From: LeBlanc, Jason <jleblanc@core.com>
Sent: Thursday, June 10, 2010 4:42 PM
To: McAughan, Kelly <Kelly.McAughan@bp.com>
Cc: Wang, Yun <Yun.Wang@bp.com>
Subject: 36126-53 PVT Study
Attach: 36126-53-5010068379.zip

Kelly,
Attached is the PVT study from PENCOR ID 36126-53 collected from 18,142 ft. Hard copies will be printed tomorrow and mailed to you. Please let me know if there are any questions.

Jason LeBlanc
Core Laboratories LP
PENCOR Division
5820 Highway 90 East
Broussard, LA 70518
337-839-9060 (office)

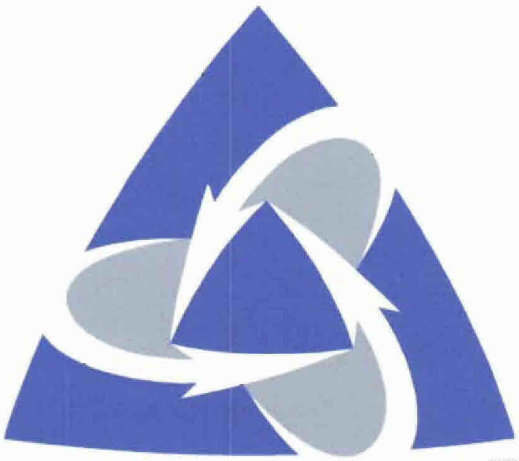
ATTACHMENT INFO

Attachment: 1 of 1 (36126-53-5010068379.xls)

Name: 36126-53-5010068379.xls

Comments: DOCUMENT PRODUCED AS NATIVE

ATTACHMENT INFO



Core Lab™

RESERVOIR OPTIMIZATION

Volatile Oil Reservoir Fluid Study

for

BP

OCS-G-32306 Well No. 1 ST00 BP01
18,142 Ft. MD Sample
Mississippi Canyon Block 252
'Macondo'
Offshore, Louisiana
Report No: 36126-53-5010068379

Standard Conditions:
15.025 psia at 60 °F

Petroleum Services Division
PENCOR
info.pencor@corelab.com · (800) 234-4205

5820 Hwy. 90 East, Broussard, Louisiana, 70518
Tel: (337) 839-9060 · Fax: (337) 839-9070 Web: http://www.corelab.com

Petroleum Services Division
PENCOR
5820 Highway 90 East
Broussard, Louisiana 70518
Tel: (337) 839-9060
Fax: (337) 839-9070
Web: http://www.corelab.com

June 10, 2010

BP
200 Westlake Park Blvd.
Houston, Texas 77079

Attention: Ms. Kelly McAughan

Subject: Volatile Oil Reservoir Fluid Study
OCS-G-32306 Well No. 1 ST00 BP01
18,142 Ft. MD Sample
Mississippi Canyon Block 252
'Macondo'
Offshore, Louisiana
Report No.: 36126-53-5010068379

Dear Ms. McAughan:

Reservoir fluid samples from the subject were collected on April 12, 2010 and received at our Broussard, Louisiana facility on April 16, 2010 for use in the performance of a reservoir fluid study. Please reference report no. 36126-5010048448 dated April 22, 2010 for a complete list of all samples collected.

One of the bottomhole samples, PENCOR ID No. 36126-53 was utilized to conduct a volatile oil reservoir fluid study. In the laboratory, the sample exhibited a saturation pressure of 6,504 psia at 243 °F and the reservoir fluid exists as an under-saturated fluid at current reservoir conditions (11,856 psia at 243 °F).

PENCOR is very pleased to have been of service to BP in this work. Should any questions arise concerning the data presented in this report, or if PENCOR may be of assistance in any other matter, please do not hesitate to contact us.

Yours sincerely,

Jason LeBlanc
BP Project Manager

Scope of Work

Findings and Recommendations

Findings

Please reference field sample summary report 36126-5010048448 dated April 22, 2010 for a complete listing of all samples collected as well as testing conducted with PENCOR's mobile laboratory.

In the laboratory, sample PENCOR ID No. 36126-53 (transferred from MPSR-3547) exhibited a saturation pressure of 6,504 psia at 243 °F and exists as an under-saturated fluid at current reservoir conditions (11,856 psia at 243 °F). This fluid is exhibiting near critical behavior where we are seeing drastic changes in liquid levels with small changes in pressure when below the saturation point. During the constant composition expansion (CCE) experiments as performed in the PVT cells utilized by PENCOR a dew point was observed and not a bubble point for this system. At pressures higher than saturation pressure the fluid column observed in the PVT cell was a dark colored fluid that we were unable to see through, behavior that is not typical of a gas system. As the pressure was decreased below saturation pressure two different color phases were observed, a small amount of dark fluid at the bottom of the PVT cell, and a slightly lighter colored fluid on top of the dark fluid. As the sample was expanded and pressure decreased the volume of the dark fluid phase increased to approximately 60 volume percent at 6,000 psia and then began decreasing again. The fluid that was observed on top of this darker fluid does get lighter and lighter in color as we decrease pressure. At no point during any of the three CCE experiments (100 °F, 170 °F or 243 °F) were we able to detect the presence of a third phase. Without being able to detect a third phase and classify this system as one that has two liquid layers and one gas phase we are assuming that the top layer of fluid is gas and the bottom layer of fluid is oil.

However in looking at the big picture, including gas-liquid ratio, fluid density, fluid viscosity, API gravity and color, it is logical that this fluid system should exhibit a bubble point, instead of a dew point. After having discussions with various BP representatives we came to the above conclusion and decided to perform a differential liberation test on the reservoir fluid. It should be noted that considerable condensate was produced during the gas displacement stages in the differential liberation experiment. This condensate was added back to the produced gas phase and is presented on page 22.

An oil base-mud contamination evaluation was performed on this sample. The results showed the residual oil was <1.0 percent by weight oil base mud contamination. **This study includes the oil base drilling fluid properties in its results.**

Comparison of results from the various flash liberation tests (separator test, single-stage flash liberation test, and differential test) exhibited the correct trends with respect to gas-liquid ratio, flash gas gravity, and stock tank gravity. This comparison is used as a validation check on the results and is tabulated on page 5 of this report.

A paraffin content of 1.8 wt % (wax appearance temperature of 89 °F) and an asphaltene content of 0.4 wt % were noted in the stock tank oil. Solids interference to the results of the PVT study, though, were not detected. Live fluid viscosity measurements did not exhibit trends indicative of a typical oil sample. The single phase region of the measurements did show some erratic behavior at cooler temperatures and the minimum viscosity value was not observed at saturation pressure. Also a significant difference was observed in viscosity between the single phase and two phase regions of the fluid.

Recommendations

Additional analyses that could be useful in the future planning and production of this well include:

Since the sample does have such a rich 'gas phase' associated with it, performing a constant volume depletion on the fluid might provide a better estimation of reservoir production than the standard black oil differential liberation.

According to the deBoer plot for the screening of crude oils for asphaltene precipitation, this sample falls into the "severe risk" category. A SARA analysis could be conducted to provide additional screening information. An asphaltene flocculation test could be performed if the SARA results reinforce the deBoer screening to identify whether or not this fluid exhibits asphaltene precipitation.

Storage of samples for future reference

Reservoir Fluid Summary

PENCOR ID No. 36126-53

Reservoir Summary

Sample Depth	18,142	Ft. MD
Reservoir Pressure	11,856	psia
Reservoir Temperature	243	°F

Stock Tank Oil Properties

Drilling Fluid Content	< 1.0	wt% STO
Drilling Fluid Type	Rheliant	
API Gravity (from R0F)	35.2	°API at 60 °F (water free)
Paraffin Content	1.8	wt%
Asphaltene Content	0.4	wt%
Sulfur Content	0.27	wt%
Wax Appearance Temp. (CPM)	89	°F
Pour Point	< -30	°F
Mini-Reid Vapor Pressure	2.86	psi
Total Acid Number	< 0.1	mg KOH / g

Fluid Properties at Reservoir Pressure & Temperature

Reservoir Pressure	11,856	psia at 243 °F
Density	0.587	g/cm^3
Density	36.6	lb/ft^3
FVF (from MSF)	2.131	P_{res} bbl/stb
Viscosity	0.168	cP
Compressibility	N/A	$\Delta vol/vol/\Delta psi \times 10^6$

Fluid Properties at Saturation Pressure & Temperature

Saturation Pressure	6,504	psia at 243 °F
Density	0.528	g/cm^3
Density	33.0	lb/ft^3
FVF (from MSF)	2.367	P_{sat} bbl/stb
Viscosity	0.162	cP
Compressibility	28.50	$\Delta vol/vol/\Delta psi \times 10^6$

Flash Comparison

Experimental Procedure	GOR (SCF/stb)	FVF (P_{sat} bbl/stb)	Gas Gravity	API at 60 °F
Reservoir Oil Single-Stage Flash	2,819	2.564	0.807	35.2
Differential Liberation at Reservoir Temperature	4,057	3.459	1.050	31.8
Multi-Stage Separator Test	2,554	2.367	0.740	38.2

Reservoir Fluid Composition

Component	Mole %
N_2	0.444
CO_2	0.919
H_2S	0.000
C1	65.467
C2	6.418
C3	4.572
iC4	0.951
nC4	2.177
iC5	0.890
nC5	1.081
C6	1.409
C7	2.010
C8	2.157
C9	1.529
C10	1.282
C11	0.944
C12	0.789
C13	0.753
C14	0.674
C15	0.564
C16	0.547
C17	0.436
C18	0.425
C19	0.360
C20	0.311
C21	0.253
C22	0.225
C23	0.203
C24	0.182
C25	0.149
C26	0.135
C27	0.141
C28	0.125
C29	0.111
C30	0.102
C31	0.096
C32	0.086
C33	0.074
C34	0.073
C35	0.060
C36	0.055
C37	0.053
C38	0.050
C39	0.043
C40	0.042
C41	0.031
C42	0.034
C43	0.031
C44	0.029
C45	0.027
C46	0.023
C47	0.025
C48	0.021
C49	0.019
C50+	0.393

C50+ Mole Wt	950.71
C50+ Sp Gr	1.148

Sample History and Information

Sample Inventory and History

PENCOR ID No.	Sample Depth (Ft. MD)	Sample Source	Reservoir Condition (psia / °F)		Sample Date	Sample Type	Opening Condition (psia / °F)		Restoration Time (Hours)	Restoration & Transfer Condition (psia / °F)		Transfer Date	Original Sample Volume (cc)
36126-01	N/A	Active Mud pit	N/A		4/10/2010	Drilling Mud	N/A		N/A	N/A		N/A	3,500
36126-01	N/A	Active Mud pit	N/A		4/10/2010	Drilling Mud	N/A		N/A	N/A		N/A	3,500
36126-39	18,142	MRSC-147	11,856	236	4/12/2010	Reservoir Fluid	6,030	68	12	14,000	170	4/14/2010	750
36126-40	18,142	MRSC-147	11,856	236	4/12/2010	Reservoir Fluid	6,030	68	12	14,000	170	4/14/2010	750
36126-41	18,142	MRSC-147	11,856	236	4/12/2010	Reservoir Fluid	6,030	68	12	14,000	170	4/14/2010	750
36126-42	18,142	MRSC-147	11,856	236	4/12/2010	Reservoir Fluid	6,030	68	12	14,000	170	4/14/2010	750
36126-43	18,142	MRSC-147	11,856	236	4/12/2010	Reservoir Fluid	6,030	68	12	14,000	170	4/14/2010	750
36126-44	18,142	MRSC-147	11,856	236	4/12/2010	Reservoir Fluid	6,030	68	12	14,000	170	4/14/2010	750
36126-45	18,142	MRSC-147	11,856	236	4/12/2010	Reservoir Fluid	6,030	68	12	14,000	170	4/14/2010	750
36126-46	18,142	MRSC-147	11,856	236	4/12/2010	Reservoir Fluid	6,030	68	12	14,000	170	4/14/2010	750
36126-47	18,142	MRSC-147	11,856	236	4/12/2010	Reservoir Fluid	6,030	68	12	14,000	170	4/14/2010	750
36126-48	18,142	MRSC-147	11,856	236	4/12/2010	Reservoir Fluid	6,030	68	12	14,000	170	4/14/2010	750
36126-49	18,142	MRSC-147	11,856	236	4/12/2010	Reservoir Fluid	6,030	68	12	14,000	170	4/14/2010	750
36126-50	18,142	MRSC-147	11,856	236	4/12/2010	Reservoir Fluid	6,030	68	12	14,000	170	4/14/2010	750
36126-51 *	18,142	MRSC-147	11,856	236	4/12/2010	Atmospheric Oil	6,030	68	12	14,000	170		425
36126-52 *	18,142	MPSR-3810	11,856	236	4/12/2010	Reservoir Fluid	5,875	66	120+	14,000	170	4/22/2010	360
36126-53	18,142	MPSR-3547	11,856	236	4/12/2010	Reservoir Fluid	5,720	66	120+	14,000	170	4/22/2010	355
36126-54 *	18,142	MPSR-1268	11,856	236	4/12/2010	Reservoir Fluid	5,950	66	120+	14,000	170	4/22/2010	360
36126-55	18,142	MPSR-1181	11,856	236	4/12/2010	Reservoir Fluid	6,645	66	120+	14,000	170	4/22/2010	360
36126-56	18,142	MPSR-3980	11,856	236	4/12/2010	Reservoir Fluid	6,500	66	120+	14,000	170	4/26/2010	350
36126-57 *	18,142	MPSR-4065	11,856	236	4/12/2010	Reservoir Fluid	6,270	66	120+	14,000	170	4/22/2010	365

