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Sent: Friday, June 11, 2010 4:31 AM
To: Wang, Yun <Yun.Wang@bp.com>
Cc: Stephanie Heard Intertek <stephanie.heard@intertek.com>
Subject: MST report
Attach: WTC-10-001812 BP MST Tables.xls; WTC-10-001812 BP Multistage Separator Test Report.pdf

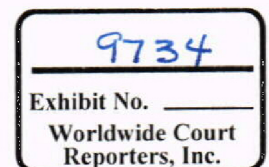
Yun,

The SSF and MST report and the tables are attached

Regards,

Edmond

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Name: WTC-10-001812 BP MST Tables.xls

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SUMMARY

MAIN PVT RESULTS

INITIAL RESERVOIR CONDITIONS

Reservoir Pressure	13500 psia	93.08 MPa
Reservoir Temperature:	243.0 F	390.4 K
Saturation Pressure	6438 psia	44.39 MPa

MULTI-STAGE SEPARATOR TEST

At Saturation Pressure		
Oil Formation Volume Factor	2.3875 res.bbl/STB	2.3875 res.m3/m3
Solution Gas-Oil Ratio	2747.13 scf/STB	489.27 m3/m3
Oil Density	0.5322 g/cm3	532.2 kg/m3
At Ambient Pressure		
Residual Oil Density	0.8331 g/cm3	833.1 kg/m3
At Stock Tank Conditions		
Residual Oil Density	0.8378 g/cm3	837.8 kg/m3
API Gravity	37.4	37.4

SINGLE-STAGE SEPARATOR TEST

At Saturation Pressure		
Oil Formation Volume Factor	2.5104 res.bbl/STB	2.5104 res.m3/m3
Solution Gas-Oil Ratio	2830.86 scf/STB	504.18 m3/m3
At Stock Tank Conditions		
Residual Oil Density	0.8467 g/cm3	846.7 kg/m3
API Gravity	35.6	35.6

**TABLE 1
SAMPLE COLLECTION DATA**

Project File:	WTC-10-001812	
Operator Name:	BP	
Pool or Zone:	.	
Field or Area:	.	
Well Location:	.	
Fluid Sample:	BOTTOMHOLE	
Sampling Company:	.	
Name of Sampler:	.	
Sampling Date:	.	
Sampling Point:	SEPARATOR	
Sampling Temperature:	243.0 F	390.4 K
Sampling Pressure:	70.0 psia	0.48 MPa
Reservoir Temperature:	243.0 F	390.4 K
Reservoir Pressure:	13500.0 psia	93.08 MPa
Initial Reservoir Pressure (Pi)	13500.0 psia	93.08 MPa
Depth of Reported Pi	N/A mMD	N/A mss

**TABLE 2
COMPOSITIONAL ANALYSIS OF RESERVOIR FLUID**

Component Name	Chemical Symbol	Mole Fraction	Mass Fraction	Calculated Properties	
Nitrogen	N ₂	0.0049	0.0026	Total Sample	
Carbon Dioxide	CO ₂	0.0092	0.0076		
Hydrogen Sulphide	H ₂ S	0.0000	0.0000	Molecular Weight	53.45
Methane	C ₁	0.6485	0.1947	C₆₊ Fraction	
Ethane	C ₂	0.0639	0.0360		
Propane	C ₃	0.0459	0.0379		
i-Butane	i-C ₄	0.0094	0.0102		
n-Butane	n-C ₄	0.0215	0.0234		
i-Pentane	i-C ₅	0.0088	0.0119		
n-Pentane	n-C ₅	0.0110	0.0149	Molecular Weight	199.81
Hexanes	C ₆	0.0195	0.0315	Mole Fraction	0.1768
Heptanes	C ₇	0.0173	0.0315	Density (g/cc)	0.8036
Octanes	C ₈	0.0268	0.0539	C₇₊ Fraction	
Nonanes	C ₉	0.0142	0.0341		
Decanes	C ₁₀	0.0119	0.0316		
Undecanes	C ₁₁	0.0093	0.0256	Molecular Weight	213.92
Dodecanes	C ₁₂	0.0076	0.0229	Mole Fraction	0.1573
Tridecanes	C ₁₃	0.0075	0.0247	Density (g/cc)	0.8183
Tetradecanes	C ₁₄	0.0066	0.0233	C₁₂₊ Fraction	
Pentadecanes	C ₁₅	0.0056	0.0214		
Hexadecanes	C ₁₆	0.0048	0.0199		
Heptadecanes	C ₁₇	0.0042	0.0185		
Octadecanes	C ₁₈	0.0039	0.0183		
Nonadecanes	C ₁₉	0.0035	0.0175		
Eicosanes	C ₂₀	0.0028	0.0145	Molecular Weight	311.11
Heneicosanes	C ₂₁	0.0026	0.0140	Mole Fraction	0.0778
Docosanes	C ₂₂	0.0022	0.0127	Density (g/cc)	0.8672
Tricosanes	C ₂₃	0.0020	0.0121		
Tetracosanes	C ₂₄	0.0018	0.0113		
Pentacosanes	C ₂₅	0.0017	0.0108		
Hexacosanes	C ₂₆	0.0015	0.0099		
Heptacosanes	C ₂₇	0.0014	0.0098		
Octacosanes	C ₂₈	0.0013	0.0097		
Nonacosanes	C ₂₉	0.0011	0.0086		
Tricontanes	C ₃₀	0.0011	0.0083		
Hentriacontanes	C ₃₁	0.0010	0.0077		
Dotriacontanes	C ₃₂	0.0009	0.0072		
Tritriacontanes	C ₃₃	0.0008	0.0066		
Tetratriacontanes	C ₃₄	0.0008	0.0067		
Pentatriacontanes	C ₃₅	0.0006	0.0059		
Hexatriacontanes plus	C ₃₆₊	0.0105	0.1304		
		1.0000	1.0000		

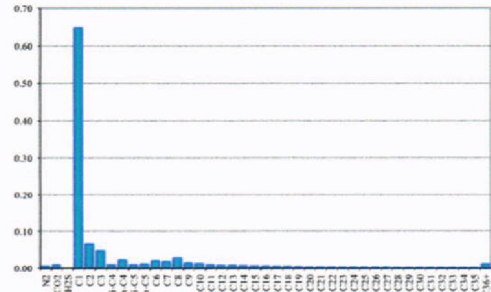


TABLE 3
MULTI-STAGE SEPARATOR OIL PROPERTIES

Pressure (psia)	Pressure (MPa)	Temperature		Oil Density (g/cm ³)	Oil Formation Volume Factor [1]	Total Formation Volume Factor [2]	Gas-Oil Ratio		Gas-Oil Ratio	
		(F)	(K)				Solution (scf/STB)	Liberated (scf/STB)	Solution (m ³ /m ³)	Liberated (m ³ /m ³)
6438 Psat	44.39	243	390.4	0.5322	2.3875	2.3875	2747.13	0.00	489.27	0.00
1235	8.52	130	327.6	0.7228	1.3073	5.8198	530.76	2216.37	94.53	394.74
435	3.00	120	322.0	0.7827	1.1439	16.4362	230.49	2516.64	41.05	448.22
135	0.93	120	322.0	0.8126	1.0748	47.0171	113.54	2633.59	20.22	469.04
15	0.10	66	292.0	0.8331	1.0035	171.4413	0.00	2747.13	0.00	489.27

Density of Residual Oil = 0.8378 g/cm³ (837.8 kg/m³) @ 60 F (288.7K)
 API Gravity of Residual Oil = 37.4

[1] Barrels (Cubic meters) of oil at indicated pressure and temperature per barrel (cubic meter) of residual oil @ 60 F (288.7 K).
 [2] Total barrels (cubic meters) of oil and liberated gas at the indicated pressure and temperature per barrel (cubic meter) of residual oil @ 60 F (288.7 K).
 Psat - Saturation Pressure
 - Standard conditions: 60 F (288.7 K) @ 14.696 psia (0.101325 MPa).

