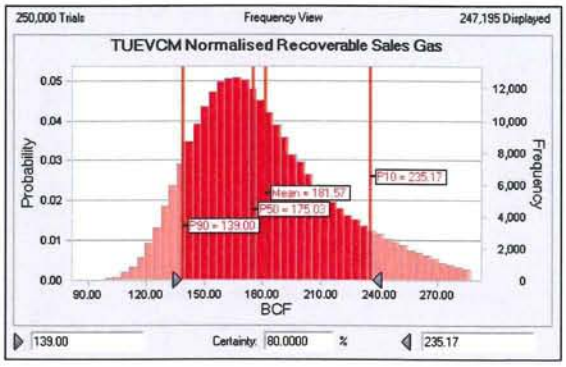


Figure 11. TUEVCM Recoverable Condensate (VF).

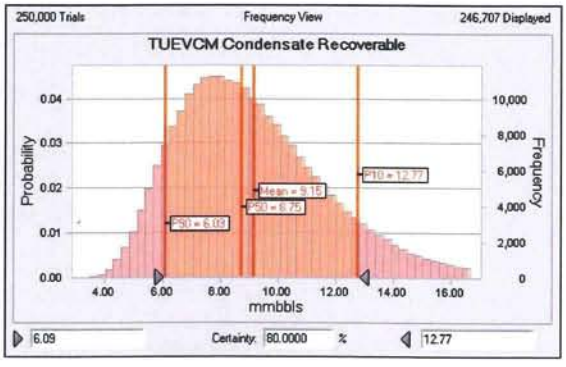


Figure 12. TUEVCM Oil in place (VF).

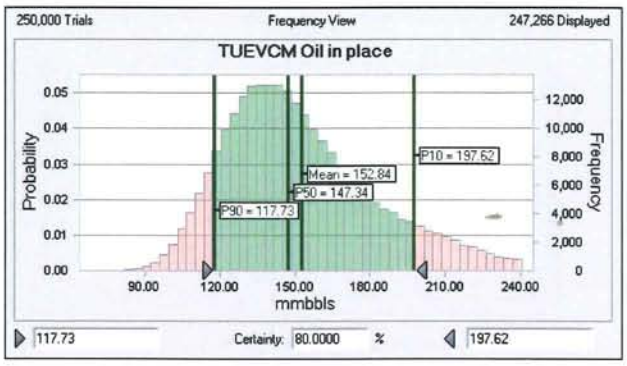


Figure 13. TUEVCM Recoverable Oil (VF).

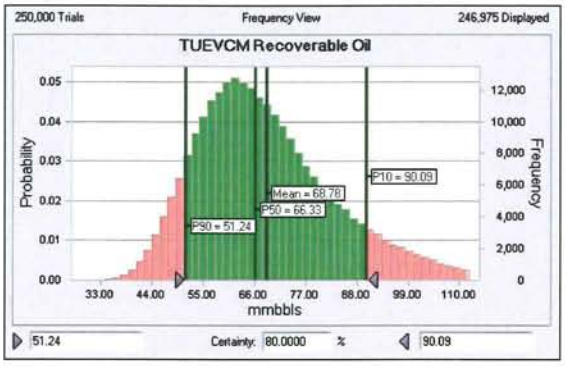
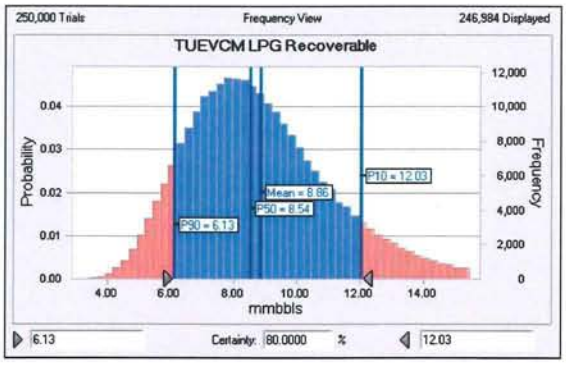


Figure 14. TUEVCM LPG (VF)



5 Reserve Distribution IUEVCM 1540 - Full to Spill (FTS)

Figure 15. IUEVCM Gas-in-place (FTS).