Sample Validation Data

PENCOR ID No.	Laboratory Opening Pressure (psia / °F)	Saturation Pressure (psia / °F)	Laboratory Analyses										Remaining Pressurized Sample (cc)
			G / L Ratio (scf / stb)	API Gravity (API)	Drilling Fluid (wt % STO)	Gas Gravity (Air = 1.000)	Liq Analysis	CCE	Diff Lib	Vis	MSF	ASTM Tests	
36126-44**	6,030 / 68		2,840	35.0	< 1.0	0.785	x						750
36126-53	5,720 / 66	6,504 / 243	2,819	35.2	< 1.0	0.807	x	x	x	x	x	x	0
36126-54 *	5,950 / 66		2,802	35.2	< 1.0	0.808	x						0
36126-57 *	6,270 / 66									x			259

*** Samples from these ID numbers were shipped to other laboratories as requested by BP**

**** Results presented are from mobile laboratory testing that was performed onsite.**

Reservoir Fluid Composition

PENCOR ID No. 36126-54

Flash Summary (14,000 psia and 170 °F to atmospheric pressure and 80 °F)

Gas-Liquid Ratio	2,802	scf/stb	Vapor Gravity	0.808	(Air = 1.00)
FVF	N/A	Vsat/Vstd	API Gravity	35.2	°API at 60 °F (Water Free)
			Water Content	0.08	weight %

	Component (Symbol / Name)	Atmospheric Vapor (mole %)	Atmospheric Liquid (mole %)	Atmospheric Liquid (weight %)	Molecular Weight	Specific Gravity (Water = 1.0)	Reservoir Fluid (mole %)	Reservoir Fluid (weight %)
N_2	Nitrogen	0.497	0.000	0.000	28.01	0.809	0.417	0.222
CO_2	Carbon Dioxide	1.111	0.000	0.000	44.01	0.818	0.933	0.780
H_2S	Hydrogen Sulfide	0.000	0.000	0.000	34.08	0.801	0.000	0.000
C1	Methane	77.647	0.003	0.000	16.04	0.300	65.222	19.872
C2	Ethane	7.598	0.065	0.009	30.07	0.356	6.393	3.651
C3	Propane	5.414	0.384	0.082	44.10	0.507	4.609	3.860
iC4	i-Butane	1.101	0.270	0.076	58.12	0.563	0.968	1.069
nC4	n-Butane	2.464	1.032	0.290	58.12	0.584	2.235	2.467
iC5	i-Pentane	0.905	1.077	0.376	72.15	0.624	0.933	1.278
nC5	n-Pentane	1.023	1.774	0.619	72.15	0.631	1.143	1.566
C6	Hexanes	0.937	4.362	1.819	86.18	0.664	1.485	2.431
C7	Heptanes	0.815	8.763	3.968	93.07	0.708	2.087	3.689
C8	Octanes	0.366	11.646	6.062	107.09	0.732	2.171	4.415
C9	Nonanes	0.088	9.115	5.291	119.96	0.764	1.533	3.491
C10	Decanes	0.034	7.781	5.044	134.20	0.779	1.274	3.246
C11	Undecanes		5.907	4.201	147.00	0.790	0.945	2.639
C12	Dodecanes		4.931	3.841	161.00	0.801	0.789	2.413
C13	Tridecanes		4.693	3.974	175.00	0.812	0.751	2.496
C14	Tetradecanes		4.199	3.859	190.00	0.815	0.672	2.425
C15	Pentadecanes		3.430	3.418	206.00	0.827	0.549	2.147
C16	Hexadecanes		3.031	3.256	222.00	0.833	0.485	2.045
C17	Heptadecanes		2.612	2.995	237.00	0.841	0.418	1.881
C18	Octadecanes		2.472	3.002	251.00	0.843	0.396	1.886
C19	Nonadecanes		2.227	2.834	263.00	0.847	0.356	1.780
C20	Eicosanes		1.842	2.451	275.00	0.858	0.295	1.539
C21	Heneicosanes		1.588	2.235	291.00	0.868	0.254	1.404
C22	Docosanes		1.448	2.137	305.00	0.873	0.232	1.342
C23	Tricosanes		1.228	1.889	318.00	0.878	0.197	1.187
C24	Tetracosanes		1.191	1.907	331.00	0.882	0.191	1.198
C25	Pentacosanes		1.047	1.748	345.00	0.886	0.168	1.098
C26	Hexacosanes		0.855	1.485	359.00	0.890	0.137	0.933
C27	Heptacosanes		0.866	1.566	374.00	0.894	0.139	0.984
C28	Octacosanes		0.792	1.486	388.00	0.897	0.127	0.934
C29	Nonacosanes		0.706	1.372	402.00	0.900	0.113	0.863
C30	Triacontanes		0.634	1.275	416.00	0.903	0.101	0.802
C31	Hentriacontanes		0.605	1.259	430.00	0.907	0.097	0.791
C32	Dotriacontanes		0.519	1.116	444.00	0.910	0.083	0.700
C33	Tritriacontanes		0.471	1.044	458.00	0.913	0.075	0.656
C34	Tetratriacontanes		0.443	1.011	472.00	0.915	0.071	0.635
C35	Pentatriacontanes		0.394	0.926	486.00	0.918	0.063	0.582
C36	Hexatriacontanes		0.332	0.803	500.00	0.920	0.053	0.504
C37	Heptatriacontanes		0.333	0.829	514.00	0.923	0.053	0.520
C38	Octatriacontanes		0.306	0.782	528.00	0.925	0.049	0.491
C39	Nonatriacontanes		0.284	0.745	542.00	0.927	0.045	0.468
C40	Tetracontanes		0.264	0.711	556.00	0.929	0.042	0.446
C41	Hentetracontanes		0.226	0.623	570.00	0.931	0.036	0.391
C42	Dotetracontanes		0.222	0.627	584.00	0.932	0.036	0.394
C43	Tritetracontanes		0.201	0.581	598.00	0.934	0.032	0.365
C44	Tetratetracontanes		0.182	0.538	612.00	0.936	0.029	0.338
C45	Pentatetracontanes		0.171	0.518	626.00	0.938	0.027	0.325
C46	Hexatetracontanes		0.162	0.502	640.00	0.941	0.026	0.315
C47	Heptatetracontanes		0.140	0.444	654.00	0.942	0.022	0.278
C48	Octactetracontanes		0.145	0.469	668.00	0.944	0.023	0.294
C49	Nonatetracontanes		0.148	0.488	682.00	0.945	0.024	0.307
C50+	Pentacontanes Plus		2.481	11.417	950.57	1.153	0.397	7.167
Total		100.000	100.000	100.000			100.000	100.000
Calculated Mole Weight		23.31	206.70				52.66	
Measured Mole Weight			206.70					

- See following pages for Liquid Analysis parameters, Different Compositional Groupings, Oil-Based Mud Calculations, Liberated gas properties, etc.
- Compositional groupings based on normal to normal carbon distribution.
- Pristane is included as C_{17} and Phytane is included as C_{18}.

Compositional Groupings of Reservoir Fluid

Group	Mole %	Weight %	MW	SG	T_b
Total Fluid	100.000	100.000	52.66		N/A
C7+	15.662	62.805	211.16	0.852	N/A
C10+	9.871	51.210	273.17	0.885	1,149
C20+	3.237	28.253	459.64	0.952	1,438
C30+	1.386	16.771	637.03	1.008	1,631
C50+	0.397	7.167	950.57	1.153	1,926

* Tb by Correlation

Atmospheric Fluid Properties (PENCOR ID No. 36126-54)

Liberated Gas Properties

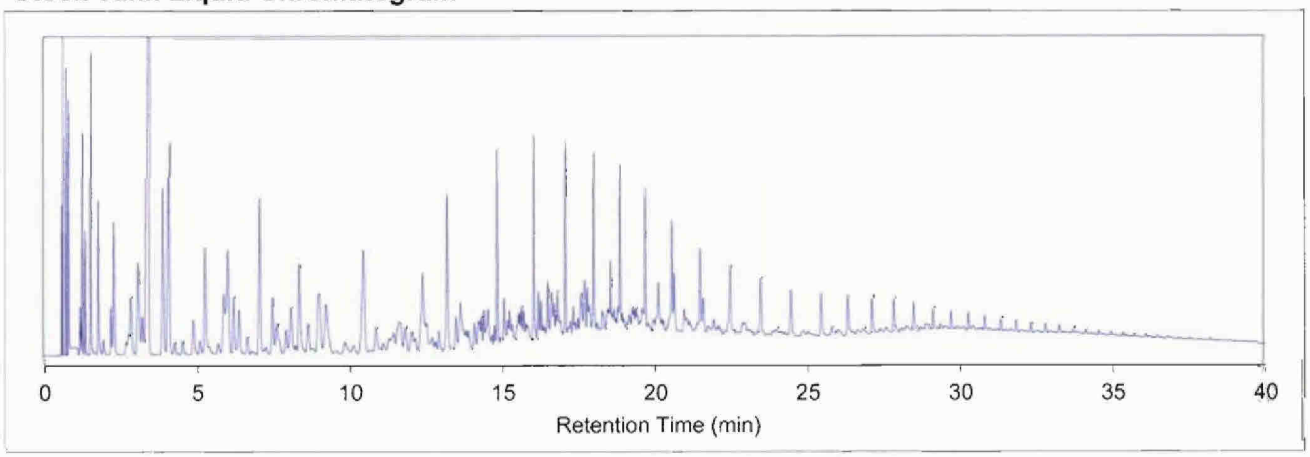
Gas specific gravity (air = 1.00)	0.808	
Net Heat of combustion (dry)	1,271.3	Real
Gross heat of combustion (dry)	1,397.9	Real
Gross heat of combustion (wet)	1,373.4	Water Saturated
Gas Compressibility (at 1 atm at 60 °F)	0.996	
GPM at 15.025 psia	6.42	

Heat of combustion is BTU/cu.ft. at 15.025 psia at 60 °F

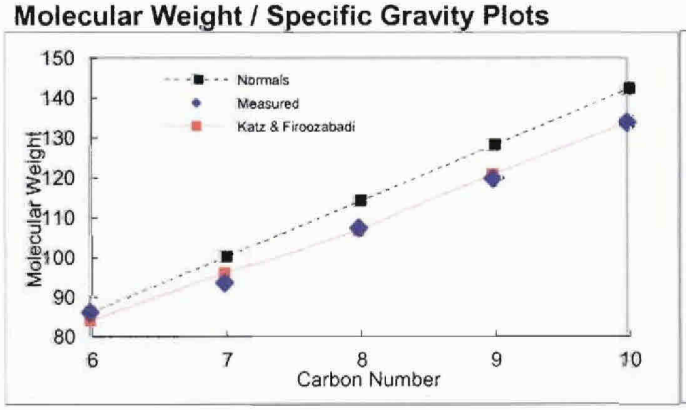
Oil Based Mud Evaluation

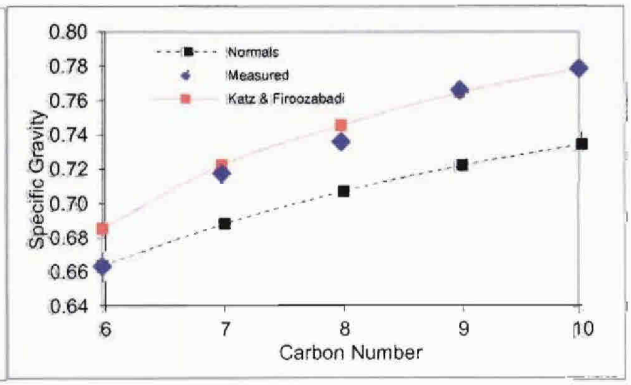
Mud Type	Rheliant	
Mud Content in STO	< 1.0	wt%
Mud Content in Res. Fluid	< 1.0	wt%
API Gravity of Contaminated STO	35.2	°API
API Gravity of Uncontaminated STO	35.2	°API
Measured GLR	2,802	scf/bbl
Corrected GLR	2,802	scf/bbl