TABLE 4
MULTI-STAGE SEPARATOR GAS PROPERTIES

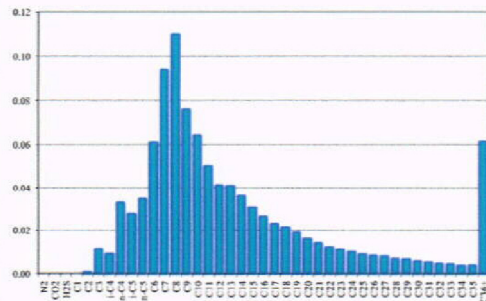
Pressure		Temperature		Gas Gravity		Gas Density (g/cm ³)	Gas Deviation Factor (-)	Gas Formation Volume Factor [1]	Gas Expansion Factor [2]
(psia)	(MPa)	(F)	(K)	Incremental (Air = 1)	Cumulative (Air = 1)				
6438 Psat	44.39	243	390.4						
1235	8.52	130	327.6	0.6681	0.6681	0.0706	0.8567	0.0114	87.477
435	3.00	120	322.0	0.7130	0.6734	0.0247	0.9359	0.0341	29.310

[1] Cubic feet (meters) of gas at indicated pressure and temperature per cubic feet (meter) @ standard conditions
 [2] Cubic feet (meters) of gas @ standard conditions per cubic feet (meter) @ indicated pressure and temperature.
 Psat - Saturation pressure
 - Standard conditions: 60 F (288.7 K) @ 14.696 psia (0.101325 MPa)

WTC-10-001812 - BP - - BOTTOMHOLE FLUID

**TABLE 5
COMPOSITIONAL ANALYSIS OF RESIDUAL OIL**

Component Name	Chemical Symbol	Mole Fraction	Mass Fraction	Calculated Properties		
Nitrogen	N ₂	0.0000	0.0000	Total Sample		
Carbon Dioxide	CO ₂	0.0000	0.0000			
Hydrogen Sulphide	H ₂ S	0.0000	0.0000			
Methane	C ₁	0.0000	0.0000	Molecular Weight	195.10	
Ethane	C ₂	0.0007	0.0001	C₆₊ Fraction		
Propane	C ₃	0.0113	0.0026			
i-Butane	i-C ₄	0.0091	0.0027			
n-Butane	n-C ₄	0.0327	0.0098	Molecular Weight	212.47	
i-Pentane	i-C ₅	0.0274	0.0101	Mole Fraction	0.8844	
n-Pentane	n-C ₅	0.0344	0.0127	Density (g/cc)	0.8085	
Hexanes	C ₆	0.0609	0.0269	C₇₊ Fraction		
Heptanes	C ₇	0.0940	0.0475			
Octanes	C ₈	0.1100	0.0623			
Nonanes	C ₉	0.0761	0.0500	Molecular Weight	221.81	
Decanes	C ₁₀	0.0640	0.0467		Mole Fraction	0.8235
Undecanes	C ₁₁	0.0504	0.0380		Density (g/cc)	0.8177
Dodecanes	C ₁₂	0.0413	0.0340	C₁₂₊ Fraction		
Tridecanes	C ₁₃	0.0409	0.0367			
Tetradecanes	C ₁₄	0.0357	0.0348			
Pentadecanes	C ₁₅	0.0304	0.0321	Molecular Weight	314.53	
Hexadecanes	C ₁₆	0.0262	0.0298		Mole Fraction	0.4291
Heptadecanes	C ₁₇	0.0229	0.0278		Density (g/cc)	0.8684
Octadecanes	C ₁₈	0.0213	0.0275			
Nonadecanes	C ₁₉	0.0189	0.0254			
Eicosanes	C ₂₀	0.0162	0.0228			
Heneicosanes	C ₂₁	0.0141	0.0211			
Docosanes	C ₂₂	0.0122	0.0191			
Tricosanes	C ₂₃	0.0112	0.0183			
Tetracosanes	C ₂₄	0.0101	0.0171			
Pentacosanes	C ₂₅	0.0089	0.0158			
Hexacosanes	C ₂₆	0.0082	0.0151			
Heptacosanes	C ₂₇	0.0080	0.0154			
Octacosanes	C ₂₈	0.0070	0.0139			
Nonacosanes	C ₂₉	0.0066	0.0136			
Tricontanes	C ₃₀	0.0058	0.0123			
Hentriacontanes	C ₃₁	0.0052	0.0114			
Dotriacontanes	C ₃₂	0.0047	0.0106			
Tritriacontanes	C ₃₃	0.0044	0.0103			
Tetratriacontanes	C ₃₄	0.0038	0.0091			
Pentatriacontanes	C ₃₅	0.0039	0.0096			
Hexatriacontanes plus	C ₃₆₊	0.0613	0.2070			
		1.0000	1.0000			





APPENDIX A

SAMPLE VALIDATION

WTC-10-001812 - BP - - BOTTOMHOLE FLUID

**TABLE A1
COMPOSITIONAL ANALYSIS OF RESERVOIR FLUID**

Component Name	Chemical Symbol	Mole Fraction	Mass Fraction	Calculated Properties	
Nitrogen	N ₂	0.0049	0.0026	Total Sample	
Carbon Dioxide	CO ₂	0.0092	0.0076		
Hydrogen Sulphide	H ₂ S	0.0000	0.0000	Molecular Weight	53.45
Methane	C ₁	0.6485	0.1947	Density (g/cc)	0.4240
Ethane	C ₂	0.0639	0.0360		
Propane	C ₃	0.0459	0.0379	C₆₊ Fraction	
i-Butane	i-C ₄	0.0094	0.0102		
n-Butane	n-C ₄	0.0215	0.0234	Molecular Weight	199.81
i-Pentane	i-C ₅	0.0088	0.0119	Mole Fraction	0.1768
n-Pentane	n-C ₅	0.0110	0.0149	Density (g/cc)	0.8036
Hexanes	C ₆	0.0195	0.0315		
Heptanes	C ₇	0.0173	0.0315	C₇₊ Fraction	
Octanes	C ₈	0.0268	0.0539		
Nonanes	C ₉	0.0142	0.0341	Molecular Weight	213.92
Decanes	C ₁₀	0.0119	0.0316	Mole Fraction	0.1573
Undecanes	C ₁₁	0.0093	0.0256	Density (g/cc)	0.8183
Dodecanes	C ₁₂	0.0076	0.0229		
Tridecanes	C ₁₃	0.0075	0.0247	C₁₂₊ Fraction	
Tetradecanes	C ₁₄	0.0066	0.0233		
Pentadecanes	C ₁₅	0.0056	0.0214	Molecular Weight	311.11
Hexadecanes	C ₁₆	0.0048	0.0199	Mole Fraction	0.0778
Heptadecanes	C ₁₇	0.0042	0.0185	Density (g/cc)	0.8672
Octadecanes	C ₁₈	0.0039	0.0183		
Nonadecanes	C ₁₉	0.0035	0.0175	C₃₀₊ Fraction	
Eicosanes	C ₂₀	0.0028	0.0145		
Heneicosanes	C ₂₁	0.0026	0.0140	Molecular Weight	592.41
Docosanes	C ₂₂	0.0022	0.0127	Mole Fraction	0.0156
Tricosanes	C ₂₃	0.0020	0.0121	Density (g/cc)	0.9655
Tetracosanes	C ₂₄	0.0018	0.0113		
Pentacosanes	C ₂₅	0.0017	0.0108	C₃₆₊ Fraction	
Hexacosanes	C ₂₆	0.0015	0.0099		
Heptacosanes	C ₂₇	0.0014	0.0098	Molecular Weight	662.30
Octacosanes	C ₂₈	0.0013	0.0097	Mole Fraction	0.0105
Nonacosanes	C ₂₉	0.0011	0.0086	Density (g/cc)	0.9926
Tricontanes	C ₃₀	0.0011	0.0083		
Hentriacontanes	C ₃₁	0.0010	0.0077		
Dotriacontanes	C ₃₂	0.0009	0.0072	Recombination Parameters	
Tritriacontanes	C ₃₃	0.0008	0.0066		
Tetracontanes	C ₃₄	0.0008	0.0067	Gas-Oil Ratio (cc/cc)	504.18
Pentatriacontanes	C ₃₅	0.0006	0.0059	Dead Oil Density (g/cc)	0.8467
Hexatriacontanes plus	C ₃₆₊	0.0105	0.1304	Dead Oil MW (g/mol)	211.73
		1.0000	1.0000		

