

# Strategic Petroleum Reserve Crude Oil Assay Manual

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Washington, DC

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## PREFACE

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This booklet provides detailed information on the specifications for crude oils to be acquired for storage in the Strategic Petroleum Reserve (SPR), procedures used to assess quality of the stored petroleum during protracted storage, and methods used in developing assays of the various streams that may be sold. Assays of the eight SPR streams are provided. This edition supersedes the first edition, which was published in November 1991.

Any questions regarding sampling practices, analysis procedures, or the assays themselves should be addressed to Operations and Readiness Office, Attn: Harry N. Giles, Strategic Petroleum Reserve Headquarters, Washington, DC 20585-0340, telephone +1 (202) 586-4731 or e-mail: [harry.giles@hq.doe.gov](mailto:harry.giles@hq.doe.gov). This office should also be contacted for the latest edition of the SPR Crude Oil Specifications shown in Table I.

## I. Acquisition And Storage Of Crude Oils.

Specifications for acquisition of crude oil for storage in the Strategic Petroleum Reserve (SPR) were originally developed in 1976. At that time, six categories of crude oil were defined. These encompassed a large segment of crude oils being processed by U. S. refineries at that time – both domestic and foreign – and projections of future runs based on new fields being developed such as those on the Alaskan North Slope and in the North Sea.

These categories included one medium gravity, sour<sup>1</sup> crude oil of nominal Arabian Light quality; four medium gravity, sweet<sup>1</sup> categories, covering North and West African streams and production coming on-stream in the North Sea; and a heavy, sour category specific to Alaskan North Slope production. Later, a seventh category was added to allow for acquisition of Mexican Maya crude oil.

For practical reasons related to drawdown logistics, it was not possible to segregate all these various categories in storage and essentially four segregations evolved. The two largest of these in terms of volume were a medium gravity, sour of nominal Mexican Isthmus quality, and a medium gravity, sweet of nominal Ninian/Forties quality. Another segregation comprised Alaskan North Slope crude commingled with medium gravity, sour crude oils, and the fourth segregation was Mexican Maya. Due to technical considerations unrelated to crude oil quality or drawdown logistics, the Alaskan North Slope segregation formerly stored in the Weeks Island Mine has been relocated and commingled with medium gravity, sour crude oils. The Maya segregation has now been disposed of and replaced by other crude oils.

Today, only two specifications – one sweet and one sour, both of medium gravity – are used for acquiring crude oil for the SPR (Table I).

Member companies of the American Petroleum Institute, the National Petrochemical and Refiners Association, and other industry groups and petroleum companies have reviewed these specifications on several occasions. For the most part, these reviews have supported the specifications, and only relatively minor changes have been made. In their present form, these specifications allow for acquisition of a relatively broad slate of crude oils, both domestic and foreign.

Experience indicates that the crude oils known to conform to each category are compatible and reactions do not occur during long-term storage that will adversely affect quality of a mixture.

Currently, the SPR has a sweet and a sour segregation at each of its four sites. The approximate crude oil makeup of each of these eight segregations is summarized in Appendix A. Mexican Isthmus is the dominant crude oil comprising all four sour segregations, and U. K. Brent, Forties, and Ninian<sup>2</sup> are the dominant crude oils comprising the four sweet segregations.

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<sup>1</sup> For the purposes of the SPR, sour crude oils are defined as those containing a maximum of 1.99 mass % total sulfur, and sweet crude oils are defined as those containing a maximum of 0.50 mass % total sulfur.

<sup>2</sup> Beginning in 1991, Ninian production was commingled with Brent and, since then, has not been a separate stream.

To maintain overall quality and minimize possible adverse reactions resulting from incompatibility, generally only crude oils of similar composition are commingled in storage. For example, North Sea crude oils such as U. K. Brent and U. K. Forties may be commingled, as would Arabian Light and Dubai. Arabian Light would not, however, be commingled with Brent or Forties, or other “sweet” crude oils. There are, however, several exceptions to this general rule. At both Bayou Choctaw and Big Hill, Alaskan North Slope has been commingled with medium gravity, sour crude oils following its transfer from the now abandoned Weeks Island Mine storage facility. And also at Bayou Choctaw and Big Hill, relatively small amounts of Maya are commingled in the sour crude oil segregations. Despite these exceptions, the composition of the crude oil mixture in the preponderance of SPR caverns conforms to one of the two specifications in Table I.

## **II. Crude Oil Quality Assessment Program.**

Shortly after a storage cavern is initially filled with crude oil, a vertical series of samples is collected for laboratory analysis to determine quality of the mixture and provide a baseline for future quality assessments. Caverns are normally sampled again at approximately five-to-seven year intervals.