Stock Tank Liquid Chromatogram



Molecular Weight / Specific Gravity Plots





Reservoir Fluid Composition

PENCOR ID No. 36126-53

Flash Summary (14,000 psia and 170 °F to atmospheric pressure and 80 °F)

Gas-Liquid Ratio	2,819	scf/stb	Vapor Gravity	0.807	(Air = 1.00)
FVF	2.564	Vsat/Vstd	API Gravity	35.2	°API at 60 °F (Water Free)
			Water Content	0.02	weight %

	Component (Symbol / Name)	Atmospheric Vapor (mole %)	Atmospheric Liquid (mole %)	Atmospheric Liquid (weight %)	Molecular Weight	Specific Gravity (Water = 1.0)	Reservoir Fluid (mole %)	Reservoir Fluid (weight %)
N_2	Nitrogen	0.528	0.000	0.000	28.01	0.809	0.444	0.237
CO_2	Carbon Dioxide	1.092	0.000	0.000	44.01	0.818	0.919	0.770
H_2S	Hydrogen Sulfide	0.000	0.000	0.000	34.08	0.801	0.000	0.000
C1	Methane	77.781	0.003	0.000	16.04	0.300	65.467	19.994
C2	Ethane	7.597	0.148	0.021	30.07	0.356	6.418	3.674
C3	Propane	5.346	0.456	0.097	44.10	0.507	4.572	3.838
iC4	i-Butane	1.080	0.263	0.073	58.12	0.563	0.951	1.052
nC4	n-Butane	2.406	0.958	0.268	58.12	0.584	2.177	2.408
iC5	i-Pentane	0.880	0.943	0.327	72.15	0.624	0.890	1.222
nC5	n-Pentane	0.995	1.536	0.533	72.15	0.631	1.081	1.484
C6	Hexanes	0.926	3.977	1.648	86.18	0.664	1.409	2.312
C7	Heptanes	0.824	8.318	3.747	93.13	0.707	2.010	3.564
C8	Octanes	0.392	11.541	5.960	106.90	0.733	2.157	4.390
C9	Nonanes	0.104	9.103	5.250	119.93	0.764	1.529	3.490
C10	Decanes	0.049	7.837	5.048	134.28	0.779	1.282	3.277
C11	Undecanes		5.965	4.215	147.00	0.790	0.944	2.643
C12	Dodecanes		4.982	3.855	161.00	0.801	0.789	2.417
C13	Tridecanes		4.754	4.000	175.00	0.812	0.753	2.507
C14	Tetradecanes		4.254	3.886	190.00	0.815	0.674	2.436
C15	Pentadecanes		3.563	3.528	206.00	0.826	0.564	2.212
C16	Hexadecanes		3.455	3.688	222.00	0.826	0.547	2.312
C17	Heptadecanes		2.755	3.139	237.00	0.839	0.436	1.968
C18	Octadecanes		2.685	3.240	251.00	0.839	0.425	2.031
C19	Nonadecanes		2.274	2.874	263.00	0.847	0.360	1.803
C20	Eicosanes		1.963	2.594	275.00	0.854	0.311	1.627
C21	Heneicosanes		1.599	2.237	291.00	0.868	0.253	1.402
C22	Docosanes		1.421	2.083	305.00	0.873	0.225	1.306
C23	Tricosanes		1.281	1.959	318.00	0.878	0.203	1.228
C24	Tetracosanes		1.149	1.827	331.00	0.882	0.182	1.146
C25	Pentacosanes		0.938	1.555	345.00	0.886	0.149	0.975
C26	Hexacosanes		0.850	1.467	359.00	0.890	0.135	0.920
C27	Heptacosanes		0.892	1.603	374.00	0.894	0.141	1.005
C28	Octacosanes		0.791	1.474	388.00	0.897	0.125	0.925
C29	Nonacosanes		0.704	1.361	402.00	0.900	0.111	0.853
C30	Triacontanes		0.642	1.283	416.00	0.903	0.102	0.805
C31	Hentriacontanes		0.607	1.255	430.00	0.907	0.096	0.787
C32	Dotriacontanes		0.543	1.159	444.00	0.910	0.086	0.727
C33	Tritriacontanes		0.470	1.035	458.00	0.913	0.074	0.649
C34	Tetratriacontanes		0.458	1.039	472.00	0.915	0.073	0.652
C35	Pentatriacontanes		0.379	0.885	486.00	0.918	0.060	0.555
C36	Hexatriacontanes		0.346	0.832	500.00	0.920	0.055	0.521
C37	Heptatriacontanes		0.333	0.823	514.00	0.923	0.053	0.516
C38	Octatriacontanes		0.316	0.802	528.00	0.925	0.050	0.503
C39	Nonatriacontanes		0.273	0.712	542.00	0.927	0.043	0.446
C40	Tetracontanes		0.268	0.717	556.00	0.929	0.042	0.449
C41	Hentetracontanes		0.195	0.534	570.00	0.931	0.031	0.335
C42	Dotetracontanes		0.217	0.610	584.00	0.932	0.034	0.382
C43	Tritetracontanes		0.194	0.557	598.00	0.934	0.031	0.350
C44	Tetratetracontanes		0.186	0.548	612.00	0.936	0.029	0.343
C45	Pentatetracontanes		0.169	0.508	626.00	0.938	0.027	0.319
C46	Hexatetracontanes		0.146	0.450	640.00	0.941	0.023	0.282
C47	Heptatetracontanes		0.160	0.503	654.00	0.942	0.025	0.315
C48	Octactetracontanes		0.135	0.434	668.00	0.944	0.021	0.272
C49	Nonatetracontanes		0.123	0.402	682.00	0.945	0.019	0.253
C50+	Pentacontanes Plus		2.482	11.355	950.71	1.148	0.393	7.112
Total		100.000	100.000	100.000			100.000	100.000
Calculated Mole Weight		23.28	208.03				52.53	
Measured Mole Weight			208.03					

- See following pages for Liquid Analysis parameters, Different Compositional Groupings, Oil-Based Mud Calculations, Liberated gas properties, etc.
- Compositional groupings based on normal to normal carbon distribution.
- Pristane is included as C_{17} and Phytane is included as C_{18}.

Compositional Groupings of Reservoir Fluid

Group	Mole %	Weight %	MW	SG	T_b
Total Fluid	100.000	100.000	52.53		N/A
C7+	15.673	63.009	211.19	0.851	N/A
C10+	9.977	51.565	271.51	0.882	1,144
C20+	3.203	27.959	458.56	0.951	1,436
C30+	1.368	16.571	636.21	1.007	1,629
C50+	0.393	7.112	950.71	1.148	1,922

* Tb by Correlation

Stock Tank Oil Properties

Compositional Groupings of Flash Liquid (PENCOR ID No. 36126-53)

Group	Mole %	Weight %	MW	SG
Total Fluid	100.000	100.000	208.03	0.849
Heptanes plus (C7+)	91.716	97.033	220.06	0.858
Decanes plus (C10+)	62.754	82.076	272.04	0.883
Eicosanes plus (C20+)	20.230	44.603	458.56	0.951
Triacontanes plus (C30+)	8.642	26.443	636.21	1.007
Pentacontanes plus (C50+)	2.482	11.355	950.71	1.148

Atmospheric Liquid Pipeline Package (PENCOR ID Nos. 36126-51 & -53 & -57)

Test	Method	Result	Units
Color	Visual	Light Crude	
API Gravity at 60 °F (water free)	ASTM D 5002	35.2	°API
Water Content	ASTM D 4377	0.02	wt%
Paraffin Content	UOP 46 modified	1.8	wt%
Asphaltene Content *	ASTM D 4055 modified	0.4	wt%
Wax Appearance Temperature	CPM	89	°F
Pour Point	ASTM D 97	< 30	°F
Reid Vapor Pressure	ASTM D 5191	2.86	psi
Total Acid Number **	ASTM D 664	< 0.1	mg KOH/g
Total Sulfur **	ASTM D 4294	0.27	wt%
Viscosity at 80 °F	ASTM D 7042	5.42	cPoise
	ASTM D 7042	6.46	cStokes
Viscosity at 100 °F	ASTM D 7042	4.04	cPoise
	ASTM D 7042	4.86	cStokes
Viscosity at 120 °F	ASTM D 7042	3.14	cPoise
	ASTM D 7042	3.81	cStokes

* Asphaltenes defined as pentane insoluble

** Analysis performed by third party

Additional Testing in Mini Assay (performed by third party)

Test	Method	Result	Units
Hydrogen Sulfide	UOP163	< 1	ppm wt
Mercaptan Sulfur	ASTM D3227	< 2	ppm wt
Organically Bound Nitrogen	ASTM D5762	1147	ppm wt
Carbon Residue Ramsbottom	ASTM D524	2.24	wt %
Carbon Residue Conradson	ASTM D189	2.04	wt %
Nickel	ASTM D5708	16.6	ppm wt
Vanadium	ASTM D5708	0.9	ppm wt
Hydrogen Content	ASTM D5291	13.39	wt %

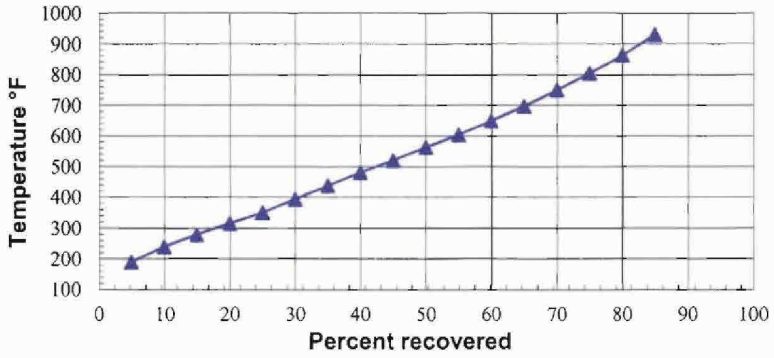
Pipeline package and mini-assay testing was done on combined residual oils from the PVT testing. This is not always the preferred sample type to use, but was necessary in this case due to limited sample volume.