Physical Properties calculated based on GPA 2145-00 physical constants

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TABLE A2
COMPOSITIONAL ANALYSIS OF FLASHED OIL

Component Name	Chemical Symbol	Mole Fraction	Mass Fraction	Calculated Properties
Nitrogen	N ₂	0.0000	0.0000	Total Sample
Carbon Dioxide	CO ₂	0.0000	0.0000	
Hydrogen Sulphide	H ₂ S	0.0000	0.0000	
Methane	C ₁	0.0000	0.0000	Molecular Weight 211.73
Ethane	C ₂	0.0006	0.0001	Density (g/cc) 0.8022
Propane	C ₃	0.0034	0.0007	C₆₊ Fraction
i-Butane	i-C ₄	0.0023	0.0006	
n-Butane	n-C ₄	0.0091	0.0025	
i-Pentane	i-C ₅	0.0097	0.0033	Molecular Weight 217.95
n-Pentane	n-C ₅	0.0157	0.0053	Mole Fraction 0.9593
Hexanes	C ₆	0.0434	0.0177	Density (g/cc) 0.8109
Heptanes	C ₇	0.0880	0.0411	C₇₊ Fraction
Octanes	C ₈	0.1140	0.0614	
Nonanes	C ₉	0.0882	0.0534	
Decanes	C ₁₀	0.0750	0.0504	Molecular Weight 224.19
Undecanes	C ₁₁	0.0590	0.0409	Mole Fraction 0.9159
Dodecanes	C ₁₂	0.0482	0.0366	Density (g/cc) 0.8169
Tridecanes	C ₁₃	0.0477	0.0394	C₁₂₊ Fraction
Tetradecanes	C ₁₄	0.0414	0.0372	
Pentadecanes	C ₁₅	0.0352	0.0342	
Hexadecanes	C ₁₆	0.0302	0.0317	Molecular Weight 311.11
Heptadecanes	C ₁₇	0.0264	0.0296	Mole Fraction 0.4917
Octadecanes	C ₁₈	0.0247	0.0293	Density (g/cc) 0.8672
Nonadecanes	C ₁₉	0.0224	0.0279	C₃₀₊ Fraction
Eicosanes	C ₂₀	0.0179	0.0232	
Heneicosanes	C ₂₁	0.0162	0.0223	
Docosanes	C ₂₂	0.0141	0.0203	Molecular Weight 592.41
Tricosanes	C ₂₃	0.0128	0.0193	Mole Fraction 0.0985
Tetracosanes	C ₂₄	0.0115	0.0180	Density (g/cc) 0.9655
Pentacosanes	C ₂₅	0.0106	0.0173	C₃₆₊ Fraction
Hexacosanes	C ₂₆	0.0093	0.0158	
Heptacosanes	C ₂₇	0.0089	0.0157	
Octacosanes	C ₂₈	0.0084	0.0154	Molecular Weight 662.30
Nonacosanes	C ₂₉	0.0072	0.0137	Mole Fraction 0.0665
Tricontanes	C ₃₀₊	0.0068	0.0133	Density (g/cc) 0.9926
Hentriacontanes	C ₃₁	0.0060	0.0122	
Dotriacontanes	C ₃₂	0.0055	0.0115	
Tritriacontanes	C ₃₃	0.0049	0.0106	
Tettriacontanes	C ₃₄	0.0048	0.0106	
Pentatriacontanes	C ₃₅	0.0041	0.0094	
Hexatriacontanes plus	C ₃₆₊	0.0665	0.2081	
		1.0000	1.0000	

Physical Properties calculated based on GPA 2145-00 physical constants



WTC-10-001812 - BP - - BOTTOMHOLE FLUID

**TABLE A3
COMPOSITIONAL ANALYSIS OF FLASHED GAS**

Component Name	Chemical Symbol	Mole Fraction		Liquid Volume	
		As Analyzed	Acid Gas Free	STB/MMscf	mL/m3
Nitrogen	N ₂	0.0059	0.0059		
Carbon Dioxide	CO ₂	0.0109	0.0000		
Hydrogen Sulphide	H ₂ S	0.0000	0.0000		
Methane	C ₁	0.7703	0.7788		
Ethane	C ₂	0.0759	0.0767		
Propane	C ₃	0.0540	0.0545	35.231	197.805
i-Butane	i-C ₄	0.0107	0.0108	8.319	46.709
n-Butane	n-C ₄	0.0238	0.0241	17.829	100.099
i-Pentane	i-C ₅	0.0087	0.0088	7.528	42.267
n-Pentane	n-C ₅	0.0101	0.0102	8.707	48.886
Hexanes	C ₆	0.0150	0.0152	14.680	82.423
Heptanes	C ₇	0.0040	0.0040	4.336	24.344
Octanes	C ₈	0.0105	0.0106	12.723	71.436
Nonanes	C ₉	0.0003	0.0003	0.428	2.401
Decanes	C ₁₀	0.0000	0.0000	0.000	0.000
Undecane	C ₁₁	0.0000	0.0000	0.000	0.000
Dodecanes Plus	C ₁₂₊	0.0000	0.0000	0.000	0.000
Total		1.0000	1.0000	109.782	616.369
Propanes Plus	C ₃₊	0.1371	0.1386	109.782	616.369
Butanes Plus	C ₄₊	0.0831	0.0840	74.550	418.564
Pentanes Plus	C ₅₊	0.0724	0.0732	48.402	271.756

Calculated Gas Properties @ Standard Conditions			Calculated Pseudocritical Properties		
Molecular Weight	23.86 kg/kmol	23.86 lb/lb-mol	Ppc	656.0 psia	4.52 MPa
Specific Gravity	0.8238 (Air = 1)	0.8238 (Air = 1)	Tpc	419.7 R	233.2 K
MW of C7+	1.54 kg/kmol	1.54 lb/lbmol	Ppc*	652.9 psia	4.50 MPa
Density of C7+	0.7392 g/cc	739.2 kg/m3	Tpc*	417.8 R	232.1 K

Calculated Gross Heating Value @ Standard Conditions			Calculated Net Heating Value @ Standard Conditions		
Dry	1,396.2 Btu/scf	52.12 MJ/m3	Dry	1,270.2 Btu/scf	47.41 MJ/m3
Wet	1,371.9 Btu/scf	51.21 MJ/m3	Wet	1,248.1 Btu/scf	46.59 MJ/m3

Standard Conditions: 60 F (288.7 K) @ 14.696 psia (0.101325 MPa)



APPENDIX B

MULTI-STAGE SEPARATOR TEST - MATERIAL BALANCE



TABLE B1
MULTI-STAGE SEPARATOR - MATERIAL BALANCE

Pressure		Measured Oil FVF [1]	Calculated Oil FVF [1]	Absolute Relative Error (%)
(psia)	(MPa)			
6438 Psat	44.39	2.3875	2.3723	0.6405
1235	8.52	1.3073	1.3006	0.5153
435	3.00	1.1439	1.1414	0.2109
135	0.93	1.0748	1.0727	0.1945
15	0.10	1.0035	1.0057	0.2157

[1] (res bbl/STB) (res m3/m3)
 Psat - Saturation Pressure
 - Standard conditions: 60 F (288.7 K) @ 14.696 psia (0.101325 MPa)



APPENDIX C

MULTI-STAGE SEPARATOR - COMPOSITIONAL ANALYSES OF LIBERATED GAS

WTC-10-001812 - BP - - - - - BOTTOMHOLE FLUID

TABLE C1
MSS GAS COMPOSITION @ 1,235 psia (8.52 MPa) AND 130.0 F (327.6 K)

Component Name	Chemical Symbol	Mole Fraction		Liquid Volume	
		As Analyzed	Acid Gas Free	STB/MMscf	mL/m3
Nitrogen	N ₂	0.0063	0.0064		
Carbon Dioxide	CO ₂	0.0105	0.0000		
Hydrogen Sulphide	H ₂ S	0.0000	0.0000		
Methane	C ₁	0.8636	0.8727		
Ethane	C ₂	0.0646	0.0653		
Propane	C ₃	0.0335	0.0339	21.899	122.950
i-Butane	i-C ₄	0.0051	0.0052	3.983	22.365
n-Butane	n-C ₄	0.0096	0.0097	7.185	40.342
i-Pentane	i-C ₅	0.0016	0.0016	1.368	7.682
n-Pentane	n-C ₅	0.0007	0.0007	0.569	3.193
Hexanes	C ₆	0.0021	0.0022	2.084	11.702
Heptanes	C ₇	0.0021	0.0021	2.261	12.695
Octanes	C ₈	0.0003	0.0003	0.353	1.984
Nonanes	C ₉	0.0000	0.0000	0.054	0.301
Decanes	C ₁₀	0.0000	0.0000	0.015	0.082
Undecane	C ₁₁	0.0000	0.0000	0.000	0.000
Dodecanes Plus	C ₁₂₊	0.0000	0.0000	0.000	0.000
Total		1.0000	1.0000	39.771	223.296
Propanes Plus	C ₃₊	0.0550	0.0556	39.771	223.296
Butanes Plus	C ₄₊	0.0215	0.0217	17.873	100.346
Pentanes Plus	C ₅₊	0.0164	0.0166	6.704	37.639

Calculated Gas Properties @ Standard Conditions			Calculated Pseudocritical Properties		
Molecular Weight	19.35 kg/kmol	19.35 lb/lb-mol	Ppc	668.4 psia	4.61 MPa
Specific Gravity	0.6681 (Air = 1)	0.6681 (Air = 1)	Tpc	378.5 R	210.3 K
MW of C7+	97.90 kg/kmol	97.90 lb/lbmol	Ppc*	665.0 psia	4.59 MPa
Density of C7+	0.7257 g/cc	725.7 kg/m3	Tpc*	376.6 R	209.2 K