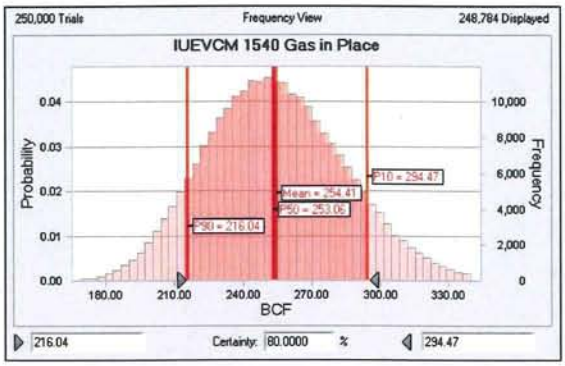


Figure 16. IUEVCM Recoverable Sales Gas (normalised) (FTS).

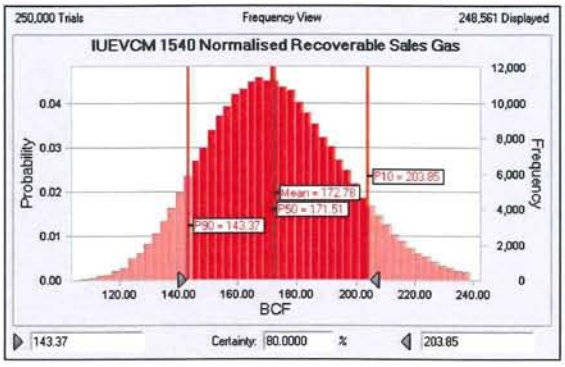


Figure 17. IUEVCM Recoverable Condensate (FTS).

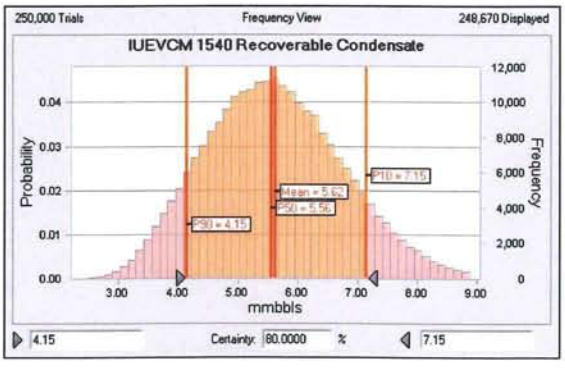


Figure 18. IUEVCM Oil in place (FTS).

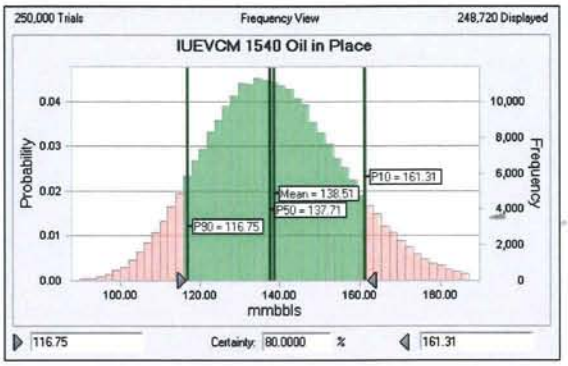


Figure 19. IUEVCM Recoverable Oil (FTS).