Simulated Distillation

ASTM D-5307 Distillation weight percent recovered	Temperature ° F
Initial Boiling Point	75
5	190
10	240
15	280
20	316
25	351
30	394
35	438
40	481
45	521
50	563
55	604
60	650
65	698
70	750
75	804
80	863
85	930
90	-
95	-

Recovery	88.7 at 1000 °F
Residual	11.3 at 1000 °F

Temperature vs. Percent Recovered



Atmospheric Fluid Properties (PENCOR ID 36126-53)

Liberated Gas Properties

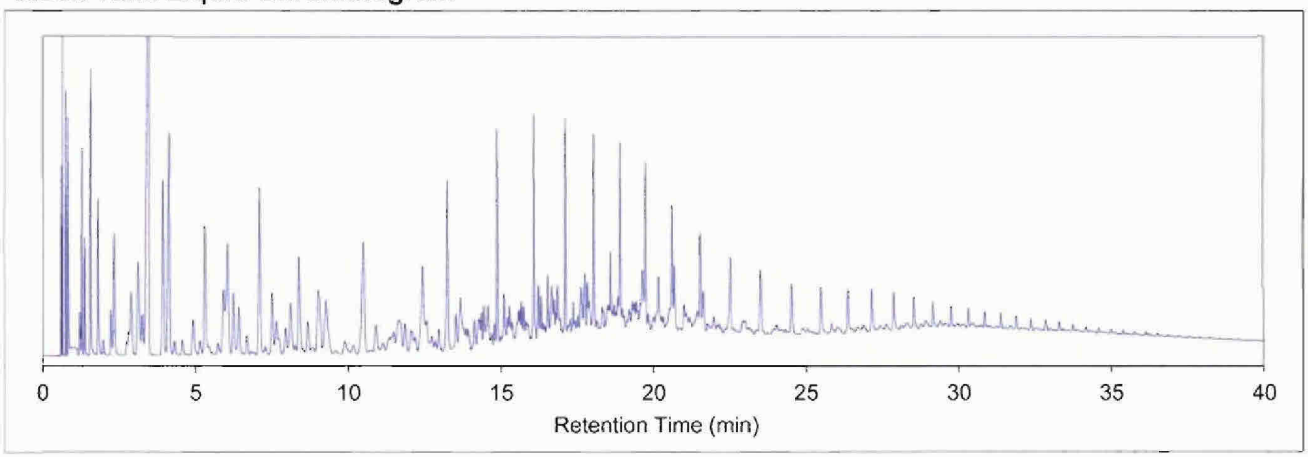
Gas specific gravity (air = 1.00)	0.807	
Net Heat of combustion (dry)	1,269.9	Real
Gross heat of combustion (dry)	1,396.4	Real
Gross heat of combustion (wet)	1,371.9	Water Saturated
Gas Compressibility (at 1 atm at 60 °F)	0.996	
GPM at 15.025 psia	6.39	

Heat of combustion is BTU/cu.ft. at 15.025 psia at 60 °F

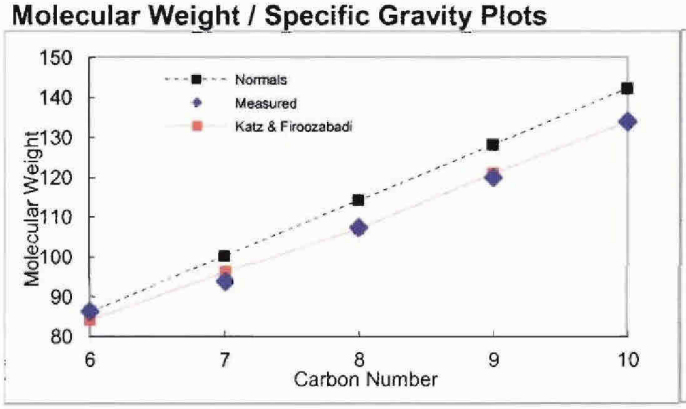
Oil Based Mud Evaluation

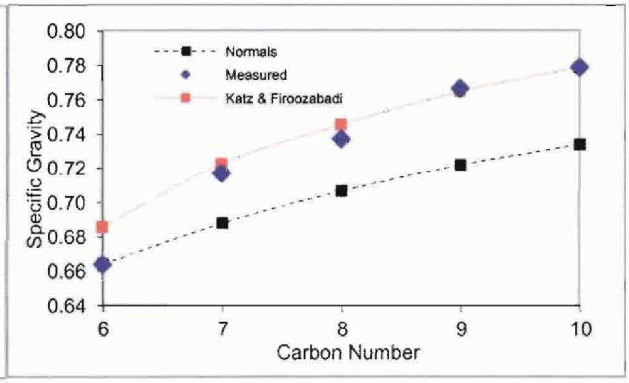
Mud Type	Rheliant	
Mud Content in STO	< 1.0	wt%
Mud Content in Res. Fluid	< 1.0	wt%
API Gravity of Contaminated STO	35.2	°API
API Gravity of Uncontaminated STO	35.2	°API
Measured GLR	2,819	scf/bbl
Corrected GLR	2,819	scf/bbl

Stock Tank Liquid Chromatogram



Molecular Weight / Specific Gravity Plots





Solids Screening

SARA Analysis**

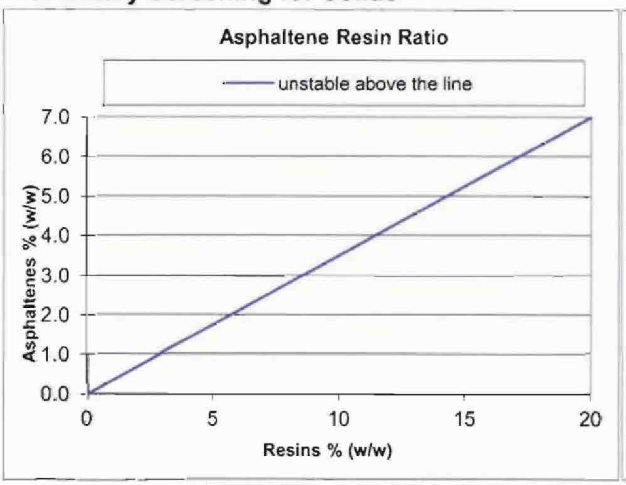
Topped	N/A	wt%
Remaining	N/A	wt%
Saturates	N/A	wt%
Aromatics	N/A	wt%
Resins	N/A	wt%
Asphaltenes*	N/A	wt%

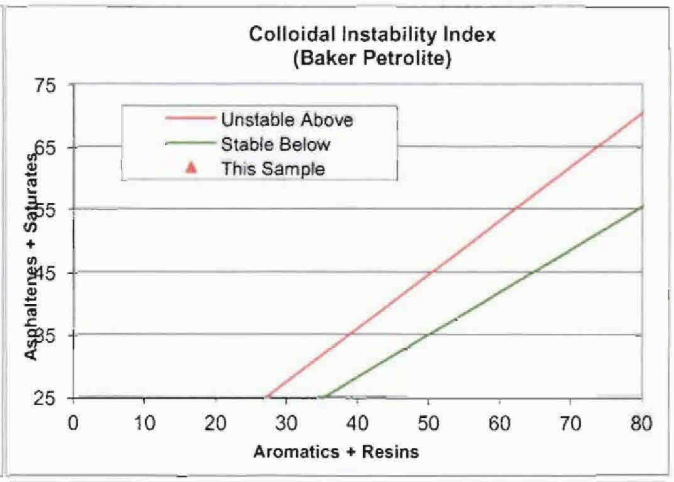
Topping performed at 60 °C under N_2 stream for 42 hours

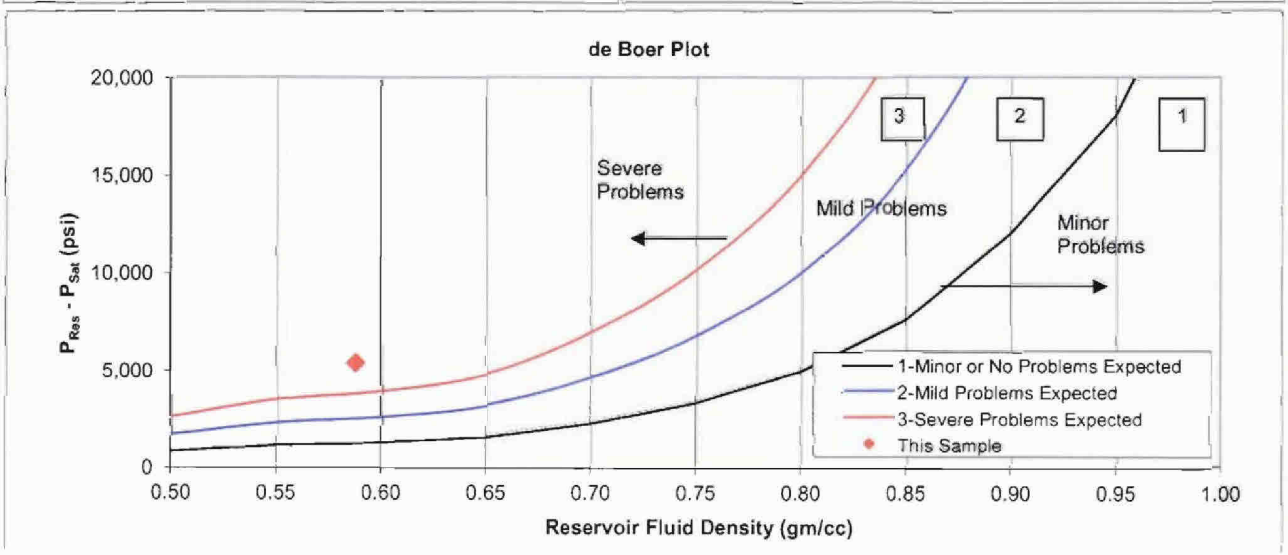
*Asphaltenes defined as heptane insoluble, methylene chloride soluble fraction

** Analysis performed by third party

Preliminary Screening for Solids







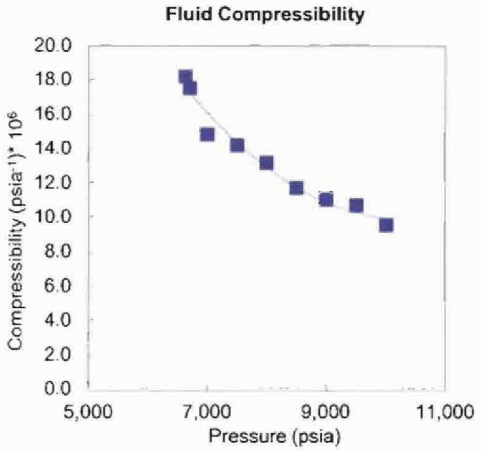
Constant Composition Expansion at 100 °F
Pressure-Volume Relations

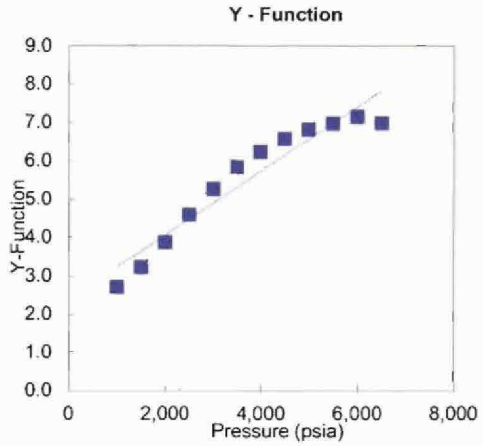
Pressure (psia)		Relative Volume (V / V_{sat})	Fluid Density (g/cm^3)	Relative Liquid Volume (%)	Fluid Compress. ($\Delta V/V/\Delta psi) \times 10^6$	Y-Function ($(P_{sat}-P)/P(V/V_{sat}-1)$)
11,856	**Reservoir**	**0.939**	**0.639**			
10,000		0.956	0.628		9.60	
9,500		0.962	0.624		10.76	
9,000		0.967	0.621		11.08	
8,500		0.973	0.617		11.77	
8,000		0.979	0.613		13.21	
7,500		0.986	0.609		14.23	
7,000		0.994	0.604		14.87	
6,710		0.999	0.601		17.54	
6,636	**Saturation**	**1.000**	**0.600**	**0.0**	**18.22**	
6,616		1.001		36.2		
6,500		1.003		57.1		6.99
6,000		1.015		68.5		7.15
5,500		1.030		68.8		6.98
5,000		1.048		68.8		6.83
4,500		1.072		69.1		6.58
4,000		1.105		68.9		6.25
3,500		1.153		68.4		5.84
3,000		1.230		68.3		5.27
2,500		1.360		67.7		4.60
2,000		1.597		66.6		3.88
1,500		2.058		64.5		3.23
1,000		3.073		61.6		2.72

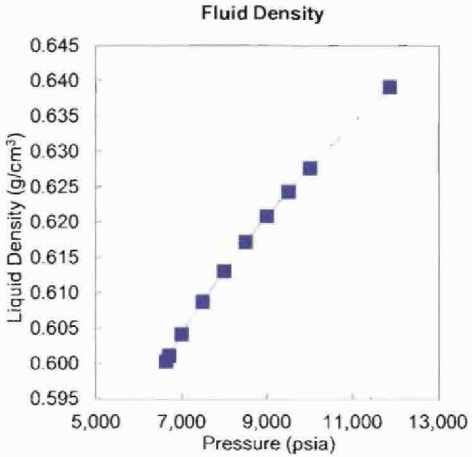
Notes:

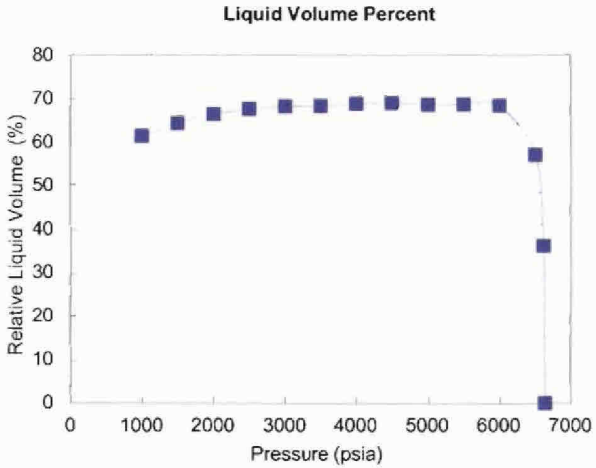
- Relative Volume (V / V_{sat}) is the fluid volume at the indicated pressure and temperature relative to the saturated fluid volume
- Density (lb/ft^3) = Density (g/cm^3) x 62.428
- Compressibility is the average compressibility between the indicated and the next highest pressure