Calculated Gross Heating Value @ Standard Conditions			Calculated Net Heating Value @ Standard Conditions		
Dry	1,151.4 Btu/scf	42.98 MJ/m3	Dry	1,041.8 Btu/scf	38.89 MJ/m3
Wet	1,131.3 Btu/scf	42.23 MJ/m3	Wet	1,023.7 Btu/scf	38.21 MJ/m3

Standard Conditions: 60 F (288.7 K) @ 14.696 psia (0.101325 MPa)

TABLE C2
MSS GAS COMPOSITION @ 435 psia (3.00 MPa) AND 120.0 F (322.0 K)

Component Name	Chemical Symbol	Mole Fraction		Liquid Volume	
		As Analyzed	Acid Gas Free	STB/MMscf	mL/m3
Nitrogen	N ₂	0.0333	0.0338		
Carbon Dioxide	CO ₂	0.0146	0.0000		
Hydrogen Sulphide	H ₂ S	0.0000	0.0000		
Methane	C ₁	0.7872	0.7989		
Ethane	C ₂	0.0933	0.0947		
Propane	C ₃	0.0467	0.0473	30.470	171.075
i-Butane	i-C ₄	0.0064	0.0065	4.944	27.758
n-Butane	n-C ₄	0.0114	0.0116	8.546	47.981
i-Pentane	i-C ₅	0.0025	0.0025	2.183	12.257
n-Pentane	n-C ₅	0.0024	0.0024	2.067	11.605
Hexanes	C ₆	0.0017	0.0018	1.704	9.565
Heptanes	C ₇	0.0005	0.0005	0.510	2.861
Octanes	C ₈	0.0000	0.0000	0.024	0.132
Nonanes	C ₉	0.0000	0.0000	0.000	0.000
Decanes	C ₁₀	0.0000	0.0000	0.000	0.000
Undecane	C ₁₁	0.0000	0.0000	0.000	0.000
Dodecanes Plus	C ₁₂₊	0.0000	0.0000	0.000	0.000
Total		1.0000	1.0000	50.447	283.235
Propanes Plus	C ₃₊	0.0716	0.0727	50.447	283.235
Butanes Plus	C ₄₊	0.0249	0.0253	19.977	112.159
Pentanes Plus	C ₅₊	0.0186	0.0188	6.487	36.421

Calculated Gas Properties @ Standard Conditions			Calculated Pseudocritical Properties		
Molecular Weight	20.65 kg/kmol	20.65 lb/lb-mol	Ppc	665.5 psia	4.59 MPa
Specific Gravity	0.7130 (Air = 1)	0.7130 (Air = 1)	Tpc	387.6 R	215.3 K
MW of C7+	96.44 kg/kmol	96.44 lb/lbmol	Ppc*	661.2 psia	4.56 MPa
Density of C7+	0.7229 g/cc	722.9 kg/m3	Tpc*	385.0 R	213.9 K

Calculated Gross Heating Value @ Standard Conditions			Calculated Net Heating Value @ Standard Conditions		
Dry	1,166.2 Btu/scf	43.53 MJ/m3	Dry	1,056.6 Btu/scf	39.44 MJ/m3
Wet	1,145.9 Btu/scf	42.77 MJ/m3	Wet	1,038.3 Btu/scf	38.76 MJ/m3

Standard Conditions: 60 F (288.7 K) @ 14.696 psia (0.101325 MPa)

TABLE C3
MULTI-STAGE SEPARATOR GAS COMPOSITION @ 135 psia (0.93 MPa) AND 120.0 F (322.0 K)

Component Name	Chemical Symbol	Mole Fraction		Liquid Volume	
		As Analyzed	Acid Gas Free	STB/MMscf	mL/m3
Nitrogen	N ₂	0.0351	0.0357		
Carbon Dioxide	CO ₂	0.0172	0.0000		
Hydrogen Sulphide	H ₂ S	0.0000	0.0000		
Methane	C ₁	0.6218	0.6327		
Ethane	C ₂	0.1681	0.1711		
Propane	C ₃	0.1027	0.1045	67.059	376.505
i-Butane	i-C ₄	0.0145	0.0147	11.222	63.006
n-Butane	n-C ₄	0.0258	0.0262	19.296	108.335
i-Pentane	i-C ₅	0.0054	0.0055	4.660	26.165
n-Pentane	n-C ₅	0.0051	0.0052	4.392	24.659
Hexanes	C ₆	0.0035	0.0035	3.375	18.951
Heptanes	C ₇	0.0009	0.0009	0.984	5.522
Octanes	C ₈	0.0000	0.0000	0.059	0.330
Nonanes	C ₉	0.0000	0.0000	0.000	0.000
Decanes	C ₁₀	0.0000	0.0000	0.000	0.000
Undecane	C ₁₁	0.0000	0.0000	0.000	0.000
Dodecanes Plus	C ₁₂₊	0.0000	0.0000	0.000	0.000
Total		1.0000	1.0000	111.047	623.473
Propanes Plus	C ₃₊	0.1578	0.1606	111.047	623.473
Butanes Plus	C ₄₊	0.0551	0.0561	43.987	246.968
Pentanes Plus	C ₅₊	0.0407	0.0414	13.470	75.628

Calculated Gas Properties @ Standard Conditions			Calculated Pseudocritical Properties		
Molecular Weight	24.78 kg/kmol	24.78 lb/lb-mol	Ppc	662.1 psia	4.56 MPa
Specific Gravity	0.8556 (Air = 1)	0.8556 (Air = 1)	Tpc	434.7 R	241.5 K
MW of C7+	96.56 kg/kmol	96.56 lb/lbmol	Ppc*	657.6 psia	4.53 MPa
Density of C7+	0.7232 g/cc	723.2 kg/m3	Tpc*	431.8 R	239.9 K

Calculated Gross Heating Value @ Standard Conditions			Calculated Net Heating Value @ Standard Conditions		
Dry	1,378.7 Btu/scf	51.46 MJ/m3	Dry	1,255.1 Btu/scf	46.85 MJ/m3
Wet	1,354.7 Btu/scf	50.57 MJ/m3	Wet	1,233.3 Btu/scf	46.03 MJ/m3

Standard Conditions: 60 F (288.7 K) @ 14.696 psia (0.101325 MPa)



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TABLE C4
MULTI-STAGE SEPARATOR GAS COMPOSITION @ 15 psia (0.10 MPa) AND 66.0 F (292.0 K)

Component Name	Chemical Symbol	Mole Fraction		Liquid Volume	
		As Analyzed	Acid Gas Free	STB/MMscf	mL/m3
Nitrogen	N ₂	0.0359	0.0363		
Carbon Dioxide	CO ₂	0.0107	0.0000		
Hydrogen Sulphide	H ₂ S	0.0000	0.0000		
Methane	C ₁	0.1944	0.1965		
Ethane	C ₂	0.2267	0.2291		
Propane	C ₃	0.2900	0.2931	189.375	1063.247
i-Butane	i-C ₄	0.0567	0.0573	44.017	247.131
n-Butane	n-C ₄	0.1124	0.1137	84.122	472.302
i-Pentane	i-C ₅	0.0265	0.0268	23.048	129.406
n-Pentane	n-C ₅	0.0257	0.0260	22.082	123.977
Hexanes	C ₆	0.0177	0.0179	17.237	96.779
Heptanes	C ₇	0.0028	0.0029	3.108	17.448
Octanes	C ₈	0.0005	0.0005	0.577	3.239
Nonanes	C ₉	0.0000	0.0000	0.000	0.000
Decanes	C ₁₀	0.0000	0.0000	0.000	0.000
Undecane	C ₁₁	0.0000	0.0000	0.000	0.000
Dodecanes Plus	C ₁₂₊	0.0000	0.0000	0.000	0.000
Total		1.0000	1.0000	383.565	2153.529
Propanes Plus	C ₃₊	0.5323	0.5381	383.565	2153.529
Butanes Plus	C ₄₊	0.2423	0.2450	194.190	1090.282
Pentanes Plus	C ₅₊	0.1856	0.1876	66.052	370.848

Calculated Gas Properties @ Standard Conditions			Calculated Pseudocritical Properties		
Molecular Weight	39.64 kg/kmol	39.64 lb/lb-mol	Ppc	624.6 psia	4.31 MPa
Specific Gravity	1.3687 (Air = 1)	1.3687 (Air = 1)	Tpc	589.2 R	327.3 K
MW of C7+	97.58 kg/kmol	97.58 lb/lbmol	Ppc*	622.6 psia	4.29 MPa
Density of C7+	0.7253 g/cc	725.3 kg/m3	Tpc*	587.2 R	326.2 K

Calculated Gross Heating Value @ Standard Conditions			Calculated Net Heating Value @ Standard Conditions		
Dry	2,190.3 Btu/scf	81.76 MJ/m3	Dry	2,012.2 Btu/scf	75.11 MJ/m3
Wet	2,152.2 Btu/scf	80.33 MJ/m3	Wet	1,977.2 Btu/scf	73.80 MJ/m3

Standard Conditions: 60 F (288.7 K) @ 14.696 psia (0.101325 MPa)



MULTI-STAGE SEPARATOR TEST

BP
POOL: .
FIELD: .
WELL: .