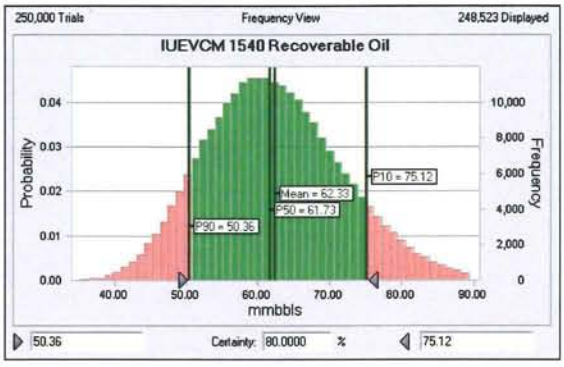
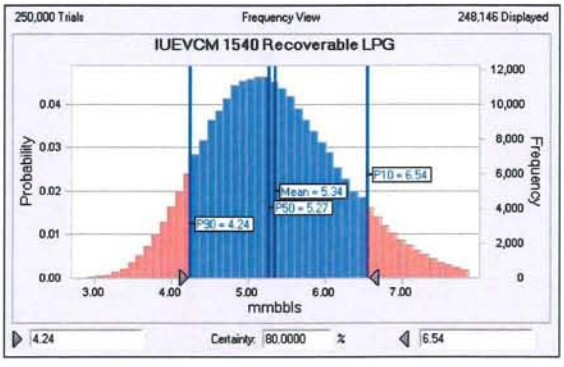


Figure 20. IUEVCM LPG (FTS)



6 Reserve Distribution IUEVCM 1540 - Variable Fill (VF)

Figure 21. IUEVCM Gas-in-place (VF).

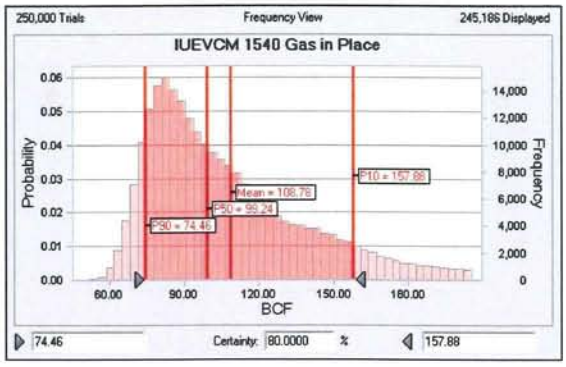


Figure 22. IUEVCM Recoverable Sales Gas (normalised) (VF).

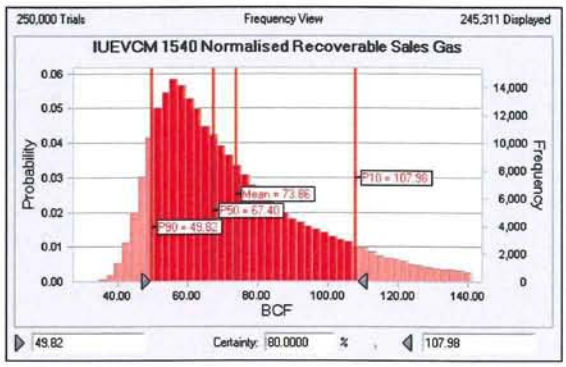


Figure 23. IUEVCM Recoverable Condensate (VF).

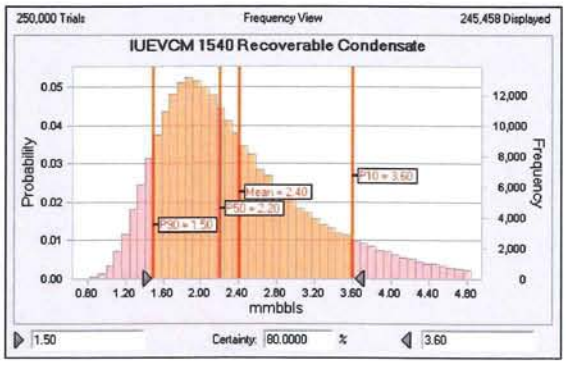


Figure 24. IUEVCM Oil in place (VF).

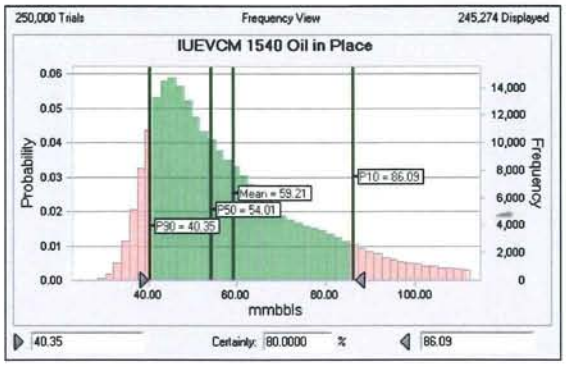


Figure 25. IUEVCM Recoverable Oil (VF).