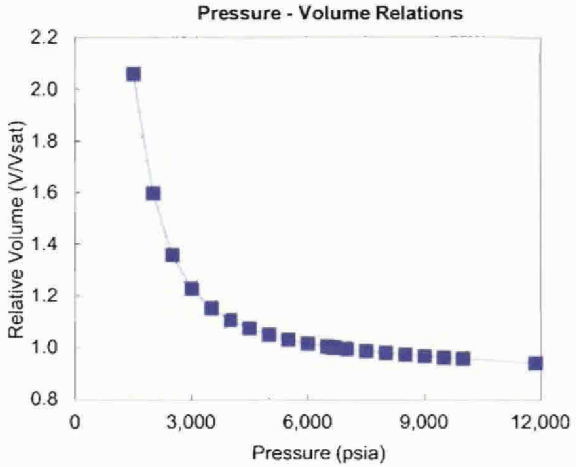
Constant Composition Expansion at 100 °F
Data Presentation Figures











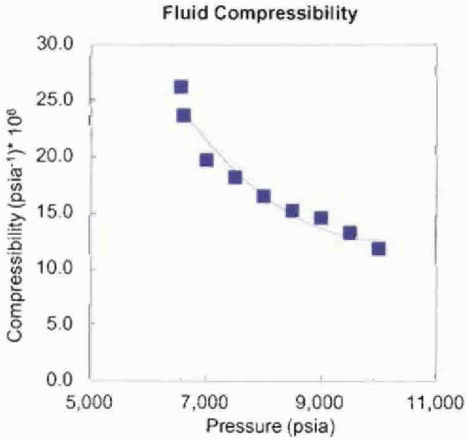
Constant Composition Expansion at 170 °F
Pressure-Volume Relations

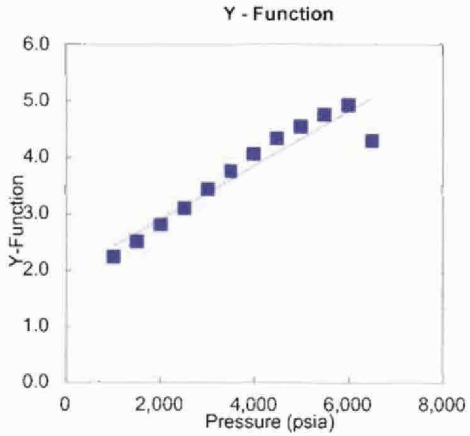
Pressure (psia)		Relative Volume (V / V_{sat})	Fluid Density (g/cm^3)	Relative Liquid Volume (%)	Fluid Compress. ($\Delta V/V/\Delta psi) \times 10^6$	Y-Function $(P_{sat}-P)/P(V/V_{sat}-1)$
11,856	**Reservoir**	**0.922**	**0.613**			
10,000		0.942	0.600		11.80	
9,500		0.948	0.596		13.19	
9,000		0.955	0.592		14.57	
8,500		0.963	0.587		15.19	
8,000		0.971	0.582		16.51	
7,500		0.980	0.577		18.14	
7,000		0.989	0.571		19.68	
6,600		0.999	0.566		23.66	
6,555	**Saturation**	**1.000**	**0.565**	**0.0**	**26.20**	
6,543		1.000		38.3		
6,536		1.001		50.0		
6,500		1.002		56.0		4.30
6,000		1.019		66.5		4.93
5,500		1.040		66.2		4.76
5,000		1.068		65.8		4.55
4,500		1.105		65.0		4.34
4,000		1.157		64.2		4.07
3,500		1.232		63.2		3.76
3,000		1.344		62.9		3.44
2,500		1.523		62.3		3.10
2,000		1.811		60.1		2.81
1,500		2.344		58.6		2.51
1,000		3.481		56.7		2.24

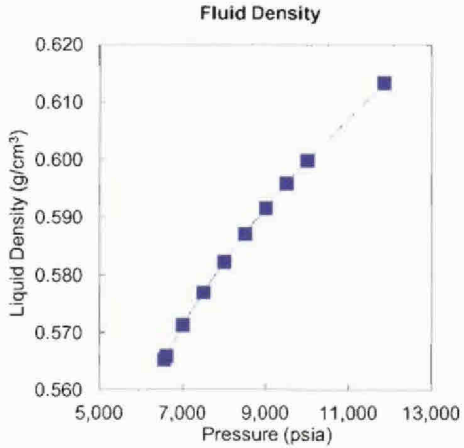
Notes:

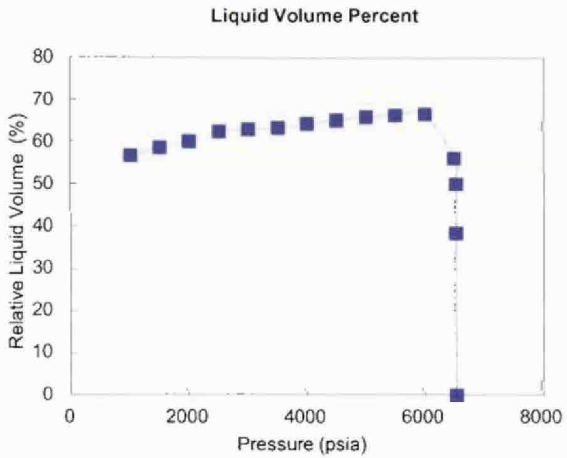
- Relative Volume (V / V_{sat}) is the fluid volume at the indicated pressure and temperature relative to the saturated fluid volume
- Density (lb/ft^3) = Density (g/cm^3) x 62.428
- Compressibility is the average compressibility between the indicated and the next highest pressure

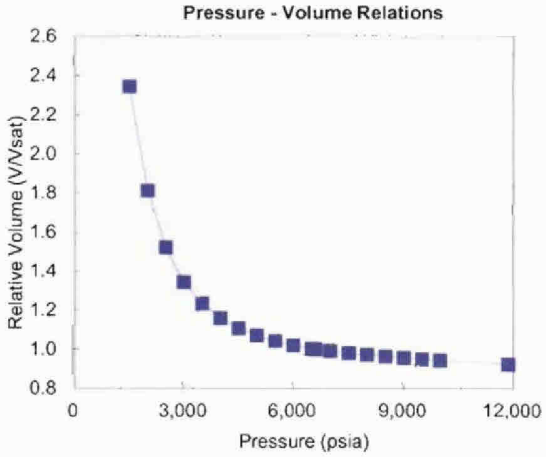
Constant Composition Expansion at 170 °F
Data Presentation Figures











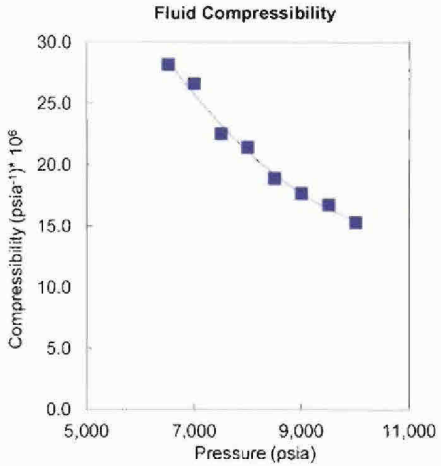
Constant Composition Expansion at 243 °F
Pressure-Volume Relations

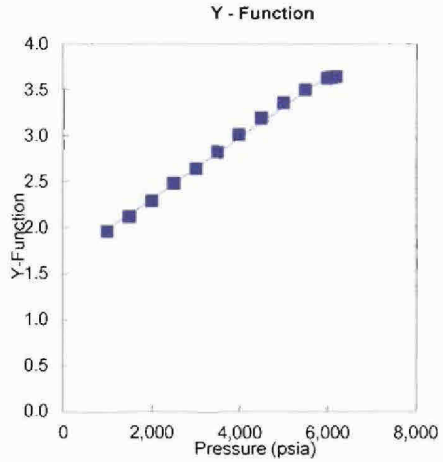
Pressure (psia)		Relative Volume (V / V_{sat})	Fluid Density (g/cm^3)	Relative Liquid Volume (%)	Fluid Compress. ($\Delta V/V/\Delta psi) \times 10^6$	Y-Function ($(P_{sat}-P)/P(V/V_{sat}-1)$)
11,856	**Reservoir**	**0.900**	**0.587**			
10,000		0.927	0.570		15.30	
9,500		0.934	0.565		16.75	
9,000		0.943	0.560		17.66	
8,500		0.952	0.555		18.88	
8,000		0.962	0.549		21.42	
7,500		0.973	0.543		22.54	
7,000		0.986	0.536		26.60	
6,504	**Saturation**	**1.000**	**0.528**	**0.0**	**28.17**	
6,495		1.001		9.2		
6,475		1.002		31.2		
6,450		1.003		39.8		
6,400		1.005		50.1		
6,300		1.009		55.5		
6,200		1.013		56.8		3.64
6,100		1.018		57.8		3.63
6,000		1.023		60.0		3.63
5,500		1.052		59.7		3.50
5,000		1.090		59.4		3.36
4,500		1.139		58.6		3.20
4,000		1.208		57.6		3.02
3,500		1.303		57.1		2.83
3,000		1.442		55.4		2.64
2,500		1.645		54.1		2.48
2,000		1.982		53.4		2.29
1,500		2.573		51.0		2.12
1,000		3.812		49.6		1.96

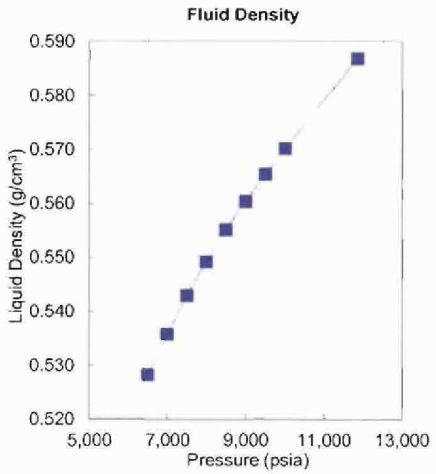
Notes:

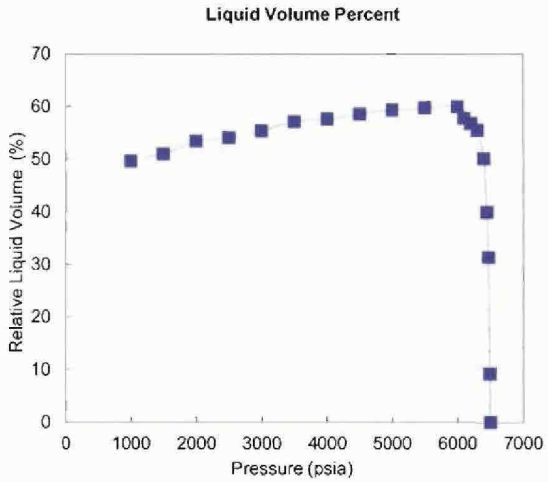
- Relative Volume (V / V_{sat}) is the fluid volume at the indicated pressure and temperature relative to the saturated fluid volume
- Density (lb/ft^3) = Density (g/cm^3) x 62.428
- Compressibility is the average compressibility between the indicated and the next highest pressure

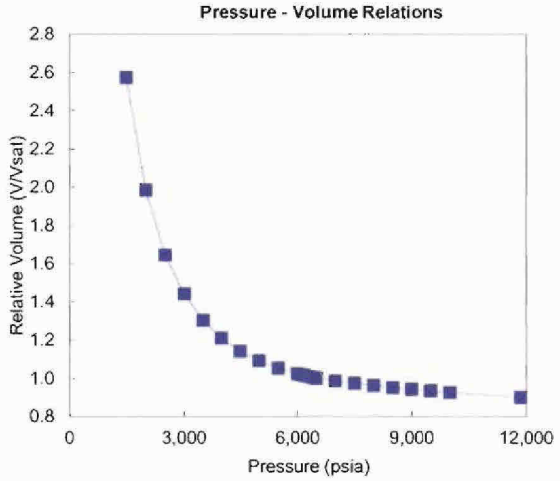
Constant Composition Expansion at 243 °F
Data Presentation Figures