FINAL REPORT

Prepared for

BP

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II - MULTI-STAGE SEPARATOR TEST

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**RESULTS AND DISCUSSION**

The multi-stage separator test was conducted on a BOTTOMHOLE sample prepared from separator oil and separator gas collected from Well . of . reservoir.

The sample collection data is provided in Table 1 and the sample validation data of the reservoir fluid used in this study is given in Appendix A.

Table 2 provides the compositional analysis of the BOTTOMHOLE sample.

Table 3 contains various oil property measurements performed on the multi-stage separator test including live oil density, oil formation volume factor and gas-oil ratios.

Table 4 contains a summary of the gas properties including gas gravities, deviation factors, gas formation volume factors and gas expansion factors.

Table 5 presents the compositional analysis of the residual oil at completion of the experiment.

Appendix B contains the material balance check performed for this experiment. It is displayed as formation volume factors so that the balance can be checked on a point by point basis. Appendix C contains the compositional analyses of the liberated gases from the multi-stage separator test.



SUMMARY

MAIN PVT RESULTS

INITIAL RESERVOIR CONDITIONS

Reservoir Pressure	13500 psia	93.08 MPa
Reservoir Temperature:	243.0 F	390.4 K
Saturation Pressure	6438 psia	44.39 MPa

MULTI-STAGE SEPARATOR TEST

At Saturation Pressure		
Oil Formation Volume Factor	2.3875 res.bbl/STB	2.3875 res.m3/m3
Solution Gas-Oil Ratio	2747.13 scf/STB	489.27 m3/m3
Oil Density	0.5322 g/cm3	532.2 kg/m3
At Ambient Pressure		
Residual Oil Density	0.8331 g/cm3	833.1 kg/m3
At Stock Tank Conditions		
Residual Oil Density	0.8378 g/cm3	837.8 kg/m3
API Gravity	37.4	37.4

SINGLE-STAGE SEPARATOR TEST

At Saturation Pressure		
Oil Formation Volume Factor	2.5104 res.bbl/STB	2.5104 res.m3/m3
Solution Gas-Oil Ratio	2830.86 scf/STB	504.18 m3/m3
At Stock Tank Conditions		
Residual Oil Density	0.8467 g/cm3	846.7 kg/m3
API Gravity	35.6	35.6



**TABLE 1
SAMPLE COLLECTION DATA**

Project File:	WTC-10-001812	
Operator Name:	BP	
Pool or Zone:	.	
Field or Area:	.	
Well Location:	.	
Fluid Sample:	BOTTOMHOLE	
Sampling Company:	.	
Name of Sampler:	.	
Sampling Date:	.	
Sampling Point:	SEPARATOR	
Sampling Temperature:	243.0 F	390.4 K
Sampling Pressure:	70.0 psia	0.48 MPa
Reservoir Temperature:	243.0 F	390.4 K
Reservoir Pressure:	13500.0 psia	93.08 MPa
Initial Reservoir Pressure (Pi)	13500.0 psia	93.08 MPa
Depth of Reported Pi	N/A mMD	N/A mss



**TABLE 2
COMPOSITIONAL ANALYSIS OF RESERVOIR FLUID**

Component Name	Chemical Symbol	Mole Fraction	Mass Fraction	Calculated Properties
Nitrogen	N ₂	0.0049	0.0026	Total Sample
Carbon Dioxide	CO ₂	0.0092	0.0076	
Hydrogen Sulphide	H ₂ S	0.0000	0.0000	
Methane	C ₁	0.6485	0.1947	Molecular Weight 53.45
Ethane	C ₂	0.0639	0.0360	C₆₊ Fraction
Propane	C ₃	0.0459	0.0379	
i-Butane	i-C ₄	0.0094	0.0102	
n-Butane	n-C ₄	0.0215	0.0234	Molecular Weight 199.81
i-Pentane	i-C ₅	0.0088	0.0119	Mole Fraction 0.1768
n-Pentane	n-C ₅	0.0110	0.0149	Density (g/cc) 0.8036
Hexanes	C ₆	0.0195	0.0315	C₇₊ Fraction
Heptanes	C ₇	0.0173	0.0315	
Octanes	C ₈	0.0268	0.0539	
Nonanes	C ₉	0.0142	0.0341	Molecular Weight 213.92
Decanes	C ₁₀	0.0119	0.0316	
Undecanes	C ₁₁	0.0093	0.0256	
Dodecanes	C ₁₂	0.0076	0.0229	Mole Fraction 0.1573
Tridecanes	C ₁₃	0.0075	0.0247	Density (g/cc) 0.8183
Tetradecanes	C ₁₄	0.0066	0.0233	C₁₂₊ Fraction
Pentadecanes	C ₁₅	0.0056	0.0214	
Hexadecanes	C ₁₆	0.0048	0.0199	
Heptadecanes	C ₁₇	0.0042	0.0185	Molecular Weight 311.11
Octadecanes	C ₁₈	0.0039	0.0183	
Nonadecanes	C ₁₉	0.0035	0.0175	
Eicosanes	C ₂₀	0.0028	0.0145	Mole Fraction 0.0778
Heneicosanes	C ₂₁	0.0026	0.0140	
Docosanes	C ₂₂	0.0022	0.0127	
Tricosanes	C ₂₃	0.0020	0.0121	Density (g/cc) 0.8672
Tetracosanes	C ₂₄	0.0018	0.0113	
Pentacosanes	C ₂₅	0.0017	0.0108	
Hexacosanes	C ₂₆	0.0015	0.0099	
Heptacosanes	C ₂₇	0.0014	0.0098	
Octacosanes	C ₂₈	0.0013	0.0097	
Nonacosanes	C ₂₉	0.0011	0.0086	
Tricontanes	C ₃₀	0.0011	0.0083	
Hentriacontanes	C ₃₁	0.0010	0.0077	
Dotriacontanes	C ₃₂	0.0009	0.0072	
Tritriacontanes	C ₃₃	0.0008	0.0066	
Tetraatriacontanes	C ₃₄	0.0008	0.0067	
Pentatriacontanes	C ₃₅	0.0006	0.0059	
Hexatriacontanes plus	C ₃₆₊	0.0105	0.1304	
		1.0000	1.0000	

TABLE 3
MULTI-STAGE SEPARATOR OIL PROPERTIES

Pressure		Temperature		Oil Density (g/cm ³)	Oil Formation Volume Factor [1]	Total Formation Volume Factor [2]	Gas-Oil Ratio		Gas-Oil Ratio	
(psia)	(MPa)	(F)	(K)				Solution (scf/STB)	Liberated (scf/STB)	Solution (m ³ /m ³)	Liberated (m ³ /m ³)
6438 Psat	44.39	243	390.4	0.5322	2.3875	2.3875	2747.13	0.00	489.27	0.00
1235	8.52	130	327.6	0.7228	1.3073	5.8198	530.76	2216.37	94.53	394.74
435	3.00	120	322.0	0.7827	1.1439	16.4362	230.49	2516.64	41.05	448.22
135	0.93	120	322.0	0.8126	1.0748	47.0171	113.54	2633.59	20.22	469.04
15	0.10	66	292.0	0.8331	1.0035	171.4413	0.00	2747.13	0.00	489.27

Density of Residual Oil = 0.8378 g/cm³ (837.8 kg/m³) @ 60 F (288.7K)
 API Gravity of Residual Oil = 37.4

[1] Barrels (Cubic meters) of oil at indicated pressure and temperature per barrel (cubic meter) of residual oil @ 60 F (288.7 K).
 [2] Total barrels (cubic meters) of oil and liberated gas at the indicated pressure and temperature per barrel (cubic meter) of residual oil @ 60 F (288.7 K).
 Psat - Saturation Pressure
 - Standard conditions: 60 F (288.7 K) @ 14.696 psia (0.101325 MPa).

TABLE 4
MULTI-STAGE SEPARATOR GAS PROPERTIES

Pressure		Temperature		Gas Gravity		Gas Density (g/cm ³)	Gas Deviation Factor (-)	Gas Formation Volume Factor [1]	Gas Expansion Factor [2]
(psia)	(MPa)	(F)	(K)	Incremental (Air = 1)	Cumulative (Air = 1)				
6438 P _{sat}	44.39	243	390.4						
1235	8.52	130	327.6	0.6681	0.6681	0.0706	0.8567	0.0114	87.477
435	3.00	120	322.0	0.7130	0.6734	0.0247	0.9359	0.0341	29.310

[1] Cubic feet (meters) of gas at indicated pressure and temperature per cubic feet (meter) @ standard conditions

[2] Cubic feet (meters) of gas @ standard conditions per cubic feet (meter) @ indicated pressure and temperature.

