ARCO Alaska, Inc.
Post Office Box 100360
Anchorage Alaska 99510-0360
Telephone 907 276 1215

March 5, 1993

U.S. Minerals Management Service
Attention: Mr. Allen D. Powers, Regional Director
949 East 36th Avenue, Room 603
Anchorage, Alaska 99508-4302

Re: Determination of Well Producibility
Kuvlum #1 Well
OCS-Y-0866, Block 673
Flaxman Island Area
Eastern Beaufort Sea

Gentlemen:

We hereby respectfully request that the Kuvlum #1 Well be determined as a well capable of producing oil in paying quantities, as provided under *30 CFR 250.11.*

The production test on this well began on September 30, 1992 and was completed on October 4, 1992. A representative from your office, Mr. Jim Reggs was present during the time of the testing of the well. The test results from this well have already been provided to your office. Additionally, we have included the PVT data from the oil sample that was taken, as well as a breakdown of lifting costs associated with the Kuvlum #1 Well. Should you need additional information to qualify the Kuvlum #1 Well, please advise the undersigned and I will be happy to provide it to you. We would respectfully request that this data be held confidential in accordance with *30 CFR 250.18.*

We intend to unitize Block 673 with additional leasehold around the block and plan to have a formal unit proposal and a request for suspension of production submitted to you no later the end of this month. Therefore your attention to this request prior to that date would be very much appreciated.

If you have any questions, please feel free to call me at (907) 263-4933.

Very truly yours,

David A. Sutter
District Landman

:jls

cc: Kuvlum Working Interest Owners

ARCO Alaska Inc.

Kuvlum #1

(OCS-Y-0866 #1 Well)

Determination of Well as Capable of Producing in Paying Quantities

Discussion in Support of the Kuvlum #1 Well
(OCS-Y-0866 #1 Well)

Paying Quantities

The following discussion provides necessary information required to certify the Kuvlum #1 (OCS-Y-0866 #1) well as capable of producing in paying quantities. This discussion will include a review of tested oil rates from the well, a complete reservoir fluids analysis of the produced oil, a brief discussion of anticipated well production operations, the anticipated incremental well operating costs, and a paying quantities calculation. ***It is understood that this information is confidential and should not be released to any 3rd party.***

Tested Oil Rate:

Two separate drill stem tests from the single hydrocarbon bearing perforated interval are available to illustrate the productive capability of the Kuvlum #1 well.

During the final 8 hours of the flow period of **DST #1** (Oct. 1, 0130-0930 hrs), the well flowed at a **stabilized oil rate of 1680 BOPD** of 33.5 Degree API oil with flowing tubing pressure of 652 psig. The detailed well production report for DST #1 is included as attachment 1.

During the final 3 hour flow period of **DST #2** (Oct. 4, 0200-0500 hrs) the well flowed at a **stabilized oil rate of 3550 BOPD** with flowing tubing pressure of 300 psig. The detailed well production report for DST #2 is included as attachment 2.

This information, along with additional test information, is available in the report entitled "Kuvlum #1, September 30 - October 4, 1992, Drill Stem Test" prepared by Halliburton Reservoir Services of which two (2) copies were previously sent to your office. Mr. Jim Regg of your office was present to witness testing of the Kuvlum #1 well.

Reservoir Fluid Analysis:

Attachment 3 is a standard reservoir fluid study of the Kuvlum #1 well prepared by Core Laboratories. For security purposes, the Kuvlum #1 well name was not referenced in the reservoir fluid analysis report. The laboratory measured oil gravity of 34.2 Degree API confirms the field oil gravity measurements and indicates that the produced oil is of high quality.

Production Operations:

A typical production completion for a Kuvlum well would consist of drilling through the productive sand interval and cementing production casing in place. The well would then be perforated through casing. The completion would consist of production tubing with gas lift mandrels, a production packer, and subsurface safety valve. The well would be manifolded to allow for gas lift operation as needed. Fluid production of a typical Kuvlum well would be by either natural flow or gas lift assisted flow. Replication of Kuvlum #1 testing parameters of wellhead pressure, tubing size, reservoir pressure drawdown, and oil production rate would be easily attainable in a continuous field production operation.

Incremental Well Operating Costs:

The incremental operating costs of a well are assumed to be those costs directly related to the operation of a given well such as chemical usage, metering, maintenance, and routine wireline work. Incremental well operating costs do not include a prorated share of the processing facility, drillsite or platform operating and maintenance costs.

Average incremental well cost for a typical Kuvlum well is estimated to be approximately 100,000 $/Well/Year. This estimate is based on a study of routine Kuparuk River Field incremental well operating costs exclusive of significant remedial repair work. It is assumed that the typical Kuvlum well would be burdened by incremental well costs similar to those seen at the Kuparuk River Field.

Break-even Oil Rate to Yield Paying Quantities

The Kuvlum #1 well can be determined to be capable of producing in paying quantities if the production of oil and/or gas in quantities sufficient to yield a return in excess of incremental well operating costs is achieved. In addition, excess returns are considered after the payment of any production royalties. A federal royalty of 12.5% is included in the paying quantities calculation.

The incremental well operating costs and royalty payments described above were used to determine the break-even oil rate required to yield paying quantities for The Kuvlum #1 well. The oil price(s) used in these calculations are based on the West Coast ANS Oil Price Projections contained in the Revenue Source Book (Fall 1992) published by the Department of Natural Resources, State of Alaska. A copy of the pertinent price table is shown in attachment 4.

An example of the break-even oil rate needed to yield paying quantities given an oil price of 17.13 $/STBO, an incremental well operating cost of 100,000 $/year/well, and a federal royalty of 12.5% is shown below.

$$\text{Break-even Oil Rate} = \frac{\text{Incremental Well Operating Cost(\$/Year/Well)}}{\text{Oil Price(\$/STBO)*(1-Royalty \%)*365(Days/Year)}}$$

$$= \frac{100{,}000(\$/\text{Year/Well})}{(17.13(\$/\text{STBO})*(1-.125)*365(\text{Days/Year})},$$

$$= 18.3 \text{ STBO/Day/Well}$$

The break-even oil rate of 18.3 STBO/Day/Well from the above example corresponds to the minimum 1993 oil price estimate of 17.13 $/STBO from the State of Alaska ANS price projection. This calculation is before federal income taxes (BFIT).

The break-even oil rate requirement to achieve economic returns in excess of operating costs was determined for a wide range of oil prices. The break-even oil rate as a function of oil price is shown in attachment 5. For the State of Alaska's 1993 range of oil price projections, the break-even oil rate to achieve economic returns is approximately 18 STBO/Day/Well. In a lower oil price scenario of 10 $/STB, it can be seen that oil rates greater than 31 STBO/Day/Well provide returns in excess of operating costs. For a higher oil price scenario of 25 $/STB, oil rates greater than 13 STBO/Day/Well provide returns in excess of operating costs.

Conclusion:

Based on the above calculations, the break-even oil rate required to achieve economic returns in excess of well operating costs and therefore achieve paying quantities ranges from 13-31 STBO/Day/Well. The drill stem testing of the Kuvlum #1 well demonstrated oil rate productivity up to 3550 STBO/Day. The Kuvlum #1 well therefore meets the MMS requirements of being capable of producing in paying quantities.

Halliburton Reservoir Services Surface Test Data

Company: ARCO Alaska,Inc.
Well: Kuvlum #1 DST #1
Date: 30-Sep-1992

				Tank And Separtor Data					SCAN Data					
Time	Whp (psig)	Wht (deg F)	Choke (64ths)	Inc Vol (bbls)	Rate (bbl/day)	Cum Vol (bbls)	Gas Rate Total (mscf/day)	Cum Gas (mscf)	Mtr Corr Vol (bbls)	Oil Rate (1.106) (bbl/day)	Mtr Prod Vol (bbls)	Gas Rate Total (mscf/day)	Cum Gas (mscf)	Comments
30-Sep-92														Page No. 3.1.1
08:43:15	0.00	21.00	12 Adj											Open Well For Initial Flow(Tank #2).
08:53:15	319.00	20.00	Closed	0.00	0.00	0.00								Close Well In @ LPR-N.
08:54:00	315.37	43.89	Closed											Colse Sub Sea Retainer Valve.
09:00:00	0.00	42.01	Closed											Rig Up Wireline w/SRO Gauge & "E" Probe.
09:37:00	329.15	39.68	Closed											Press Up To Open Sub Sea Retainer Valve.
09:43:00	329.40	38.19	Closed											RIH w/Wireline.
10:19:00	332.20	33.57	Closed											Attempt To Latch "E" Probe. Pulls Out @700# Over
10:19:00	332.20	33.57	Closed											Line Wt. Make Five Attempts To Latch "E" Probe.
10:20:00	332.20	33.40	Closed											POOH w/Wireline.
11:12:00	331.70	30.81	Closed											Out Of Hole w/Wireline. Close Sub Sea Retainer.
11:31:00	0.00	34.03	Closed											WL Rigged Down. Open Sub Sea Retainer.
11:40:30	327.00	34.00	12 Adj	0.00	0.00	0.00								Open Well For Test(Tank #2).
12:00:00	321.00	42.00	16 Adj	0.00	0.00	0.00								Divert To Heater. Dirty Diesel Returns.
12:15:00	287.00	38.00	20 Adj	2.50	240.05	2.50								BS&W=0.01% Solids and Diesel Returns.
12:30:00	286.00	38.00	24 Adj	2.50	240.05	5.00								BS&W=0.001% Solids and Diesel Returns.
12:45:00	239.00	39.00	24 Adj	5.83	560.11	10.84								BS&W=0.02% Solids and Diesel Returns.
13:00:00	284.00	38.00	24 Adj	9.59	920.18	20.42								BS&W=0.001% Solids and Diesel Returns.
13:15:00	370.00	39.00	28 Adj	15.00	1440.29	35.42								BS&W=0.001% Solids and Diesel Returns.

Note: 1.) Opening Sub Sea Retainer Valve Requires Pressuring Up Tubing Above Retainer.

2.) Failed Attempts To Latch "E" Probe Could Be The Result Of Debris From Initial Flow. The Buffer Tube Assembly Still Pluged At Surface.

3.) Possible Failure Of LPR-N Invalidates Initial Flow And Buildup.

Halliburton Reservoir Services Surface Test Data

Company: ARCO Alaska,Inc.
Well: Kuvlum #1 DST #1
Date: 30-Sep-1992

				Tank And Separtor Data					SCAN Data					
Time	Whp (psig)	Wht (deg F)	Choke (64ths)	Inc Vol (bbls)	Rate (bbl/day)	Cum Vol (bbls)	Gas Rate Total (mscf/day)	Cum Gas (mscf)	Mtr Corr Vol (bbls)	Oil Rate (1.106) (bbl/day)	Mtr Prod Vol (bbls)	Gas Rate Total (mscf/day)	Cum Gas (mscf)	Comments
30-Sep-92														Page No. 3.1.2
13:30:00	519.00	39.00	28 Adj	10.42	1000.20	45.84								BS&W=0.01% Solids 27% H2O and Diesel.
13:45:00	592.00	39.00	28 Adj	2.92	280.06	48.76								Oil At Surface.
14:00:00	611.00	41.00	28 Adj	0.42	40.01	49.18								Gas At Surface Divert To Lo Stage.
14:15:00	665.00	38.00	28 Adj	2.50	240.05	51.68	178.57	1.86						BS&W=1.0% H2O.
14:30:00	691.00	38.00	28 Adj	0.83	80.02	52.51	N/A							BS&W=1.0% H2O.
14:45:00	751.00	38.00	28 Adj	0.83	80.02	53.34	N/A							BS&W=0.5% H2O 0.001% Solids.
15:00:00	745.00	37.00	28 Adj	10.42	1000.20	63.76	683.05	8.98				588.06	2.04	BS&W=0.1% H2O 0.001% Solids CO2=0.2%.
15:15:00	784.00	38.00	28 Adj	11.25	1080.22	75.02	683.78	16.10						BS&W=0.75% H2O.
15:30:00	782.00	38.00	28 Adj	9.17	880.18	84.18	661.56	22.99				588.47	14.30	BS&W=0.75% H2O.
15:45:00	780.00	38.00	28 Adj	17.09	1640.33	101.27	665.24	29.92						BS&W=0.25% H2O.
16:00:00	782.00	38.00	28 Adj	6.67	640.13	107.94	745.60	37.69				701.95	28.93	BS&W=0.1% H2O CO2=0.3% Divert To HI Stage
16:15:00	780.00	38.00	28 Adj	0.00	0.00	107.94	785.32	45.87						BS&W=0.2% H2O.
16:30:00	780.00	38.00	28 Adj	0.00	0.00	107.94	768.97	53.88				775.11	45.07	BS&W=0.0%.
16:45:00	759.00	38.00	28 Adj	0.00	0.00	107.94	1047.53	64.79						BS&W=0.0%.
17:00:00	713.00	38.00	28 Pos	0.42	13.34	108.36	1081.17	76.05				934.13	64.53	BS&W=0.0% OG= 34 @ 60 D.F. CO2=0.2%
17:15:00	705.00	38.00	28 Pos	9.17	880.18	117.52	1093.88	87.44						BS&W=0.1% H2O Lo Stage Meter Freezing Up.
17:30:00	703.00	38.00	28 Pos	25.84	2480.50	143.36	1102.63	98.93				1094.68	87.34	BS&W=0.01%.
17:45:00	701.00	38.00	28 Pos	24.59	2360.48	167.95	1083.45	110.22						BS&W=0.02%. Inject Defoamer Data Header.
18:00:00	699.00	39.00	28 Pos	22.50	2160.43	190.45	1088.68	121.56				1079.40	109.83	BS&W=0.25% OG= 33.3 @ 60 D.F. CO2=0.35%
18:15:00	698.00	39.00	28 Pos	19.17	1840.37	209.63	1077.14	132.78						BS&W=0.1% Gel.
18:30:00	695.00	39.00	28 Pos	19.17	1840.37	228.80	1094.93	144.16	33.93	1801.65	33.93	1073.45	132.19	BS&W=0.1% Gel.
18:45:00	695.00	40.00	28 Pos	20.00	1920.38	248.80	1108.81	155.73						BS&W=0.05% Gel. Gas Gravity = 0.722.

Halliburton Reservoir Services Surface Test Data

Company: ARCO Alaska,Inc.
Well: Kuvlum #1 DST #1
Date: 30-Sep-1992

				Tank And Separtor Data					SCAN Data					
Time	Whp (psig)	Wht (deg F)	Choke (64ths)	Inc Vol (bbls)	Rate (bbl/day)	Cum Vol (bbls)	Gas Rate Total (mscf/day)	Cum Gas (mscf)	Mtr Corr Vol (bbls)	Oil Rate (1.106) (bbl/day)	Mtr Prod Vol (bbls)	Gas Rate Total (mscf/day)	Cum Gas (mscf)	Comments
30-Sep-92														Page No. 3.1.3
19:00:00	693.00	40.00	28 Pos	21.25	2040.41	270.05	1107.18	167.27	33.54	1780.57	67.47	1085.41	154.80	BS&W=0.1% Gel OG= 33.9 @ 60 D.F. CO2=0.4%
19:15:00	691.00	40.00	28 Pos	22.09	2121.42	292.14	1102.43	178.75						
19:30:00	690.00	40.00	28 Pos	18.34	1760.35	310.48	1102.01	190.23	32.99	1751.01	100.46	1107.25	177.87	
19:45:00	689.00	40.00	28 Pos	20.42	1960.39	330.90	1140.28	202.11						
20:00:00	687.00	41.00	28 Pos	18.34	1760.35	349.24	1086.31	213.42	33.02	1752.98	133.48	1091.94	200.62	BS&W=0.0% OG= 34.0 @ 60 D.F. CO2=0.02%
20:30:00	685.00	41.00	28 Pos				984.96	233.94	32.61	1731.53	166.09	1110.89	223.76	Started One Hour Tank Straps.
21:00:00	683.00	42.00	28 Pos	81.68	1960.39	430.92	1061.68	256.06	32.45	1722.63	198.54	1087.78	246.43	BS&W=0.0% OG= 33.9 @ 60 D.F. CO2=0.4%.
21:30:00	680.00	42.00	28 Pos				1068.90	278.33	32.49	1724.55	231.03	1088.37	269.10	
22:00:00	678.00	43.00	28 Pos	47.09	1130.23	478.01	1061.40	300.44	31.96	1696.71	262.99	1054.75	291.07	BS&W=0.0% OG= 33.6 @ 60 D.F. CO2=0.4%.
22:30:00	675.00	44.00	28 Pos				1038.21	322.07	31.83	1689.75	294.82	1029.68	312.53	
23:00:00	672.00	44.00	28 Pos	80.02	1920.38	558.03	1018.32	343.29	31.71	1683.55	326.53	1016.98	333.71	BS&W=0.0% OG= 33.8 @ 60 D.F. CO2=0.3%.
23:30:00	672.00	44.00	28 Pos				1005.92	364.24	31.83	1689.88	358.36	1005.74	354.67	
01-Oct-92														
00:00:00	671.00	44.00	28 Pos	70.43	1690.34	628.46	1000.98	385.10	32.08	1702.94	390.44	991.84	375.33	BS&W=0.0% OG= 33.7 @ 60 D.F. CO2=0.3%.
00:30:00	668.00	45.00	28 Pos				979.35	405.50	31.18	1655.24	421.62	1001.11	396.19	Gas Gravity = 0.730.
01:00:00	666.00	45.00	28 Pos	75.02	1800.36	703.47	995.71	426.24	31.69	1682.44	453.31	1012.74	417.29	BS&W=0.0% Oil Grav= 33.6 @ 60 D.F.
01:30:00	664.00	45.00	28 Pos				1006.68	447.22	31.26	1659.82	484.57	1014.50	438.42	
02:00:00	663.00	46.00	28 Pos	74.18	1780.36	777.66	1000.11	468.05	31.14	1652.85	515.71	991.20	459.07	BS&W=0.0% OG= 33.9 @ 60 D.F. CO2=0.3%.
02:30:00	661.00	46.00	28 Pos				990.80	488.69	30.95	1643.39	546.66	1009.60	480.10	
03:00:00	659.00	46.00	28 Pos	67.51	1620.32	845.17	1024.99	510.05	30.85	1637.43	577.51	1018.51	501.32	BS&W=0.0% Oil Grav= 33.6 @ 60 D.F.
03:30:00	657.00	46.00	28 Pos				1030.16	531.51	30.67	1628.26	608.18	1041.28	523.02	
04:00:00	656.00	47.00	28 Pos	62.51	1500.30	907.68	1027.72	552.92	30.71	1630.81	638.90	1045.93	544.81	BS&W=0.0% OG= 33.6 @ 60 D.F. CO2=0.2%.

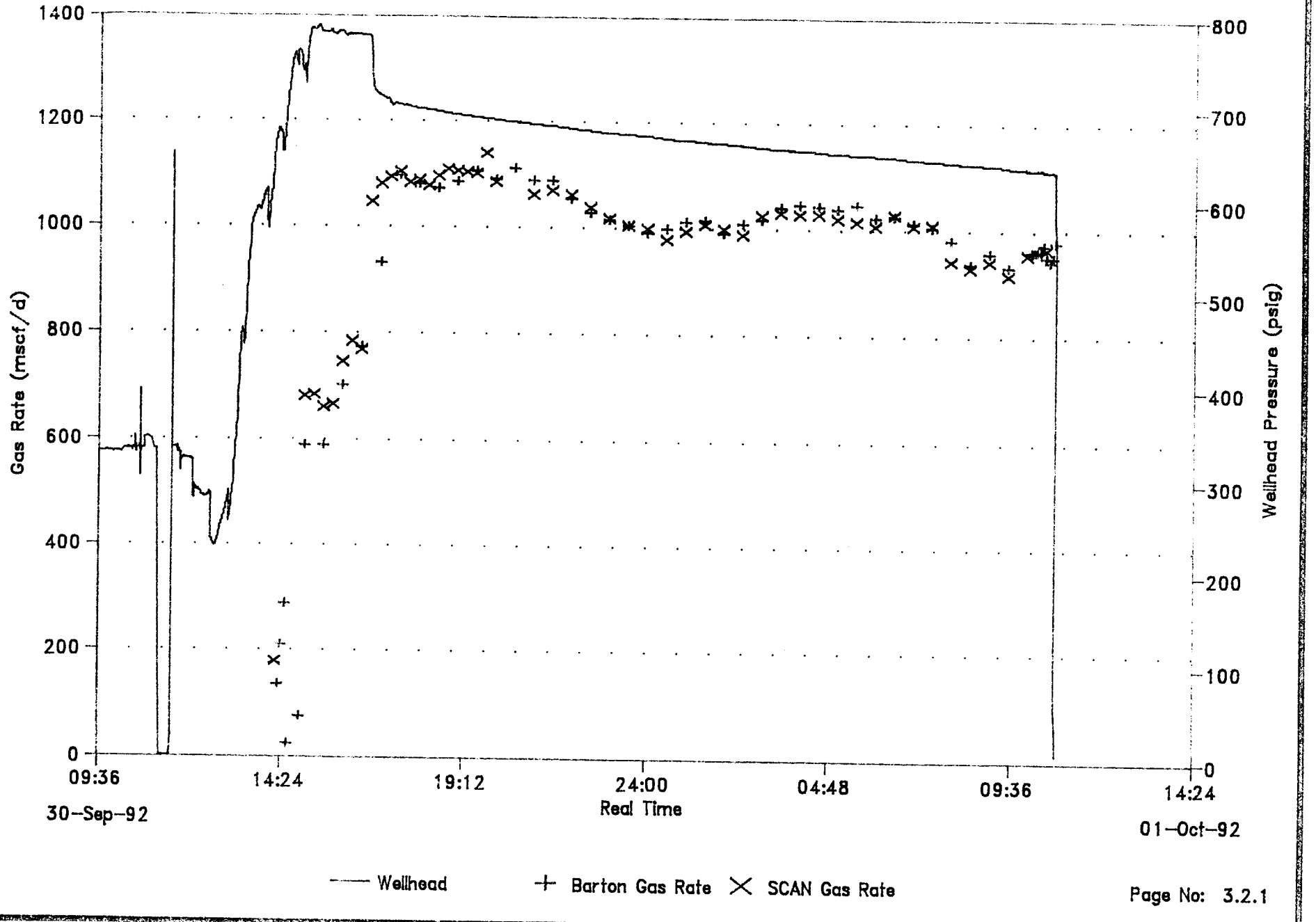
Halliburton Reservoir Services Surface Test Data

Company: ARCO Alaska,Inc.
Well: Kuvlum #1 DST #1
Date: 30-Sep-1992

				Tank And Separtor Data					SCAN Data					
Time	Whp (psig)	Wht (deg F)	Choke (64ths)	Inc Vol (bbls)	Rate (bbl/day)	Cum Vol (bbls)	Gas Rate Total (mscf/day)	Cum Gas (mscf)	Mtr Corr Vol (bbls)	Oil Rate (1.106) (bbl/day)	Mtr Prod Vol (bbls)	Gas Rate Total (mscf/day)	Cum Gas (mscf)	Comments
01-Oct-92														Page No. 3.1.4
04:30:00	655.00	48.00	28 Pos				1027.76	574.33	30.58	1623.37	669.48	1043.70	586.55	
05:00:00	653.00	47.00	28 Pos	78.77	1890.38	986.45	1019.84	595.58	31.62	1678.66	701.10	1037.76	588.17	BS&W=0.0% Oil Grav= 34.8 @ 60 D.F.
05:30:00	652.00	47.00	28 Pos				1016.07	616.75	31.45	1669.55	732.54	1047.78	610.00	
06:00:00	651.00	48.00	28 Pos	67.51	1620.32	1053.96	1007.72	637.74	30.45	1616.47	763.00	1023.64	631.32	BS&W=0.0% OG= 32.1 @ 60 D.F. CO2=0.2%.
06:30:00	649.00	48.00	28 Pos				1028.29	659.16	31.66	1681.09	794.66	1026.58	652.71	
07:00:00	647.00	48.00	28 Pos	74.18	1780.36	1128.14	1007.08	680.14	32.09	1703.80	826.75	1012.53	673.81	BS&W=0.0% Oil Grav= 32.9 @ 60 D.F.
07:30:00	646.00	48.00	28 Pos				1009.29	701.17	31.25	1659.23	858.00	1005.23	694.75	
08:00:00	644.00	48.00	28 Pos	84.18	2020.40	1212.33	942.29	720.80	30.76	1633.26	888.77	982.16	715.21	BS&W=0.0% OG= 33.2 @ 60 D.F. CO2=0.2%.
08:30:00	643.00	49.00	28 Pos				931.59	740.21	31.08	1650.14	919.85	937.87	734.75	
09:00:00	642.00	49.00	28 Pos	54.18	1300.26	1266.50	942.94	759.85	31.69	1682.17	951.54	959.12	754.73	Started 30 Minute Tank Straps.
09:30:00	640.00	49.00	28 Pos	30.84	1480.30	1297.34	918.01	778.98	31.77	1686.86	983.32	933.33	774.18	Attempt To Close LPR-N Valve. Did
10:00:00	637.00	49.00	28 Pos	32.92	1580.32	1330.27	956.13	798.90						Not Close. Continue To Cycle Annulus
10:30:00	635.00	49.00	28 Pos	40.42	1940.39	1370.69	966.90	819.04				962.52	794.23	Pressure With No Success.
10:46:00	558.00	47.00	28 Pos	17.09	1537.81	1387.78						957.75	804.20	Close OMNI Valve.
10:47:00	160.00	41.00	Closed	0.83	1200.24	1388.61								Close Sub Sea Retainer Valve.