An inspection analysis (Figure 1) of each cavern sample is performed to ascertain if there is any stratification or differentiation of the crude oil mixture. If none is evident, a composite sample is made of the separate samples for comprehensive analysis in accordance with standard methods<sup>3,4</sup>. Should stratification or differentiation be apparent, each individual sample or a combination of samples will be analyzed separately using the same methods. On the basis of extensive studies of crude oil stockpiles in both the United States and Germany, it is evident that convective mixing induced by the natural geothermal gradient in the salt stock results in commingled crude oils becoming well mixed when stored in large underground caverns such as those of the SPR<sup>5</sup>. In most cases, little or no difference in quality will be present within 18 to 24 months following completion of cavern fill. While no deleterious changes in quality are known to occur to crude oil stored in solution-mined caverns in salt, a relatively small amount of dense, viscous, and waxy material containing emulsified water may accumulate in some caverns. This “sludge layer” appears to be a natural phenomenon and not the result of incompatibility between various crude oils commingled in storage<sup>6</sup>.

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<sup>3</sup> *Manual on Hydrocarbon Analysis – 6<sup>th</sup> Edition*, A. W. Drews, Editor. Chapter 6, “Crude Oils”, ASTM, West Conshohocken, PA, 1998.

<sup>4</sup> *Manual on Significance of Tests for Petroleum Products – 7<sup>th</sup> Edition*, S. J. Rand, Editor. “Crude Oils”, ASTM, West Conshohocken, PA, 2002.

<sup>5</sup> “Stability of Refined Products and Crude Oil Stored in Large Caverns in Salt Deposits: Biogeochemical Aspects.” H. N. Giles and others, *Energy & Fuels*, July 1991.

<sup>6</sup> “Microbial Aspects of Crude Oil Storage in Salt Dome Caverns.” R. A. Neihof and H. N. Giles, *Biodegradation and Biodegradation 8*, H. W. Ross Moore, Editor, Elsevier Applied Science, London, 1991.

### **III. Crude Oil Composition of SPR Streams.**

Each SPR crude oil stream is comprised of crude oil stored in multiple caverns. The storage volume of individual caverns varies, with most being on the order of 10 million barrels (1.6 million m<sup>3</sup>). Depending on the magnitude of a sale and drawdown of the SPR, one or more caverns comprising the segregation may be used to make up a delivery stream. The analyses published elsewhere in this booklet are, essentially, an average of all of the caverns comprising a given SPR stream. For five of the eight streams, these composite assays are, nevertheless, clearly indicative of the quality generally available, although some minor deviation in quality of the crude oil delivered can be expected. Detailed laboratory analyses of the crude inventory in each cavern comprising these five streams confirm that there are no significant differences in quality among them.

For the other three streams, namely Bayou Choctaw Sour, Big Hill Sweet, and Big Hill Sour, there are differences in crude oil composition between the various caverns used to constitute the stream (Appendix A). While the analysis published for these three streams is also an average, the delivered stream can be expected to exhibit some deviation in quality from the published analysis, depending on which caverns are commingled during a drawdown. To minimize variations in quality, a proportional drawdown of caverns comprising a given stream is practiced to the extent practicable.

As analytical data exists on the crude oil composition of each storage cavern and on the crude oil streams stored, assays can be generated using the Haverly Systems, Inc. H/CAMS crude oil management system. This is an important capability in two respects. First, it allows a stream-specific assay to be developed for any combination of SPR caverns. Second, caverns are normally sampled only every five to seven years for the purpose of assessing quality. During the interim between cavern samplings, changes in quality could result from the storage of additional crude oil. Again, the Haverly system allows an assay to be developed using existing analytical data for the cavern and the crude oil streams stored. The number of different crude oils commingled in storage is relatively limited which enhances the reliability of computer-generated assays. This is advantageous to both the SPR and those eventually purchasing the SPR streams in assessing their value and in determining refining characteristics and product slates.

### **IV. Laboratory Procedures.**

All crude oil samples are analyzed using ASTM standard test methods to the maximum extent possible, following the scheme depicted in Figure 2. Distillation of the crude oil samples or composites is performed in accordance with ASTM D 2892 Standard Test Method for Distillation of Crude Petroleum (15-Theoretical Plate Column) at pressures of atmospheric to 0.266 kPa. Subsequent distillation of the residuum at a pressure of 0.13 kPa is performed using ASTM D 5236 Standard Test Method for Distillation of Heavy Hydrocarbon Mixtures (Vacuum Potstill Method). Distillation is on a mass percent basis, with volume percent calculated using specific gravity of the fractions.

Detailed Paraffin, Isoparaffin, Aromatic, Naphthene (PIAN) analysis of the naphtha fractions to 191°C (375°F) for C<sub>1</sub> through C<sub>12</sub> hydrocarbons is performed using a modified version of ASTM D 5134 Standard Test Method for Detailed Analysis of Petroleum Naphthas Through *n*-Nonane by Capillary Gas Chromatography. This modified version provides for elution and identification of components up to a nominal *n*-C<sub>12</sub> (216°C). Analyses of the distillation fractions also use standard ASTM test methods for the most part (see references 1 and 2), with results reported in accordance with the respective method's instructions.