P_{sat} - Saturation pressure

- Standard conditions: 60 F (288.7 K) @ 14.696 psia (0.101325 MPa)



**TABLE 5
COMPOSITIONAL ANALYSIS OF RESIDUAL OIL**

Component Name	Chemical Symbol	Mole Fraction	Mass Fraction	Calculated Properties		
Nitrogen	N ₂	0.0000	0.0000	Total Sample		
Carbon Dioxide	CO ₂	0.0000	0.0000			
Hydrogen Sulphide	H ₂ S	0.0000	0.0000			
Methane	C ₁	0.0000	0.0000	Molecular Weight	195.10	
Ethane	C ₂	0.0007	0.0001	C₆₊ Fraction		
Propane	C ₃	0.0113	0.0026			
i-Butane	i-C ₄	0.0091	0.0027			
n-Butane	n-C ₄	0.0327	0.0098	Molecular Weight	212.47	
i-Pentane	i-C ₅	0.0274	0.0101	Mole Fraction	0.8844	
n-Pentane	n-C ₅	0.0344	0.0127	Density (g/cc)	0.8085	
Hexanes	C ₆	0.0609	0.0269	C₇₊ Fraction		
Heptanes	C ₇	0.0940	0.0475			
Octanes	C ₈	0.1100	0.0623			
Nonanes	C ₉	0.0761	0.0500	Molecular Weight	221.81	
Decanes	C ₁₀	0.0640	0.0467			
Undecanes	C ₁₁	0.0504	0.0380			
Dodecanes	C ₁₂	0.0413	0.0340	Mole Fraction	0.8235	
Tridecanes	C ₁₃	0.0409	0.0367	Density (g/cc)	0.8177	
Tetradecanes	C ₁₄	0.0357	0.0348	C₁₂₊ Fraction		
Pentadecanes	C ₁₅	0.0304	0.0321			
Hexadecanes	C ₁₆	0.0262	0.0298			
Heptadecanes	C ₁₇	0.0229	0.0278	Molecular Weight	314.53	
Octadecanes	C ₁₈	0.0213	0.0275			
Nonadecanes	C ₁₉	0.0189	0.0254			
Eicosanes	C ₂₀	0.0162	0.0228	Mole Fraction	0.4291	
Heneicosanes	C ₂₁	0.0141	0.0211	Density (g/cc)	0.8684	
Docosanes	C ₂₂	0.0122	0.0191			
Tricosanes	C ₂₃	0.0112	0.0183			
Tetracosanes	C ₂₄	0.0101	0.0171			
Pentacosanes	C ₂₅	0.0089	0.0158			
Hexacosanes	C ₂₆	0.0082	0.0151			
Heptacosanes	C ₂₇	0.0080	0.0154			
Octacosanes	C ₂₈	0.0070	0.0139			
Nonacosanes	C ₂₉	0.0066	0.0136			
Tricontanes	C ₃₀	0.0058	0.0123			
Hentriacontanes	C ₃₁	0.0052	0.0114			
Dotriacontanes	C ₃₂	0.0047	0.0106			
Tritriacontanes	C ₃₃	0.0044	0.0103			
Tetratriacontanes	C ₃₄	0.0038	0.0091			
Pentatriacontanes	C ₃₅	0.0039	0.0096			
Hexatriacontanes plus	C ₃₆₊	0.0613	0.2070			
		1.0000	1.0000			



APPENDIX A

SAMPLE VALIDATION



**TABLE A1
COMPOSITIONAL ANALYSIS OF RESERVOIR FLUID**

Component Name	Chemical Symbol	Mole Fraction	Mass Fraction	Calculated Properties
Nitrogen	N ₂	0.0049	0.0026	Total Sample Molecular Weight 53.45 Density (g/cc) 0.4240
Carbon Dioxide	CO ₂	0.0092	0.0076	
Hydrogen Sulphide	H ₂ S	0.0000	0.0000	
Methane	C ₁	0.6485	0.1947	C₆₊ Fraction Molecular Weight 199.81 Mole Fraction 0.1768 Density (g/cc) 0.8036
Ethane	C ₂	0.0639	0.0360	
Propane	C ₃	0.0459	0.0379	
i-Butane	i-C ₄	0.0094	0.0102	C₇₊ Fraction Molecular Weight 213.92 Mole Fraction 0.1573 Density (g/cc) 0.8183
n-Butane	n-C ₄	0.0215	0.0234	
i-Pentane	i-C ₅	0.0088	0.0119	
n-Pentane	n-C ₅	0.0110	0.0149	C₁₂₊ Fraction Molecular Weight 311.11 Mole Fraction 0.0778 Density (g/cc) 0.8672
Hexanes	C ₆	0.0195	0.0315	
Heptanes	C ₇	0.0173	0.0315	
Octanes	C ₈	0.0268	0.0539	C₃₀₊ Fraction Molecular Weight 592.41 Mole Fraction 0.0156 Density (g/cc) 0.9655
Nonanes	C ₉	0.0142	0.0341	
Decanes	C ₁₀	0.0119	0.0316	
Undecanes	C ₁₁	0.0093	0.0256	C₃₆₊ Fraction Molecular Weight 662.30 Mole Fraction 0.0105 Density (g/cc) 0.9926
Dodecanes	C ₁₂	0.0076	0.0229	
Tridecanes	C ₁₃	0.0075	0.0247	
Tetradecanes	C ₁₄	0.0066	0.0233	Recombination Parameters Gas-Oil Ratio (cc/cc) 504.18 Dead Oil Density (g/cc) 0.8467 Dead Oil MW (g/mol) 211.73
Pentadecanes	C ₁₅	0.0056	0.0214	
Hexadecanes	C ₁₆	0.0048	0.0199	
Heptadecanes	C ₁₇	0.0042	0.0185	
Octadecanes	C ₁₈	0.0039	0.0183	
Nonadecanes	C ₁₉	0.0035	0.0175	
Eicosanes	C ₂₀	0.0028	0.0145	
Heneicosanes	C ₂₁	0.0026	0.0140	
Docosanes	C ₂₂	0.0022	0.0127	
Tricosanes	C ₂₃	0.0020	0.0121	
Tetracosanes	C ₂₄	0.0018	0.0113	
Pentacosanes	C ₂₅	0.0017	0.0108	
Hexacosanes	C ₂₆	0.0015	0.0099	
Heptacosanes	C ₂₇	0.0014	0.0098	
Octacosanes	C ₂₈	0.0013	0.0097	
Nonacosanes	C ₂₉	0.0011	0.0086	
Tricontanes	C ₃₀	0.0011	0.0083	
Hentriacontanes	C ₃₁	0.0010	0.0077	
Dotriacontanes	C ₃₂	0.0009	0.0072	
Tritriacontanes	C ₃₃	0.0008	0.0066	
Tetracontanes	C ₃₄	0.0008	0.0067	
Pentatriacontanes	C ₃₅	0.0006	0.0059	
Hexatriacontanes plus	C ₃₆₊	0.0105	0.1304	
		1.0000	1.0000	