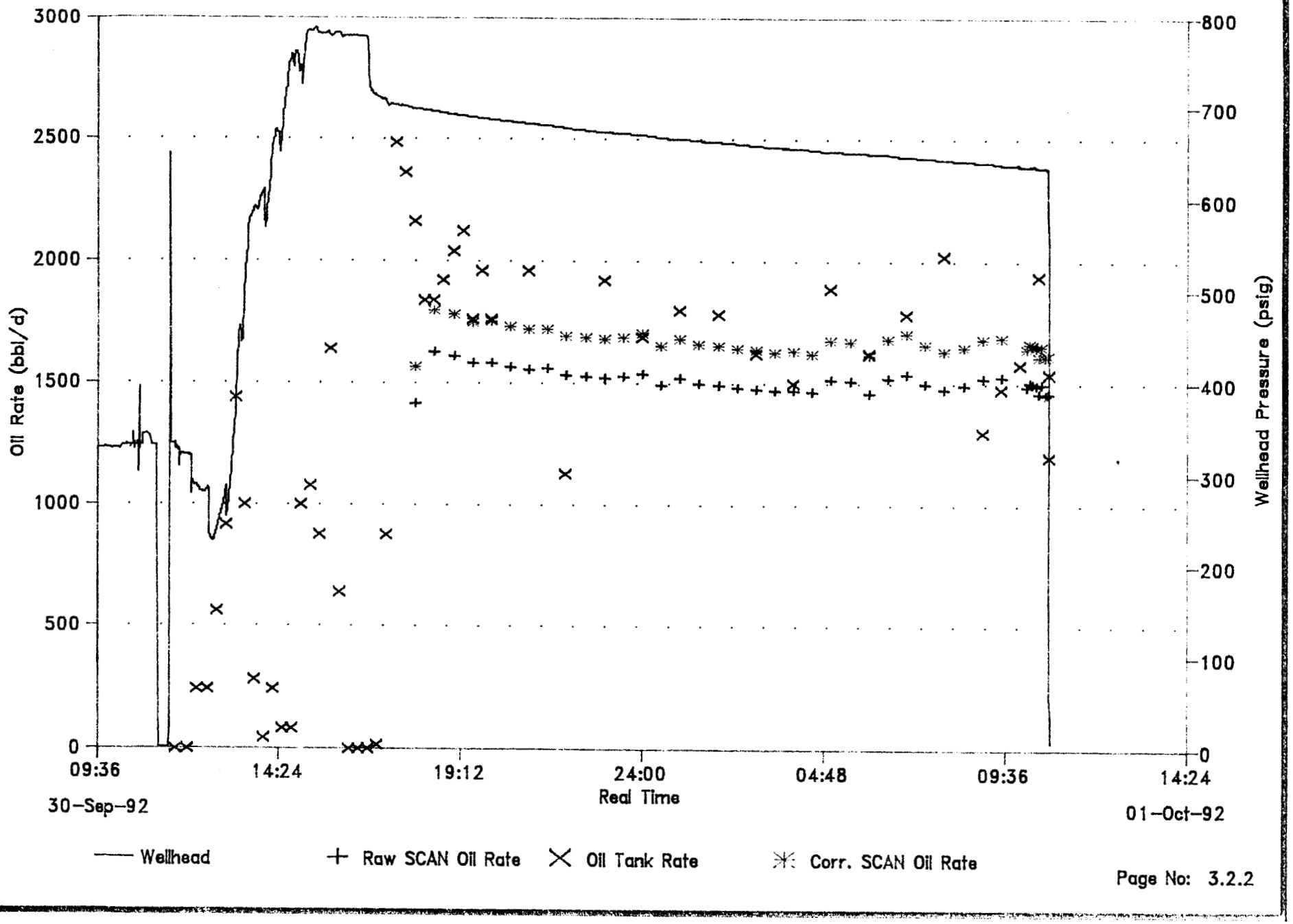
Halliburton Reservoir Services

Wellhead Press & Rates VS Real Time



Halliburton Reservoir Services

Wellhead Press & Oil Rates VS Real Time



Halliburton Reservoir Services Surface Test Data

Company: ARCO Alaska,Inc.
Well: Kuvlum #1 DST #2
Date: 02-Oct-1992

				Tank And Separtor Data					SCAN Data					
Time	Whp (psig)	Wht (deg F)	Choke (64ths)	Inc Vol (bbls)	Rate (bbl/day)	Cum Vol (bbls)	Gas Rate Total (mscf/day)	Cum Gas (mscf)	Mtr Corr Vol (bbls)	Oil Rate (0.80446) (bbl/day)	Mtr Prod Vol (bbls)	Gas Rate Total (mscf/day)	Cum Gas (mscf)	Comments
03-Oct-92														Page No. 6.1.1
10:36:00	0.00	36.71	16 Adj											Open LPR-N For Flow.
11:00:00	0.00	37.56	28 Adj	6.25	375.08	6.25								Diesel Returns.
11:30:00	0.00	36.55	28 Adj	2.08	100.02	8.34								No Sample - Gas Only.
12:00:00	0.00	36.35	28 Adj	0.42	20.01	8.75								No Sample - Gas Only.
12:30:00	0.00	35.74	28 Adj	0.83	40.01	9.59								No Sample - Gas Only.
13:00:00	0.00	35.61	28 Adj	0.42	20.01	10.00								No Sample - Gas Only.
13:30:00	0.00	36.36	28 Adj	0.00	0.00	10.00								No Sample - Gas Only.
14:00:00	0.00	35.96	28 Adj	1.67	80.02	11.67								No Sample - Gas Only.
14:30:00	0.00	34.48	28 Adj											No Sample - Gas Only.
15:00:00	0.00	32.99	28 Adj	0.42	20.01	12.09								No Sample - Gas Only.
15:30:00	0.00	31.49	28 Adj											No Sample - Gas Only.
15:43:00	0.00	30.80	Closed	0.00	0.00	12.09								Close In Well @ LPR-N & Cycle OMNI To Cir Pos
15:55:00	0.00	30.02	Closed											LPR-N Valve Closed - OMNI Valve In Cir. Pos.
16:03:00	179.50	35.16	28 Adj											Open Choke Manifold To Reverse Out To Tanks.
16:15:00	406.10	39.42	28 Adj											Oil & Gas Returns.
16:18:00	415.13	39.79	28 Adj											Emulsified H2O @ Data Header.
16:20:00	382.63	40.05	32 Adj											
16:23:00	380.08	40.75	36 Adj											
16:30:00	391.48	42.53	36 Adj											BS&W=90% H2O 0.25% Solids.
16:45:00	387.50	43.76	36 Adj											BS&W=99.8% H2O 0.2% Solids.
16:55:00	296.75	44.13	Closed											Finish Reversing Out. 61 bbls Returned To Tank.
17:05:00	10.65	42.32	Closed											Start Displacing w/Diesel. Returns Going To Rig.
17:30:00	307.62	38.59	Closed											Continue Pumping Diesel.

Halliburton Reservoir Services Surface Test Data

Company: ARCO Alaska,Inc.
Well: Kuvlum #1 DST #2
Date: 02-Oct-1992

				Tank And Separtor Data					SCAN Data					
Time	Whp (psig)	Wht (deg F)	Choke (64ths)	Inc Vol (bbls)	Rate (bbl/day)	Cum Vol (bbls)	Gas Rate Total (mscf/day)	Cum Gas (mscf)	Mtr Corr Vol (bbls)	Oil Rate (0.80446) (bbl/day)	Mtr Prod Vol (bbls)	Gas Rate Total (mscf/day)	Cum Gas (mscf)	Comments
03-Oct-92														Page No. 6.1.2
17:55:00	642.50	36.39	Closed											Finish Displacing w/Diesel. 44 bbls Pumped.
18:05:00	2176.75	36.01	Closed											Cycle OMNI Valve To Well Test Pos.
18:21:00	0.00	34.05	28 Adj											Open Well To Flow @ LPR-N And Ch. Man.
18:23:00	151.60	43.47	32 Adj											
18:24:00	97.52	41.22	37 Adj											
18:24:30	42.82	39.05	40 Adj											
18:25:00	28.02	39.53	44 Adj											
18:30:00	0.00	42.15	44 Adj	4.58	733.48	16.67								Sample - Clean Diesel.
18:36:00	0.00	41.68	40 Adj											Sample - Clean Diesel.
18:37:00	0.00	41.61	36 Adj											Sample - Clean Diesel.
18:38:00	0.00	41.57	32 Adj											Sample - Clean Diesel.
18:42:00	0.00	41.37	28 Adj											Sample - Clean Diesel.
18:45:00	0.00	41.27	28 Adj	7.08	680.14	23.76								Sample - Clean Diesel.
18:49:00	0.00	41.54	20 Adj											Sample - Clean Diesel.
18:52:00	0.00	41.52	16 Adj											Sample - Clean Diesel.
19:00:00	0.00	41.23	16 Adj	4.58	440.09	28.34								Sample - Clean Diesel.
19:15:00	0.00	40.82	16 Adj	3.33	320.06	31.67								Sample - Clean Diesel.
19:30:00	0.00	40.31	16 Adj	2.50	240.05	34.17								Sample - Clean Diesel.
19:45:00	1.88	39.61	16 Adj	3.33	320.06	37.51								Sample - Clean Diesel.
19:55:00	21.95	39.47	20 Adj											Sample - Clean Diesel.
19:58:00	29.90	39.41	24 Adj											Sample - Clean Diesel.
20:00:00	31.30	39.25	28 Adj	5.00	480.10	42.51								Sample - Clean Diesel.
20:07:00	75.27	40.63	36 Adj											Sample - Clean Diesel.

Halliburton Reservoir Services Surface Test Data

Company: ARCO Alaska,Inc.
Well: Kuvlum #1 DST #2
Date: 02-Oct-1992

				Tank And Separtor Data					SCAN Data					
Time	Whp (psig)	Wht (deg F)	Choke (64ths)	Inc Vol (bbls)	Rate (bbl/day)	Cum Vol (bbls)	Gas Rate Total (mscf/day)	Cum Gas (mscf)	Mtr Corr Vol (bbls)	Oil Rate (0.80446) (bbl/day)	Mtr Prod Vol (bbls)	Gas Rate Total (mscf/day)	Cum Gas (mscf)	Comments
03-Oct-92														Page No. 6.1.3
20:15:00	55.33	38.60	36 Adj	12.50	1200.24	55.01								Sample - Clean Diesel.
20:19:00	34.35	38.55	36 Adj											Trace Formation Fluids To Surface.
20:30:00	125.88	39.82	36 Adj	3.75	360.07	58.76								BS&W=75% H2O Salinity=110,000 ppm PH=7.5.
20:45:00	230.65	39.91	36 Adj	15.84	1520.30	74.60								BS&W=90% H2O 0.3% Solids PH=8.
21:00:00	289.25	40.24	36 Adj	3.33	320.06	77.93	567.80	5.91						BS&W=30% H2O 0.2% Solids CO2=0.15%.
21:15:00	356.50	40.47	36 Adj											BS&W=6% H2O 0.1% Solids Sal.=108,000 ppm.
21:30:00	449.00	40.85	36 Adj	0.00	0.00	77.93						342.78	1.19021	BS&W=0.3% H2O Salinity=108,000 ppm PH=7.5.
21:45:00	439.25	41.06	40 Adj									336.5	2.35861	BS&W=5% H2O Trace Solids.
22:00:00	478.75	42.00	40 Adj	20.00	960.19	97.94								BS&W=0.5% H2O Trace Solids.
22:30:00	553.75	43.01	40 Adj	35.42	1700.34	133.36	847.71	23.58				750.52	9.13414	BS&W=0.5% H2O Trace Solids.
23:00:00	564.50	41.89	40 Adj	26.67	1280.26	160.03	904.66	42.42	44.67	1724.89	44.67	902.364	27.9334	BS&W=0.1% H2O. Oil Grav.= 31.5 @60 D.F.
23:07:00	576.00	41.88	Closed	2.08	428.66	162.12	898.25	46.79	6.06	1002.29	50.73	879.436	32.2084	Shut Well In @ Choke Manifold.
23:11:00	688.75	42.71	Closed											Shut Sub Sea Retainer Valve.
23:12:00	688.50	42.24	Closed											Bleed Off Press. To Rig Up Wireline PLT.
23:15:00	0.00	31.17	Closed											Rig Up Wireline PLT.
04-Oct-92														
00:11:00	831.00	52.24	Closed											Open Sub Sea Retainer Valve And RIH w/PLT.
01:15:00	933.25	39.05	16 Adj											Open Well @ Choke Manifold. Increase Choke Slow
01:30:00	511.75	39.52	46 Adj	3.75	360.07	165.87	1110.43	58.36				1116.55	33.7592	BS&W=0.5% H2O Trace Solids.
01:37:00	466.75	40.93	52 Adj											Increase Choke.
01:44:00	425.00	42.23	60 Adj											Increase Choke.
02:00:00	351.75	43.78	60 Adj	91.27	4380.88	257.14	1640.30	92.53	49.06	5711.69	99.79	1664.27	66.9341	BS&W=0.1% H2O Trace Solids CO2=0.15%.
02:30:00	309.25	45.91	60 Adj	65.85	3160.63	322.98	1513.79	124.07	106.93	4129.07	206.72	1532.17	98.8543	BS&W=0.3% Emulsion. @02:00 Start Defoamer.

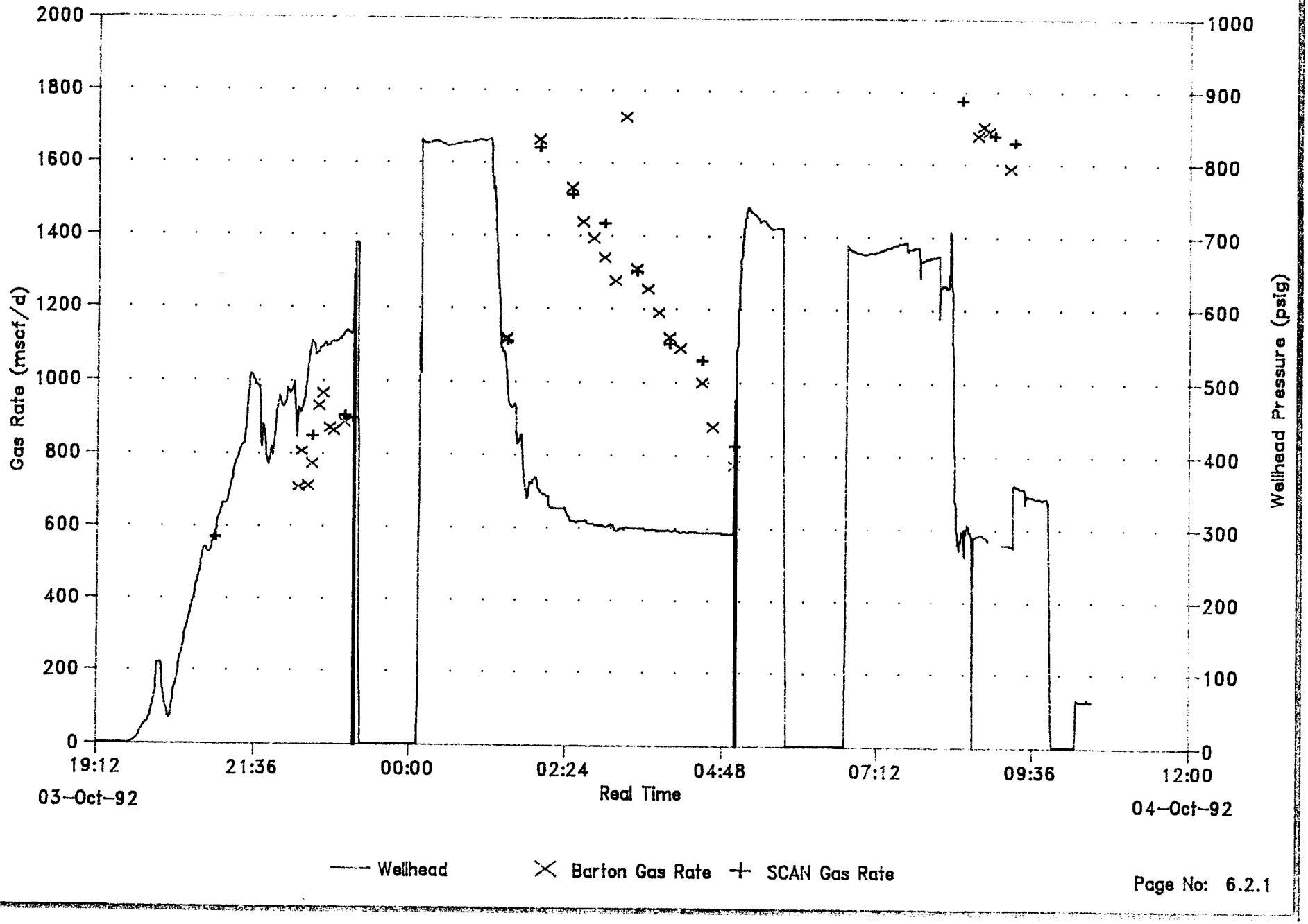
Halliburton Reservoir Services Surface Test Data

Company: ARCO Alaska,Inc.
Well: Kuvlum #1 DST #2
Date: 02-Oct-1992

				Tank And Separtor Data					SCAN Data					
Time	Whp (psig)	Wht (deg F)	Choke (64ths)	Inc Vol (bbls)	Rate (bbl/day)	Cum Vol (bbls)	Gas Rate Total (mscf/day)	Cum Gas (mscf)	Mtr Corr Vol (bbls)	Oil Rate (0.80446) (bbl/day)	Mtr Prod Vol (bbls)	Gas Rate Total (mscf/day)	Cum Gas (mscf)	Comments
04-Oct-92														Page No. 6.1.4
03:00:00	302.50	47.38	60 Adj	65.85	3160.63	386.83	1435.90	153.98	100.58	3883.80	307.30	1389.86033	127.81	BS%W=0.1% Emulsion. Trace Sand.
03:30:00	299.50	48.66	60 Adj	61.68	2960.59	450.51	1301.30	181.09	101.63	3924.35	408.93	1438.267	157.774	BS%W=0.1% Emulsion. Trace Sand.
04:00:00	298.25	49.83	60 Adj	67.93	3260.65	518.44	1101.92	204.05	93.09	3594.58	502.02	1188.303	182.53	BS&W=0.0% Trace Sand. OG=31.6 @60 D.F.
04:30:00	294.50	50.74	60 Adj	70.01	3360.67	588.45	1059.25	226.12	98.55	3805.42	600.57	1045.22	204.305	
05:00:00	292.25	51.64	Closed	95.02	4560.91	683.47	823.50	243.27	98.24	3793.45	698.81	823.88	221.47	Close Well In @ Choke Manifold.
05:12:00	737.00	49.01	Closed											Close LPR-N Valve.
05:41:00	711.50	39.13	Closed											Close Sub Sea Retainer Valve.
05:50:00	0.00	31.63	Closed											Rig Down PLT & Rig Up SRO Gauge w/"E" Probe.
06:42:00	0.00	31.73	Closed											Open Sub Sea Valve.
06:45:00	688.00	40.72	Closed											Run In Hole w/SRO Gauge.
07:26:00	687.75	31.89	closed											Latch "E" Probe. Pull 1100# Over Line Wt.
08:09:00	673.50	29.20	Closed											2 Attempts Can Not Open Valve. Remain Latched.
08:18:00	630.25	31.60	Closed											Open LPR-N Valve.
08:19:00	653.00	30.97	18 Adj											Open Well @Choke Man. Increase Slowly.
08:30:00	287.25	44.55	128 Adj	22.09	2891.49	705.56	1774.84	256.83						BS&W=0.25% H2O. Trace Sand.
09:00:00	279.83	48.75	128 Adj	60.43	2900.58	765.99	1676.68	291.76				1697.27	233.256	BS&W=0.0% Trace Sand. Oil Grav.=31.8 @60 D.F.
09:18:00	275.75	49.22	Closed	62.51	5001.00	828.50	1658.23	326.31						Close Well In @ LPR-N And Ch. Man. For Ice Event.
09:20:00	359.53	49.44	Closed											Unlatch "E" Probe And POOH.
09:47:00	342.99	39.44	Closed											OOH w/Wireline.
09:51:00	338.03	38.55	Closed											Close Sub Sea Retainer Valve. Bleed Off Press.
10:20:00														Rig Down CoFlex Line. Rig Up Kill Line.