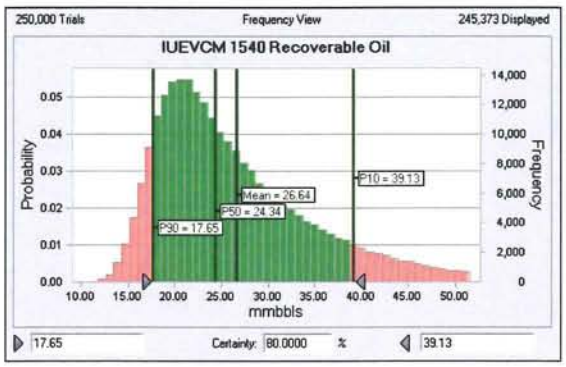
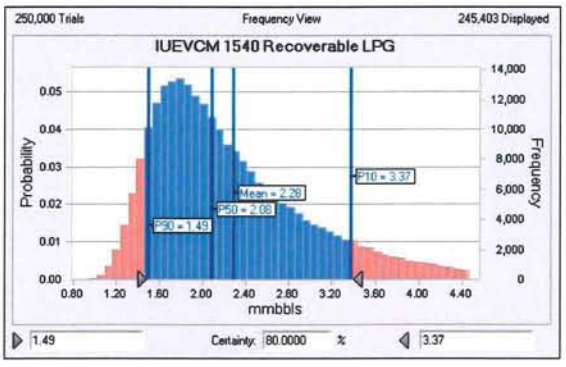


Figure 26. IUEVCM LPG (VF)



7 Reserve Distribution BUEVCM 1710 - Full to Spill (FTS)

Figure 27. BUEVCM Gas-in-place (FTS).

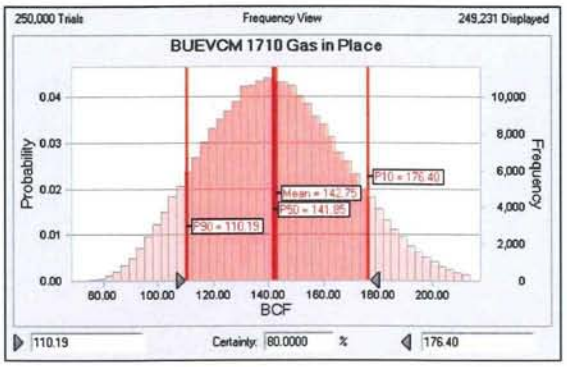


Figure 28. BUEVCM Recoverable Sales Gas (normalised) (FTS).

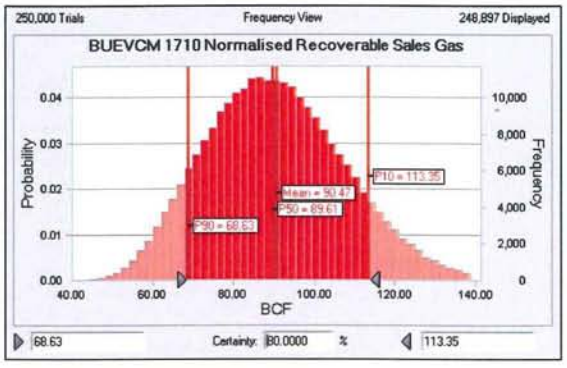


Figure 29. BUEVCM Recoverable Condensate (FTS).

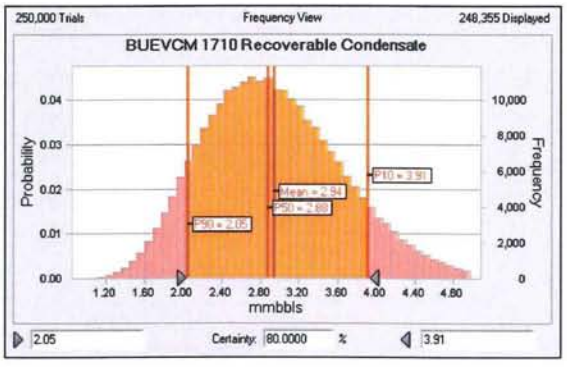


Figure 30. BUEVCM Oil in place (FTS).