Physical Properties calculated based on GPA 2145-00 physical constants



**TABLE A2
COMPOSITIONAL ANALYSIS OF FLASHED OIL**

Component Name	Chemical Symbol	Mole Fraction	Mass Fraction	Calculated Properties	
Nitrogen	N ₂	0.0000	0.0000	Total Sample	
Carbon Dioxide	CO ₂	0.0000	0.0000		
Hydrogen Sulphide	H ₂ S	0.0000	0.0000	Molecular Weight	211.73
Methane	C ₁	0.0000	0.0000	Density (g/cc)	0.8022
Ethane	C ₂	0.0006	0.0001		
Propane	C ₃	0.0034	0.0007	C₆₊ Fraction	
i-Butane	i-C ₄	0.0023	0.0006		
n-Butane	n-C ₄	0.0091	0.0025	Molecular Weight	217.95
i-Pentane	i-C ₅	0.0097	0.0033	Mole Fraction	0.9593
n-Pentane	n-C ₅	0.0157	0.0053	Density (g/cc)	0.8109
Hexanes	C ₆	0.0434	0.0177		
Heptanes	C ₇	0.0880	0.0411	C₇₊ Fraction	
Octanes	C ₈	0.1140	0.0614		
Nonanes	C ₉	0.0882	0.0534	Molecular Weight	224.19
Decanes	C ₁₀	0.0750	0.0504	Mole Fraction	0.9159
Undecanes	C ₁₁	0.0590	0.0409	Density (g/cc)	0.8169
Dodecanes	C ₁₂	0.0482	0.0366		
Tridecanes	C ₁₃	0.0477	0.0394	C₁₂₊ Fraction	
Tetradecanes	C ₁₄	0.0414	0.0372		
Pentadecanes	C ₁₅	0.0352	0.0342	Molecular Weight	311.11
Hexadecanes	C ₁₆	0.0302	0.0317	Mole Fraction	0.4917
Heptadecanes	C ₁₇	0.0264	0.0296	Density (g/cc)	0.8672
Octadecanes	C ₁₈	0.0247	0.0293		
Nonadecanes	C ₁₉	0.0224	0.0279	C₃₀₊ Fraction	
Eicosanes	C ₂₀	0.0179	0.0232		
Heneicosanes	C ₂₁	0.0162	0.0223	Molecular Weight	592.41
Docosanes	C ₂₂	0.0141	0.0203	Mole Fraction	0.0985
Tricosanes	C ₂₃	0.0128	0.0193	Density (g/cc)	0.9655
Tetracosanes	C ₂₄	0.0115	0.0180		
Pentacosanes	C ₂₅	0.0106	0.0173	C₃₆₊ Fraction	
Hexacosanes	C ₂₆	0.0093	0.0158		
Heptacosanes	C ₂₇	0.0089	0.0157	Molecular Weight	662.30
Octacosanes	C ₂₈	0.0084	0.0154	Mole Fraction	0.0665
Nonacosanes	C ₂₉	0.0072	0.0137	Density (g/cc)	0.9926
Tricontanes	C ₃₀₋	0.0068	0.0133		
Hentriacontanes	C ₃₁	0.0060	0.0122		
Dotriacontanes	C ₃₂	0.0055	0.0115		
Tritriacontanes	C ₃₃	0.0049	0.0106		
Tetatriacontanes	C ₃₄	0.0048	0.0106		
Pentatriacontanes	C ₃₅	0.0041	0.0094		
Hexatriacontanes plus	C ₃₆₋	0.0665	0.2081		
		1.0000	1.0000		

Physical Properties calculated based on GPA 2145-00 physical constants

**TABLE A3
COMPOSITIONAL ANALYSIS OF FLASHED GAS**

Component Name	Chemical Symbol	Mole Fraction		Liquid Volume	
		As Analyzed	Acid Gas Free	STB/MMscf	mL/m3
Nitrogen	N ₂	0.0059	0.0059		
Carbon Dioxide	CO ₂	0.0109	0.0000		
Hydrogen Sulphide	H ₂ S	0.0000	0.0000		
Methane	C ₁	0.7703	0.7788		
Ethane	C ₂	0.0759	0.0767		
Propane	C ₃	0.0540	0.0545	35.231	197.805
i-Butane	i-C ₄	0.0107	0.0108	8.319	46.709
n-Butane	n-C ₄	0.0238	0.0241	17.829	100.099
i-Pentane	i-C ₅	0.0087	0.0088	7.528	42.267
n-Pentane	n-C ₅	0.0101	0.0102	8.707	48.886
Hexanes	C ₆	0.0150	0.0152	14.680	82.423
Heptanes	C ₇	0.0040	0.0040	4.336	24.344
Octanes	C ₈	0.0105	0.0106	12.723	71.436
Nonanes	C ₉	0.0003	0.0003	0.428	2.401
Decanes	C ₁₀	0.0000	0.0000	0.000	0.000
Undecane	C ₁₁	0.0000	0.0000	0.000	0.000
Dodecanes Plus	C ₁₂₊	0.0000	0.0000	0.000	0.000
Total		1.0000	1.0000	109.782	616.369
Propanes Plus	C ₃₊	0.1371	0.1386	109.782	616.369
Butanes Plus	C ₄₊	0.0831	0.0840	74.550	418.564
Pentanes Plus	C ₅₊	0.0724	0.0732	48.402	271.756

Calculated Gas Properties @ Standard Conditions			Calculated Pseudocritical Properties		
Molecular Weight	23.86 kg/kmol	23.86 lb/lb-mol	Ppc	656.0 psia	4.52 MPa
Specific Gravity	0.8238 (Air = 1)	0.8238 (Air = 1)	Tpc	419.7 R	233.2 K
MW of C7+	1.54 kg/kmol	1.54 lb/lbmol	Ppc*	652.9 psia	4.50 MPa
Density of C7+	0.7392 g/cc	739.2 kg/m3	Tpc*	417.8 R	232.1 K

Calculated Gross Heating Value @ Standard Conditions			Calculated Net Heating Value @ Standard Conditions		
Dry	1,396.2 Btu/scf	52.12 MJ/m3	Dry	1,270.2 Btu/scf	47.41 MJ/m3
Wet	1,371.9 Btu/scf	51.21 MJ/m3	Wet	1,248.1 Btu/scf	46.59 MJ/m3

Standard Conditions: 60 F (288.7 K) @ 14.696 psia (0.101325 MPa)



MULTI-STAGE SEPARATOR TEST



WTC-10-001812 - BP - . . . - . . . - BOTTOMHOLE FLUID

APPENDIX B

MULTI-STAGE SEPARATOR TEST - MATERIAL BALANCE

Project No.: WTC-10-001812

II - 12

DW 0007255

TREX 009734.0034



TABLE B1
MULTI-STAGE SEPARATOR - MATERIAL BALANCE

Pressure		Measured Oil FVF [1]	Calculated Oil FVF [1]	Absolute Relative Error (%)
(psia)	(MPa)			
6438 Psat	44.39	2.3875	2.3723	0.6405
1235	8.52	1.3073	1.3006	0.5153
435	3.00	1.1439	1.1414	0.2109
135	0.93	1.0748	1.0727	0.1945
15	0.10	1.0035	1.0057	0.2157

[1] (res bbl/STB) (res m3/m3)
 Psat - Saturation Pressure
 - Standard conditions: 60 F (288.7 K) @ 14.696 psia (0.101325 MPa)



APPENDIX C

MULTI-STAGE SEPARATOR - COMPOSITIONAL ANALYSES OF LIBERATED GAS



TABLE C1
MSS GAS COMPOSITION @ 1,235 psia (8.52 MPa) AND 130.0 F (327.6 K)

Component Name	Chemical Symbol	Mole Fraction		Liquid Volume	
		As Analyzed	Acid Gas Free	STB/MMscf	mL/m3
Nitrogen	N ₂	0.0063	0.0064		
Carbon Dioxide	CO ₂	0.0105	0.0000		
Hydrogen Sulphide	H ₂ S	0.0000	0.0000		
Methane	C ₁	0.8636	0.8727		
Ethane	C ₂	0.0646	0.0653		
Propane	C ₃	0.0335	0.0339	21.899	122.950
i-Butane	i-C ₄	0.0051	0.0052	3.983	22.365
n-Butane	n-C ₄	0.0096	0.0097	7.185	40.342
i-Pentane	i-C ₅	0.0016	0.0016	1.368	7.682
n-Pentane	n-C ₅	0.0007	0.0007	0.569	3.193
Hexanes	C ₆	0.0021	0.0022	2.084	11.702
Heptanes	C ₇	0.0021	0.0021	2.261	12.695
Octanes	C ₈	0.0003	0.0003	0.353	1.984
Nonanes	C ₉	0.0000	0.0000	0.054	0.301
Decanes	C ₁₀	0.0000	0.0000	0.015	0.082
Undecane	C ₁₁	0.0000	0.0000	0.000	0.000
Dodecanes Plus	C ₁₂₊	0.0000	0.0000	0.000	0.000
Total		1.0000	1.0000	39.771	223.296
Propanes Plus	C ₃₊	0.0550	0.0556	39.771	223.296
Butanes Plus	C ₄₊	0.0215	0.0217	17.873	100.346
Pentanes Plus	C ₅₊	0.0164	0.0166	6.704	37.639

Calculated Gas Properties @ Standard Conditions			Calculated Pseudocritical Properties		
Molecular Weight	19.35 kg/kmol	19.35 lb/lb-mol	Ppc	668.4 psia	4.61 MPa
Specific Gravity	0.6681 (Air = 1)	0.6681 (Air = 1)	Tpc	378.5 R	210.3 K
MW of C7+	97.90 kg/kmol	97.90 lb/lbmol	Ppc*	665.0 psia	4.59 MPa
Density of C7+	0.7257 g/cc	725.7 kg/m3	Tpc*	376.6 R	209.2 K

Calculated Gross Heating Value @ Standard Conditions			Calculated Net Heating Value @ Standard Conditions		
Dry	1,151.4 Btu/scf	42.98 MJ/m3	Dry	1,041.8 Btu/scf	38.89 MJ/m3
Wet	1,131.3 Btu/scf	42.23 MJ/m3	Wet	1,023.7 Btu/scf	38.21 MJ/m3