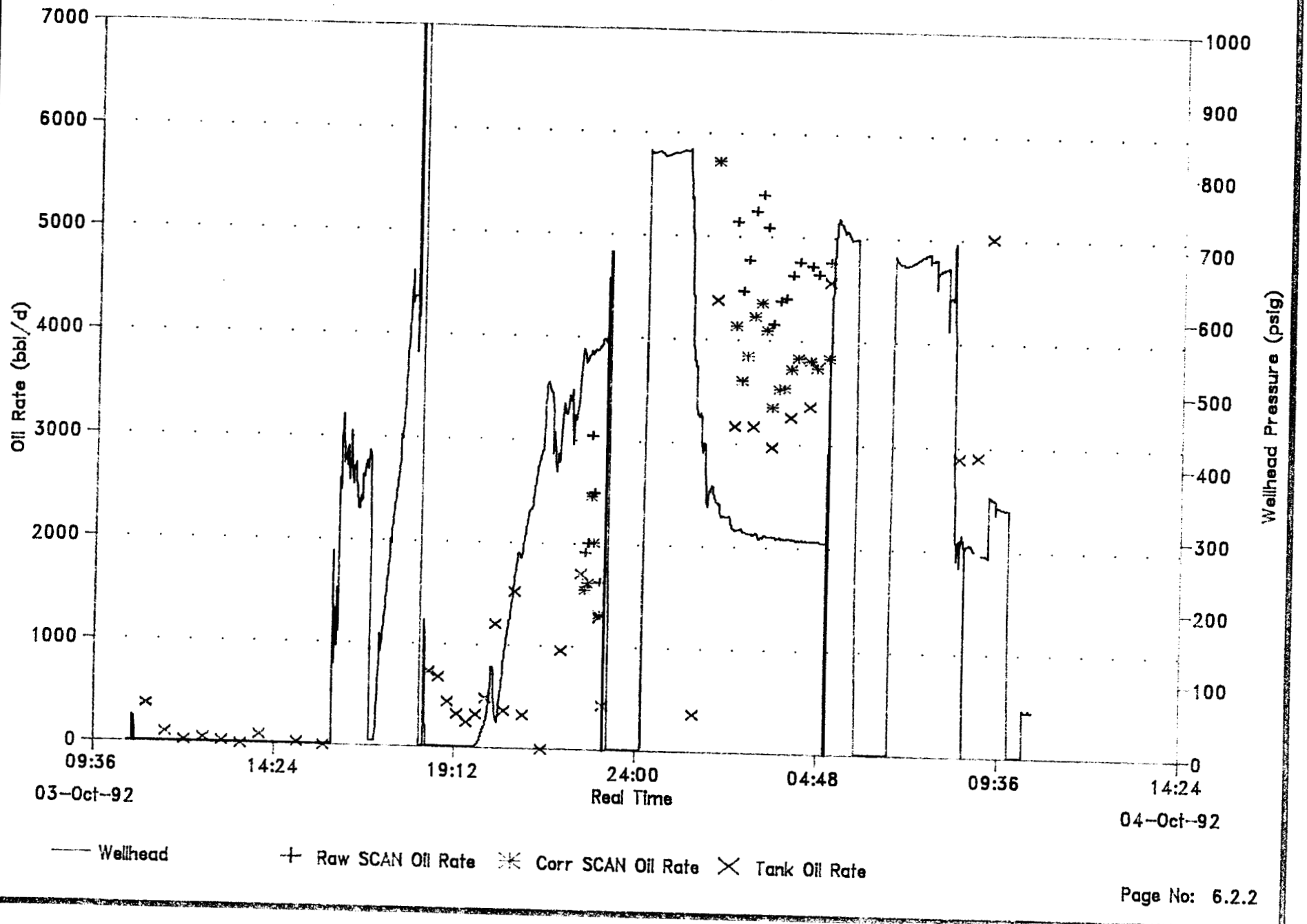
Halliburton Reservoir Services

Wellhead Press & Gas Rates VS Real Time



Halliburton Reservoir Services

Wellhead Press & Oil Rates VS Real Time



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CORE LABORATORIES

Reservoir Fluid Study
for

Arco Exploration & Production Technology

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RFL 920279
19-Nov-92

A product of
Core Laboratories
a division of Western Atlas International, Inc.

Western Atlas International
A Litton Dresser Company

CORE LABORATORIES

November 19, 1992

Arco Exploration and Production Technology
2300 West Plano Parkway
Rm PRC -E1115
Plano, TX 75075

ATTENTION: Mr. Russ Bone

Subject: **Reservoir Fluid Study**
Well:
File: **RFL 920279**

Dear Mr. Bone,

Multiple samples of separator gas and oil were collected from the subject well by representatives of Arco Exploration and Production Technology. These samples were shipped to our laboratory in Carrollton, Texas for use in a reservoir fluid study. The results of this study are presented on the following pages.

It has been a pleasure to perform this reservoir fluid study for Arco Exploration and Production Technology. Should any questions arise or if we may be of further service in any way, please do not hesitate to contact us.

Sincerely,

Karl W. Karnes

Karl W. Karnes
Supervising Engineer
Reservoir Fluid Analysis

KWK
16 cc: Addressee
15 bound & 1 unbound

Laboratory Procedures

Arco Exploration & Production Technology
Reservoir Fluid Study

RFL 920279

On October 16, 1992, multiple samples of separator gas and oil were received in our Carrollton, Texas laboratory. Bubblepoint determinations of each liquid sample were measured at lab ambient temperature as a quality check. Gas opening pressures were also measured. A summary of samples received in the laboratory may be found on page four.

Each of the six separator gas samples was analyzed by extended gas chromatography to determine gas composition to the last detectable peak. These data are presented on pages five through ten. The compositions of the two separator oil samples were measured through a heptanes plus residual fraction by low temperature fractional distillation. The heptanes plus fractions were further analyzed by gas chromatography through hexatriacontanes plus. The composition and density of the fluids can be found on pages 11 through 16.

A routine quality control check of separator products' compositions is a "K-value" plot of relative component content versus component boiling point. Specifically, the K-value is the mole percent of a particular hydrocarbon component of the gas divided by the mole percent of this component of the separator oil. When the logs of the K-values of methane through hexanes plus nitrogen, carbon dioxide and hydrogen sulfide are plotted against the boiling points of the individual components, the results should yield a smooth line. Additionally, theoretical equilibrium ratios (K-values) can be determined for specific separator conditions and plotted with the measured data. When these plots were made for the above compositional data, the plots did not agree well with the theoretical data. An example of the K-value plots is presented following the separator products' compositions and is designated figure QC-1.

The separator gas was combined with the separator oil to yield a saturation pressure of 3000 psig at 119°F. This recombined reservoir fluid was used for all further analyses. The composition of the reservoir fluid was determined through a heptanes plus residual fraction by low temperature fractional distillation. The heptanes plus fractions were further analyzed by gas chromatography through hexatriacontanes plus. These data are presented on pages 17 through 19.

A portion of the reservoir fluid was charged to a high pressure, windowed cell heated to the reported reservoir temperature of 119°F. During the constant composition expansion at this temperature, a bubblepoint was observed at 3019 psig. The results of the pressure-volume relations are presented on pages 20 and 21.

During the differential vaporization at the reservoir temperature, the fluid evolved a total of 612 cubic feet of gas at 14.65 psia and 60°F per barrel of residual oil at 60°F. The resulting relative oil volume factor was 1.272 barrels of saturated fluid per barrel of residual oil at 60°F. The oil density and the properties of the evolved gases were measured at each point during the differential pressure depletion and the data included in the summary of the differential vaporization data on page 22.

The viscosity of the reservoir fluid was measured over a wide range of pressures at 119°F in a rolling ball viscosimeter. The viscosity of the fluid was found to vary from a minimum of 1.014 centipoises at the saturation pressure to a maximum of 3.623 centipoises at atmospheric pressure. The results of the viscosity measurements are presented on page 23.

Small portions of the reservoir fluid were subjected to two two-stage and one three-stage separator tests to determine gas/oil ratio, stock tank oil gravity and formation volume factor. These data can be found on page 24. The gases and stock tank oil evolved from the "base case" separator test were collected and analyzed. These compositions are presented on pages 25 through 28. The separator test data were used to adjust the differential vaporization data to surface conditions and are summarized on pages 30 and 32.

A large portion of reservoir fluid was charged to a PVT cell at 119°F. From this sample three gas depleted oils were prepared at specified saturation pressures. A separator test was performed on the individual "DV" oils at the same conditions as the "base case" multi-stage separator test investigated above. The results of these analyses are presented on page 29.

Equations and nomenclature are included in the appendix of the report which extend and define the analytical expressions and data relationships presented in the study.

TABLE OF CONTENTS

LIST OF FIGURES

Arco Exploration & Production Technology

RFL 920279

SUMMARY OF PVT DATA

Reservoir Conditions

Current Reservoir Pressure	3000	psig
Reservoir Temperature	119	°F

Pressure-Volume Relations

Saturation Pressure	3019	psig
Avg Single-Phase Compressibility	8.08	E-6 v/v/psi (5000 to 3019 psig)
Thermal Exp @ 5000 psig	1.02791	V at 119 °F / V at 70 °F

Differential Vaporization Data

(at 3019 psig and 119 °F)

Solution Gas/Oil Ratio	612	scf / bbl of residual oil at 60 °F
Relative Oil Volume	1.272	bbl / bbl of residual oil at 60 °F
Density of Reservoir Fluid	0.7448	gm/cc

Reservoir Fluid Viscosity

1.01 cp at 3019 psig and 119 °F

Separator Test Data

Separator Conditions		Formation Volume Factor	Total Solution Gas/Oil Ratio	Tank Oil Gravity (°API at 60 °F)
psig	°F	(A)	(B)	
100	90	1.276	625	34.1
100	140	1.284	632	34.0
500	90	1.260	593	34.6

(A) Barrels of oil at 3019 psig and 119 °F per barrel of stock tank oil at 60 °F.

(B) Total standard cubic feet of gas per barrel of stock tank oil at 60 °F.

Arco Exploration & Production Technology

RFL 920279

General Well Information

Company	**Arco Exploration & Production Technology**
Well Name	**Brad Berg #1**
API Well Number	*
File Number	**RFL 920279**
Date Sample Collected	*
Sample Type	**Separator**
Geographical Location	*
Field	*

Well Description

Formation	*	
Pool (or Zone)	*	
Date Completed	*	
Elevation	*	ft
Producing Interval	*	ft
Total Depth	*	ft
Tubing Size	*	in
Tubing Depth	*	ft
Casing Size	*	in
Casing Depth	*	ft

Pressure Survey Data

Data from Original Discovery Well

Date	*	
Reservoir Pressure	*	psig

Data at Sample Collection

Date	*	
Reservoir Pressure	**3000**	psig
Reservoir Temperature	**119**	°F
Pressure Tool	*	
Flowing Bottom-Hole Pressure	*	psig
Flowing Tubing Pressure	*	psig

* Data not forwarded to Core Laboratories.

Arco Exploration & Production Technology

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Production Data

Data from Original Discovery Well

Location	*	
Date	*	
Oil Gravity @ STP	*	°API
Separator Pressure	*	psig
Separator Temperature	*	°F
Production Rates		
Gas	*	Mscf/D
Liquid	*	STbbl/D
Gas/Liquid Ratio	*	scf/bbl

Separator Conditions

Primary Separator Pressure	*	psig
Primary Separator Temperature	*	°F
Secondary Separator Pressure	*	psig
Secondary Separator Temperature	*	°F
Primary Separator Gas Production Rate	*	Mscf/D

Gas Factors -

Field Values:		
Pressure Base	*	psia
Temperature Base	*	°F
Compressibility Factor (Fpv)	*	
Gas Gravity Factor (Fg)	*	
Laboratory Values:		
Pressure Base	**14.65**	psia
Temperature Base	**60**	°F
Compressibility Factor (Fpv)		
Gas Gravity Factor (Fg)		

Primary Separator Liquid Rate	*	bbl/D at	°F
Stock Tank Liquid Rate	*	bbl/D at	°F
Separator Gas / Separator Liquid Ratio	*	scf/bbl	
Separator Gas / Stock Tank Liquid Ratio	*	scf/bbl	
Stock Tank Liquid / Separator Gas Ratio	*	bbl/Mscf	
Separator Liquid / Stock Tank Liquid Ratio	*	bbl/bbl at	°F

* Data not forwarded to Core Laboratories.

PRELIMINARY QUALITY CHECKS PERFORMED ON SAMPLES
RECEIVED IN LABORATORY

Separator Gas					
Cylinder Number	Sampling Conditions		Laboratory Opening Conditions		
	psig	°F	psig	°F	Liquid Recovered (cc)
257903D	127	106	125	71	2
349859C	127	106	135	71	2
349869D*	127	106	127	71	2
8EK080	127	106	125	71	2
G20033	127	106	125	71	1
CLH478	127	106	125	71	0

Separator Oil					
Cylinder Number	Sampling Conditions		Laboratory Bubblepoint		Water Recovered (cc)
	psig	°F	psig	°F	
193471D*	127	106	98	71	3
W3A8814	127	106	61	69	2

* Sample selected for recombination.

Arco Exploration & Production Technology

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Composition of Separator Gas

(From Chromatographic Technique)

Component	Mol %	GPM	MW	Liq Dens (gm/cc)
Hydrogen Sulfide	0.00			
Carbon Dioxide	0.41		44.010	.8172
Nitrogen	0.24		28.013	.8086
Methane	82.30		16.043	.2997
Ethane	5.67	1.508	30.070	.3558
Propane	5.17	1.417	44.097	.5065
iso-Butane	1.43	.465	58.123	.5623
n-Butane	1.93	.605	58.123	.5834
iso-Pentane	0.88	.320	72.150	.6241
n-Pentane	0.51	.184	72.150	.6305
Hexanes	0.58	.224	84.000	.6850
Heptanes	0.47	.197	96.000	.7220
Octanes	0.29	.131	107.00	.7450
Nonanes	0.09	.045	121.00	.7640
Decanes plus	0.03	.017	141.00	.7840
Totals	100.00	5.113		

Properties of Plus Fractions

Component	Mol %	MW	Liq Dens (gm/cc)	API Gravity
Heptanes plus	0.88	103.7	0.736	44.6
Decanes plus	0.03	141.0	0.784	38.3

Sampling Conditions

125 psig
106 °F

Sample Characteristics

Cylinder No. 257903D

Critical Pressure (psia)	644.2
Critical Temperature (°R)	376.3
Average Molecular Weight	21.79
Calculated Gas Gravity (air = 1.000)	0.752
Gas Gravity Factor, Fg	1.1528
Super Compressibility Factor, Fpv at sampling conditions	1.0091
Gas Z-Factor at sampling conditions *	0.982

at 14.65 psia and 60 °F

Gross Heating Value (BTU/scf dry gas)	1299

Air Content, mol %

Air Oxygen	0.20
Air Nitrogen	0.72
Total Air Content	0.92

* From: Standing, M.B., "Volumetric and Phase Behavior of Oil Field Hydrocarbon Systems", SPE (Dallas),1977, 8th Edition, Appendix II.

Arco Exploration & Production Technology

RFL 920279

Composition of Separator Gas

(From Chromatographic Technique)

Component	Mol %	GPM	MW	Liq Dens (gm/cc)
Hydrogen Sulfide	0.00			
Carbon Dioxide	0.43		44.010	.8172
Nitrogen	0.13		28.013	.8086
Methane	81.03		16.043	.2997
Ethane	5.86	1.559	30.070	.3558
Propane	5.50	1.507	44.097	.5065
iso-Butane	1.55	.504	58.123	.5623
n-Butane	2.24	.702	58.123	.5834
iso-Pentane	1.07	.389	72.150	.6241
n-Pentane	0.62	.223	72.150	.6305
Hexanes	0.68	.262	84.000	.6850
Heptanes	0.48	.201	96.000	.7220
Octanes	0.25	.113	107.00	.7450
Nonanes	0.10	.050	121.00	.7640
Decanes	0.06	.033	134.00	.7780
Undecanes plus	0.00			
Totals	100.00	5.543		

Properties of Plus Fractions

Component	Mol %	MW	Liq Dens (gm/cc)	API Gravity
Heptanes plus	0.89	104.5	0.737	44.5
Decanes plus	0.06	134.0	0.778	39.1

Sampling Conditions

125 psig
106 °F

Sample Characteristics

Cylinder No. 349859C

Critical Pressure (psia)	641.1
Critical Temperature (°R)	378.3
Average Molecular Weight	22.34
Calculated Gas Gravity (air = 1.000)	0.771
Gas Gravity Factor, Fg	1.1387
Super Compressibility Factor, Fpv at sampling conditions	1.0093
Gas Z-Factor at sampling conditions *	0.982

at 14.65 psia and 60 °F

Gross Heating Value (BTU/scf dry gas)	1330

Air Content, mol %

Air Oxygen	0.11
Air Nitrogen	0.40
Total Air Content	0.52

* From: Standing, M.B., "Volumetric and Phase Behavior of Oil Field Hydrocarbon Systems", SPE (Dallas),1977, 8th Edition, Appendix II.

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Composition of Separator Gas

(From Chromatographic Technique)

Component	Mol %	GPM	MW	Liq Dens (gm/cc)
Hydrogen Sulfide	0.00			
Carbon Dioxide	0.43		44.010	.8172
Nitrogen	0.14		28.013	.8086
Methane	81.53		16.043	.2997
Ethane	5.81	1.545	30.070	.3558
Propane	5.33	1.461	44.097	.5065
iso-Butane	1.47	.478	58.123	.5623
n-Butane	2.07	.649	58.123	.5834
iso-Pentane	0.97	.353	72.150	.6241
n-Pentane	0.56	.202	72.150	.6305
Hexanes	0.66	.255	84.000	.6850
Heptanes	0.54	.226	96.000	.7220
Octanes	0.37	.167	107.00	.7450
Nonanes	0.10	.050	121.00	.7640
Decanes	0.02	.011	134.00	.7780
Undecanes plus	Trace			
Totals	100.00	5.397		

Properties of Plus Fractions

Component	Mol %	MW	Liq Dens (gm/cc)	API Gravity
Heptanes plus	1.03	103.1	0.735	44.8
Decanes plus	0.02	134.0	0.779	39.0

Sampling Conditions

127 psig
106 °F

Sample Characteristics

Cylinder No. 349869D

Critical Pressure (psia)	641.6
Critical Temperature (°R)	376.7
Average Molecular Weight	22.18
Calculated Gas Gravity (air = 1.000)	0.766
Gas Gravity Factor, Fg	1.1426
Super Compressibility Factor, Fpv at sampling conditions	1.0093
Gas Z-Factor at sampling conditions *	0.982

at 14.65 psia and 60 °F

Gross Heating Value (BTU/scf dry gas)	1321

Air Content, mol %

Air Oxygen	0.20
Air Nitrogen	0.72
Total Air Content	0.92

* From: Standing, M.B., "Volumetric and Phase Behavior of Oil Field Hydrocarbon Systems", SPE (Dallas),1977, 8th Edition, Appendix II.

Composition of Separator Gas

(From Chromatographic Technique)

Component	Mol %	GPM	MW	Liq Dens (gm/cc)
Hydrogen Sulfide	0.00			
Carbon Dioxide	0.43		44.010	.8172
Nitrogen	0.13		28.013	.8086
Methane	81.39		16.043	.2997
Ethane	5.68	1.511	30.070	.3558
Propane	5.28	1.447	44.097	.5065
iso-Butane	1.47	.478	58.123	.5623
n-Butane	2.04	.640	58.123	.5834
iso-Pentane	1.02	.371	72.150	.6241
n-Pentane	0.60	.216	72.150	.6305
Hexanes	0.73	.282	84.000	.6850
Heptanes	0.59	.247	96.000	.7220
Octanes	0.38	.172	107.00	.7450
Nonanes	0.12	.060	121.00	.7640
Decanes	0.09	.049	134.00	.7780
Undecanes plus	0.05	.030	154.00	.7950
Totals	100.00	5.503		

Sampling Conditions

127 psig
106 °F

Sample Characteristics

Cylinder No. 8EK080

Critical Pressure (psia)	639.3
Critical Temperature (°R)	374.9
Average Molecular Weight	22.46
Calculated Gas Gravity (air = 1.000)	0.775
Gas Gravity Factor, Fg	1.1356
Super Compressibility Factor, Fpv at sampling conditions	1.0092
Gas Z-Factor at sampling conditions *	0.982

at 14.65 psia and 60 °F

Gross Heating Value (BTU/scf dry gas)	1336

Properties of Plus Fractions

Component	Mol %	MW	Liq Dens (gm/cc)	API Gravity
Heptanes plus	1.23	107.0	0.740	44.1
Decanes plus	0.14	141.1	0.784	38.3
Undecanes plus	0.05	154.0	0.795	36.9

Air Content, mol %

Air Oxygen	0.00
Air Nitrogen	0.00
Total Air Content	0.00

* From: Standing, M.B., "Volumetric and Phase Behavior of Oil Field Hydrocarbon Systems", SPE (Dallas),1977, 8th Edition, Appendix II.

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Composition of Separator Gas

(From Chromatographic Technique)

Component	Mol %	GPM	MW	Liq Dens (gm/cc)
Hydrogen Sulfide	0.00			
Carbon Dioxide	0.40		44.010	.8172
Nitrogen	0.25		28.013	.8086
Methane	82.65		16.043	.2997
Ethane	5.73	1.524	30.070	.3558
Propane	5.21	1.428	44.097	.5065
iso-Butane	1.39	.452	58.123	.5623
n-Butane	1.87	.586	58.123	.5834
iso-Pentane	0.85	.309	72.150	.6241
n-Pentane	0.49	.176	72.150	.6305
Hexanes	0.51	.197	84.000	.6850
Heptanes	0.36	.151	96.000	.7220
Octanes	0.21	.095	107.00	.7450
Nonanes	0.07	.035	121.00	.7640
Decanes plus	0.01	.006	141.00	.7840
Totals	100.00	4.959		

Sampling Conditions

125 psig
106 °F

Sample Characteristics

Cylinder No. G20033

Critical Pressure (psia)	646.6
Critical Temperature (°R)	377.3
Average Molecular Weight	21.49
Calculated Gas Gravity (air = 1.000)	0.742
Gas Gravity Factor, Fg	1.1610
Super Compressibility Factor, Fpv at sampling conditions	1.0091
Gas Z-Factor at sampling conditions *	0.982

at 14.65 psia and 60 °F

Gross Heating Value (BTU/scf dry gas)	1283

Properties of Plus Fractions

Component	Mol %	MW	Liq Dens (gm/cc)	API Gravity
Heptanes plus	0.65	102.9	0.735	44.8
Decanes plus	0.01	141.0	0.784	38.3

Air Content, mol %

Air Oxygen	0.10
Air Nitrogen	0.37
Total Air Content	0.47

* From: Standing, M.B., "Volumetric and Phase Behavior of Oil Field Hydrocarbon Systems", SPE (Dallas),1977, 8th Edition, Appendix II.