Differential Liberation at 243 °F

Oil Properties

Pressure (psia)		Oil Density (g/cm^3)	Oil Compress. (V/V/psi) x 10^6	Oil Viscosity (cP)	Liberated GLR, R_l (scf/bbl)	Solution GLR, R_{sd} (scf/bbl)	Oil FVF, B_{od} (vol/resid. vol)	Solution GLR, R_s (scf/bbl)	Sep. Adj. FVF, B_o (vol/ST vol)
11,856	**Reservoir**	**0.587**		**0.168**	**0**	**4,057**	**3.114**	**2,554**	**2.131**
10,000		0.570	15.30	0.154	0	4,057	3.205	2,554	2.193
9,500		0.565	16.75	0.150	0	4,057	3.232	2,554	2.211
9,000		0.560	17.66	0.146	0	4,057	3.261	2,554	2.231
8,500		0.555	18.88	0.142	0	4,057	3.292	2,554	2.252
8,000		0.549	21.42	0.139	0	4,057	3.328	2,554	2.277
7,500		0.543	22.88		0	4,057	3.366	2,554	2.303
7,000		0.536	25.93	0.139	0	4,057	3.410	2,554	2.333
6,504	**Saturation**	**0.528**	**28.50**	**0.162**	**0**	**4,057**	**3.459**	**2,554**	**2.367**
6,000		0.616	22.27	0.205	1,953	2,104	2.127	1,325	1.649
4,500		0.678	17.50	0.298	2,800	1,257	1.673	791	1.405
3,000		0.724	14.43	0.405	3,255	802	1.452	505	1.286
1,500		0.757	12.37	0.535	3,654	403	1.296	254	1.202
150		0.789	10.74	0.879	3,972	85	1.134	53	1.115
15		0.792		0.999	4,057	0	1.093	0	1.093
15	@ 60°F	0.866	**API =31.8 °**				1.000		

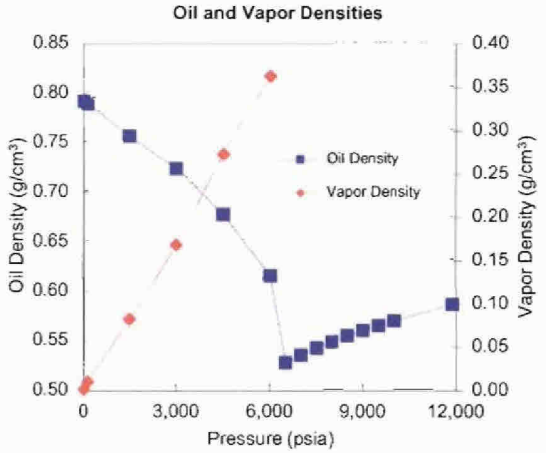
Vapor Properties

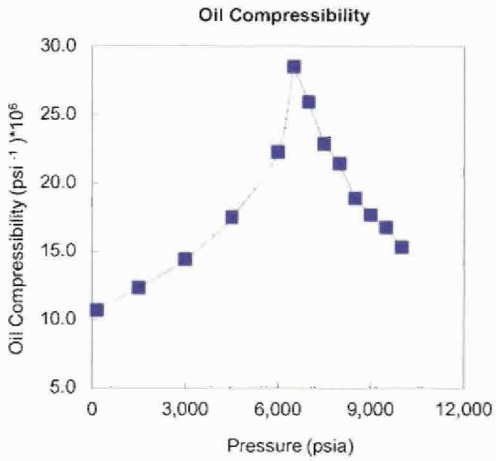
Pressure (psia)	Gas Density (g/cm^3)	Gas Z Factor (vol/vol at std)	Incr. Gas Gravity (Air = 1.00)	Cum. Gas Gravity (Air = 1.00)	Gas FVF, B_g (res bbl /mmscf)	Gas FVF, B_g (res cu ft / scf)	Total FVF, B_t (vol/resid. vol)	Calc. Gas Viscosity (cP)
6,000	0.362	1.170	1.148	1.148	705	0.004	3.504	0.050
4,500	0.273	0.958	0.943	1.086	771	0.004	3.831	0.034
3,000	0.168	0.898	0.818	1.049	1,082	0.006	4.975	0.022
1,500	0.082	0.875	0.780	1.019	2,110	0.012	9.007	0.016
150	0.010	0.987	1.116	1.027	23,805	0.134	95.699	0.012
15	0.002	1.000	2.104	1.050	240,828	1.352	978.189	0.009

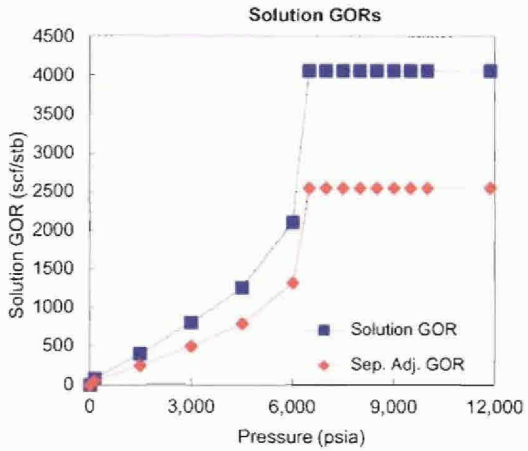
Notes:

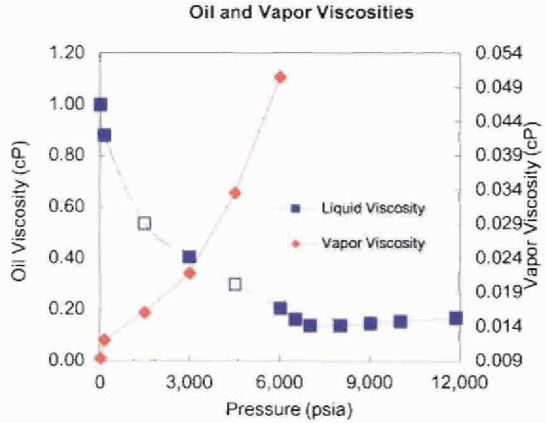
- Compressibility is calculated using the indicated and previous pressures
- The Separator Adjusted GLR and FVF represent the differentially liberated oil produced through the surface separators (see MSF)
- Sep. Adjusted Data using Muhammad A. Al-Marhoun method
- Gas MW = Vapor Gravity x Molecular Weight Air
- Standard Conditions: 15.025 psia at 60 °F
- Atmospheric Step completed at Reservoir Temperature
- B_o = Oil Volume at P,T / Stock Tank Volume at 60 °F
- B_{od} = Oil Volume at P,T / Residual Oil Volume at 60 °F
- R_s = Gas Volume at Standard Conditions / Stock Tank Volume at 60 °F
- $B_t = B_o + [(\text{Total Liberated Vapor, } R_l) \times B_g] \times 10^{-6}$
- R_l is cumulative liberated gas / Residual Oil Volume
- Vapor Viscosity calculated with Lee-Gonzales Correlation
- Oil Viscosity measured using electro-magnetic viscometer

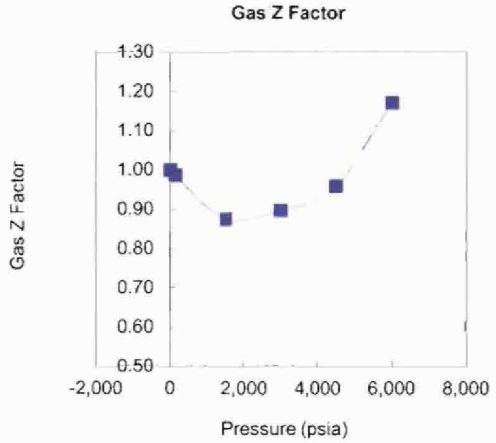
Differential Liberation at 243 °F

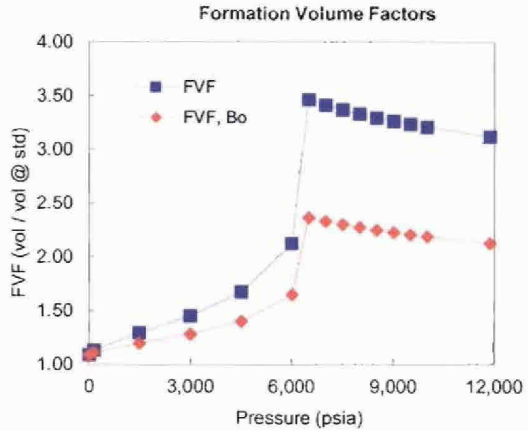












Differential Liberation Fluid Compositions

Component	Liberated Gas 6,000 psia (mole %)	4,500 psia (mole %)	3,000 psia (mole %)	1,500 psia (mole %)	150 psia (mole %)	15 psia (mole %)	Residual Liquid (mole %)	Calc. Res. Fluid (mole %)
Nitrogen	0.445	0.424	0.392	0.323	0.101	0.060	0.000	0.344
Carbon Dioxide	0.963	0.999	1.050	1.172	1.272	0.485	0.000	0.901
Hydrogen Sulfide	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Methane	72.769	78.125	81.243	80.863	57.932	12.239	0.048	64.990
Ethane	6.598	6.551	6.718	7.695	12.301	8.715	0.077	6.402
Propane	4.592	4.241	4.022	4.527	11.018	17.124	0.513	4.687
Iso-Butane	0.959	0.834	0.740	0.776	2.178	4.933	0.338	0.987
N-Butane	2.178	1.814	1.562	1.601	4.983	14.135	1.177	2.304
Iso-Pentane	0.912	0.689	0.545	0.503	1.748	6.391	1.046	0.973
N-Pentane	1.124	0.807	0.620	0.557	1.999	7.870	1.699	1.216
Hexanes	1.407	0.952	0.667	0.517	1.998	8.941	3.627	1.602
Heptanes	1.676	1.207	0.764	0.511	2.072	9.907	7.123	2.189
Octanes	1.657	1.034	0.555	0.309	1.348	6.035	9.716	2.279
Nonanes	1.136	0.566	0.233	0.124	0.405	2.063	7.345	1.515
Decanes	0.706	0.342	0.172	0.082	0.115	0.771	6.800	1.175
Undecanes	0.427	0.185	0.104	0.066	0.053	0.230	5.436	0.851
Dodecanes	0.318	0.145	0.085	0.054	0.040	0.066	4.566	0.693
Tridecanes	0.288	0.103	0.049	0.037	0.066	0.020	4.723	0.685
Tetradecanes	0.243	0.088	0.052	0.027	0.037	0.007	4.185	0.600
Pentadecanes	0.308	0.118	0.095	0.074	0.044	0.004	3.858	0.606
Hexadecanes	0.187	0.094	0.044	0.022	0.033	0.002	3.686	0.520
Heptadecanes	0.145	0.082	0.036	0.019	0.034	0.001	2.976	0.419
Octadecanes	0.142	0.086	0.037	0.021	0.036	0.002	3.017	0.423
Nonadecanes	0.112	0.071	0.030	0.017	0.029	0.001	2.547	0.353
Eicosanes	0.709	0.445	0.183	0.103	0.157	0.000*	2.138	0.664
Heneicosanes							1.921	0.216
Docosanes							1.555	0.175
Tricosanes							1.520	0.171
Tetracosanes							1.377	0.155
Pentacosanes							1.283	0.144
Hexacosanes							1.236	0.139
Heptacosanes							1.071	0.120
Octacosanes							1.045	0.117
Nonacosanes							0.901	0.101
Triacontanes Plus							11.450	1.286
Totals	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000
C30+ MW	-	-	-	-	-	-	641.80	641.80
C30+ Gravity	-	-	-	-	-	-	1.017	1.017
Mol. Weight	33.26	27.33	23.69	22.58	32.32	60.94	222.32	52.80
SP. Gravity (Air = 1.0)	1.148	0.943	0.818	0.780	1.116	2.104	-	-