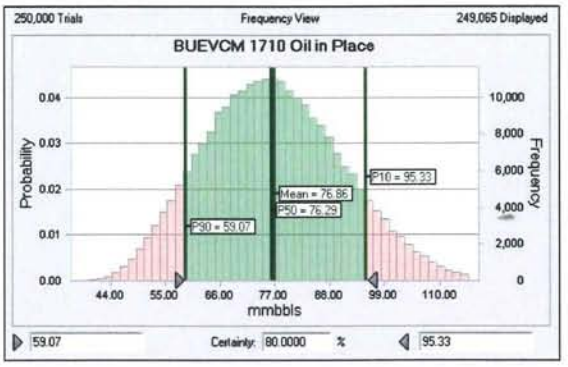


Figure 31. BUEVCM Recoverable Oil (FTS).

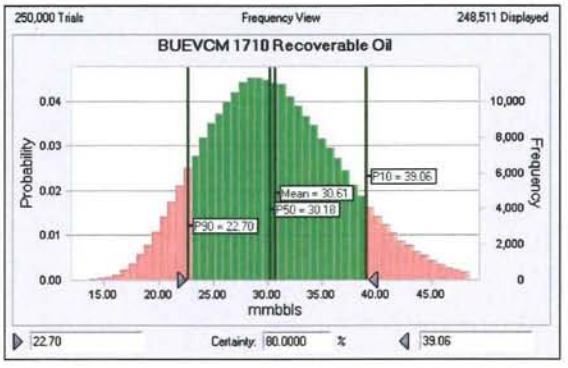
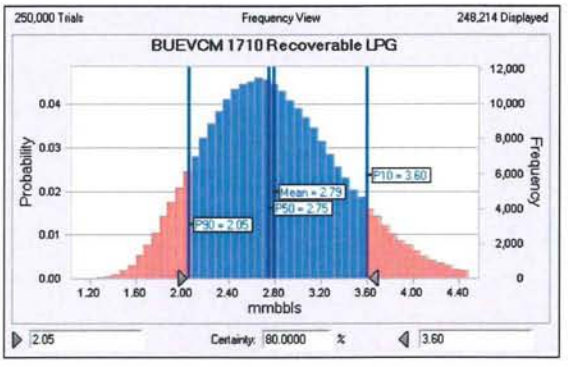


Figure 32. BUEVCM LPG (FTS).



8 Reserve Distribution BUEVCM 1710 – Variable Fill (VF)

Figure 33. BUEVCM Gas-in-place (VF).

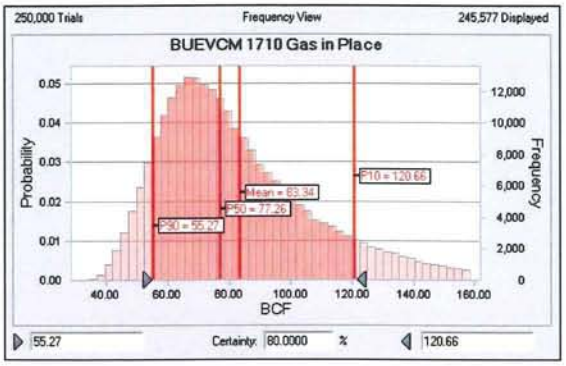


Figure 34. BUEVCM Recoverable Sales Gas (normalised) (VF).

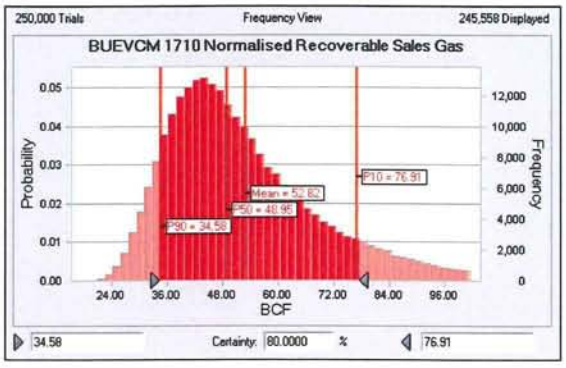


Figure 35. BUEVCM Recoverable Condensate (VF).