Composition of Separator Gas

(From Chromatographic Technique)

Component	Mol %	GPM	MW	Liq Dens (gm/cc)
Hydrogen Sulfide	0.00			
Carbon Dioxide	0.48		44.010	.8172
Nitrogen	0.12		28.013	.8086
Methane	78.87		16.043	.2997
Ethane	5.49	1.460	30.070	.3558
Propane	5.48	1.502	44.097	.5065
iso-Butane	1.62	.527	58.123	.5623
n-Butane	2.41	.756	58.123	.5834
iso-Pentane	1.28	.466	72.150	.6241
n-Pentane	0.80	.288	72.150	.6305
Hexanes	1.27	.490	84.000	.6850
Heptanes	1.47	.615	96.000	.7220
Octanes	0.53	.240	107.00	.7450
Nonanes	0.11	.055	121.00	.7640
Decanes plus	0.07	.040	141.00	.7840
Totals	100.00	6.439		

Properties of Plus Fractions

Component	Mol %	MW	Liq Dens (gm/cc)	API Gravity
Heptanes plus	2.18	101.4	0.732	45.1
Decanes plus	0.07	141.0	0.784	38.3

Sampling Conditions

125 psig
106 °F

Sample Characteristics

Cylinder No. CLH478

Critical Pressure (psia)	625.8
Critical Temperature (°R)	370.8
Average Molecular Weight	24.09
Calculated Gas Gravity (air = 1.000)	0.832
Gas Gravity Factor, Fg	1.0966
Super Compressibility Factor, Fpv at sampling conditions	1.0089
Gas Z-Factor at sampling conditions *	0.982

at 14.65 psia and 60 °F

Gross Heating Value (BTU/scf dry gas)	1421

Air Content, mol %

Air Oxygen	0.01
Air Nitrogen	0.04
Total Air Content	0.06

* From: Standing, M.B., "Volumetric and Phase Behavior of Oil Field Hydrocarbon Systems", SPE (Dallas),1977, 8th Edition, Appendix II.

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Composition of Separator Oil*

Component	Mol %	Wt %	MW	Liq Dens (gm/cc)
Hydrogen	0.00			
Hydrogen Sulfide	0.00			
Carbon Dioxide	0.05	0.010	44.010	0.8172
Nitrogen	0.00			
Methane	2.34	0.180	16.043	0.2997
Ethane	0.69	0.100	30.070	0.3558
Propane	1.61	0.340	44.097	0.5065
i-Butane	0.83	0.230	58.123	0.5623
n-Butane	1.51	0.420	58.123	0.5834
i-Pentane	1.27	0.440	72.15	0.6241
n-Pentane	1.47	0.510	72.15	0.6305
Hexanes	3.05	1.230	84.00	0.6850
Heptanes plus	87.18	96.540	231.00	0.8750
	100.00	100.00		

Note: Heptanes plus MW and Density are measured values.

* Corrected for hexanes minus fraction identified in residue analysis.

Sampling Conditions

127 psig
106 °F

Sample Characteristics

Cylinder No. 193471D

Average Molecular Weight 208.6
Sample Density (at 60 °F) 0.8596

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Composition of Heptanes Plus Fraction

(From Chromatographic Technique)

Component	Mol %	Wt %	Density (gm/cc)	MW	Vol %
Hydrogen Sulfide	.00	.00			
Carbon Dioxide	.00	.00			
Nitrogen	.00	.00			
Methane	.00	.00			
Ethane	.00	.00			
Propane	.00	.00			
iso-Butane	.00	.00			
n-Butane	.00	.00			
iso-Pentane	.00	.00			
n-Pentane	.00	.00			
Hexanes	.00	.00			
Heptanes	6.70	2.76	.722	96.0	3.35
Octanes	10.58	4.85	.745	107.0	5.70
Nonanes	7.84	4.07	.764	121.0	4.67
Decanes	7.40	4.25	.778	134.0	4.78
Undecanes	5.93	3.74	.789	147.0	4.15
Dodecanes	5.01	3.46	.800	161.0	3.79
Tridecanes	5.58	4.19	.811	175.0	4.53
Tetradecanes	4.98	4.06	.822	190.0	4.33
Pentadecanes	4.90	4.33	.832	206.0	4.55
Hexadecanes	3.86	3.67	.839	222.0	3.83
Heptadecanes	3.38	3.44	.847	237.0	3.56
Octadecanes	3.40	3.66	.852	251.0	3.77
Nonadecanes	2.75	3.10	.857	263.0	3.17
Eicosanes	2.25	2.65	.862	275.0	2.69
Heneicosanes	1.98	2.47	.867	291.0	2.50
Docosanes	1.80	2.35	.872	305.0	2.36
Tricosanes	1.57	2.14	.877	318.0	2.14
Tetracosanes	1.39	1.97	.881	331.0	1.96
Pentacosanes	1.24	1.84	.885	345.0	1.82
Hexacosanes	1.08	1.66	.889	359.0	1.64
Heptacosanes	1.07	1.72	.893	374.0	1.69
Octacosanes	1.00	1.66	.896	388.0	1.62
Nonacosanes	.91	1.57	.899	402.0	1.53
Triacontanes	.87	1.56	.902	416.0	1.52
Hentriacontanes	.74	1.36	.906	430.0	1.31
Dotriacontanes	.64	1.21	.909	444.0	1.16
Tritriacontanes	.57	1.12	.912	458.0	1.08
Tetratriacontanes	.45	.91	.914	472.0	0.88
Pentatriacontanes	.35	.73	.917	486.0	0.70
Hexatriacontanes plus	9.78	23.50	1.070	560.3	19.23
Totals	100.00	100.00			100.00

Sample Characteristics

Cylinder No. 193471D

Total Liquid Molecular Weight	233.2
Total Liquid Density (gm/cc)	0.8760
Total Liquid API Gravity	30.0

Properties of Heavy Fractions

Plus Fractions	Mol %	Wt %	Density (gm/cc)	°API	MW
Heptanes plus	100.00	100.00	0.876	30.0	233.2
Decanes plus	74.88	88.32	0.897	26.3	275.1
Undecanes plus	67.48	84.07	0.904	25.1	290.5
Pentadecanes plus	45.98	68.62	0.929	20.8	348.1
Eicosanes plus	27.69	50.42	0.964	15.3	424.7
Pentacosanes plus	18.70	38.84	0.995	10.6	484.3
Triacontanes plus	13.40	30.39	1.029	6.1	528.9
Pentatriacontanes plus	10.13	24.23	1.065	1.4	557.7

Composition of Low Temperature Distillation Residue

(From Chromatographic Technique)

Component	Mol %	Wt %	Density (gm/cc)	MW	Vol %
Hydrogen Sulfide	.00	.00			
Carbon Dioxide	.00	.00			
Nitrogen	.00	.00			
Methane	.00	.00			
Ethane	.00	.00			
Propane	.00	.00			
iso-Butane	.00	.00			
n-Butane	.04	.01	.583	58.1	0.02
iso-Pentane	.10	.03	.624	72.2	0.04
n-Pentane	.10	.03	.630	72.2	0.04
Hexanes	1.21	.44	.685	84.0	0.56
Heptanes	6.62	2.75	.722	96.0	3.33
Octanes	10.40	4.83	.745	107.0	5.67
Nonanes	7.73	4.05	.764	121.0	4.64
Decanes	7.29	4.23	.778	134.0	4.76
Undecanes	5.85	3.72	.789	147.0	4.12
Dodecanes	4.94	3.44	.800	161.0	3.76
Tridecanes	5.50	4.17	.811	175.0	4.50
Tetradecanes	4.91	4.04	.822	190.0	4.29
Pentadecanes	4.83	4.31	.832	206.0	4.53
Hexadecanes	3.80	3.65	.839	222.0	3.80
Heptadecanes	3.33	3.42	.847	237.0	3.53
Octadecanes	3.35	3.64	.852	251.0	3.73
Nonadecanes	2.71	3.08	.857	263.0	3.14
Eicosanes	2.22	2.64	.862	275.0	2.68
Heneicosanes	1.95	2.46	.867	291.0	2.48
Docosanes	1.77	2.34	.872	305.0	2.34
Tricosanes	1.55	2.13	.877	318.0	2.13
Tetracosanes	1.37	1.96	.881	331.0	1.94
Pentacosanes	1.23	1.83	.885	345.0	1.81
Hexacosanes	1.06	1.65	.889	359.0	1.63
Heptacosanes	1.06	1.71	.893	374.0	1.67
Octacosanes	.98	1.65	.896	388.0	1.61
Nonacosanes	.90	1.56	.899	402.0	1.52
Triacontanes	.86	1.55	.902	416.0	1.50
Hentriacontanes	.73	1.35	.906	430.0	1.30
Dotriacontanes	.62	1.20	.909	444.0	1.15
Tritriacontanes	.56	1.11	.912	458.0	1.07
Tetratriacontanes	.45	.91	.914	472.0	0.87
Pentatriacontanes	.35	.73	.917	486.0	0.70
Hexatriacontanes pl	9.63	23.38	1.070	560.3	19.12
Totals	100.00	100.00			100.00

Sample Characteristics

Cylinder No. 193471D

Total Liquid Molecular Weight	231.0
Total Liquid Density (gm/cc)	0.8746
Total Liquid API Gravity	30.3

Properties of Heavy Fractions

Plus Fractions	Mol %	Wt %	Density (gm/cc)	°API	MW
Hexanes plus	99.76	99.93	0.875	30.2	231.4
Heptanes plus	98.55	99.49	0.876	30.0	233.2
Decanes plus	73.80	87.86	0.897	26.3	275.0
Undecanes plus	66.51	83.63	0.904	25.1	290.5
Pentadecanes plus	45.31	68.26	0.929	20.8	348.1
Eicosanes plus	27.29	50.16	0.964	15.3	424.7
Pentacosanes plus	18.43	38.63	0.995	10.7	484.3
Triacontanes plus	13.20	30.23	1.028	6.1	528.9
Pentatriacontanes plus	9.98	24.11	1.064	1.4	557.7

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Composition of Separator Liquid*

Component	Mol %	Wt %	MW	Liq Dens (gm/cc)
Hydrogen	0.00			
Hydrogen Sulfide	0.00			
Carbon Dioxide	0.03	0.010	44.010	0.8172
Nitrogen	0.01	0.000	28.013	0.8086
Methane	2.65	0.200	16.043	0.2997
Ethane	0.74	0.100	30.070	0.3558
Propane	1.72	0.350	44.097	0.5065
i-Butane	0.90	0.240	58.123	0.5623
n-Butane	1.70	0.460	58.123	0.5834
i-Pentane	1.40	0.470	72.15	0.6241
n-Pentane	1.37	0.460	72.15	0.6305
Hexanes	3.71	1.460	84.00	0.6850
Heptanes plus	85.77	96.250	240.00	0.8740
	100.00	100.00		

Note: Heptanes plus MW and Density are measured values.

* Corrected for hexanes minus fraction identified in residue analysis.

Sampling Conditions

127 psig
106 °F

Sample Characteristics

Cylinder No. W3A8814

Average Molecular Weight 213.9
Sample Density (at 60 °F) 0.8575

Composition of Heptanes Plus Fraction

(From Chromatographic Technique)

Component	Mol %	Wt %	Density (gm/cc)	MW	Vol %
Hydrogen Sulfide	.00	.00			
Carbon Dioxide	.00	.00			
Nitrogen	.00	.00			
Methane	.00	.00			
Ethane	.00	.00			
Propane	.00	.00			
iso-Butane	.00	.00			
n-Butane	.00	.00			
iso-Pentane	.00	.00			
n-Pentane	.00	.00			
Hexanes	.00	.00			
Heptanes	5.71	2.28	.722	96.0	2.76
Octanes	9.08	4.04	.745	107.0	4.74
Nonanes	7.09	3.57	.764	121.0	4.08
Decanes	6.87	3.83	.778	134.0	4.30
Undecanes	5.64	3.45	.789	147.0	3.82
Dodecanes	4.88	3.27	.800	161.0	3.58
Tridecanes	5.55	4.04	.811	175.0	4.35
Tetradecanes	5.11	4.04	.822	190.0	4.29
Pentadecanes	5.17	4.42	.832	206.0	4.65
Hexadecanes	4.04	3.73	.839	222.0	3.89
Heptadecanes	3.61	3.56	.847	237.0	3.67
Octadecanes	3.71	3.87	.852	251.0	3.97
Nonadecanes	3.02	3.30	.857	263.0	3.37
Eicosanes	2.48	2.84	.862	275.0	2.88
Heneicosanes	2.22	2.69	.867	291.0	2.71
Docosanes	2.03	2.57	.872	305.0	2.58
Tricosanes	1.80	2.38	.877	318.0	2.37
Tetracosanes	1.61	2.21	.881	331.0	2.19
Pentacosanes	1.57	2.26	.885	345.0	2.23
Hexacosanes	1.21	1.81	.889	359.0	1.78
Heptacosanes	1.28	1.99	.893	374.0	1.95
Octacosanes	1.19	1.92	.896	388.0	1.87
Nonacosanes	1.09	1.82	.899	402.0	1.77
Triacontanes	1.05	1.81	.902	416.0	1.76
Hentriacontanes	.89	1.60	.906	430.0	1.55
Dotriacontanes	.77	1.42	.909	444.0	1.36
Tritriacontanes	.69	1.32	.912	458.0	1.27
Tetratriacontanes	.56	1.10	.914	472.0	1.05
Pentatriacontanes	.44	.89	.917	486.0	0.85
Hexatriacontanes plus	9.64	21.97	1.047	546.8	18.35
Totals	100.00	100.00			100.00

Sample Characteristics

Cylinder No. W3A8814

Total Liquid Molecular Weight	240.4
Total Liquid Density (gm/cc)	0.8740
Total Liquid API Gravity	30.4

Properties of Heavy Fractions

Plus Fractions	Mol %	Wt %	Density (gm/cc)	°API	MW
Heptanes plus	100.00	100.00	0.874	30.3	240.3
Decanes plus	78.12	90.11	0.891	27.3	277.2
Undecanes plus	71.25	86.28	0.897	26.3	291.0
Pentadecanes plus	50.07	71.48	0.918	22.6	343.1
Eicosanes plus	30.52	52.60	0.948	17.8	414.0
Pentacosanes plus	20.38	39.91	0.975	13.6	470.1
Triacontanes plus	14.04	30.11	1.006	9.2	514.7
Pentatriacontanes plus	10.08	22.86	1.041	4.4	544.1

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Composition of Low Temperature Distillation Residue

(From Chromatographic Technique)

Component	Mol %	Wt %	Density (gm/cc)	MW	Vol %
Hydrogen Sulfide	.00	.00			
Carbon Dioxide	.00	.00			
Nitrogen	.00	.00			
Methane	.00	.00			
Ethane	.00	.00			
Propane	.00	.00			
iso-Butane	.00	.00			
n-Butane	.04	.01	.583	58.1	0.02
iso-Pentane	.07	.02	.624	72.2	0.03
n-Pentane	.03	.01	.630	72.2	0.02
Hexanes	.71	.25	.685	84.0	0.31
Heptanes	5.65	2.27	.722	96.0	2.74
Octanes	9.00	4.03	.745	107.0	4.73
Nonanes	7.03	3.56	.764	121.0	4.07
Decanes	6.81	3.82	.778	134.0	4.29
Undecanes	5.59	3.44	.789	147.0	3.81
Dodecanes	4.84	3.26	.800	161.0	3.56
Tridecanes	5.50	4.03	.811	175.0	4.34
Tetradecanes	5.07	4.03	.822	190.0	4.28
Pentadecanes	5.15	4.42	.832	206.0	4.67
Hexadecanes	4.00	3.72	.839	222.0	3.87
Heptadecanes	3.58	3.55	.847	237.0	3.66
Octadecanes	3.68	3.86	.852	251.0	3.96
Nonadecanes	2.99	3.29	.857	263.0	3.35
Eicosanes	2.46	2.83	.862	275.0	2.87
Heneicosanes	2.20	2.68	.867	291.0	2.70
Docosanes	2.01	2.56	.872	305.0	2.57
Tricosanes	1.78	2.37	.877	318.0	2.36
Tetracosanes	1.59	2.20	.881	331.0	2.18
Pentacosanes	1.56	2.25	.885	345.0	2.22
Hexacosanes	1.20	1.80	.889	359.0	1.76
Heptacosanes	1.27	1.98	.893	374.0	1.94
Octacosanes	1.18	1.91	.896	388.0	1.86
Nonacosanes	1.08	1.81	.899	402.0	1.76
Triacontanes	1.03	1.80	.902	416.0	1.75
Hentriacontanes	.89	1.60	.906	430.0	1.55
Dotriacontanes	.76	1.42	.909	444.0	1.36
Tritriacontanes	.69	1.32	.912	458.0	1.27
Tetratriacontanes	.56	1.10	.914	472.0	1.05
Pentatriacontanes	.44	.89	.917	486.0	0.85
Hexatriacontanes pl	9.56	21.91	1.047	546.8	18.25
Totals	100.00	100.00			100.00

Sample Characteristics

Cylinder No. W3A8814

Total Liquid Molecular Weight	239.0
Total Liquid Density (gm/cc)	0.8736
Total Liquid API Gravity	30.5

Properties of Heavy Fractions

Plus Fractions	Mol %	Wt %	Density (gm/cc)	°API	MW
Hexanes plus	99.86	99.96	0.874	30.4	239.2
Heptanes plus	99.15	99.71	0.874	30.3	240.4
Decanes plus	77.47	89.85	0.891	27.3	277.2
Undecanes plus	70.66	86.03	0.897	26.3	291.0
Pentadecanes plus	49.66	71.27	0.918	22.6	343.0
Eicosanes plus	30.26	52.43	0.948	17.8	414.0
Pentacosanes plus	20.22	39.79	0.975	13.6	470.1
Triacontanes plus	13.93	30.04	1.006	9.2	514.7
Pentatriacontanes plus	10.00	22.80	1.042	4.3	544.1

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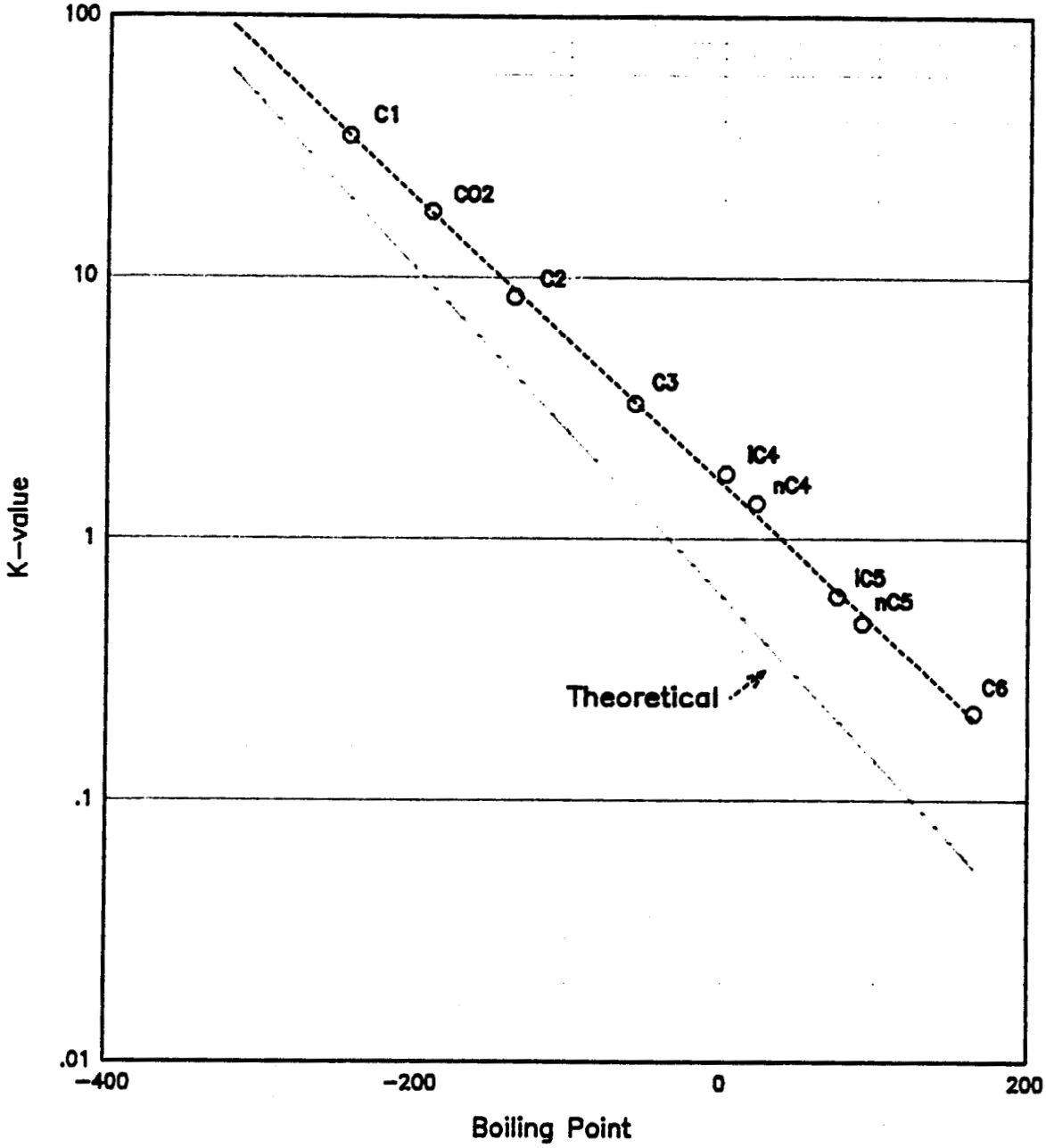
Equilibrium Ratios
(at 106 °F)



Separator Pressure 127 psig	K-Value Plot Figure QC-1

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Composition of Reservoir Fluid*

Component	Mol %	Wt %	MW	Liq Dens (gm/cc)
Hydrogen	0.00			
Hydrogen Sulfide	0.00			
Carbon Dioxide	0.27	0.110	44.010	0.8172
Nitrogen	0.07	0.020	28.013	0.8086
Methane	45.49	6.790	16.043	0.2997
Ethane	3.59	1.000	30.070	0.3558
Propane	3.75	1.540	44.097	0.5065
i-Butane	1.21	0.650	58.123	0.5623
n-Butane	2.01	1.090	58.123	0.5834
i-Pentane	0.93	0.620	72.15	0.6241
n-Pentane	1.05	0.700	72.15	0.6305
Hexanes	2.02	1.580	84.00	0.6850
Heptanes plus	39.61	85.900	233.00	0.8670
	100.00	100.00		

Note: Heptanes plus MW and Density are measured values.