Hydrogen sulfide. The hydrogen sulfide values reported for the whole crude are for naturally occurring, dissolved (existent) gas, while the values reported for distillation fractions represent evolved (potential) gas resulting from decomposition of thermally unstable sulfur compounds. Due to the reactivity of dissolved hydrogen sulfide, a collection and handling procedure has been adopted that reasonably assures that little of the compound is lost between the time samples are collected and later analyzed. Efficacy of this procedure has been corroborated using a field test specific for hydrogen sulfide<sup>7</sup>. As this collection and handling procedure has only recently been adopted, data on the whole crude oil hydrogen sulfide content are currently unavailable for the two Big Hill SPR streams. These data will be added to the Web-based assays for these two streams when they become available. A modified version of UOP 163 *Hydrogen Sulfide and Mercaptan Sulfur in Liquid Hydrocarbons by Potentiometric Titration* is used for determination of hydrogen sulfide in the laboratory.

Organic Chlorides. Several of the SPR stream assays published in 1998, indicated the presence of up to 10 ppm organic chlorides in the whole crude. This was a consequence of the inadvertent use of an halogenated solvent for cleaning the tool used for sampling SPR caverns and subsequent contamination of samples analyzed in developing these assays. Data for subsequent samples collected from these caverns and independent analyses of the streams by third-party laboratories have unequivocally demonstrated that the crude oil in storage is not contaminated with organic chlorides. To monitor for possible contamination, all shipments of crude oil received for storage in the reserve are now routinely analyzed for organic chlorides. ASTM D 4929 Test Method for *Determination of Organic Chloride Content in Crude Oil* is used for this determination.

Quality Assurance. The laboratory providing crude oil analytical services for the SPR participates in the ASTM Interlaboratory Crosscheck Program for crude oil. Results from this program help provide assurance that the testing is being done to the precision and accuracy of the respective test methods used. Additionally, the laboratory has an established internal quality assurance program to ensure conformance to best industry laboratory practices and in meeting defined standards of quality with a stated level of confidence.

Expanded Assay Format. Beginning with cavern samples collected in 2002, an expanded comprehensive analysis format will be used. This new format breaks the 650-1050°F residuum into two fractions; a light vacuum gas oil (650-850°F) and a heavy vacuum gas oil (850-1050°F). Several additional tests are also being added to the analysis scheme. These include high temperature simulated distillation, asphaltenes, refractive index, and mass percent hydrogen and

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<sup>7</sup> Neihof, Rex A. *Hydrogen Sulfide Analyzer With Protective Barrier*. U. S. Patent No. 5,529,841. U. S. Patent and Trademark Office, Washington, DC, June 25, 1996.

carbon. As analyses of SPR crude oil streams are completed using this expanded format, the assays published elsewhere in this manual and on the SPR Web site will be replaced.

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**TABLE I. SPR CRUDE OIL SPECIFICATIONS (SPRO 2001 MAY)<sup>aε2</sup>**

CHARACTERISTIC	SOUR <sup>b</sup>	SWEET <sup>c</sup>	PRIMARY ASTM TEST METHOD <sup>d</sup>
API Gravity [°API]	30 - 45	30 - 45	D 1298 or D 5002
Total Sulfur [Mass %], max.	1.99	0.50	D 4294
Pour Point [°C], max.	10	10	D 97
Salt Content [Mass %], max.	0.050	0.050	D 6470
Viscosity [cSt @ 15.6°C], max.	32	32	D 445
[cSt @ 37.8°C], max.	13	13	
Reid Vapor Pressure [kPa @ 37.8°C], max.	76	76	D 323 or D 5191
Total Acid Number [mg KOH/g], max.	1.00	1.00	D 664
Water and Sediment [Vol. %], max.	1.0	1.0	D 473 & D 4006 or D4928
Yields [Vol. %]			D 2892 & D 5236
Naphtha [28-191°C]	24 - 30	21 - 42	
Distillate [191-327°C]	17 - 31	19 - 45	
Gas Oil [327-566°C]	26 - 38	20 - 42	
Residuum [>566°C]	10 - 19	14 max.	

<sup>ε2</sup> This revision changes the limit on salt content, and the primary ASTM method used for its determination.

<sup>a</sup>Marketable virgin crude petroleum suitable for normal refinery processing and free of foreign contaminants or chemicals including, but not limited to, chlorinated and/or oxygenated hydrocarbons, and lead.

<sup>b</sup> Crude oils that meet these sour specifications include Arabian Berri, Arabian Light, Bonito Sour, Eugene Island, Flotta, Isthmus, Lagomedio, Mars, Mesa 30, Olmeca, Oman, Qatar Marine, Tia Juana Light, and West Texas Sour.

<sup>c</sup> Crude oils that meet these sweet specifications include Bonny Light, Brass River, Brent, Cusiana, Ekofisk, Escravos, Forties, Heavy Louisiana Sweet, Kole Marine, Light Louisiana Sweet, Oseberg, Qua Iboe, Saharan Blend, Statfjord, West Texas Intermediate, and Zarzaitine.

NOTE 1: Crude oils other than those listed above may be acceptable. The acceptability of any crude oil depends upon an assay typical of current production quality of the stream.