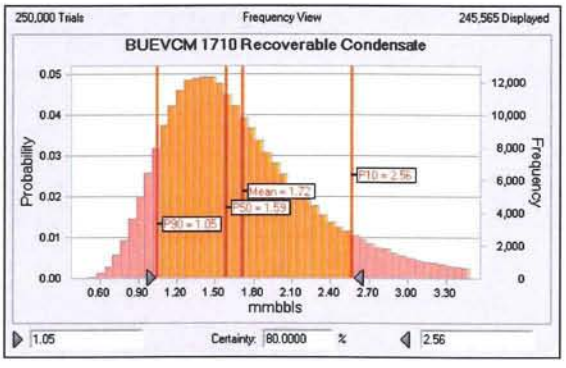


Figure 36. BUEVCM Oil in Place (VF).

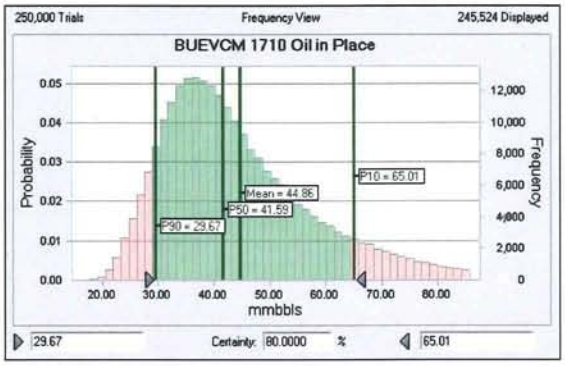


Figure 37. BUEVCM Recoverable Oil (VF).

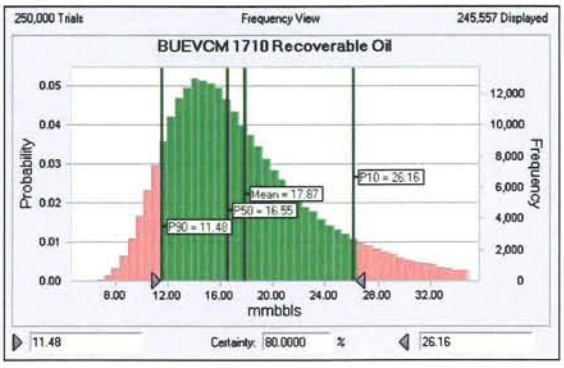
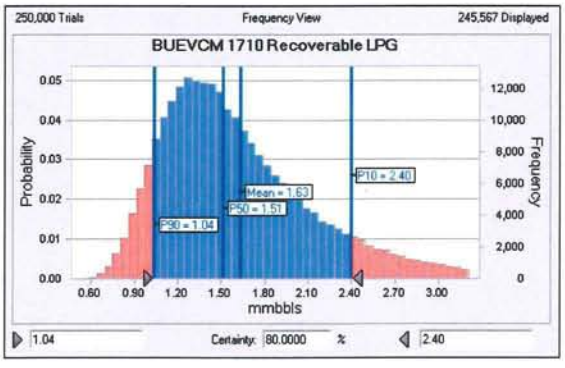
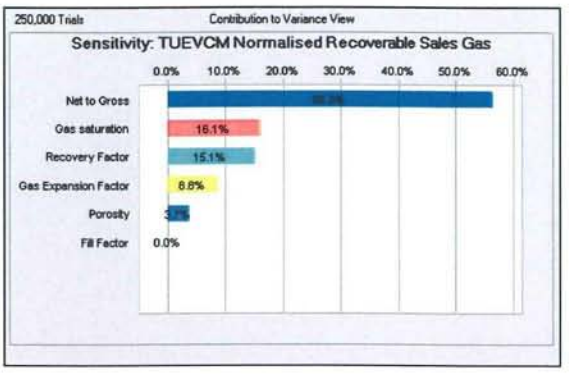