* Corrected for hexanes minus fraction identified in residue analysis.

Sample Characteristics

Pb Adjusted Recombination

Average Molecular Weight 107.5

Sample Density (at 60 °F) 0.7397

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Composition of Heptanes Plus Fraction

(From Chromatographic Technique)

Component	Mol %	Wt %	Density (gm/cc)	MW	Vol %
Hydrogen Sulfide	.00	.00			
Carbon Dioxide	.00	.00			
Nitrogen	.00	.00			
Methane	.00	.00			
Ethane	.00	.00			
Propane	.00	.00			
iso-Butane	.00	.00			
n-Butane	.00	.00			
iso-Pentane	.00	.00			
n-Pentane	.00	.00			
Hexanes	.00	.00			
Heptanes	6.54	2.70	.722	96.0	3.24
Octanes	10.25	4.70	.745	107.0	5.47
Nonanes	7.30	3.80	.764	121.0	4.31
Decanes	6.91	3.98	.778	134.0	4.44
Undecanes	5.44	3.44	.789	147.0	3.78
Dodecanes	4.75	3.29	.800	161.0	3.56
Tridecanes	5.52	4.15	.811	175.0	4.44
Tetradecanes	5.19	4.24	.822	190.0	4.47
Pentadecanes	5.35	4.74	.832	206.0	4.94
Hexadecanes	3.83	3.66	.839	222.0	3.78
Heptadecanes	3.43	3.49	.847	237.0	3.57
Octadecanes	3.39	3.66	.852	251.0	3.73
Nonadecanes	2.91	3.29	.857	263.0	3.33
Eicosanes	2.30	2.72	.862	275.0	2.74
Heneicosanes	2.03	2.54	.867	291.0	2.54
Docosanes	1.86	2.44	.872	305.0	2.43
Tricosanes	1.62	2.22	.877	318.0	2.19
Tetracosanes	1.46	2.08	.881	331.0	2.05
Pentacosanes	1.46	2.17	.885	345.0	2.12
Hexacosanes	1.09	1.68	.889	359.0	1.64
Heptacosanes	1.21	1.95	.893	374.0	1.89
Octacosanes	1.06	1.77	.896	388.0	1.72
Nonacosanes	.92	1.59	.899	402.0	1.53
Triacontanes	1.00	1.79	.902	416.0	1.72
Hentriacontanes	.85	1.58	.906	430.0	1.51
Dotriacontanes	.68	1.30	.909	444.0	1.24
Tritriacontanes	.62	1.23	.912	458.0	1.17
Tetratriacontanes	.57	1.16	.914	472.0	1.10
Pentatriacontanes	.48	1.00	.917	486.0	0.95
Hexatriacontanes plus	9.98	21.64	1.021	504.2	18.38
Totals	100.00	100.00			100.00

Sample Characteristics

Pb Adjusted Recombination

Total Liquid Molecular Weight	232.6
Total Liquid Density (gm/cc)	0.8670
Total Liquid API Gravity	31.7

Properties of Heavy Fractions

Plus Fractions	Mol %	Wt %	Density (gm/cc)	°API	MW
Heptanes plus	100.00	100.00	0.867	31.7	232.5
Decanes plus	75.91	88.80	0.885	28.3	271.9
Undecanes plus	69.00	84.82	0.891	27.3	285.8
Pentadecanes plus	48.10	69.70	0.912	23.6	336.8
Eicosanes plus	29.19	50.86	0.940	19.0	404.9
Pentacosanes plus	19.92	38.86	0.964	15.4	453.3
Triacontanes plus	14.18	29.70	0.988	11.7	486.7
Pentatriacontanes plus	10.46	22.64	1.016	7.8	503.4

Composition of Low Temperature Distillation Residue

(From Chromatographic Technique)

Component	Mol %	Wt %	Density (gm/cc)	MW	Vol %
Hydrogen Sulfide	.00	.00			
Carbon Dioxide	.00	.00			
Nitrogen	.00	.00			
Methane	.00	.00			
Ethane	.00	.00			
Propane	.00	.00			
iso-Butane	.00	.00			
n-Butane	.00	.00			
iso-Pentane	.00	.00			
n-Pentane	.00	.00			
Hexanes	1.07	.39	.685	84.0	0.49
Heptanes	6.47	2.69	.722	96.0	3.23
Octanes	10.09	4.68	.745	107.0	5.44
Nonanes	7.24	3.79	.764	121.0	4.30
Decanes	6.83	3.96	.778	134.0	4.41
Undecanes	5.39	3.43	.789	147.0	3.77
Dodecanes	4.71	3.28	.800	161.0	3.55
Tridecanes	5.45	4.13	.811	175.0	4.41
Tetradecanes	5.13	4.22	.822	190.0	4.45
Pentadecanes	5.29	4.72	.832	206.0	4.91
Hexadecanes	3.80	3.65	.839	222.0	3.77
Heptadecanes	3.39	3.48	.847	237.0	3.56
Octadecanes	3.36	3.65	.852	251.0	3.71
Nonadecanes	2.88	3.28	.857	263.0	3.32
Eicosanes	2.28	2.71	.862	275.0	2.72
Heneicosanes	2.01	2.53	.867	291.0	2.53
Docosanes	1.84	2.43	.872	305.0	2.42
Tricosanes	1.61	2.21	.877	318.0	2.18
Tetracosanes	1.44	2.07	.881	331.0	2.04
Pentacosanes	1.45	2.16	.885	345.0	2.11
Hexacosanes	1.07	1.67	.889	359.0	1.63
Heptacosanes	1.20	1.94	.893	374.0	1.88
Octacosanes	1.05	1.76	.896	388.0	1.70
Nonacosanes	.91	1.58	.899	402.0	1.52
Triacontanes	.99	1.78	.902	416.0	1.71
Hentriacontanes	.84	1.57	.906	430.0	1.50
Dotriacontanes	.67	1.29	.909	444.0	1.23
Tritriacontanes	.62	1.23	.912	458.0	1.17
Tetratriacontanes	.57	1.16	.914	472.0	1.10
Pentatriacontanes	.48	1.00	.917	486.0	0.94
Hexatriacontanes plu	9.87	21.56	1.021	504.2	18.29
Totals	100.00	100.00			100.00

Sample Characteristics

Pb Adjusted Recombination

Total Liquid Molecular Weight	231.0
Total Liquid Density (gm/cc)	0.8664
Total Liquid API Gravity	31.8

Properties of Heavy Fractions

Plus Fractions	Mol %	Wt %	Density (gm/cc)	°API	MW
Hexanes plus	100.00	100.00	0.866	31.8	231.0
Heptanes plus	98.93	99.61	0.867	31.7	232.6
Decanes plus	75.13	88.45	0.886	28.3	272.0
Undecanes plus	68.30	84.49	0.891	27.3	285.8
Pentadecanes plus	47.62	69.43	0.912	23.6	336.8
Eicosanes plus	28.90	50.65	0.940	19.0	404.9
Pentacosanes plus	19.72	38.70	0.964	15.3	453.3
Triacontanes plus	14.04	29.59	0.988	11.7	486.7
Pentatriacontanes plus	10.35	22.56	1.016	7.7	503.4

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VOLUMETRIC DATA

(at 119 °F)

Saturation Pressure (Psat)	3019	psig
Density at Psat	0.7448	gm/cc
Thermal Exp @ 5000 psig	1.02791	V at 119 °F / V at 70 °F

AVERAGE SINGLE-PHASE COMPRESSIBILITIES

Pressure Range psig			Single-Phase Compressibility v/v/psi
5000	to	4500	7.64 E -6
4500	to	4000	7.95 E -6
4000	to	3500	8.31 E -6
3500	to	3019	8.65 E -6

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PRESSURE-VOLUME RELATIONS

(at 119 °F)

Pressure psig	Relative Volume (A)	Y-Function (B)	Density gm/cc
5000	0.9840		0.7569
4500	0.9878		0.7540
4000	0.9917		0.7510
3500	0.9958		0.7479
3400	0.9967		0.7473
3300	0.9976		0.7466
3200	0.9984		0.7460
3100	0.9993		0.7453
b»3019	1.0000		0.7448
3007	1.0008		
2999	1.0014		
2990	1.0020		
2981	1.0027		
2902	1.0086		
2747	1.0219		
2535	1.0442	4.299	
2237	1.0864	4.019	
1937	1.1483	3.737	
1670	1.2297	3.486	
1438	1.3330	3.268	
1241	1.4592	3.083	
1078	1.6062	2.930	
868	1.8917	2.733	
679	2.3201	2.556	
516	2.9634	2.402	
371	4.0298	2.266	

(A) Relative Volume: V/Vsat or volume at indicated pressure per volume at saturation pressure.

(B) Where: Y-Function $= \dfrac{(Psat - P)}{(Pabs) * (V/Vsat - 1)}$

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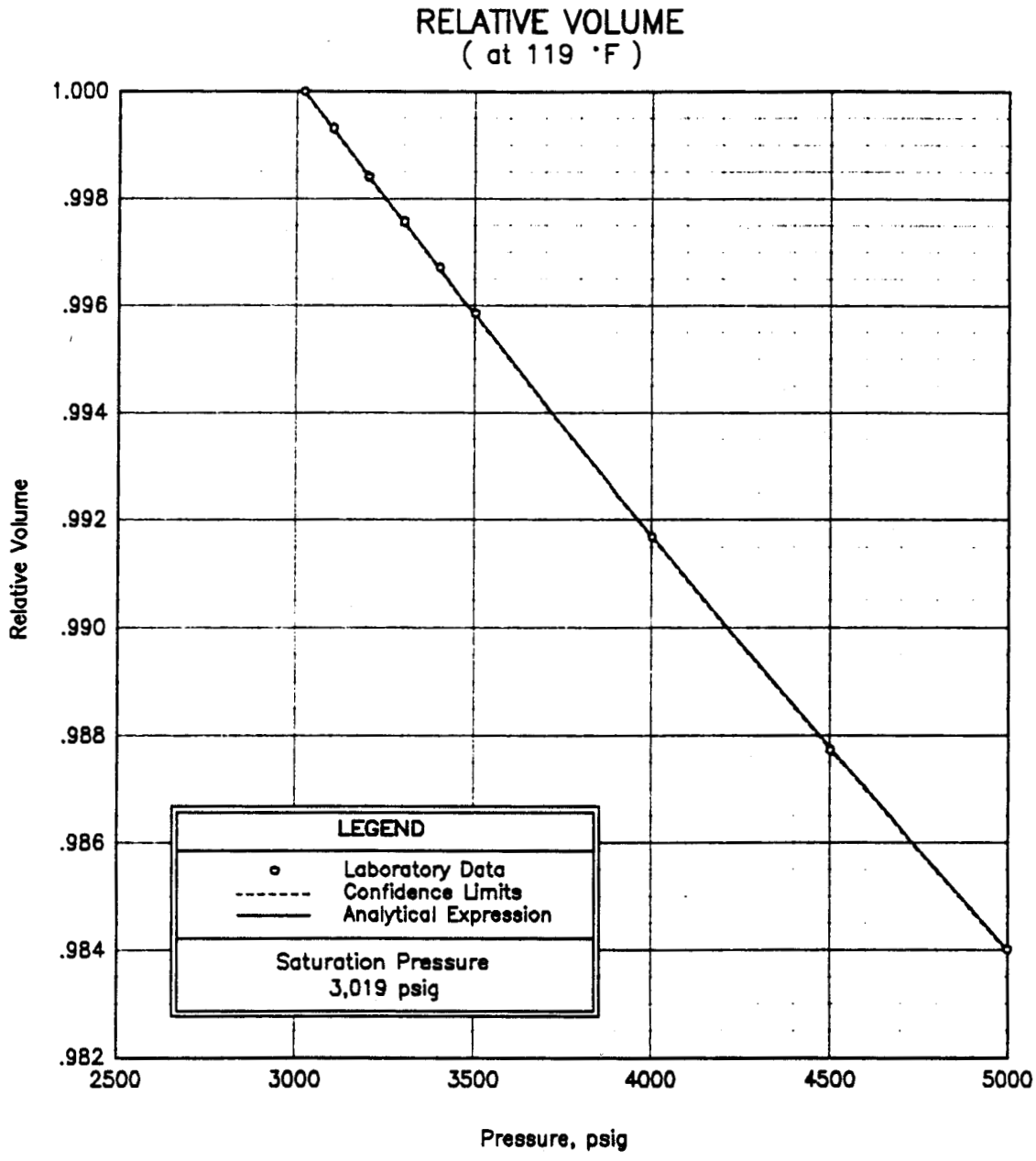

Analytical Expression

$$1 - 10^{[\ -5.124E00\ +\ 1.033E00\ (\log(\ dP\ ))\ +\ -1.982E-04\ (\log(\ dP\ ))^{5}\ ]}$$

Note: dP is defined as | Pi − Psat |, psig

Statistical Summary	
r squared:	0.999981
Confidence Interval (+/−):	0.0000
Confidence:	99 %

Pressure–Volume Relations

Figure A–1

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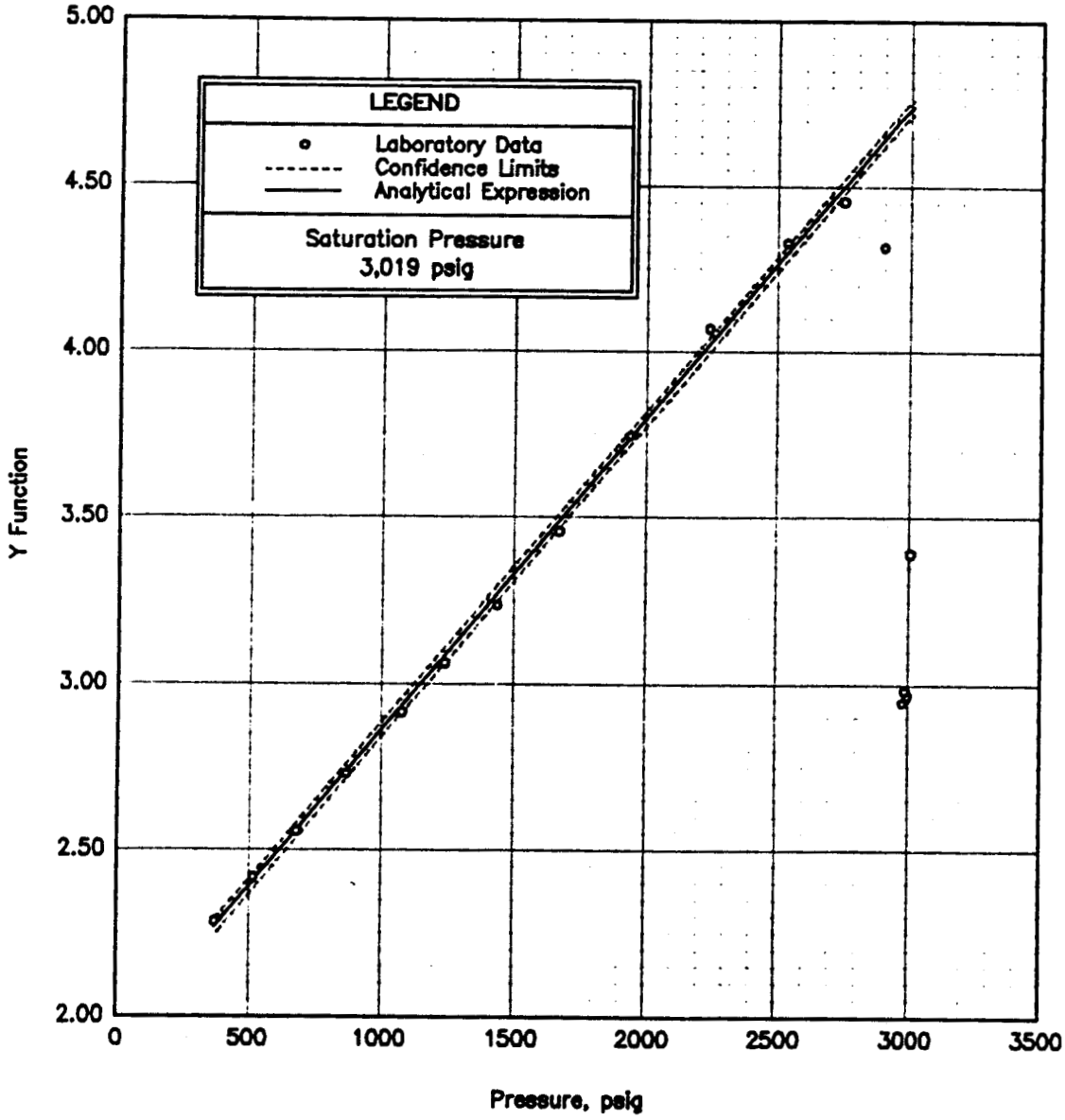
Y–FUNCTION
(at 119 °F)



Analytical Expression	
	9.393E–04 (Xd) + 1.918E00
Note: Xd is defined as Pi / Psat	

Statistical Summary		Pressure–Volume Relations
r squared:	0.998527	Figure A–2
Confidence Interval (+/–):	0.0227	
Confidence:	98 %	

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DIFFERENTIAL VAPORIZATION

(at 119 °F)

Pressure psig	Solution Gas/Oil Ratio Rsd (A)	Relative Oil Volume Bod (B)	Relative Total Volume Btd (C)	Oil Density gm/cc	Deviation Factor Z	Gas Formation Volume Factor (D)	Incremental Gas Gravity (Air=1.000)
b»3019	612	1.272	1.272	0.7448			
2700	550	1.249	1.305	0.7512	0.825	0.00496	0.653
2400	493	1.228	1.344	0.7576	0.820	0.00554	0.650
2100	435	1.207	1.408	0.7644	0.828	0.00639	0.646
1800	378	1.185	1.502	0.7715	0.843	0.00758	0.642
1500	321	1.164	1.645	0.7789	0.863	0.00929	0.640
1200	264	1.142	1.880	0.7866	0.886	0.01190	0.640
900	206	1.121	2.298	0.7945	0.912	0.01627	0.645
600	148	1.099	3.163	0.8025	0.940	0.02495	0.665
300	87	1.076	5.773	0.8107	0.970	0.05028	0.720
105	42	1.059	14.767	0.8164	0.989	0.13489	0.825
0	0	1.029		0.8293			1.256
	@ 60 °F	= 1.000					

Gravity of Residual Oil = 34.2 °API at 60 °F
Density of Residual Oil = 0.8531 gm/cc at 60 °F

(A) Cubic Feet of gas at 14.65 psia and 60 °F per Barrel of residual oil at 60 °F.

(B) Barrel of oil at indicated pressure and temperature per Barrel of residual oil at 60 °F.

(C) Barrels of oil plus liberated gas at indicated pressure and temperature per Barrel of residual oil at 60 °F.

(D) Cubic Feet of gas at indicated pressure and temperature per Cubic Feet at 14.65 psia and 60 °F.