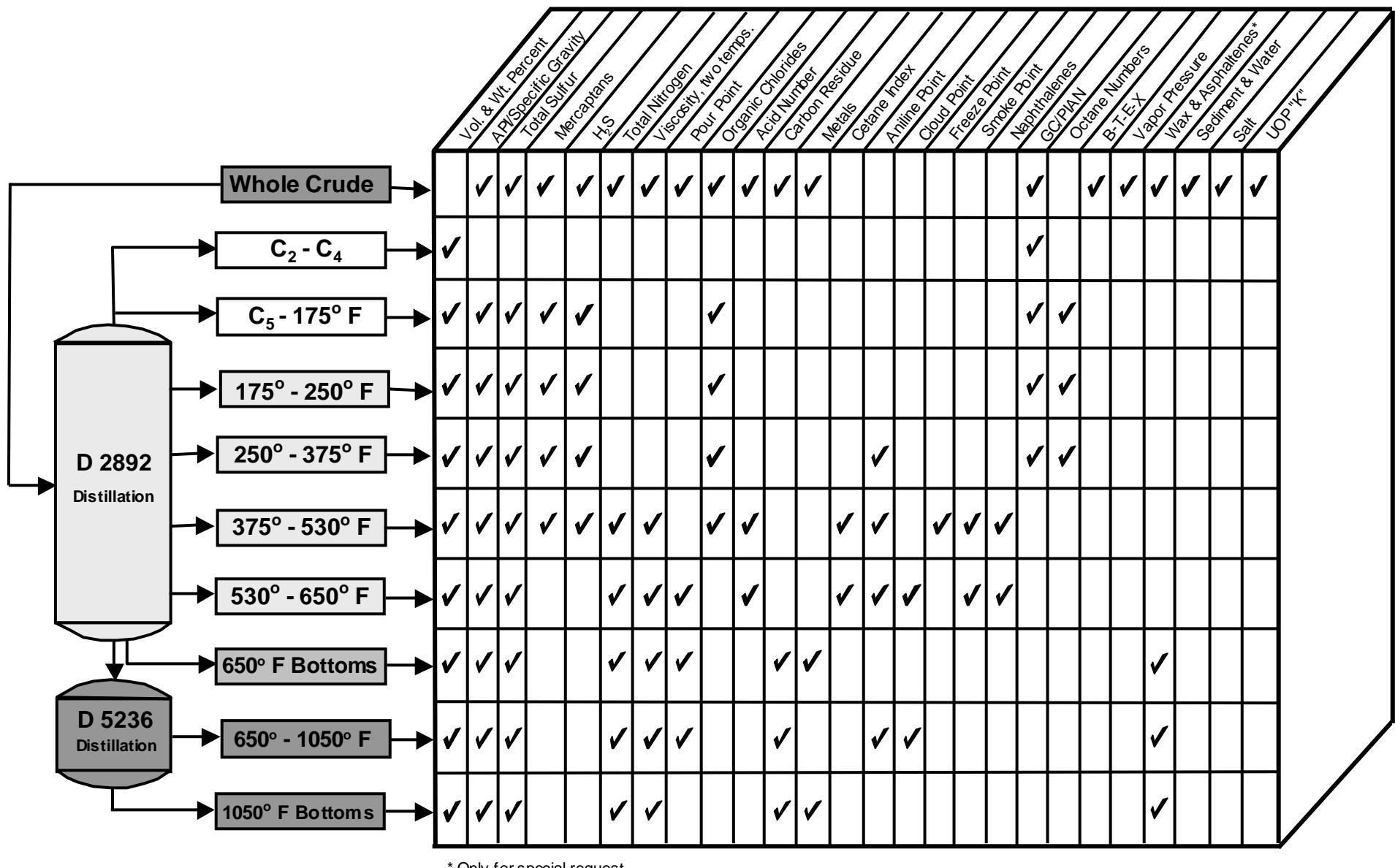
NOTE 2: All crude oil shipments received by the SPR are tested to ensure they meet the above specifications. Should successive shipments fail to meet these specifications, the stream may be deleted from the list of approved crude oils.

<sup>d</sup> Alternate methods may be used if approved by the contracting officer.

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## Fig. 1. TYPICAL SPR CRUDE OIL INSPECTION ANALYSIS