* less than 0.0005

Oil Viscosities at Specified Temperatures

Measured using Electro-Magnetic Viscometer
PENCOR ID No. 36126-53 & 36126-57

Pressure (psia)		Viscosity at 243 °F 36126-53 Centipoise (cP)	Viscosity at 170 °F 36126-57 Centipoise (cP)	Viscosity at 100 °F 36126-53 Centipoise (cP)	Viscosity at 40 °F 36126-53 Centipoise (cP)
15,000				0.397	
14,500		0.190	0.290		
14,000		0.186	0.281	0.374	0.474
13,500			0.274		0.463
13,000		0.178		0.375	0.457
12,075			0.259		
12,000				0.390	
11,856		**0.168**	**0.255**	**0.391**	**0.445**
11,000		0.161	0.245	0.360	0.442
10,000		0.154	0.235	0.709	0.502
9,000		0.146		0.543	0.748
8,000		0.139	0.262	0.357	0.416
7,000		0.139	0.241	0.325	0.397
6,900		0.140			
6,800		0.134			
6,705	**Est Psat at 40°F**				**0.572**
6,636	**Psat at 100°F**			**0.400**	
6,605					0.666
6,555	**Psat at 170°F**		**0.276**	0.415	
6,504	**Psat at 243°F**	**0.162**			0.696
6,450			0.287	0.444	
6,430		0.172			
6,405					0.722
6,320			0.301		
6,300		0.182			
6,000		0.205		0.508	0.862
5,835			0.342		
5,000		0.266			
4,500			0.445	0.607	1.073
4,000		0.330			
3,000		0.405	0.575	0.786	1.418
2,000		0.475			
1,500		0.535	0.759	1.038	1.869
1,000		0.595			
150		0.879	1.297	1.970	3.730
15		0.999	1.825	4.139	11.136

Temperature (°F)	Saturation Pressure (psia)
40	6,705 estimate
100	6,636
170	6,555
243	6,504

Reservoir Pressure = 11,856 psia

Post Test Calibration Check (0.25 - 5 cP piston) used for 40 °F and 100 °F

Fluid Standard	Standard Viscosity (cP)	Measured Viscosity (cP)
N.4	0.268	0.273
S6	5.061	5.078

Post Test Calibration Check (0.2 - 2 cP piston) used for 170 °F and 243 °F

Fluid Standard	Standard Viscosity (cP)	Measured Viscosity (cP)
N.4	0.271	0.276
S3	2.000	1.998

Multi-Stage Separator Test

Separator Conditions Pressure (psia)	Separator Conditions Temperature (°F)	Liquid Density (g/cm^3)	Gas Density (g/cm^3)	Gas Gravity (Air = 1.0)	Solution GLR, R_s (scf/stb)	Solution GLR, R_s (scf/sep bbl)	Liberated GLR, R_l (scf/stb)	Separator Shrinkage (stb/bbl at P,T)
6,504	**243**	**0.528**		**N/A**	**2,554**		**0**	**N/A**
1,250	130	0.731	0.073	0.683	475	607	2,079	0.783
450	120	0.763	0.027	0.730	260	306	215	0.848
150	120	0.768	0.015	0.894	123	139	137	0.881
15	60	0.833	0.002	1.538	0	0	123	1.000

Summary Data

Total Solution Gas-Liquid Ratio	2,554	scf/stb
Stock Tank Oil Gravity	38.2	°API at 60 °F
Formation Volume Factor	2.367	(Bbl at P_{sat} /stb)
Accumulated Gas Gravity	0.740	(Air = 1.00)
Color of Stock Tank Oil	Light Crude	

Notes:

- stb: stock tank barrel at 60 °F
- sep bbl: volume of separator liquid at P,T.
- Solution GOR is given as the gas volume per stock tank barrel (stb) and per separator barrel (sep bbl)
- Separator Volume Factor is the inverse of the Separator Shrinkage Factor
- Liberated GOR (R_l) is gas liberated from previous stage to current stage per stock tank barrel (stb)
- See following page for flash gas compositional analyses

Multi-Stage Flash Fluid Compositions

Stage Condition	Stage 1	Stage 2	Stage 3	Stage 4	Stock Tank Liquid
Pressure (psia)	1,250	450	150	15	15
Temperature (°F)	130	120	120	60	60
Component	*(mole %)*	*(mole %)*	*(mole %)*	*(mole %)*	*(mole %)*
Nitrogen	0.539	0.250	0.021	0.019	0.000
Carbon Dioxide	1.094	1.445	1.832	0.986	0.000
Hydrogen Sulfide	0.000	0.000	0.000	0.000	0.000
Methane	85.643	79.501	63.838	16.377	0.055
Ethane	6.585	10.135	14.955	20.217	0.308
Propane	3.432	5.341	11.878	30.791	1.991
Iso-Butane	0.537	0.760	1.725	5.860	1.129
N-Butane	1.020	1.390	3.162	13.400	3.620
Iso-Pentane	0.278	0.331	0.729	3.624	2.544
N-Pentane	0.287	0.325	0.711	3.680	3.921
Hexanes	0.224	0.217	0.457	2.432	6.580
Heptanes	0.191	0.166	0.354	1.721	10.031
Octanes	0.108	0.079	0.203	0.692	11.499
Nonanes	0.037	0.025	0.094	0.154	7.479
Decanes Plus	0.024	0.035	0.041	0.047	50.843
Totals	100.000	100.000	100.000	100.000	100.000
Mole Weight	19.743	21.091	25.768	43.827	190.51
Gravity (Air = 1.0)	0.683	0.730	0.894	1.538	-
Net Heat of combustion (dry)	1,089.8	1,155.6	1,394.6	2,378.3	-
Gross heat of combustion (dry)	1,203.6	1,274.2	1,530.3	2,585.5	-
Gross heat of combustion (wet)	1,182.6	1,251.9	1,503.6	2,540.3	-
Gas Compressibility (at 1 atm at 60 °F)	0.997	0.997	0.995	0.983	-
GPM at 15.025 psia	3.695	5.452	10.082	25.451	-

- Heat of combustion is the quantity of heat produced when gas is burned completely to carbon dioxide and water, BTU/cuft
- Wet and dry refer to the condition of the gas prior to combustion
- Wet refers to a gas that is saturated with water vapor, and dry refers to a gas that contains no water vapor prior to combustion
- Net and gross refer to the condition of the water resulting from combustion
- Gross heat is the heat produced in complete combustion under constant pressure with the combustion products cooled to standard conditions and the water of the combustion products condensed to the liquid state
- Net heat is the heat produced in complete combustion under constant pressure with the combustion products cooled to standard conditions and the water of combustion products remains in the vapor phase

Chromatographic Analysis of Stock Tank Oil
Multi Stage Flash Residual Oil

	Component	Mole %	Volume %	Weight %	Molecular Weight	Specific Gravity
C1	Methane	0.055	0.013	0.005	16.04	0.300
C2	Ethane	0.308	0.114	0.049	30.07	0.356
C3	Propane	1.991	0.758	0.461	44.10	0.507
iC4	i-Butane	1.129	0.510	0.344	58.12	0.563
nC4	n-Butane	3.620	1.577	1.104	58.12	0.584
iC5	i-Pentane	2.544	1.287	0.964	72.15	0.624
nC5	n-Pentane	3.921	1.962	1.485	72.15	0.631
C6	Hexanes	6.580	3.740	2.976	86.18	0.664
C7	Heptanes	10.031	5.666	4.898	93.03	0.721
C8	Octanes	11.499	7.259	6.447	106.81	0.741
C9	Nonanes	7.479	5.163	4.728	120.43	0.764
C10	Decanes	6.363	4.793	4.476	134.00	0.779
C11	Undecanes	4.791	3.903	3.696	147.00	0.790
C12	Dodecanes	3.838	3.377	3.243	161.00	0.801
C13	Tridecanes	3.817	3.602	3.507	175.00	0.812
C14	Tetradecanes	3.251	3.330	3.242	190.00	0.812
C15	Pentadecanes	2.923	3.223	3.160	206.00	0.818
C16	Hexadecanes	2.718	3.220	3.167	222.00	0.820
C17	Heptadecanes	2.138	2.664	2.659	237.00	0.833
C18	Octadecanes	2.146	2.835	2.827	251.00	0.832
C19	Nonadecanes	1.779	2.435	2.455	263.00	0.841
C20	Eicosanes	1.547	2.193	2.232	275.00	0.849
C21	Heneicosanes	1.222	1.794	1.867	291.00	0.868
C22	Docosanes	1.053	1.611	1.686	305.00	0.873
C23	Tricosanes	1.004	1.593	1.677	318.00	0.878
C24	Tetracosanes	0.904	1.486	1.571	331.00	0.882
C25	Pentacosanes	0.838	1.429	1.518	345.00	0.886
C26	Hexacosanes	0.787	1.391	1.484	359.00	0.890
C27	Heptacosanes	0.677	1.240	1.330	374.00	0.894
C28	Octacosanes	0.653	1.236	1.330	388.00	0.897
C29	Nonacosanes	0.505	0.988	1.066	402.00	0.900
C30+	Triacontanes Plus	7.889	23.608	28.346	684.55	1.001
	Total	100.000	100.000	100.000		

Properties of Liquid at 60/60 °F	Measured	Calculated	Calculated Properties of C30+	
Specific Gravity	0.834	0.834	Specific Gravity	1.001
Molecular Weight	190.51	190.51	Molecular Weight	684.55

* Calculations are based on normal carbon distribution (from normal to normal)

Compositional Analysis of Rheliant Oil Base Mud

PENCOR ID No. 36126-01

	Component	Mole %	Volume %	Weight %	Molecular Weight	Specific Gravity
C1	Methane	0.009	0.002	0.001	16.04	0.300
C2	Ethane	0.003	0.001	0.000	30.07	0.356
C3	Propane	0.004	0.001	0.001	44.10	0.507
iC4	i-Butane	0.002	0.001	0.001	58.12	0.563
nC4	n-Butane	0.001	0.000	0.000	58.12	0.584
iC5	i-Pentane	0.005	0.002	0.001	72.15	0.624
nC5	n-Pentane	0.001	0.000	0.000	72.15	0.631
C6	Hexanes	0.024	0.010	0.008	86.18	0.664
C7	Heptanes	0.109	0.051	0.045	96.31	0.704
C8	Octanes	0.094	0.048	0.044	109.56	0.729
C9	Nonanes	0.117	0.066	0.062	124.92	0.739
C10	Decanes	0.097	0.056	0.055	134.00	0.779
C11	Undecanes	0.518	0.322	0.322	147.00	0.790
C12	Dodecanes	0.698	0.469	0.475	161.00	0.801
C13	Tridecanes	0.636	0.458	0.470	175.00	0.812
C14	Tetradecanes	1.291	1.071	1.072	196.39	0.791
C15	Pentadecanes	10.211	9.266	9.086	210.41	0.775
C16	Hexadecanes	44.106	42.429	41.862	224.44	0.780
C17	Heptadecanes	12.739	12.885	12.847	238.47	0.788
C18	Octadecanes	22.058	23.468	23.553	252.49	0.793
C19	Nonadecanes	3.492	3.871	3.935	266.52	0.804
C20	Eicosanes	1.567	1.807	1.860	280.55	0.814
C21	Heneicosanes	0.307	0.344	0.378	291.00	0.868
C22	Docosanes	0.230	0.269	0.297	305.00	0.873
C23	Tricosanes	0.081	0.098	0.109	318.00	0.878
C24	Tetracosanes	0.062	0.078	0.087	331.00	0.882
C25	Pentacosanes	0.049	0.063	0.071	345.00	0.886
C26	Hexacosanes	0.017	0.023	0.026	359.00	0.890
C27	Heptacosanes	0.070	0.098	0.111	374.00	0.894
C28	Octacosanes	0.054	0.079	0.089	388.00	0.897
C29	Nonacosanes	0.090	0.134	0.153	402.00	0.900
C30+	Triacontanes Plus	1.258	2.530	2.979	560.15	0.930
	Total	100.000	100.000	100.000		

Properties of Liquid at 60/60 °F	Measured	Calculated	Calculated Properties of C30+	
Specific Gravity	0.790	0.790	Specific Gravity	0.930
Molecular Weight	230.78	236.47	Molecular Weight	560.15

* Calculations are based on normal carbon distribution (from normal to normal).

Laboratory Procedures

Sample Quality
The selected samples are heated to collection temperature prior to performing any further testing to avoid wax deposition problems and assure a uniform sample. A reservoir to zero flash is performed in duplicate to assure repeatable results.

Sample Restoration
Reservoir fluid samples are heated to 170 °F or reservoir temperature, depending on the sample container, pressured to some safe pressure above reservoir and continually agitated for a period of from 24 to 120 hours. This assures that any asphaltenes, if flocculation is reversible, have been dispersed throughout the sample, paraffins have been resoluablized, and the sample is homogonous.

Reservoir Fluid Compositions
Each pressurized liquid is analyzed using a combination of flash separation and gas chromatography. The liquid is flashed at a controlled temperature and separated into liquid and gas components. The gas composition is determined by GPA 2286 method using a multi-column gas chromatograph and the flashed liquid by temperature programmed capillary chromatography. The two analyses are then mathematically recombined to the flash gas-liquid ratio.