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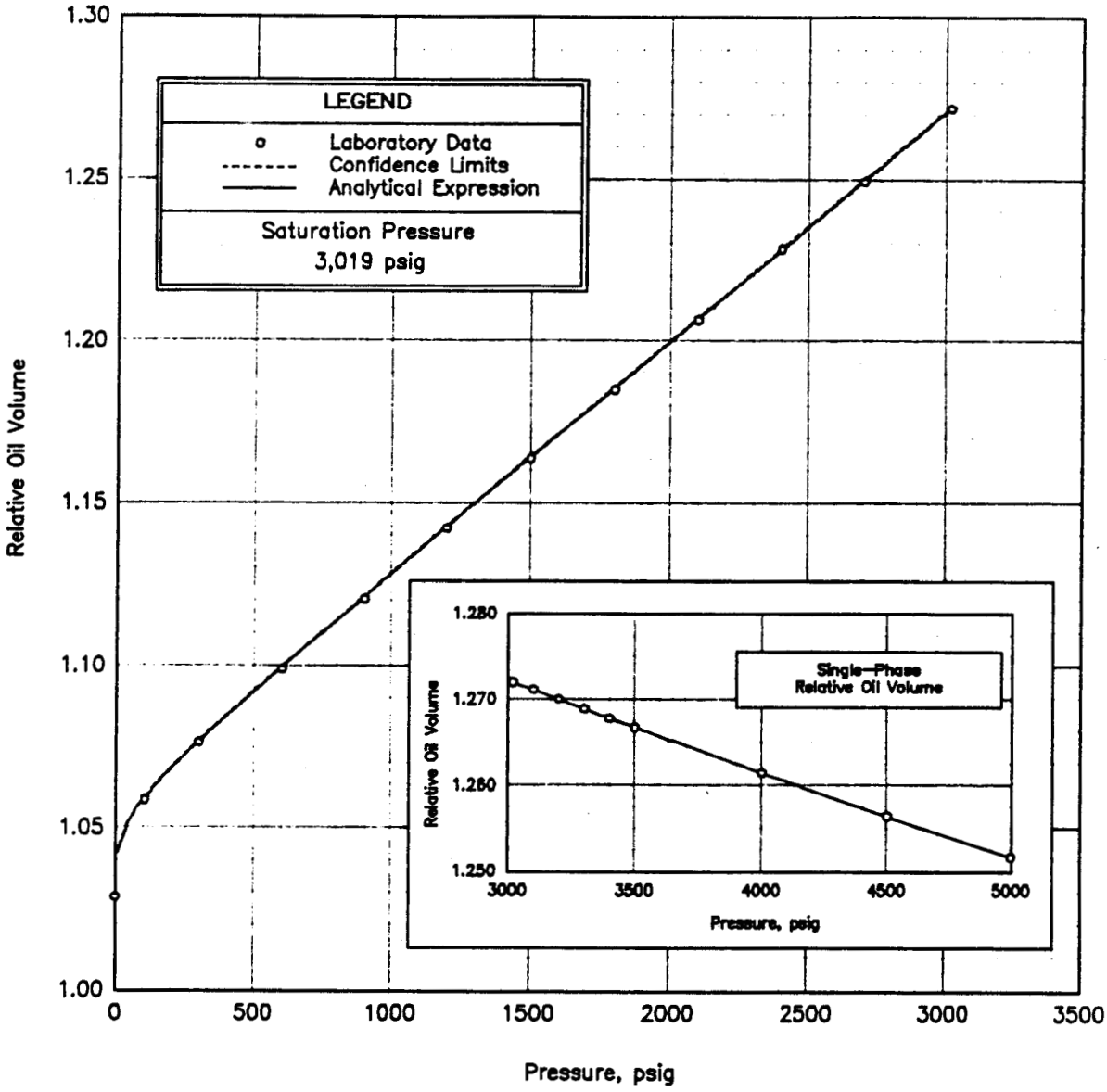
RELATIVE OIL VOLUME
(at 119 °F)



Analytical Expression (below bubblepoint)

1.029E00 + 8.010E-05 (Pi) + 2.150E-02 (Pi)^0.4 + -1.435E-02 (Pi)^0.45

Note: Pi is defined as pressure, psig

Statistical Summary	
r squared:	0.999995
Confidence Interval (+/-):	.0002
Confidence:	99 %

Differential Vaporization

Figure B-1

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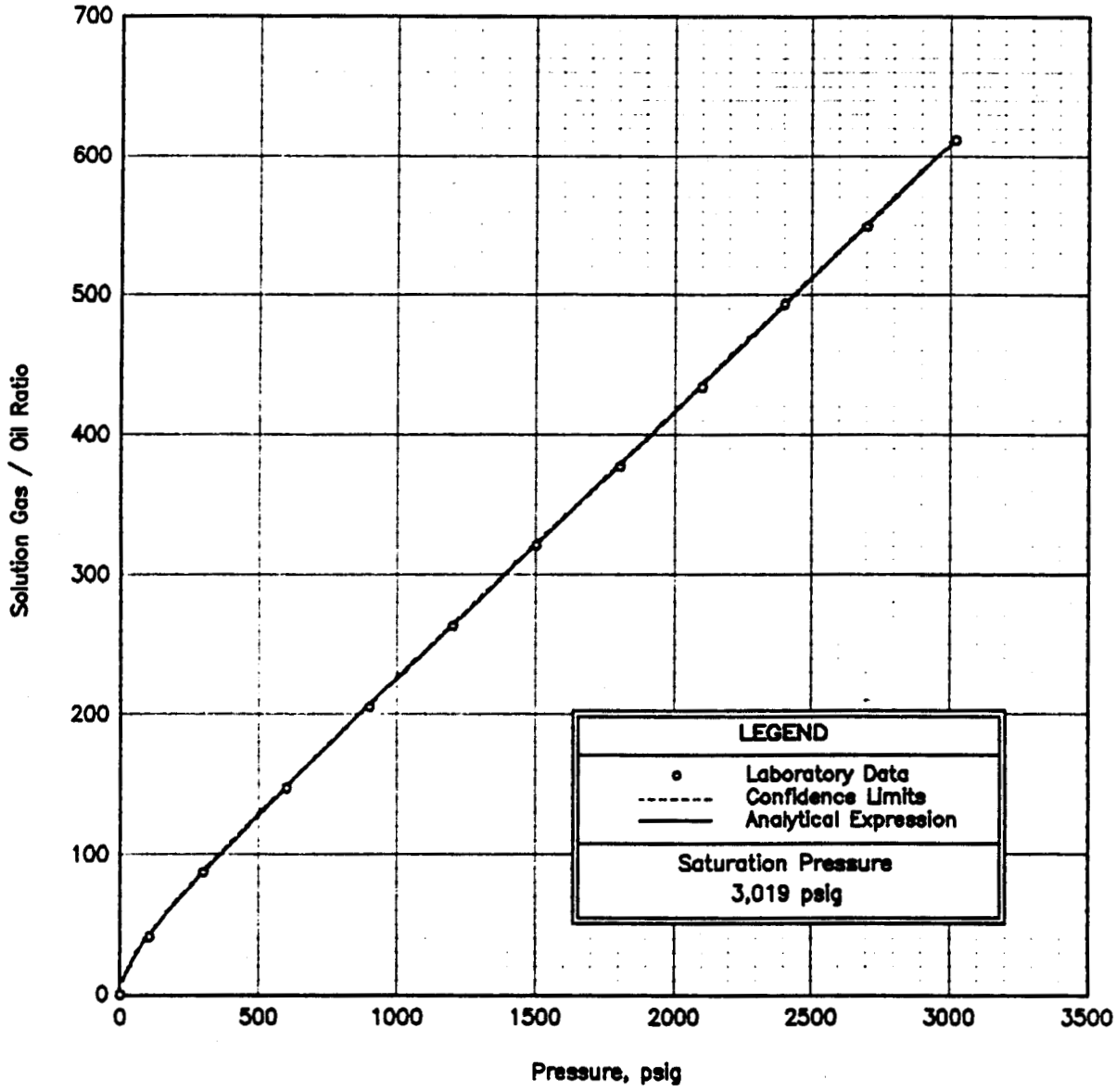
SOLUTION GAS/OIL RATIO
(scf/bbl at 119 °F)



Analytical Expression (below bubblepoint)

$$6.418E{-}02\ (Pi)^{1.1} + 3.038E00\ (Pi)^{0.5} + 1.460E{-}06\ (Pi)^{2}$$

Note: Pi is defined as pressure, psig

Statistical Summary		Differential Vaporization
r squared:	0.999990	Figure B–2
Confidence Interval (+/–):	1	
Confidence:	99 %	

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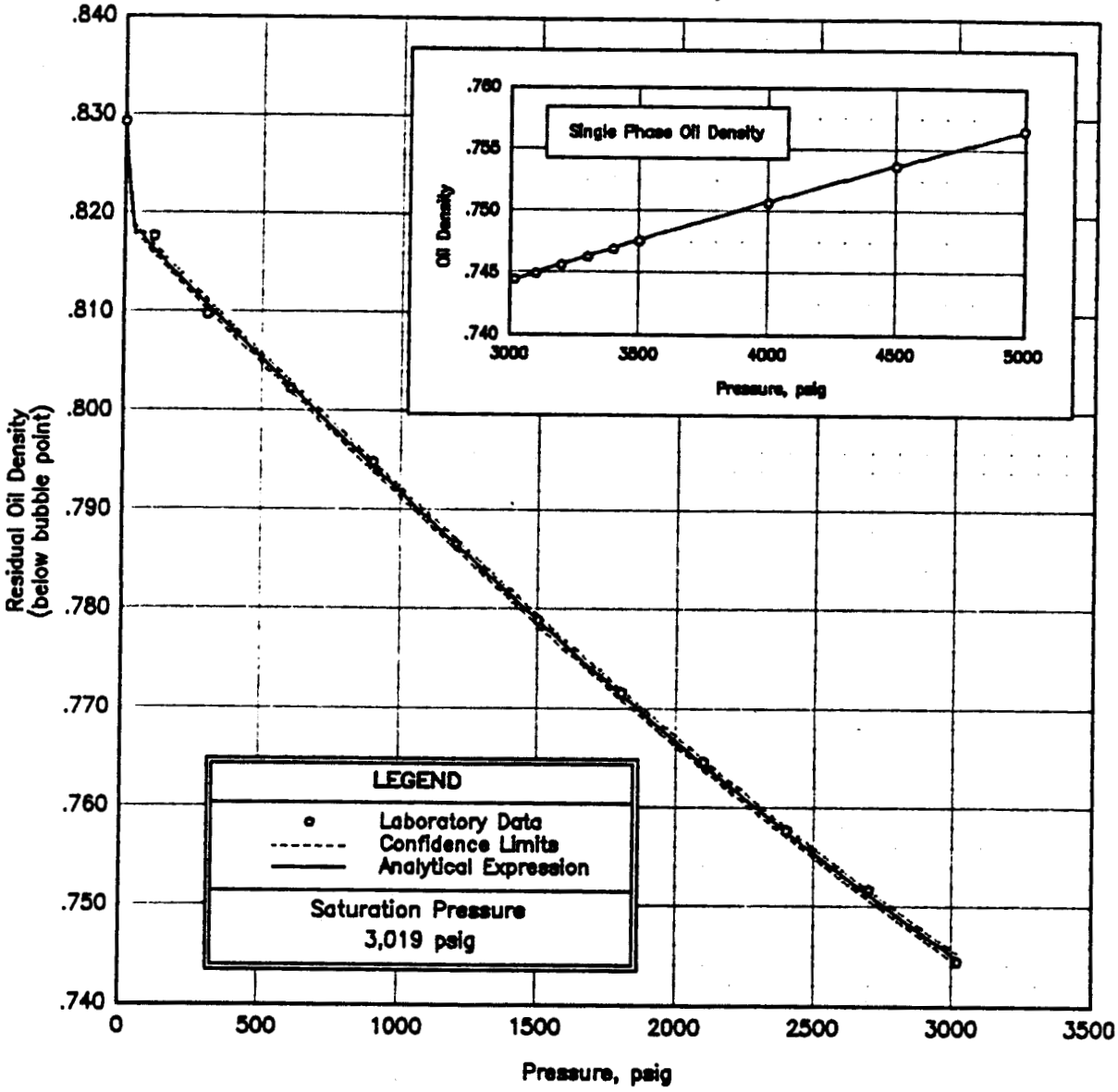
OIL DENSITY

(gm/cc at 119 °F)



Analytical Expression (below bubblepoint)

0.82934 + −6.833E−03 (Pi)^0.1 + −1.241E−05 (Pi)^1.1 + 2.820E−11 (Pi)^2.5

Note: Pi is defined as pressure, psig

Statistical Summary	
r squared:	0.999603
Confidence Interval (+/−):	0.0005
Confidence:	99 %

Differential Vaporization

Figure B−3

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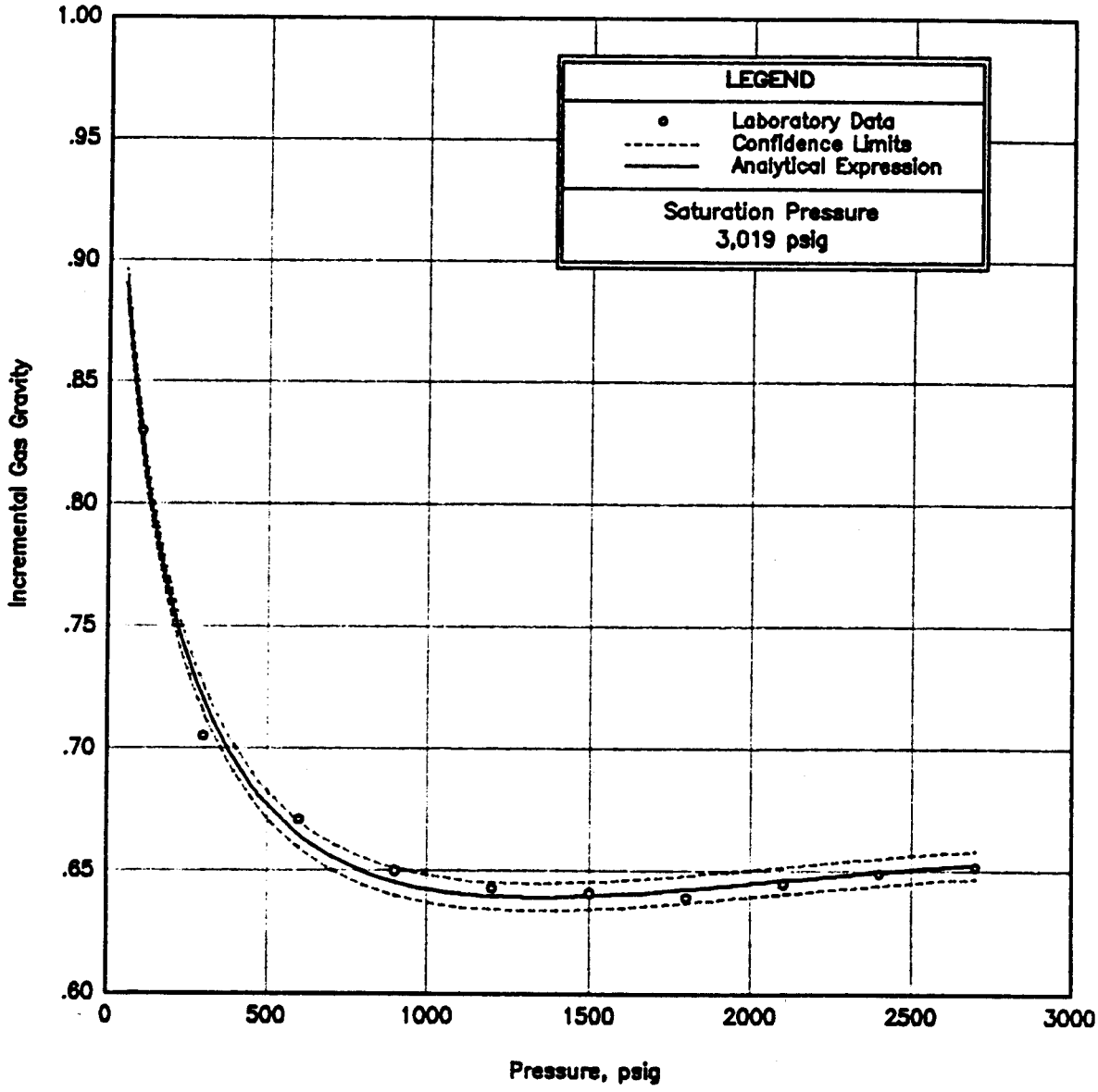
GAS GRAVITY
(at 119 °F)



Analytical Expression

2.177E00 + −1.221E−01 (Pi)^0.300 + 3.054E−03 (Pi)^0.500 + −9.210E−01 (exp(−Xd))

Note: Xd is defined as Pi / Pest

Statistical Summary		Differential Vaporization
r squared:	0.999009	Figure B−4
Confidence Interval (+/−):	0.0056	
Confidence:	99 %	

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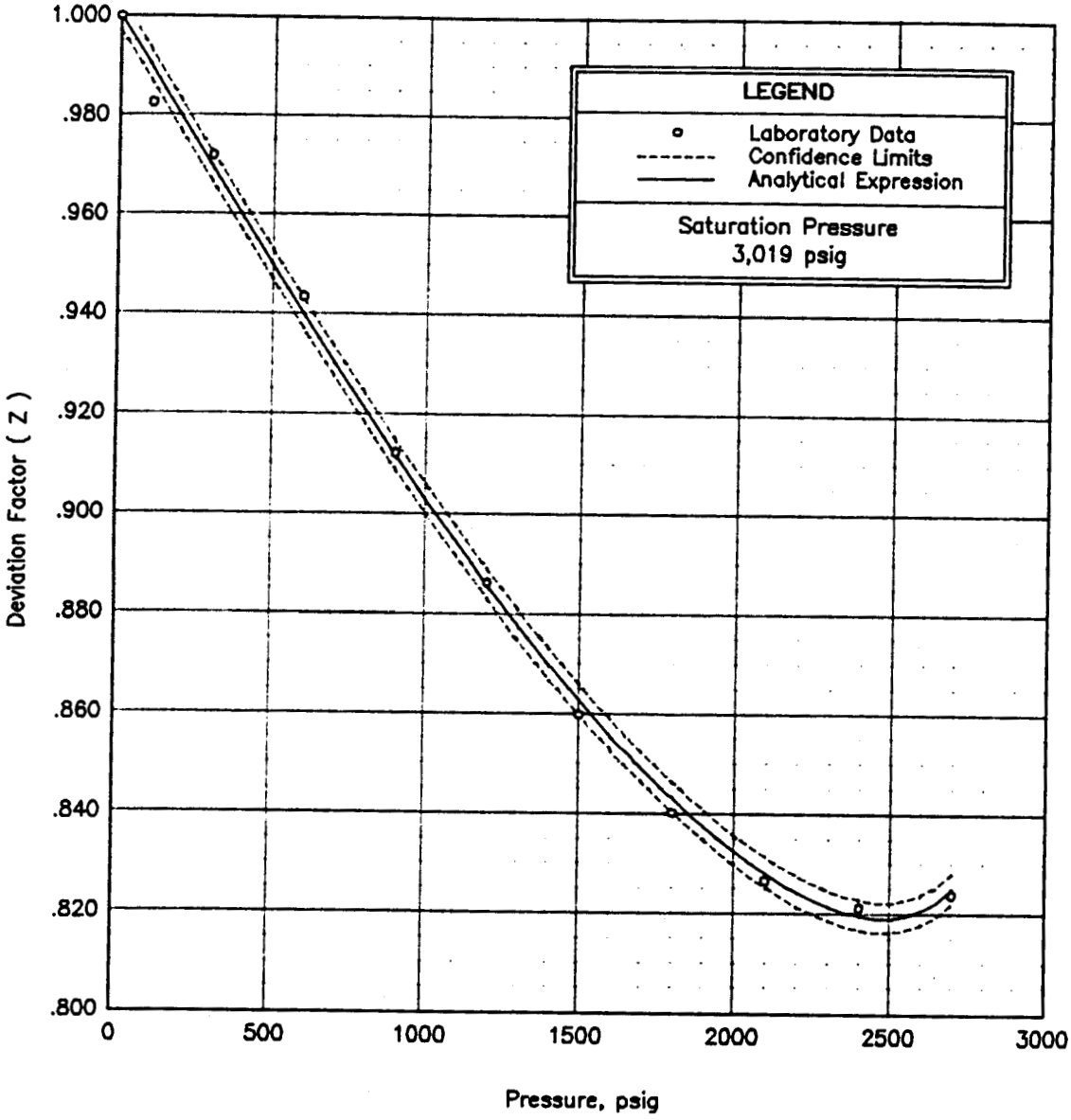
Z–FACTOR
(at 119 °F)



Analytical Expression

$$1 + -1.012E-04 (Pi) + 4.173E-54 (Pi)^{15} + 4.377E-12 (Pi)^{3}$$

Note: Pi is defined as pressure, psig

Statistical Summary		Differential Vaporization
r squared:	0.998154	Figure B–5
Confidence Interval (+/–):	0.003	
Confidence:	99 %	

CORE LABORATORIES

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RESERVOIR FLUID VISCOSITY

(at 119 °F)

Pressure psig	Oil Viscosity cp	Calculated Gas Viscosity* cp	Oil/Gas Viscosity Ratio
5000	1.18		
4500	1.14		
4000	1.10		
3600	1.06		
3200	1.03		
b»3019	1.01		
2700	1.11	0.0200	55.8
2400	1.22	0.0186	65.7
2100	1.36	0.0172	78.8
1800	1.52	0.0160	95.0
1500	1.70	0.0149	114
1200	1.92	0.0140	138
900	2.18	0.0132	165
600	2.47	0.0125	198
300	2.84	0.0118	242
105	3.19	0.0110	289
0	3.62		

* Gas Viscosity data calculated from correlation of Lee A.L., Gonzalez M.H., and Eakin B.E., 'The Viscosity of Natural Gases', Journal of Petroleum Technology, August, 1966, pp. 997-1000.

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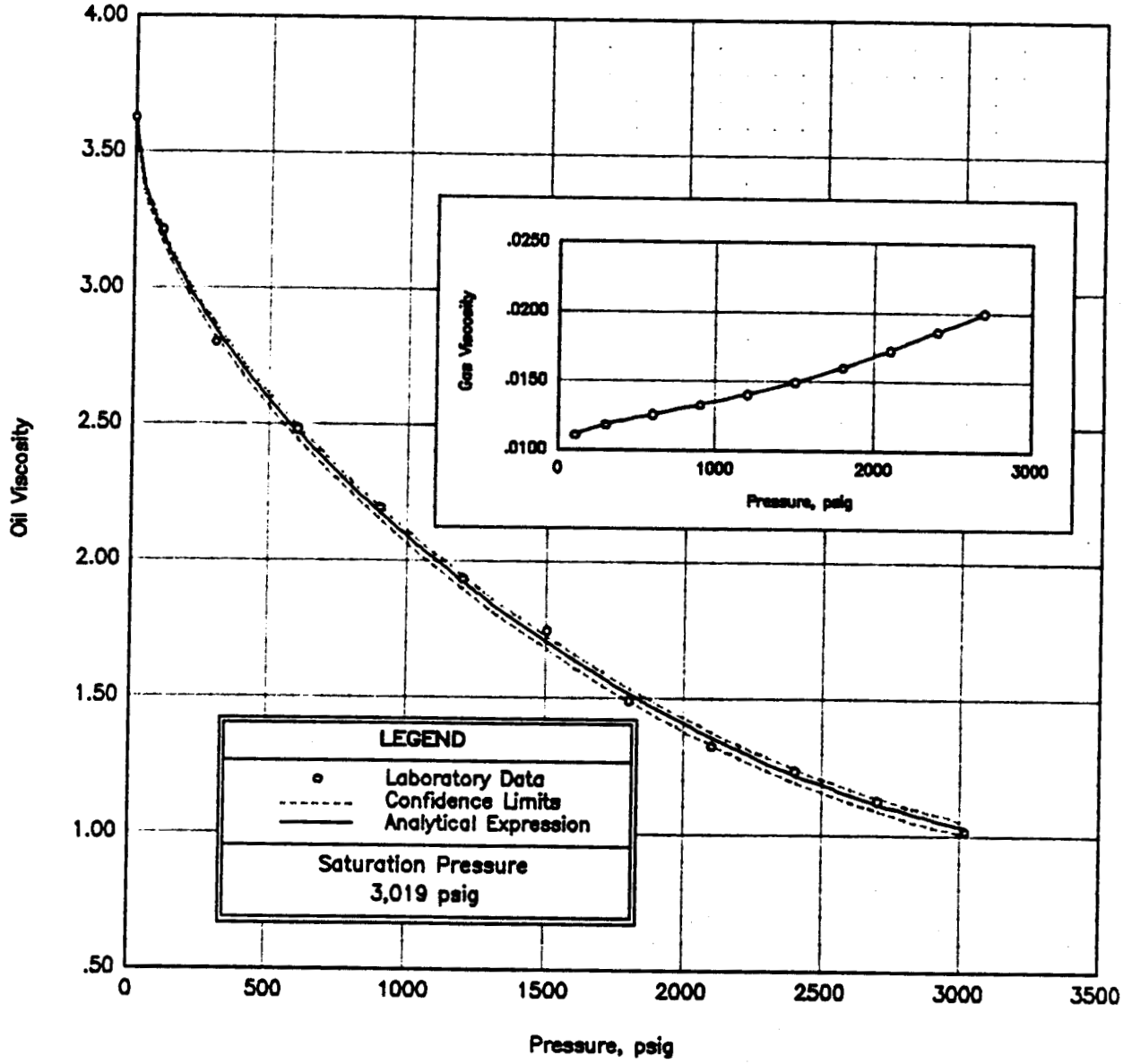
RESERVOIR FLUID VISCOSITIES
(cp at 119 °F)



Analytical Expression (below bubblepoint)

3.623 E00 + −3.144E−04 (Pi) + 4.742E−10 (Pi)^2.6 + −3.958E−02 (Pi)^0.5

Note: Pi is defined as pressure, psig

Statistical Summary		Viscosity Analyses
r squared:	0.999161	Figure C−1
Confidence Interval (+/−):	0.023	
Confidence:	99 %	