Figure 38. BUEVCM LPG (VF)

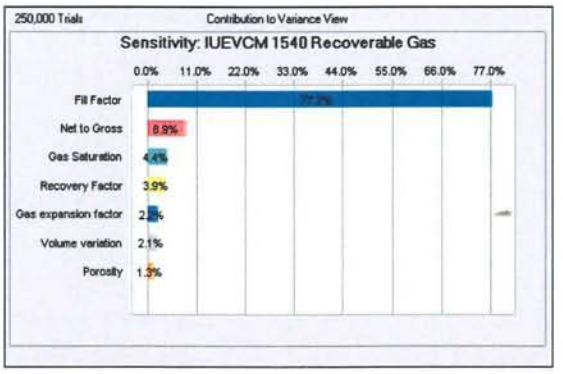


9 Sensitivities

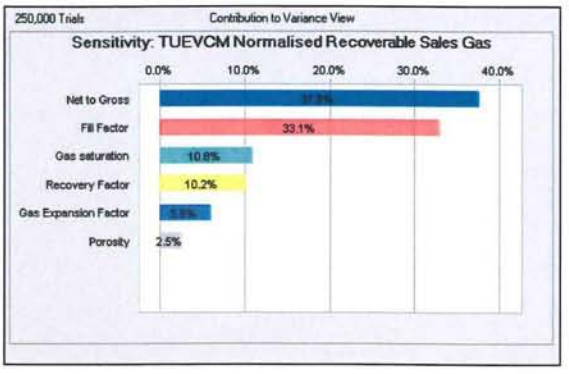
TUEVCM Full to Spill



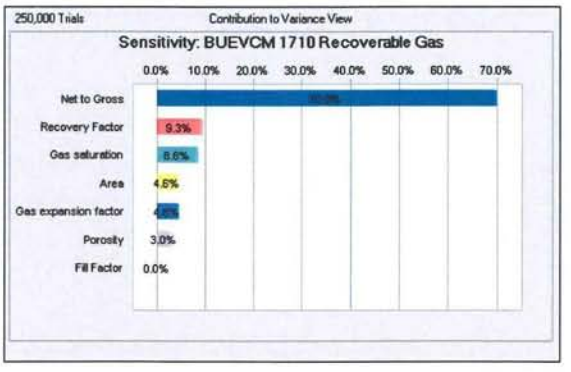
IUEVCM Variable Fill



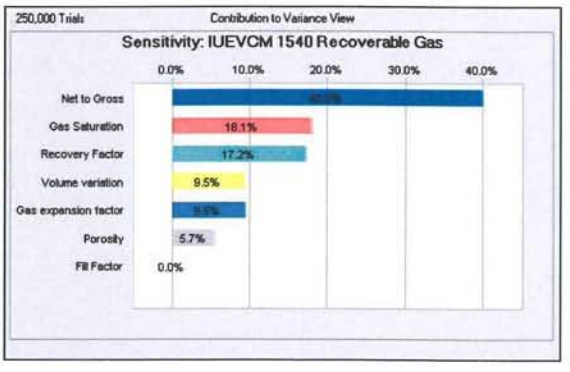
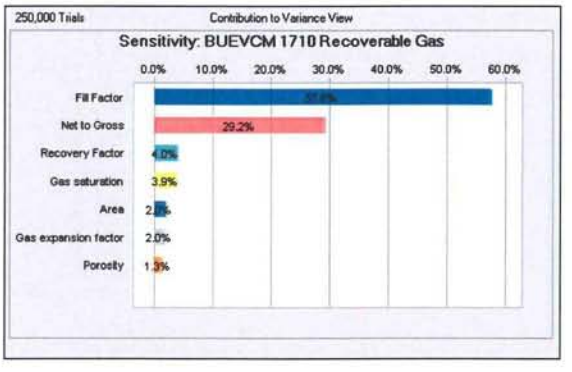
TUEVCM Variable spill



BUEVCM Full to Spill



IUEVCM Full to Spill



BUEVCM Variable Fill