Constant Composition Expansion
A portion of the reservoir fluid sample is charged to a high pressure visual cell that is maintained at reservoir temperature. A constant composition expansion is carried out during which the saturation pressure is determined. Pressure-volume data for the single phase and two-phase fluid are also determined. The density of the single phase fluid is determined by two separate methods. A reservoir to zero flash is performed on a portion of fluid from the PVT cell and the mass of the resulting fluids are used in conjunction with the cell volumetrics. Secondly, a calibrated, high-pressure Anton Paar densitometer is also employed to measure the density of the reservoir fluid. Density data for other pressures are calculated using the volumetric data.

Differential Vaporization
This test is typically performed on low-shrinkage reservoir oil samples. After discussions with multiple BP engineers it was decided to proceed with this test even though this fluid is not a low shrinkage oil, the DV will provide adequate data and compositions so that reservoir simulations can be constructed. The test is carried out in a high pressure visual cell, at reservoir temperature. At several pressure stages, below the observed saturation pressure, the sample is stabilized. The gas evolved is then displaced from the cell and the volume, compressibility and composition are determined. The final stage is performed by flashing the fluid to ambient pressure at reservoir temperature. The residual liquid and associated gas, maintained at reservoir temperature, are collected and their density and compositions determined.

Viscosity
Viscosity is measured in an electro-magnetic viscometer at reservoir temperature. The viscometer contains a stainless steel piston which is magnetically driven back and forth inside a measurement chamber and the travel time recorded. These times correlate directly to the dynamic viscosities of calibration standards used in the commissioning of the viscometer. Viscosity determinations are carried out over a wide range of pressures from above the reservoir pressure to atmospheric pressure. The viscosity measurement at each pressure stage is recorded when the standard deviation of the last 10 measurements is typically less than 0.1% of the measured viscosity. A viscosity standard is run before and after each test to confirm that the calibration coefficients stored within the viscometer remain valid.

Separator Tests
A multi-stage separator test is carried out using a visual PVT cell. A portion of the sample, at a pressure above saturation pressure, is transferred into the PVT cell and stabilized at the pressure and temperature required for the first stage of separation. The gas evolved is displaced from the cell and the volume and composition are determined. This is repeated for each successive pressurized stage. The final stage is conducted at atmospheric pressure and some temperature and the density of the residual liquid is determined.

Data Used in Gas Compositional Calculations

Component		Mole Weight	Sp Gravity at 60/60 °F	Component		Mole Weight	Sp Gravity at 60/60 °F
Hydrogen	*	2.016	N/A	33DMC5	*	100.2	0.6961
Oxygen/(Argon)	**	32.00	1.1421	Cyclohexane	*	84.16	0.7835
Nitrogen (Corrected)	**	28.01	0.8094	2MC6/23DMC5	*	100.2	0.6924
Methane	**	16.04	0.3000	11DMCYC5/3MC6	*	99.20	0.7260
Carbon Dioxide	**	44.01	0.8180	t13DMCYC5	*	98.19	0.7535
Ethane	**	30.07	0.3562	c13DMCYC5/3EC5	*	99.20	0.7269
Hydrogen Sulphide	**	34.08	0.8014	t12DMCYC5	*	98.19	0.7561
Propane	**	44.10	0.5070	Heptanes (nC7)	*	100.2	0.6882
i-Butane	**	58.12	0.5629	22DMC6	*	114.2	0.7001
n-Butane	**	58.12	0.5840	MCYC6	*	98.19	0.7748
Neo-Pentane	*	72.15	0.5974	ECYC5	*	98.19	0.7712
i-Pentane	**	72.15	0.6244	223TMC5/24&25DMC6	*	114.2	0.7067
n-Pentane	**	72.15	0.6311	ctc124TMCYC5	*	112.2	0.7518
22DMC4	*	86.18	0.6535	ctc123TMCYC5	*	112.2	0.7581
23DMC4/CYC5	*	78.16	0.7137	Toluene	*	92.14	0.8743
2MC5	*	86.18	0.6578	Octanes (nC8)	*	114.2	0.7070
3MC5	*	86.18	0.6689	E-Benzene	*	106.2	0.8744
Hexanes (nC6)	*	86.18	0.6638	M/P-Xylene	*	106.2	0.8680
22DMC5	*	100.2	0.6821	O-Xylene	*	106.2	0.8849
M-C-Pentane	*	84.16	0.7540	Nonanes (nC9)	*	128.3	0.7219
24DMC5	*	100.2	0.6764	Decanes	***	134.0	0.7788
223TMC4	*	100.2	0.6954	Undecanes	***	147.0	0.7898
Benzene	*	78.11	0.8829	Dodecanes	***	161.0	0.8008

Data Source References :

* ASTM Data Series Publication DS 4B (1991) - Physical Constants of Hydrocarbon and Non-Hydrocarbon Compounds.

** GPA Table of Physical Constants of Paraffin Hydrocarbons and Other Components of Natural Gas, GPA 2145-96.

*** Journal of Petroleum Technology, Nov 1978, Pages 1649-1655.
Predicting Phase Behavior of Condensate/Crude Oil Systems Using Methane Interaction Coefficients - D.L. Katz & A. Firoozabadi.

Note :
The gas mole % compositions were calculated from the measured weight % compositions using the most detailed analysis results, involving as many of the above components as were identified. The reported component mole % compositions were then sub-grouped into the generic carbon number components.

Katz and Firoozabadi Data Used in Liquid Composition Calculations

Component		Mole Weight	Density (g/cc at 60°F)	Component		Mole Weight	Density (g/cc at 60°F)
Hydrogen	*	2.016	N/A	Undecanes	***	147	0.7890
Hydrogen Sulfide	**	34.08	0.8006	Dodecanes	***	161	0.8000
Carbon Dioxide	**	44.01	0.8172	Tridecanes	***	175	0.8110
Nitrogen	**	28.01	0.8086	Tetradecanes	***	190	0.8220
Methane	**	16.04	0.2997	Pentadecanes	***	206	0.8320
Ethane	**	30.07	0.3558	Hexadecanes	***	222	0.8390
Propane	**	44.10	0.5065	Heptadecanes	***	237	0.8470
i-Butane	**	58.12	0.5623	Octadecanes	***	251	0.8520
n-Butane	**	58.12	0.5834	Nonadecanes	***	263	0.8570
i-Pentane	**	72.15	0.6238	Eicosanes	***	275	0.8620
n-Pentane	**	72.15	0.6305	Heneicosanes	***	291	0.8670
Hexanes	**	84.16	0.7533	Docosanes	***	305	0.8720
Me-cyclo-pentane	*	84.16	0.7533	Tricosanes	***	318	0.8770
Benzene	*	78.11	0.8820	Tetracosanes	***	331	0.8810
Cyclo-hexane	*	84.16	0.7827	Pentacosanes	***	345	0.8850
Heptanes	**	92.1	0.7220	Hexacosanes	***	359	0.8890
Me-cyclo-hexane	*	98.19	0.7740	Heptacosanes	***	374	0.8930
Toluene	*	92.14	0.8734	Octacosanes	***	388	0.8960
Octanes	**	106.2	0.7450	Nonacosanes	***	402	0.8990
Ethyl-benzene	*	106.2	0.8735	Triacontanes	***	416	0.9020
Meta/Para-xylene	*	106.2	0.8671	Hentriacontanes	***	430	0.9060
Ortho-xylene	*	106.2	0.8840	Dotriacontanes	***	444	0.9090
Nonanes	**	121.0	0.7640	Tritriacontanes	***	458	0.9120
1-2-4-T-M-benzene	*	120.2	0.8797	Tetratriacontanes	***	472	0.9140
Decanes	**	134.0	0.7780	Pentatriacontanes	***	486	0.9170

Data Source References :

* ASTM Data Series Publication DS 4B (1991) - Physical Constants of Hydrocarbon and Non-Hydrocarbon Compounds.

** GPA Table of Physical Constants of Paraffin Hydrocarbons and Other Components of Natural Gas GPA 2145-96.

*** Journal of Petroleum Technology, Nov 1978, Pages 1649-1655.
Predicting Phase Behavior of Condensate/Crude Oil Systems Using Methane Interaction Coefficients - D.L. Katz & A. Firoozabadi.

Note :
The residue mole weight and density values (eg heptanes plus, undecanes plus, eicosanes plus) are calculated so that the calculated average mole weights and densities correspond with the measured values. This can lead to anomalous residue mole weights and densities where the Katz and Firoozabadi values may not be suitable for the isomer groups detected.

Normal Hydrocarbon Data Used in Liquid Composition Calculations

Component		Mole Weight	Density (g/cc at 60°F)	Component		Mole Weight	Density (g/cc at 60°F)
Hydrogen	*	2.016	N/A	Undecanes	*	156	0.7438
Hydrogen Sulfide	**	34.08	0.8006	Dodecanes	*	170	0.7520
Carbon Dioxide	**	44.01	0.8172	Tridecanes	*	184	0.7609
Nitrogen	**	28.01	0.8086	Tetradecanes	*	198	0.7625
Methane	**	16.04	0.2997	Pentadecanes	*	212	0.7714
Ethane	**	30.07	0.3558	Hexadecanes	*	226	0.7764
Propane	**	44.10	0.5065	Heptadecanes	*	240	0.7789
i-Butane	**	58.12	0.5623	Octadecanes	*	254	0.7812
n-Butane	**	58.12	0.5834	Nonadecanes	*	269	0.7861
i-Pentane	**	72.15	0.6238	Eicosanes	*	283	0.7916
n-Pentane	**	72.15	0.6305	Heneicosanes	*	297	0.7946
Hexanes	**	86.18	0.6631	Docosanes	*	311	0.7973
Me-cyclo-pentane	*	84.16	0.7533	Tricosanes	*	325	0.7996
Benzene	*	78.11	0.8820	Tetracosanes	*	339	0.8017
Cyclo-hexane	*	84.16	0.7827	Pentacosanes	*	353	0.8019
Heptanes	**	100.2	0.6875	Hexacosanes	*	367	0.8071
Me-cyclo-hexane	*	98.19	0.7740	Heptacosanes	*	381	0.8078
Toluene	*	92.14	0.8734	Octacosanes	*	395	0.8093
Octanes	**	114.2	0.7063	Nonacosanes	*	409	0.8112
Ethyl-benzene	*	106.2	0.8735	Triacontanes	*	423	0.8124
Meta/Para-xylene	*	106.2	0.8671	Hentriacontanes	*	437	0.8141
Ortho-xylene	*	106.2	0.8840	Dotriacontanes	*	451	0.8159
Nonanes	**	128.3	0.7212	Tritriacontanes	*	465	0.8179
1-2-4-T-M-benzene	*	120.2	0.8797	Tetratriacontanes	*	479	0.8200
Decanes	**	142.3	0.7335	Pentatriacontanes	*	493	0.8234

Data Source References :

* ASTM Data Series Publication DS 4B (1991) - Physical Constants of Hydrocarbon and Non-Hydrocarbon Compounds.
** GPA Table of Physical Constants of Paraffin Hydrocarbons and Other Components of Natural Gas GPA 2145-96.

Quality Assurance

The above work, and data presented herein, was performed by PENCOR (an ISO 9001 registered company) located at 5820 Highway 90 East, Broussard, LA 70518. As part of our quality assurance program, in addition to mass balance checks that must match within 1%, this data was modeled by equation-of-state (EOS) and met specific matching criteria before these results were approved for release. The signatures below verify that this process, and an overall quality assurance review of this report, was performed. All work was carried out according to PENCOR's ISO approved sample handling and analysis procedures. A detailed listing and explanation of these procedures may be found in PENCOR's Reference Manual.

PENCOR is committed to enhancing production by offering the best available reservoir fluid sampling and analytical technology, methodology, personnel and management. Our equipment is regularly calibrated, checked and upgraded as necessary. Our procedures are continually evolving based on the latest industry findings and requirements. Our people are thoroughly trained and held to the highest standards of professional conduct. Our management is committed to providing the resources and manpower necessary to get the timely answers needed to make informed reservoir engineering and production decisions. Constructive feedback is always welcome and we pledge to incorporate these ideas into our ongoing quest to provide the best available service and data in the reservoir fluid sampling and analysis industry.

Report prepared by

Jason LeBlanc
BP Project Manager
jason.leblanc@corelab.com

Technical review by

Ross Coleman
Project Manager
ross.coleman@corelab.com