Standard Conditions: 60 F (288.7 K) @ 14.696 psia (0.101325 MPa)



TABLE C2
MSS GAS COMPOSITION @ 435 psia (3.00 MPa) AND 120.0 F (322.0 K)

Component Name	Chemical Symbol	Mole Fraction		Liquid Volume	
		As Analyzed	Acid Gas Free	STB/MMscf	mL/m3
Nitrogen	N ₂	0.0333	0.0338		
Carbon Dioxide	CO ₂	0.0146	0.0000		
Hydrogen Sulphide	H ₂ S	0.0000	0.0000		
Methane	C ₁	0.7872	0.7989		
Ethane	C ₂	0.0933	0.0947		
Propane	C ₃	0.0467	0.0473	30.470	171.075
i-Butane	i-C ₄	0.0064	0.0065	4.944	27.758
n-Butane	n-C ₄	0.0114	0.0116	8.546	47.981
i-Pentane	i-C ₅	0.0025	0.0025	2.183	12.257
n-Pentane	n-C ₅	0.0024	0.0024	2.067	11.605
Hexanes	C ₆	0.0017	0.0018	1.704	9.565
Heptanes	C ₇	0.0005	0.0005	0.510	2.861
Octanes	C ₈	0.0000	0.0000	0.024	0.132
Nonanes	C ₉	0.0000	0.0000	0.000	0.000
Decanes	C ₁₀	0.0000	0.0000	0.000	0.000
Undecane	C ₁₁	0.0000	0.0000	0.000	0.000
Dodecanes Plus	C ₁₂₊	0.0000	0.0000	0.000	0.000
Total		1.0000	1.0000	50.447	283.235
Propanes Plus	C ₃₊	0.0716	0.0727	50.447	283.235
Butanes Plus	C ₄₊	0.0249	0.0253	19.977	112.159
Pentanes Plus	C ₅₊	0.0186	0.0188	6.487	36.421

Calculated Gas Properties @ Standard Conditions			Calculated Pseudocritical Properties		
Molecular Weight	20.65 kg/kmol	20.65 lb/lb-mol	Ppc	665.5 psia	4.59 MPa
Specific Gravity	0.7130 (Air = 1)	0.7130 (Air = 1)	Tpc	387.6 R	215.3 K
MW of C7+	96.44 kg/kmol	96.44 lb/lbmol	Ppc*	661.2 psia	4.56 MPa
Density of C7+	0.7229 g/cc	722.9 kg/m3	Tpc*	385.0 R	213.9 K

Calculated Gross Heating Value @ Standard Conditions			Calculated Net Heating Value @ Standard Conditions		
Dry	1,166.2 Btu/scf	43.53 MJ/m3	Dry	1,056.6 Btu/scf	39.44 MJ/m3
Wet	1,145.9 Btu/scf	42.77 MJ/m3	Wet	1,038.3 Btu/scf	38.76 MJ/m3

Standard Conditions: 60 F (288.7 K) @ 14.696 psia (0.101325 MPa)



**TABLE C3
MULTI-STAGE SEPARATOR GAS COMPOSITION @ 135 psia (0.93 MPa) AND 120.0 F (322.0 K)**

Component Name	Chemical Symbol	Mole Fraction		Liquid Volume	
		As Analyzed	Acid Gas Free	STB/MMscf	mL/m3
Nitrogen	N ₂	0.0351	0.0357		
Carbon Dioxide	CO ₂	0.0172	0.0000		
Hydrogen Sulphide	H ₂ S	0.0000	0.0000		
Methane	C ₁	0.6218	0.6327		
Ethane	C ₂	0.1681	0.1711		
Propane	C ₃	0.1027	0.1045	67.059	376.505
i-Butane	i-C ₄	0.0145	0.0147	11.222	63.006
n-Butane	n-C ₄	0.0258	0.0262	19.296	108.335
i-Pentane	i-C ₅	0.0054	0.0055	4.660	26.165
n-Pentane	n-C ₅	0.0051	0.0052	4.392	24.659
Hexanes	C ₆	0.0035	0.0035	3.375	18.951
Heptanes	C ₇	0.0009	0.0009	0.984	5.522
Octanes	C ₈	0.0000	0.0000	0.059	0.330
Nonanes	C ₉	0.0000	0.0000	0.000	0.000
Decanes	C ₁₀	0.0000	0.0000	0.000	0.000
Undecane	C ₁₁	0.0000	0.0000	0.000	0.000
Dodecanes Plus	C ₁₂₊	0.0000	0.0000	0.000	0.000
Total		1.0000	1.0000	111.047	623.473
Propanes Plus	C ₃₊	0.1578	0.1606	111.047	623.473
Butanes Plus	C ₄₊	0.0551	0.0561	43.987	246.968
Pentanes Plus	C ₅₊	0.0407	0.0414	13.470	75.628

Calculated Gas Properties @ Standard Conditions			Calculated Pseudocritical Properties		
Molecular Weight	24.78 kg/kmol	24.78 lb/lb-mol	Ppc	662.1 psia	4.56 MPa
Specific Gravity	0.8556 (Air = 1)	0.8556 (Air = 1)	Tpc	434.7 R	241.5 K
MW of C7+	96.56 kg/kmol	96.56 lb/lbmol	Ppc*	657.6 psia	4.53 MPa
Density of C7+	0.7232 g/cc	723.2 kg/m3	Tpc*	431.8 R	239.9 K

Calculated Gross Heating Value @ Standard Conditions			Calculated Net Heating Value @ Standard Conditions		
Dry	1,378.7 Btu/scf	51.46 MJ/m3	Dry	1,255.1 Btu/scf	46.85 MJ/m3
Wet	1,354.7 Btu/scf	50.57 MJ/m3	Wet	1,233.3 Btu/scf	46.03 MJ/m3

Standard Conditions: 60 F (288.7 K) @ 14.696 psia (0.101325 MPa)

TABLE C4
MULTI-STAGE SEPARATOR GAS COMPOSITION @ 15 psia (0.10 MPa) AND 66.0 F (292.0 K)

Component Name	Chemical Symbol	Mole Fraction		Liquid Volume	
		As Analyzed	Acid Gas Free	STB/MMscf	mL/m3
Nitrogen	N ₂	0.0359	0.0363		
Carbon Dioxide	CO ₂	0.0107	0.0000		
Hydrogen Sulphide	H ₂ S	0.0000	0.0000		
Methane	C ₁	0.1944	0.1965		
Ethane	C ₂	0.2267	0.2291		
Propane	C ₃	0.2900	0.2931	189.375	1063.247
i-Butane	i-C ₄	0.0567	0.0573	44.017	247.131
n-Butane	n-C ₄	0.1124	0.1137	84.122	472.302
i-Pentane	i-C ₅	0.0265	0.0268	23.048	129.406
n-Pentane	n-C ₅	0.0257	0.0260	22.082	123.977
Hexanes	C ₆	0.0177	0.0179	17.237	96.779
Heptanes	C ₇	0.0028	0.0029	3.108	17.448
Octanes	C ₈	0.0005	0.0005	0.577	3.239
Nonanes	C ₉	0.0000	0.0000	0.000	0.000
Decanes	C ₁₀	0.0000	0.0000	0.000	0.000
Undecane	C ₁₁	0.0000	0.0000	0.000	0.000
Dodecanes Plus	C ₁₂₊	0.0000	0.0000	0.000	0.000
Total		1.0000	1.0000	383.565	2153.529
Propanes Plus	C ₃₊	0.5323	0.5381	383.565	2153.529
Butanes Plus	C ₄₊	0.2423	0.2450	194.190	1090.282
Pentanes Plus	C ₅₊	0.1856	0.1876	66.052	370.848

Calculated Gas Properties @ Standard Conditions			Calculated Pseudocritical Properties		
Molecular Weight	39.64 kg/kmol	39.64 lb/lb-mol	Ppc	624.6 psia	4.31 MPa
Specific Gravity	1.3687 (Air = 1)	1.3687 (Air = 1)	Tpc	589.2 R	327.3 K
MW of C7+	97.58 kg/kmol	97.58 lb/lbmol	Ppc*	622.6 psia	4.29 MPa
Density of C7+	0.7253 g/cc	725.3 kg/m3	Tpc*	587.2 R	326.2 K

Calculated Gross Heating Value @ Standard Conditions			Calculated Net Heating Value @ Standard Conditions		
Dry	2,190.3 Btu/scf	81.76 MJ/m3	Dry	2,012.2 Btu/scf	75.11 MJ/m3
Wet	2,152.2 Btu/scf	80.33 MJ/m3	Wet	1,977.2 Btu/scf	73.80 MJ/m3

Standard Conditions: 60 F (288.7 K) @ 14.696 psia (0.101325 MPa)