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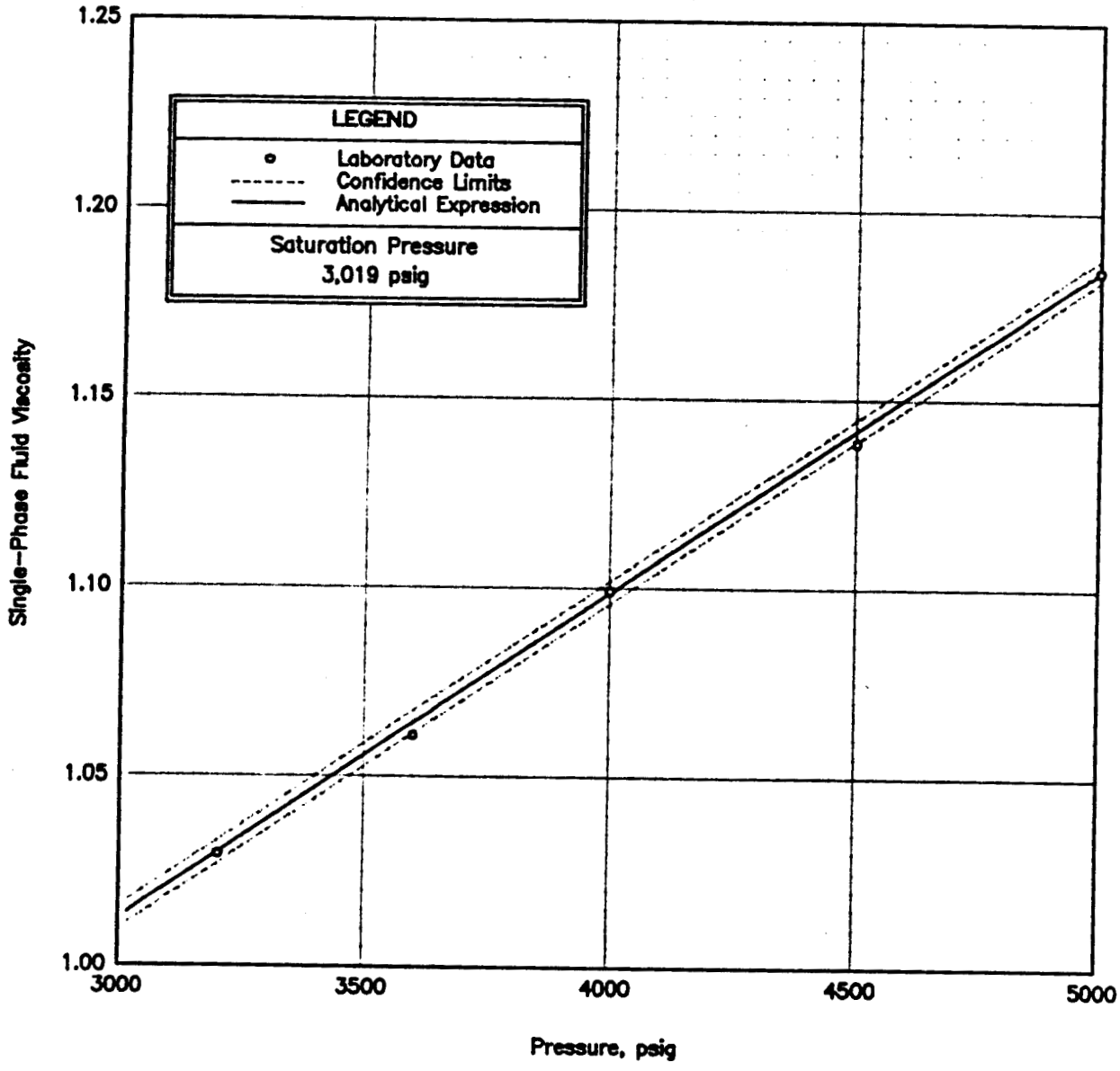
SINGLE-PHASE VISCOSITY
(cp at 119 °F)



Analytical Expression	
	1.014E00 + 1.017E00 (dP)
Note: dP is defined as | Pi – Pact |, psig	

Statistical Summary		Viscosity Analyses
r squared:	0.998835	Figure C-2
Confidence Interval (+/-):	0.003	
Confidence:	99 %	

RFL 920279

SEPARATOR FLASH ANALYSIS

Flash Conditions		Gas/Oil Ratio (scf/bbl) (A)	Gas/Oil Ratio (scf/STbbl) (B)	Stock Tank Oil Gravity at 60 °F (°API)	Formation Volume Factor Bofb (C)	Separator Volume Factor (D)	Specific Gravity of Flashed Gas (Air=1.000)	Oil Phase Density (gm/cc)
psig	°F							
3019	119							0.7425
100	90	580	596			1.026	0.670 *	0.8386
25	140	17	17			1.038	0.908 *	0.8260
0	60	12	12	34.1	1.276	1.000	1.308 *	0.8538
			Rsfb = 625					
3019	119							0.7448
100	140	587	615			1.048	0.745	0.8179
25	140	12	12			1.038	0.782	0.8238
0	60	4	4	34.0	1.284	1.000	1.300	0.8540
			Rsfb = 632					
3019	119							0.7448
500	90	426	457			1.073	0.638	0.8160
100	90	96	99			1.033	0.749	0.8319
25	140	25	26			1.039	1.064	0.8212
0	60	10	10	34.6	1.260	1.000	1.007	0.8510
			Rsfb = 593					

* Collected and analyzed in the laboratory by gas chromatography.

(A) Cubic Feet of gas at 14.65 psia and 60 °F per Barrel of oil at indicated pressure and temperature.
(B) Cubic Feet of gas at 14.65 psia and 60 °F per Barrel of Stock Tank Oil at 60 °F.
(C) Barrels of saturated oil at 3019 psig and 119 °F per Barrel of Stock Tank Oil at 60 °F.
(D) Barrels of oil at indicated pressure and temperature per Barrel of Stock Tank Oil at 60 °F.

Composition of Primary Separator Gas

(From Chromatographic Technique)

Component	Mol %	GPM	MW	Liq Dens (gm/cc)
Hydrogen Sulfide	0.00			
Carbon Dioxide	0.46		44.010	.8172
Nitrogen	0.15		28.013	.8086
Methane	86.88		16.043	.2997
Ethane	5.85	1.556	30.070	.3558
Propane	4.17	1.143	44.097	.5065
iso-Butane	0.81	.264	58.123	.5623
n-Butane	0.96	.301	58.123	.5834
iso-Pentane	0.30	.109	72.150	.6241
n-Pentane	0.15	.054	72.150	.6305
Hexanes	0.13	.050	84.000	.6850
Heptanes	0.08	.033	96.000	.7220
Octanes	0.04	.018	107.00	.7450
Nonanes	Trace			
Decanes plus	0.02	.011	141.00	.7840
Totals	100.00	3.539		

Properties of Plus Fractions

Component	Mol %	MW	Liq Dens (gm/cc)	API Gravity
Heptanes plus	0.14	105.6	0.739	44.2
Decanes plus	0.02	141.0	0.784	38.3

Sampling Conditions

100 psig
90 °F

Sample Characteristics

"Base Case" Separator Test

Critical Pressure (psia)	664.5
Critical Temperature (°R)	380.7
Average Molecular Weight	19.39
Calculated Gas Gravity (air = 1.000)	0.670
Gas Gravity Factor, Fg	1.2221
Super Compressibility Factor, Fpv at sampling conditions	1.0081
Gas Z-Factor at sampling conditions *	0.984

at 14.65 psia and 60 °F

Gross Heating Value (BTU/scf dry gas)	1172

* From: Standing, M.B., "Volumetric and Phase Behavior of Oil Field Hydrocarbon Systems", SPE (Dallas),1977, 8th Edition, Appendix II.

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Composition of Secondary Separator Gas

(From Chromatographic Technique)

Component	Mol %	GPM	MW	Liq Dens (gm/cc)
Hydrogen Sulfide	0.00			
Carbon Dioxide	0.66		44.010	.8172
Nitrogen	0.00			
Methane	63.64		16.043	.2997
Ethane	12.86	3.421	30.070	.3558
Propane	13.50	3.700	44.097	.5065
iso-Butane	3.14	1.022	58.123	.5623
n-Butane	3.61	1.132	58.123	.5834
iso-Pentane	1.12	.408	72.150	.6241
n-Pentane	0.56	.202	72.150	.6305
Hexanes	0.46	.178	84.000	.6850
Heptanes	0.28	.117	96.000	.7220
Octanes	0.13	.059	107.00	.7450
Nonanes	0.04	.020	121.00	.7640
Decanes plus	Trace			
Totals	100.00	10.259		

Sampling Conditions

25 psig
140 °F

Sample Characteristics

'Base Case' Separator Test

Critical Pressure (psia)	654.3
Critical Temperature (°R)	456.4
Average Molecular Weight	26.30
Calculated Gas Gravity (air = 1.000)	0.908
Gas Gravity Factor, Fg	1.0494
Super Compressibility Factor, Fpv at sampling conditions	1.0036
Gas Z-Factor at sampling conditions *	0.993

at 14.65 psia and 60 °F

Gross Heating Value (BTU/scf dry gas)	1539

Properties of Plus Fractions

Component	Mol %	MW	Liq Dens (gm/cc)	API Gravity
Heptanes plus	0.45	101.4	0.732	45.1

* From: Standing, M.B., "Volumetric and Phase Behavior of Oil Field Hydrocarbon Systems", SPE (Dallas),1977, 8th Edition, Appendix II.

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Composition of Stock Tank Gas

(From Chromatographic Technique)

Component	Mol %	GPM	MW	Liq Dens (gm/cc)
Hydrogen Sulfide	0.00			
Carbon Dioxide	0.54		44.010	.8172
Nitrogen	0.12		28.013	.8086
Methane	32.39		16.043	.2997
Ethane	16.07	4.274	30.070	.3558
Propane	26.17	7.172	44.097	.5065
iso-Butane	7.06	2.297	58.123	.5623
n-Butane	9.63	3.020	58.123	.5834
iso-Pentane	3.42	1.245	72.150	.6241
n-Pentane	1.78	.641	72.150	.6305
Hexanes	1.50	.579	84.000	.6850
Heptanes	0.88	.368	96.000	.7220
Octanes	0.40	.181	107.00	.7450
Nonanes	0.04	.020	121.00	.7640
Decanes plus	Nil			
Totals	100.00	19.797		

Sampling Conditions

0 psig
60 °F

Sample Characteristics

"Base Case" Separator Test

Critical Pressure (psia)	624.6
Critical Temperature (°R)	572.7
Average Molecular Weight	37.87
Calculated Gas Gravity (air = 1.000)	1.308

Properties of Plus Fractions

Component	Mol %	MW	Liq Dens (gm/cc)	API Gravity
Heptanes plus	1.32	100.1	0.730	45.4

at 14.65 psia and 60 °F

Gross Heating Value (BTU/scf dry gas)	2156

Composition of Stock Tank Oil

(From Chromatographic Technique)

Component	Mol %	Wt %	Density (gm/cc)	MW	Vol %
Hydrogen Sulfide	.00	.00			
Carbon Dioxide	.00	.00			
Nitrogen	.00	.00			
Methane	.00	.00			
Ethane	.00	.00			
Propane	2.23	.48	.506	44.1	0.81
iso-Butane	.00	.00			
n-Butane	3.88	1.10	.583	58.1	1.61
iso-Pentane	2.56	.90	.624	72.2	1.23
n-Pentane	1.76	.62	.630	72.2	0.84
Hexanes	4.10	1.68	.685	84.0	2.09
Heptanes	6.66	3.12	.722	96.0	3.69
Octanes	9.13	4.79	.745	107.0	5.48
Nonanes	6.74	3.98	.764	121.0	4.45
Decanes	6.32	4.13	.778	134.0	4.53
Undecanes	4.99	3.58	.789	147.0	3.88
Dodecanes	4.33	3.40	.800	161.0	3.63
Tridecanes	4.93	4.21	.811	175.0	4.43
Tetradecanes	4.59	4.25	.822	190.0	4.41
Pentadecanes	4.68	4.70	.832	206.0	4.82
Hexadecanes	3.39	3.67	.839	222.0	3.73
Heptadecanes	3.02	3.49	.847	237.0	3.52
Octadecanes	3.01	3.68	.852	251.0	3.69
Nonadecanes	2.53	3.24	.857	263.0	3.23
Eicosanes	2.15	2.88	.862	275.0	2.85
Heneicosanes	1.84	2.61	.867	291.0	2.57
Docosanes	1.69	2.51	.872	305.0	2.46
Tricosanes	1.49	2.31	.877	318.0	2.25
Tetracosanes	1.33	2.15	.881	331.0	2.08
Pentacosanes	1.27	2.14	.885	345.0	2.07
Hexacosanes	.98	1.72	.889	359.0	1.65
Heptacosanes	1.08	1.97	.893	374.0	1.89
Octacosanes	.97	1.83	.896	388.0	1.74
Nonacosanes	.83	1.62	.899	402.0	1.54
Triacontanes	.88	1.79	.902	416.0	1.69
Hentriacontanes	.76	1.59	.906	430.0	1.49
Dotriacontanes	.60	1.29	.909	444.0	1.21
Tritriacontanes	.56	1.24	.912	458.0	1.16
Tetratriacontanes	.50	1.15	.914	472.0	1.08
Pentatriacontanes	.35	.84	.917	486.0	0.79
Hexatriacontanes plu	3.87	15.34	1.149	811.5	11.41
Totals	100.00	100.00			100.00

Sample Characteristics

"Base Case" Separator Test

Total Liquid Molecular Weight	205.0
Total Liquid Density (gm/cc)	0.8538
Total Liquid API Gravity	34.2

Properties of Heavy Fractions

Plus Fractions	Mol %	Wt %	Density (gm/cc)	°API	MW
Hexanes plus	89.57	96.90	0.866	31.9	221.8
Heptanes plus	85.47	95.22	0.870	31.1	228.4
Decanes plus	62.94	83.33	0.892	27.2	271.5
Undecanes plus	56.62	79.20	0.899	26.0	286.8
Pentadecanes plus	37.78	63.76	0.924	21.6	346.1
Eicosanes plus	21.15	44.98	0.962	15.6	436.1
Pentacosanes plus	12.65	32.52	1.002	9.7	527.0
Triacontanes plus	7.52	23.24	1.054	2.7	633.3
Pentatriacontanes plus	4.22	16.18	1.134	-6.7	784.5

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SEPARATOR FLASH ANALYSIS*

Flash Conditions		Gas/Oil Ratio (scf/bbl)	Gas/Oil Ratio (scf/STbbl)	Stock Tank Oil Gravity at 60 °F	Formation Volume Factor	Separator Volume Factor	Specific Gravity of Flashed Gas	Oil Phase Density (gm/cc)
psig	°F	(A)	(B)	(°API)	Bofb (C)	(D)	(Air=1.000)	
2200	119							0.7557
100	90	453	466			1.030	0.733	0.8365
25	140	28	29			1.038	0.952	0.8242
0	60	15	15	34.4	1.238	1.000	**	0.8518
			Rsfb = 510					
1500	119							0.7706
100	90	314	324			1.033	0.772	0.8359
25	140	33	35			1.039	0.985	0.8239
0	60	10	10	34.6	1.191	1.000	**	0.8537
			Rsfb = 369					
800	119							0.7822
100	90	153	159			1.038	0.817	0.8258
25	140	35	36			1.039	1.032	0.8172
0	60	10	10	34.8	1.132	1.000	**	0.8467
			Rsfb = 206					

* Performed on prepared differential vaporization fluids.
** Insufficient quantity for measurement.

(A) Cubic Feet of gas at 14.65 psia and 60 °F per Barrel of oil at indicated pressure and temperature.
(B) Cubic Feet of gas at 14.65 psia and 60 °F per Barrel of Stock Tank Oil at 60 °F.
(C) Barrels of saturated oil at indicated pressure and 119°F per Barrel of Stock Tank Oil at 60°F.
(D) Barrels of oil at indicated pressure and temperature per Barrel of Stock Tank Oil at 60 °F.

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DIFFERENTIAL VAPORIZATION
ADJUSTED TO SEPARATOR CONDITIONS*

	Pressure psig	Solution Gas/Oil Ratio Rs (A)	Formation Volume Factor Bo (B)	Gas Formation Volume Factor (C)	Oil Density gm/cc	Oil/Gas Viscosity Ratio
	5000	625.	1.255		0.7569	
	4500	625.	1.260		0.7540	
	4000	625.	1.265		0.7510	
	3500	625.	1.271		0.7479	
	3400	625.	1.272		0.7473	
	3300	625.	1.273		0.7466	
	3200	625.	1.274		0.7460	
	3100	625.	1.275		0.7453	
b»	3019	625.	1.276		0.7448	
	2700	563.	1.253	0.00496	0.7512	55.8
	2400	505.	1.232	0.00554	0.7576	65.7
	2100	448.	1.210	0.00639	0.7644	78.8
	1800	390.	1.189	0.00758	0.7715	95.0
	1500	333.	1.167	0.00929	0.7789	114.0
	1200	276.	1.146	0.01190	0.7866	138.0
	900	218.	1.124	0.01627	0.7945	165.0
	600	160.	1.102	0.02495	0.8025	198.0
	300	98.	1.079	0.05028	0.8107	242.0
	105	53.	1.062	0.13489	0.8164	289.0
	0	11.	1.032		0.8293	

*Separator Conditions	
First Stage	100 psig at 90 °F
Second Stage	25 psig at 140 °F
Stock Tank	0 psig at 60 °F

(A) Cubic Feet of gas at 14.65 psia and 60 °F per Barrel of Stock Tank Oil at 60 °F.

(B) Barrel of oil at indicated pressure and temperature per Barrel of Stock Tank Oil at 60 °F.

(C) Cubic Feet of gas at indicated pressure and temperature per Cubic Feet at 14.65 psia and 60 °F.

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DIFFERENTIAL VAPORIZATION
ADJUSTED TO SEPARATOR CONDITIONS*

	Pressure psig	Solution Gas/Oil Ratio Rs (A)	Formation Volume Factor Bo (B)	Gas Formation Volume Factor (C)	Oil Density gm/cc	Oil/Gas Viscosity Ratio
	5000	632.	1.264		0.7569	
	4500	632.	1.269		0.7540	
	4000	632.	1.274		0.7510	
	3500	632.	1.279		0.7479	
	3400	632.	1.280		0.7473	
	3300	632.	1.281		0.7466	
	3200	632.	1.282		0.7460	
	3100	632.	1.284		0.7453	
b»	3019	632.	1.284		0.7448	
	2700	569.	1.261	0.00496	0.7512	55.8
	2400	511.	1.240	0.00554	0.7576	65.7
	2100	453.	1.218	0.00639	0.7644	78.8
	1800	395.	1.197	0.00758	0.7715	95.0
	1500	338.	1.175	0.00929	0.7789	114.0
	1200	280.	1.153	0.01190	0.7866	138.0
	900	222.	1.132	0.01627	0.7945	165.0
	600	163.	1.110	0.02495	0.8025	198.0
	300	101.	1.087	0.05028	0.8107	242.0
	105	56.	1.069	0.13489	0.8164	289.0
	0	14.	1.039		0.8293	

*Separator Conditions	
First Stage	100 psig at 140 °F
Second Stage	25 psig at 140 °F
Stock Tank	0 psig at 60 °F

(A) Cubic Feet of gas at 14.65 psia and 60 °F per Barrel of Stock Tank Oil at 60 °F.

(B) Barrel of oil at indicated pressure and temperature per Barrel of Stock Tank Oil at 60 °F.

(C) Cubic Feet of gas at indicated pressure and temperature per Cubic Feet at 14.65 psia and 60 °F.

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DIFFERENTIAL VAPORIZATION
ADJUSTED TO SEPARATOR CONDITIONS*

	Pressure psig	Solution Gas/Oil Ratio Rs (A)	Formation Volume Factor Bo (B)	Gas Formation Volume Factor (C)	Oil Density gm/cc	Oil/Gas Viscosity Ratio
	5000	593.	1.240		0.7569	
	4500	593.	1.245		0.7540	
	4000	593.	1.250		0.7510	
	3500	593.	1.255		0.7479	
	3400	593.	1.256		0.7473	
	3300	593.	1.257		0.7466	
	3200	593.	1.258		0.7460	
	3100	593.	1.260		0.7453	
b»	3019	593.	1.260		0.7448	
	2700	532.	1.238	0.00496	0.7512	55.8
	2400	474.	1.217	0.00554	0.7576	65.7
	2100	418.	1.195	0.00639	0.7644	78.8
	1800	361.	1.174	0.00758	0.7715	95.0
	1500	304.	1.153	0.00929	0.7789	114.0
	1200	248.	1.132	0.01190	0.7866	138.0
	900	191.	1.111	0.01627	0.7945	165.0
	600	133.	1.089	0.02495	0.8025	198.0
	300	72.	1.066	0.05028	0.8107	242.0
	105	28.	1.049	0.13489	0.8164	289.0
	0		1.019		0.8293	

*Separator Conditions	
First Stage	500 psig at 90 °F
Second Stage	100 psig at 90 °F
Third Stage	25 psig at 140 °F
Stock Tank	0 psig at 60 °F

(A) Cubic Feet of gas at 14.65 psia and 60 °F per Barrel of Stock Tank Oil at 60 °F.

(B) Barrel of oil at indicated pressure and temperature per Barrel of Stock Tank Oil at 60 °F.

(C) Cubic Feet of gas at indicated pressure and temperature per Cubic Feet at 14.65 psia and 60 °F.