Date Started	xx/xx/xxxx		Site Name, Cavern Number			Date Reported	xx/xx/xxxx			
Sample No. Date Collected	Depth (ft.)	Sp. Gr. D 5002 at 60/60° F	Gravity °API	Pour Pt. D 5853 °F	Nitrogen D 5762 (wt. %)	Sulfur D 4294 (wt. %)	Viscosity		Water D 4928 (wt. %)	
							centistokes, D 445			
							at 77° F	at 100° F		
2001SPR086 9/7/01	2100	0.8444	36.1	35	0.115	0.34	7.160	4.532	0.02	
2001SPR087 9/7/01	2400	0.8445	36.1	35	0.115	0.35	7.204	4.523	0.02	
2001SPR088 9/7/01	2710	0.8448	36.0	40	0.115	0.34	7.234	4.576	0.02	
2001SPR089 9/7/01	3020	0.8446	36.0	25	0.111	0.35	7.254	4.616	0.02	
2001SPR090 9/7/01	3330	0.8444	36.1	30	0.112	0.35	7.263	4.541	0.05	
2001SPR091 9/7/01	3640	0.8440	36.2	25	0.111	0.34	7.087	4.535	0.02	
2001SPR092 9/6/01	3950	0.8446	36.0	30	0.114	0.36	7.161	4.545	0.02	
2001SPR093 9/6/01	3998	0.8438	36.2	30	0.113	0.36	7.158	4.460	0.01	
2001SPR094 9/6/01	4002	0.8441	36.1	30	0.114	0.36	7.183	4.510	0.01	
2001SPR095 9/6/01	4003	0.8449	36.0	20	0.104	0.35	7.961	4.817	0.17	
2001SPR096 9/6/01	4004	1.2061	--	--	--	--	Brine	--	--	
2001SPR097 9/6/01	4008	1.2062	--	--	--	--	Brine	--	--	



**Fig. 2. Detailed Crude Oil Analysis Scheme for Strategic Petroleum Reserve Samples.**

## **Appendix A. Crude Oil Composition of SPR Streams<sup>8</sup>**

### SPR Bayou Choctaw Sour

Seventy-five percent of the caverns comprising this stream contain a mix of approximately 45 % Mexican Isthmus, 33% Iranian Light, and 9% Mexican Maya; with the balance comprised mostly of Egyptian Gulf of Suez Blend, Dubai Fateh, and Arabian Light.

The remaining caverns contain crude oil transferred from Weeks Island Mine. Its composition is approximately 43 % Alaskan North Slope and 21 % Mexican Isthmus; approximately 5 % each of Egyptian Gulf of Suez Blend, Mexican Maya, Dubai Fateh, Arabian Light, and Omani; with the balance comprised mostly of Gabon Mandji and Iranian Light.

### SPR Bayou Choctaw Sweet

The caverns comprising this stream contain a mixture of approximately 39 % U. K. Ninian, 27 % Libyan Es Sider, 15 % U.K. Forties, and 8 % U. K. Brent; with the balance comprised mostly of Algerian Zarzaitine, Cameroon Kole Marine, and Libyan Sirtica.

### SPR Big Hill Sour

Approximately one-third of the caverns comprising this stream contain a mixture of approximately 72 % Mexican Isthmus and 11 % Arabian Light; with the balance comprised mostly of Iranian Light, Dubai Fateh, and Omani.

The other caverns contain crude oil transferred from Weeks Island Mine. Its composition is approximately 43 % Alaskan North Slope and 21 % Mexican Isthmus; approximately 5 % each of Egyptian Gulf of Suez Blend, Mexican Maya, Dubai Fateh, Arabian Light, and Omani; with the balance comprised mostly of Gabon Mandji and Iranian Light.

### SPR Big Hill Sweet

Each of the caverns comprising this stream contain a different crude oil mixture. Some caverns contain a mixture of Angola Palanca, U. K. Brent, Norwegian Oseberg, and U.S. Naval Petroleum Reserve (CA) Stephens Zone.

Others contain almost entirely U.S. Naval Petroleum Reserve (CA) Stephens Zone crude oil.

Still others contain mostly U.K. Brent and Norwegian Oseberg crude oils.

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<sup>8</sup> Current as of March 31, 1999. These figures are **subject to change** as additional crude oil is acquired through the ongoing Royalty-in-Kind and Exchange 2000 programs. To date Brent, Light Louisiana Sweet, and Mars Blend have been the major streams added to the reserve as a result of these programs.

### SPR Bryan Mound Sour

The caverns comprising this stream contain a mixture of approximately 80 % Mexican Isthmus; with the balance comprised mostly of Arabian Light, Dubai Fateh, Mexican Olmeca, and Omani.

### SPR Bryan Mound Sweet

The caverns comprising this stream contain a mixture of approximately 47 % U. K. Forties, 21 % U. K. Ninian, and 17 % Libyan Es Sider; with the balance comprised mostly of Nigerian Bonny Light, Libyan Sirtica, and Nigerian Forcados.

### West Hackberry Sour

The caverns comprising this stream contain a mixture of approximately 72 % Mexican Isthmus and 11 % Arabian Light; with the balance comprised mostly of Iranian Light, Dubai Fateh, and Omani.

### West Hackberry Sweet

The caverns comprising this stream contain a mixture of approximately 32 % U. K. Forties, 21 % U. K. Brent, and 20 % U. K. Ninian; with the balance comprised mostly of Norwegian Ekofisk, Nigerian Bonny Light, Libyan Es Sider, Nigerian Escravos, Algerian Saharan Blend, and Cameroon Kole Marine.

## **Appendix B. SPR Crude Oil Assays**

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**SPR CRUDE OIL COMPREHENSIVE ANALYSIS**

Sample ID

**BRYAN MOUND SWEET**

Date of Assay

**9/18/2000**

<b>Crude</b>					
Specific Gravity, 60/60° F	0.8454	Ni, ppm	3.41	RVP, psi @ 100° F	5.28
API Gravity	35.9	V, ppm	4.12	Acid number, mg KOH/g	0.10
Sulfur, Wt. %	0.33	Fe, ppm	0.822	Mercaptan Sulfur, ppm	7.26
Nitrogen, Wt. %	0.111	Org. Cl, ppm	0.3	H <sub>2</sub> S Sulfur, ppm	5
Micro Car. Res., Wt. %	2.21	UOP "K"	11.96	Viscosity: 77° F	6.99 cSt
Pour Point, °F	25			100° F	4.666 cSt

Fraction	Gas	1	2	3	4	5	6	Residuum	Residuum
Cut Temp.	C <sub>2</sub> - C <sub>4</sub>	C5 - 175° F	175° - 250° F	250° - 375° F	375° - 530° F	530° - 650° F	650° - 1050° F	650° F+	1050° F+
Vol. %	1.9	7.0	8.2	14.1	16.8	12.5	28.8	39.6	10.8
Vol. Sum %	1.9	8.8	17.0	31.1	47.9	60.4	89.2	100.0	100.0
Wt. %	1.3	5.5	7.2	12.9	16.5	12.7	31.1	43.9	12.8
Wt. Sum %	1.3	6.8	14.0	26.9	43.4	56.1	87.2	100.0	100.0
Specific Gravity, 60/60° F	0.6747	0.7391	0.7774	0.8275	0.8604	0.9143	0.9371	0.998	
API Gravity	78.2	60.0	50.5	39.5	33.0	23.3	19.5	10.4	
Sulfur, Wt. %	0.0013	0.0018	0.0113	0.07	0.25	0.51	0.65	0.98	
Molecular Weight	96	111	134	185	245	403			
Hydrogen, Wt. %	15.88	14.73	na				12.91	10.82	
Mercaptan Sulfur, ppm	3.6	8.8	27.8	19.4					
H <sub>2</sub> S Sulfur, ppm	< 0.1	< 0.1	< 0.1	< 0.1					
Organic Cl, ppm	4.1	1.0	0.1	<0.1					
Research Octane Number*	69.9	62.4	46.7						
Motor Octane Number*	67.5	60.0	44.8						
Flash Point, °F			77	172	246	301			
Aniline Point, °F			123.0	143.2	163.0	194.1			
Acid Number, mg KOH/g				0.04	0.10				
Cetane Index				45.5	51.0				
Diesel Index			62.1	56.6	53.7				
Naphthalenes, Vol. %				4.83	10.24				
Smoke point, mm				19.9	15.6				
Nitrogen, Wt. %				0.0006	0.010	0.154	0.276	0.572	
Viscosity, cSt	77° F			2.537					
	100° F			1.990	5.691				
	130° F				3.814	39.07	109.5		
	180° F					14.77	32.12	2923	
	210° F							920.6	
	275° F								143.5
Freezing Point, °F				-28.1					
Cloud Point, °F					31.1	105			
Pour Point, °F					27.0	101	85		
Ni, ppm							7.66	25.8	
V, ppm							9.29	31.4	
Fe, ppm							6.41	21.6	
Micro Car. Res., Wt. %							5.00	17.25	

\* = calculated from gas chromatographic data

## Compositional Analysis - Bryan Mound Sweet

	Gas	1	2	3
	IBP	59 -	175° -	250° -
	59° F	175° F	250° F	375° F
<b>Paraffins, Wt.%</b>	99.85	77.86	52.61	41.48
<b>Naphthenes, Wt.%</b>	0.15	20.86	40.54	36.50
<b>Aromatics, Wt.%</b>	0.00	1.28	6.86	22.02
<b>Benzene Precursor Index</b>	0.03	11.14	5.14	0.02