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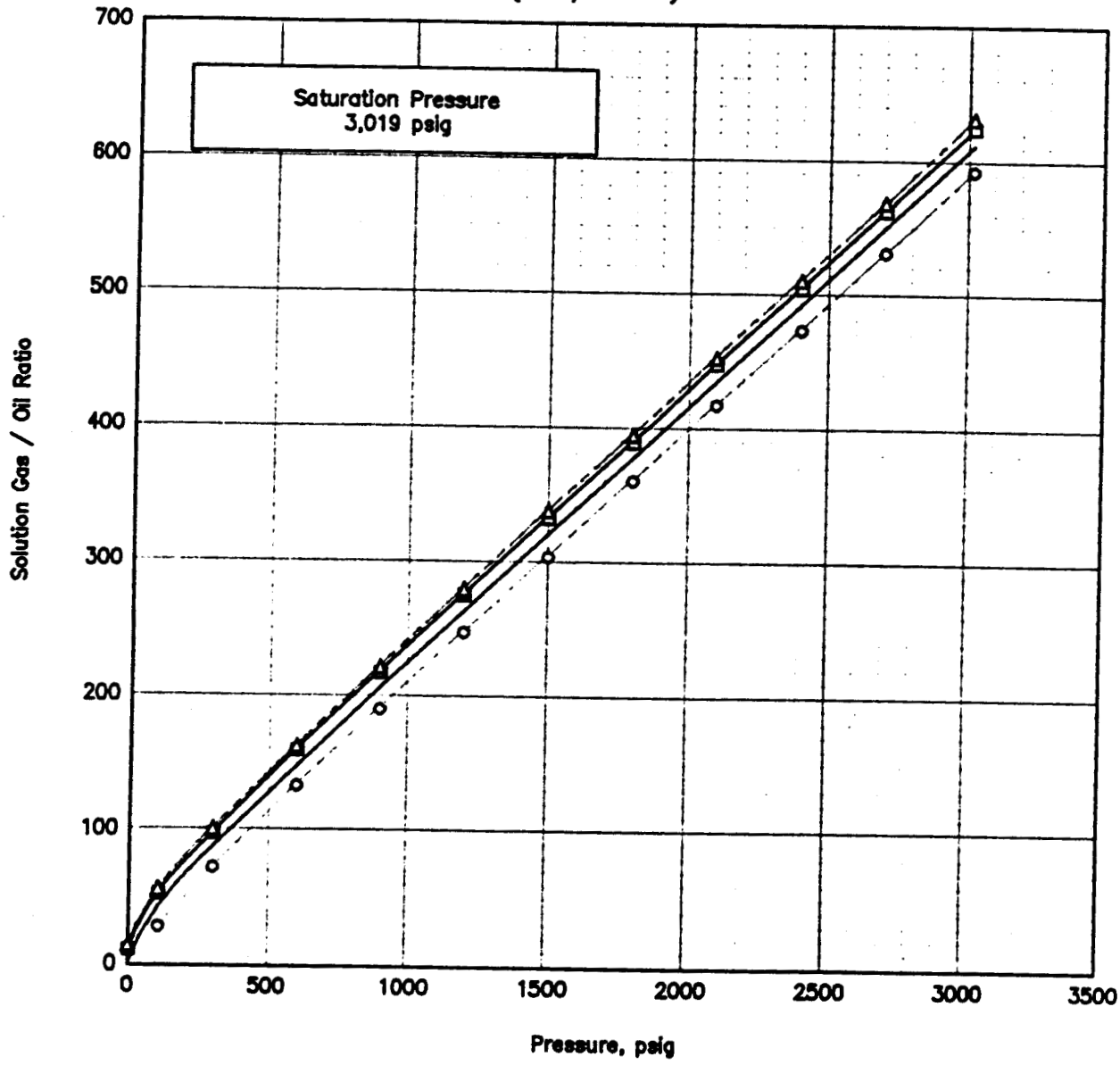
SOLUTION GAS/OIL RATIO
(scf/STbbl)



LEGEND	
Differential Vaporization 100 psig at 90 °F 100 psig at 140 °F 500 psig at 90 °F	DV Adjusted to Separator Figure D–1

CORE LABORATORIES

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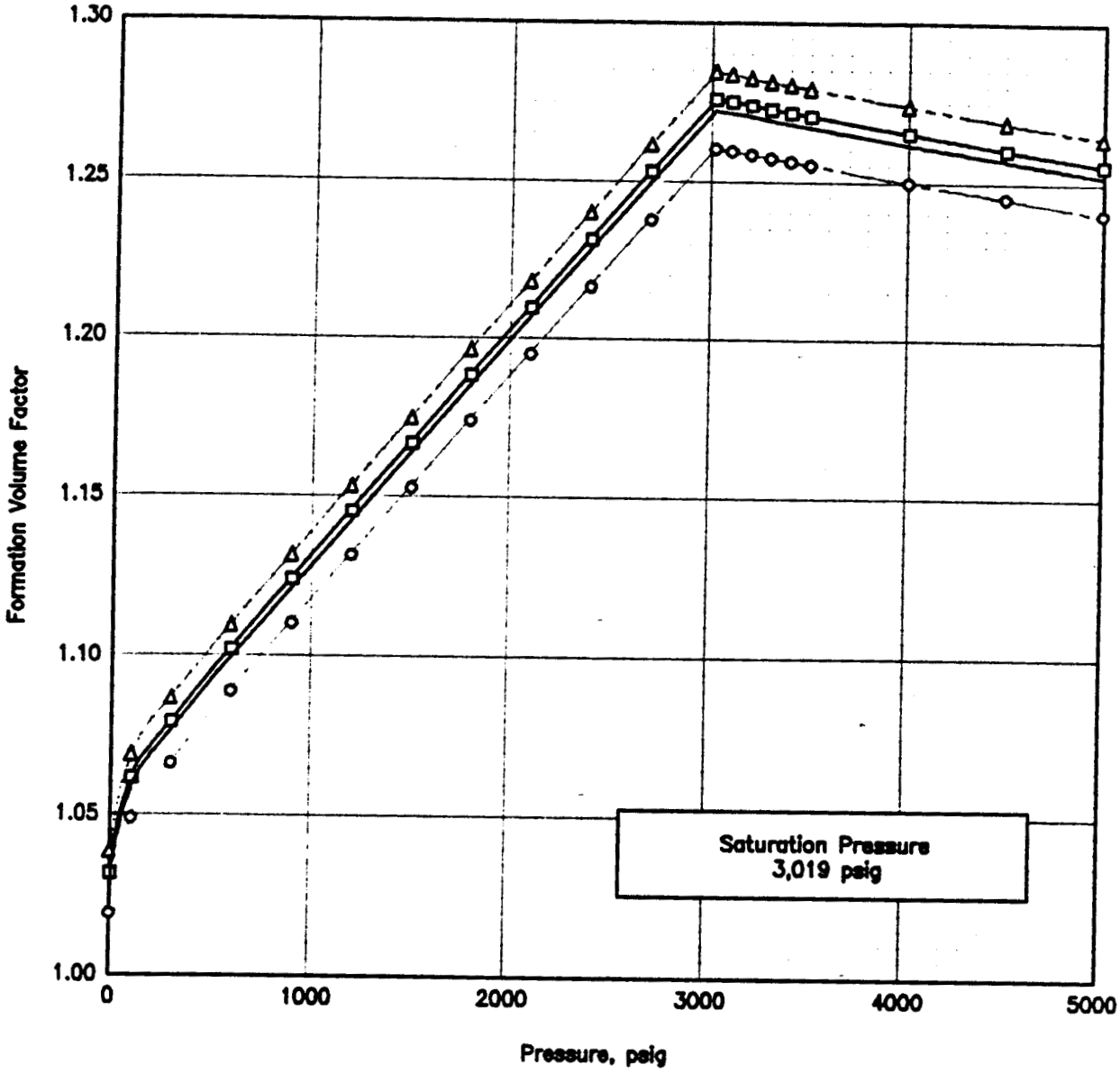
FORMATION VOLUME FACTOR



LEGEND	
Differential Vaporization 100 psig at 90 °F 100 psig at 140 °F 500 psig at 90 °F	DV Adjusted to Separator Figure D–2

CORE LABORATORIES

Appendix
Nomenclature and Equations

PRESSURE-VOLUME RELATIONS

Nomenclature and Equations

P_b	=	Bubblepoint Pressure
X_d	=	Dimensionless Pressure (P_i / P_b)
dP	=	Pressure Difference ($P_i - P_b$)
Y_f	=	Y-Function (dimensionless compressibility)
RV	=	PV Relative Volume
C_{sp}	=	Average Single-Phase Compressibility of Reservoir Fluid

For Relative Volume below bubblepoint pressure:

$$RV_i = ((P_b - P_i)/P_i) / Y_f$$

For Average Single-Phase Compressibility above bubblepoint pressure:

$$C_{sp} = (RV_i - RV_{i-1})/[RV_i(P_{i-1} - P_i)]$$

DIFFERENTIAL VAPORIZATION

Nomenclature and Equations

P_b	=	Bubblepoint Pressure
P_{base}	=	Base Pressure
T_{base}	=	Base Temperature
T_{res}	=	Reservoir Temperature
X_d	=	Dimensionless Pressure (P_i / P_b)
dP	=	Pressure Difference ($P_i - P_b$)
RV	=	Relative Volume from Pressure-Volume Relations
Dens	=	Single-Phase Oil Density
$Dens_b$	=	Oil Density at Bubblepoint Pressure
ROV	=	Relative Oil Volume
ROV_b	=	Relative Oil Volume at Bubblepoint Pressure
B_g	=	Gas Formation Volume Factor

For Oil Density above bubblepoint pressure:

$$Dens_i = Dens_b / RV_i$$

For Relative Oil Volume above bubblepoint pressure:

$$ROV_i = ROV_b * RV_i$$

For Gas Formation Volume Factor below bubblepoint pressure:

$$B_g = P_{base} * Z_i * T_{res} / (P_i * T_{base})$$

DIFFERENTIAL VAPORIZATION DATA
ADJUSTED TO SURFACE CONDITIONS
Nomenclature and Equations

P_b	=	Bubblepoint Pressure
B_o	=	Oil Formation Volume Factor
B_{ofb}	=	Formation Volume Factor from field conditions or optimum separator flash test
B_{od}	=	Relative Oil Volume from differential vaporization test
B_{odb}	=	Value of B_{od} at bubblepoint pressure
RV	=	Relative Volume from Pressure-Volume relations

For B_o above bubblepoint pressure:

$$B_o = RV * B_{ofb}$$

For B_o below bubblepoint pressure:

$$B_o = (B_{od}) * (B_{ofb} / B_{odb})$$

R_s	=	Gas in solution
R_{sfb}	=	Sum of separator gas and the stock tank gas from field conditions (or optimum) separator flash test
R_{sd}	=	Gas in solution from the differential vaporization test
R_{sdb}	=	R_{sd} at bubblepoint pressure

$$R_s = R_{sfb} - [(R_{sdb} - R_{sd}) * (B_{ofb} / B_{odb})]$$

Alaska North Slope Market

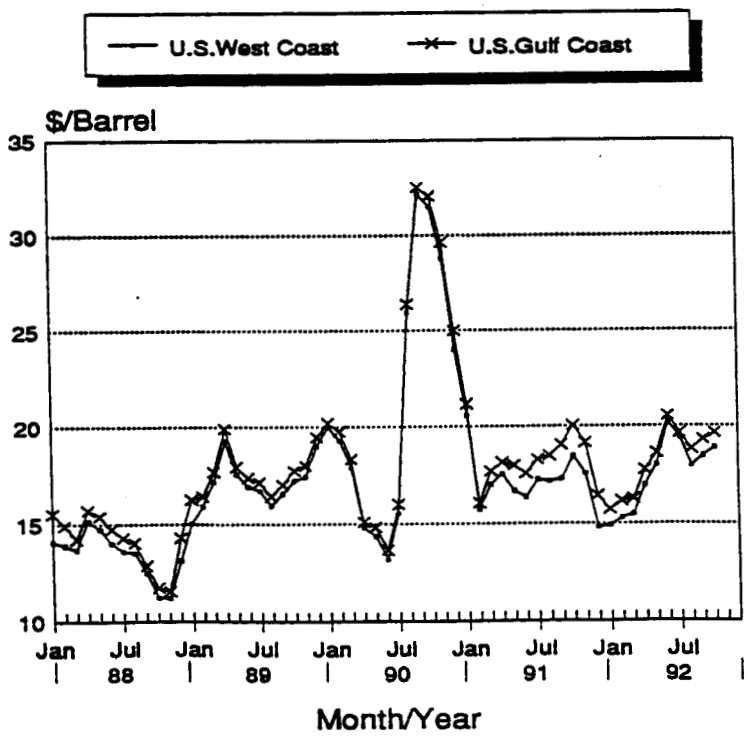
Alaska North Slope (ANS) prices have ranged between $17.00 and $20.00/bbl since last Spring. For the past six months, concern over the health of the global economy, plus uncertainty as to when Iraqi exports will return to the world market, have led to the price fluctuations of ANS. The price increase this year has been driven mainly by OPEC's decision to maintain fourth quarter production at its summer quota. ANS Lower 48 price has averaged just under $19.00/bbl so far for FY 1993.

BP Exploration announced its official selling prices for November 1992 as $18.80/bbl on the West Coast and $19.40/bbl on the Gulf Coast. Recent spot prices have been running $0.10/bbl lower than the official price.

Roughly 85 percent of ANS production is sold on the West Coast while 15 percent is marketed in the Eastern half of the United States and the Caribbean. As ANS production declines, it is expected that shipments to Eastern U.S. destinations will cease after 1996. Greater transportation costs to the more distant markets result in a Gulf Coast derived wellhead price which is lower than the West Coast price. ANS spot prices are graphed below in Figure 6.

Figure 6

ANS Spot Price
January 1988 - October 1992



Forecast Assumptions

ANS Lower 48 Prices

Beginning with this forecast, the oil price assumptions start with the price of ANS at the U.S. Gulf Coast. ANS Gulf is now used as a benchmark instead of West Texas Intermediate (WTI) for the following practical and theoretical reasons:

1. Saudi Light is marketed in the U.S. based on the Gulf ANS spot price. This provides a link to worldwide markets.

2. WTI is a lighter gravity, lower sulfur crude than ANS, and is thus valued higher. By using ANS itself as a marker, any price variations that occur due to quality differentials are eliminated and forecasting error can be attributed solely to incorrect assumptions about ANS price.

We do continue to forecast a WTI price based on the historical relationship between WTI and ANS.

The discussion of price forecast assumptions starts with the Gulf Coast ANS price and outlines the other variables which translate this price into the wellhead price for ANS crude oil. The wellhead price determines the value of production and thus the state's severance tax and royalty income.

The price of West Coast ANS is forecasted based on its historical relationship to Gulf Coast ANS. West Coast ANS sells at a discount to the Gulf because the presence of ANS on the West Coast creates a crude oil glut there. It is this glut that necessitates the shipment of ANS to the Gulf. The short term forecast for ANS is illustrated below.

Figure 7 ANS at the U. S. Gulf

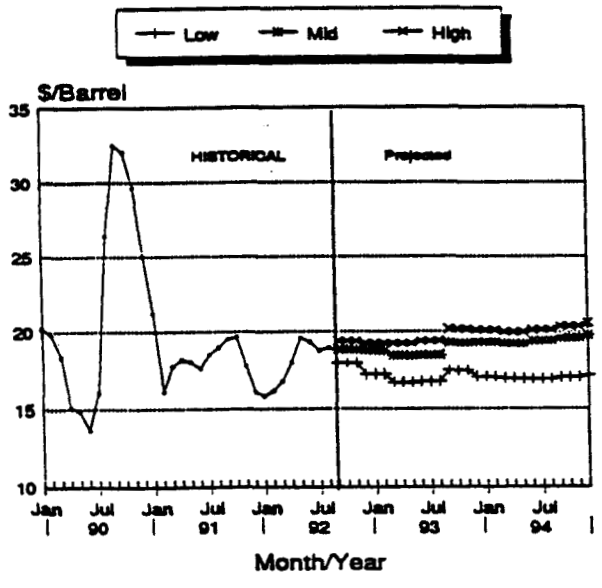
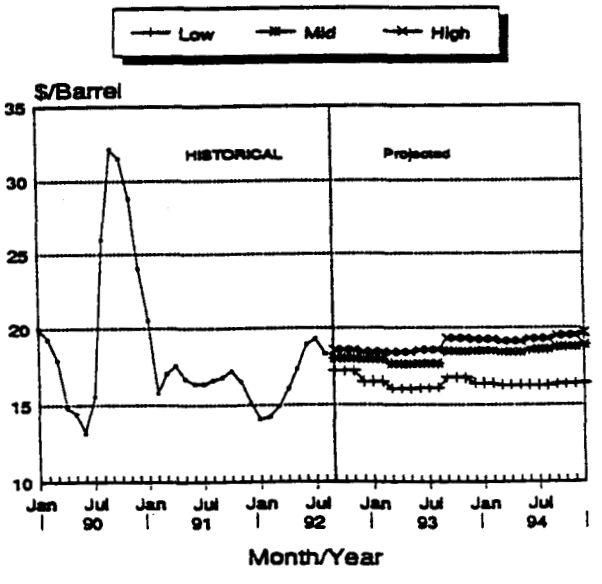


Figure 8 ANS at the U. S. West Coast



Over the longer term, as demand on the West Coast grows and ANS production declines, the West Coast oil glut will disappear. In this forecast West Coast and Gulf Coast oil prices are assumed to converge when the West Coast surplus disappears. The long term forecast for ANS is illustrated below.

Table 8 Scenarios for ANS Oil Price Gulf Coast and West Coast ($/bbl)

Fiscal	Low		Mid		High	
Year	West	Gulf	West	Gulf	West	Gulf
1993	17.13	17.71	18.11	18.73	18.56	19.21
1994	16.35	17.07	18.26	19.07	19.06	19.90
1995	16.43	17.15	18.91	19.74	19.67	20.52
2000	19.48	19.48	24.67	24.67	27.02	27.02
2005	22.65	22.65	30.68	30.68	37.14	37.14

Table 9 Marine Transportation Costs Valdez to Lower 48 ($/bbl)

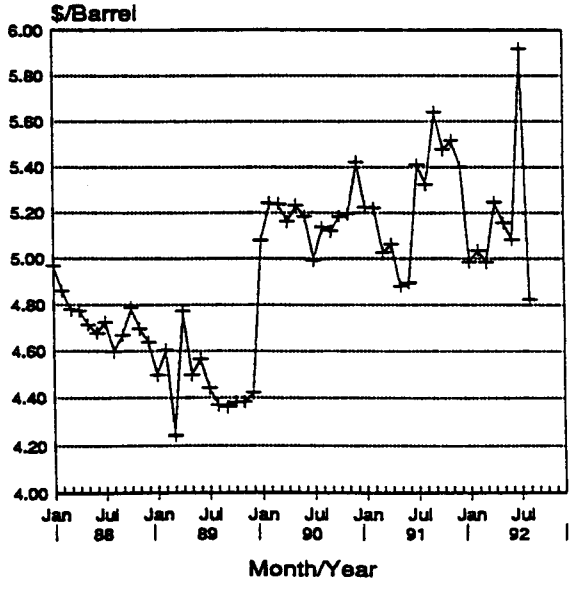
Fiscal Year	Low	Mid	High
1993	1.83	1.83	1.83
1994	1.95	1.95	1.95
1995	1.90	1.90	1.94
2000	1.68	1.71	1.73
2005	1.46	1.50	1.59

Transportation Costs to Lower 48 Markets

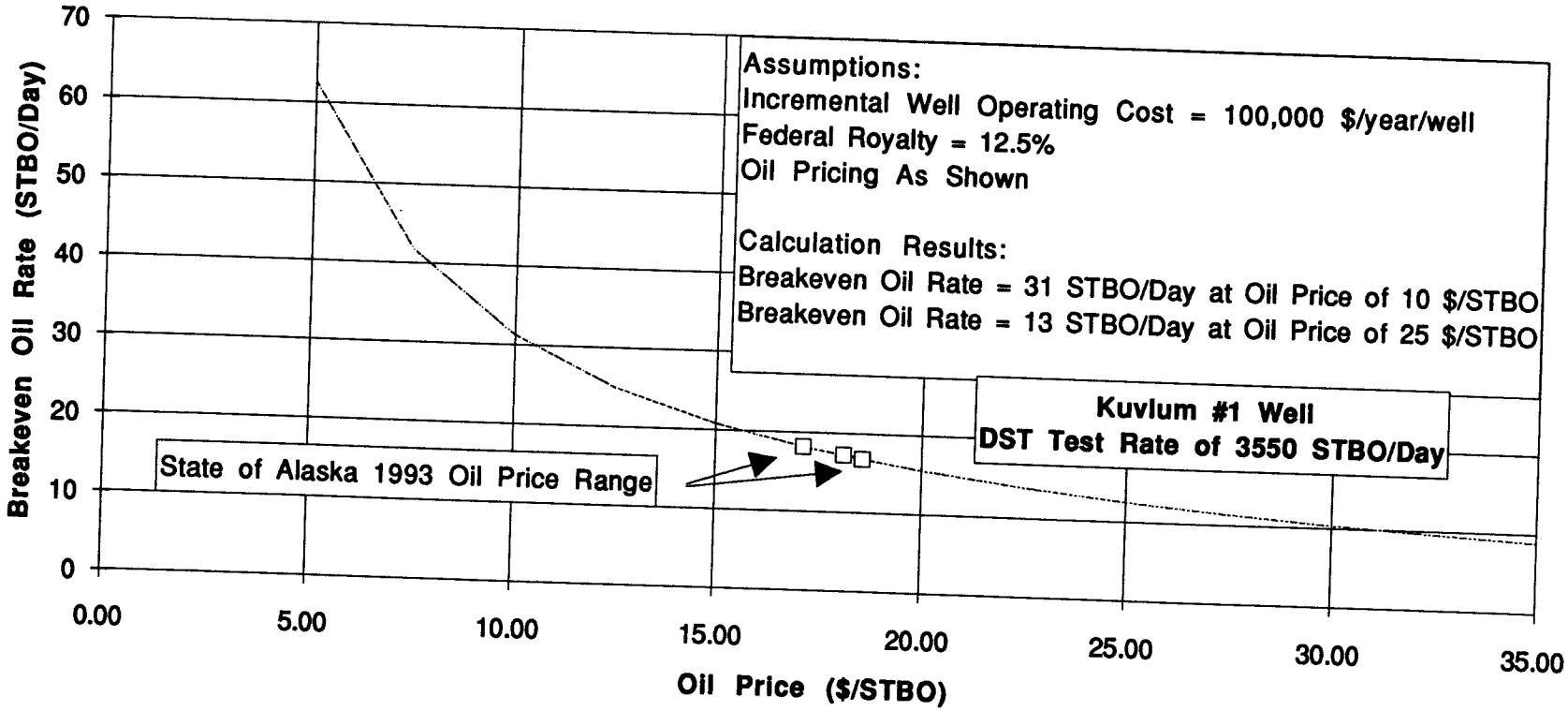
The weighted average Lower 48 shipping cost averaged $1.75/bbl in FY 1992, $0.40/bbl higher than in the prior year. This increase was mostly attributable to tight markets in the higher cost Gulf trade, where there is significant chartering, and results of the Oilspill Pollution Act of 1990 (OPA90).

As ANS production declines and West Coast petroleum demand increases, shipments to the Gulf will diminish. This will free up excess tonnage. Consequently, average shipping costs are expected to stay fairly constant over the next few years. In the long term the double hulling requirements of OPA90 will result in increased shipping costs.

Figure 9
Total Transportation Costs to Lower 48 Pipeline and Tanker



Kuvlum #1
Breakeven Oil Rate vs. Oil Price
Paying Quantities Determination



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