### **Composition, Wt.%**

Ethane	0.21	-	-	-
Propane	16.33	0.00	0.00	0.00
N-Butane	54.66	1.47	0.00	0.00
I-Butane	14.43	0.08	0.00	0.00
N-Pentane	4.39	18.44	0.04	0.00
I-Pentane	9.36	12.64	0.01	0.00
Cyclopentane	0.16	4.16	0.05	0.00
N-Hexane	0.05	15.87	2.93	0.00
2-Methylpentane	0.10	10.93	0.63	0.00
3-Methylpentane	0.04	6.59	0.58	0.00
2,2-Dimethylbutane	0.01	0.16	0.00	0.00
2,3-Dimethylbutane	0.04	3.03	0.13	0.00
Methylcyclopentane	0.02	10.50	2.98	0.00
Cyclohexane	0.01	5.16	4.99	0.01
Benzene	0.00	1.54	1.37	0.00
N-Heptane	0.00	1.18	12.64	0.13
2-Methylhexane	0.00	1.39	4.82	0.02
3-Methylhexane	0.00	1.22	5.38	0.02
2,2-Dimethylpentane	0.00	0.30	0.23	0.00
2,3-Dimethylpentane	0.00	0.85	2.85	0.01
2,4-Dimethylpentane	0.00	0.32	0.30	0.00
3,3-Dimethylpentane	0.00	0.11	0.23	0.00
2,3,3-Trimethylbutane	0.00	0.04	0.04	0.00
3-Ethylpentane	0.00	0.05	0.28	0.00
1,1-Dimethylcyclopentane	0.00	0.04	0.09	0.00
1,Cis-2-DimethylcyC5	0.00	0.07	0.82	0.01
1,Cis-3-DimethylcyC5	0.00	0.57	2.48	0.01
1-Trans-2-DimethcyC5	0.00	0.92	4.08	0.02
1-Trans-3-DimethcyC5	0.00	0.80	3.08	0.01
Ethylcyclopentane	0.00	0.11	2.18	0.04
Methylcyclohexane	0.00	1.14	17.08	0.24
Toluene (Methylbenzene)	0.00	0.12	5.94	0.31
N-Octane	0.00	0.02	3.77	1.54
I-Octane	0.00	0.14	14.16	2.10
Methyl-Ethylcyclopentane	0.00	0.04	4.22	0.63
Dimethylcyclohexane	0.00	0.00	0.65	0.97
P-Xylene	0.00	0.00	0.00	0.00
M-Xylene	0.00	0.00	0.00	0.00
O-Xylene	0.00	0.00	0.00	0.00
Ethylbenzene	0.00	0.00	0.00	0.00
N-Nonane	0.00	0.00	0.00	0.00
C9 isoparaffins	0.00	0.00	0.71	1.54

# SPR CRUDE OIL COMPREHENSIVE ANALYSIS

Sample ID Bryan Mound Sour

Date of Assay 10/24/2001

Sediment by Extraction, wt. %	<u>0.027</u>	<b>Crude</b>		Water, wt. %	<u>0.19</u>	Salt, wt. %		<u>0.009</u>
Specific Gravity, 60/60° F	<u>0.8589</u>	Ni, ppm	<u>11.2</u>	RVP, psi @ 100° F				<u>4.29</u>
API Gravity	<u>33.2</u>	V, ppm	<u>50.6</u>	Acid number, mg KOH/g				<u>0.19</u>
Sulfur, Wt. %	<u>1.39</u>	Fe, ppm	<u>0.45</u>	Mercaptan Sulfur, ppm				<u>37.6</u>
Nitrogen, Wt. %	<u>0.142</u>	Cu, ppm	<u>0.17</u>	H <sub>2</sub> S Sulfur, ppm				<u>75</u>
Micro Car. Res., Wt. %	<u>4.3</u>	Org. Cl, ppm	<u>0.8</u>	Viscosity: 77° F	<u>9.126</u>	cSt	<u>55.7</u>	SUS
Pour Point, °F	<u>-5</u>	UOP "K"	<u>11.9</u>	100° F	<u>6.045</u>	cSt	<u>45.7</u>	SUS

Fraction	Gas	1	2	3	4	5	6	Residuum	Residuum
Cut Temp.	C <sub>2</sub> - C <sub>4</sub> 175° F	C5 - 250° F	175° - 250° F	250° - 375° F	375° - 530° F	530° - 650° F	650° - 1050° F	650° F+	1050° F+
Vol. %	2.3	5.9	7.7	14.2	16.7	11.9	26.3	41.7	15.3
Vol. Sum %	2.3	8.2	15.9	30.1	46.8	58.7	85.0	100.4	100.3
Wt. %	1.6	4.6	6.5	12.8	15.9	11.9	28.3	46.7	18.4
Wt. Sum %	1.6	6.2	12.7	25.5	41.4	53.3	81.6	100.0	100.0
Specific Gravity, 60/60° F	0.6620	0.7249	0.7712	0.8199	0.8634	0.9262	0.9625	1.032	
API Gravity	82.2	63.7	52.0	41.1	32.4	21.3	15.5	5.6	
Sulfur, Wt. %	0.0047	0.0086	0.0510	0.40	1.35	1.90	2.49	3.39	
Mercaptan Sulfur, ppm	25.1	31.1	53.9	14.1					
H <sub>2</sub> S Sulfur, ppm	6.7	17.7	30.7	0.0					
Organic Cl, ppm	0.5	0.7	0.9	4.0					
Research Octane Number*	63.0	56.1	47.1						
Motor Octane Number*	62.0	54.1	42.4						
RON for C <sub>8</sub> - 375° F									
MON for C <sub>6</sub> - 375° F									
Aniline Point, °F			125.4	145.6	161.4	184.6			
Acid Number, mg KOH/g				0.02	0.03				
Cetane Index				49.1	49.8				
Naphthalenes, Vol. %				3.81	11.00				
Smoke point, mm				20.0	15.8				
Nitrogen, Wt. %				0.0004	0.0183	0.150	0.273	0.428	
Viscosity, cSt	77° F			2.326					
	100° F			1.853	5.160				
	130° F				3.497	33.37	247.0		
	180° F					12.58	62.34	23505	
	210° F							5239	
	275° F								
Freezing Point, °F				-31					
Cloud Point, °F					27	104			
Pour Point, °F					18	105	60		
Ni, ppm							23.6	59.3	
V, ppm							105	268	
Fe, ppm							4.19	11.1	
Cu, ppm							0.05	0.16	
Micro Car. Res., Wt. %						0.5	9.2	23.8	

\* = calculated from gas chromatographic data

**GAS CHROMATOGRAPHIC ANALYSIS**  
**Bryan Mound Sour**

		Distillate fractions, ASTM D2892		
		C <sub>5</sub> -175° F Wt. %	175-250° F Wt. %	250-375° F Wt. %
* Total Paraffins		47.38	30.10	24.69
Total Iso-paraffins		39.18	37.94	33.51
Total Aromatics		2.50	9.01	21.69
Total Naphthenes		10.93	22.96	18.32
Unknowns		0.00	0.00	1.78
Paraffins	C2	0.00	0.00	0.00
	C3	0.00	0.00	0.00
	C4	1.90	0.14	0.03
	C5	21.20	0.30	0.04
	C6	24.13	2.43	0.04
	C7	0.15	20.30	0.24
	C8	0.00	6.93	5.45
	C9	0.00	0.00	8.41
	C10	0.00	0.00	8.17
	C11	0.00	0.00	2.31
	C12	0.00	0.00	0.00
Iso-paraffins	C4	0.11	0.02	0.00
	C5	10.98	0.23	0.03
	C6	25.46	0.89	0.02
	C7	2.64	15.72	0.11
	C8	0.00	20.46	3.10
	C9	0.00	0.62	10.36
	C10	0.00	0.00	14.76
	C11	0.00	0.00	5.10
	C12	0.00	0.00	0.02
Aromatics	C6	2.38	0.55	0.01
	C7	0.13	7.98	0.54
	C8	0.00	0.47	8.40
	C9	0.00	0.00	4.76
	C10	0.00	0.00	7.58
	C11	0.00	0.00	0.41
	C12	0.00	0.00	0.00
Naphthenes	C5	2.06	0.03	0.00
	C6	8.35	3.48	0.04
	C7	0.52	15.28	0.41
	C8	0.00	4.07	3.45
	C9	0.00	0.10	7.04
	C10	0.00	0.00	6.04
	C11	0.00	0.00	1.33
	C12	0.00	0.00	0.00

**Debutanization Fraction**

Component	Wt. %
Methane	0.00
Ethane	0.78
Propane	21.42
i-Butane	14.43
n-Butane	54.25
2,2-dimethylpropane	0.16
i-Pentane	6.48
n-Pentane	2.33
C <sub>6</sub> +	0.16

**From PIAN analysis of whole crude**

Component	Wt. % of crude
Benzene	0.17
Toluene	0.81
Ethylbenzene	0.24
m-Xylene	0.46
p-Xylene	0.18
o-Xylene	0.30

\*The modified D 5134 gas chromatographic PIAN method used provides for elution and identification of components up to a nominal n-C<sub>12</sub> (420°F)

# SPR CRUDE OIL COMPREHENSIVE ANALYSIS

Sample ID West Hackberry Sweet

Date of Assay

11/14/2001

Sediment by Extraction, wt. %	<u>0.017</u>	Crude	Water, wt. %	<u>0.09</u>	Salt, wt. %	<u>0.005</u>
Specific Gravity, 60/60° F	<u>0.8382</u>	Ni, ppm	<u>3.01</u>	RVP, psi @ 100° F	<u>6.96</u>	
API Gravity	<u>37.3</u>	V, ppm	<u>4.50</u>	Acid number, mg KOH/g	<u>0.22</u>	
Sulfur, Wt. %	<u>0.32</u>	Fe, ppm	<u>0.90</u>	Mercaptan Sulfur, ppm	<u>5.6</u>	
Nitrogen, Wt. %	<u>0.101</u>	Cu, ppm	<u>0.01</u>	H <sub>2</sub> S Sulfur, ppm	<u>0</u>	
Micro Car. Res., Wt. %	<u>1.7</u>	Org. Cl, ppm	<u>0.2</u>	Viscosity: 77° F	<u>5.523</u>	cSt <u>44.0</u> SUS
Pour Point, °F	<u>25</u>	UOP "K"	<u>11.9</u>	100° F	<u>3.735</u>	cSt <u>38.3</u> SUS

Fraction	Gas	1	2	3	4	5	6	Residuum	Residuum
Cut Temp.	C <sub>2</sub> - C <sub>4</sub>	C5 - 175° F	175° - 250° F	250° - 375° F	375° - 530° F	530° - 650° F	650° - 1050° F	650° F+	1050° F+
Vol. %	<u>3.8</u>	<u>7.9</u>	<u>9.1</u>	<u>13.3</u>	<u>16.5</u>	<u>12.4</u>	<u>27.7</u>	<u>37.7</u>	<u>9.5</u>
Vol. Sum %	<u>3.8</u>	<u>11.7</u>	<u>20.8</u>	<u>34.1</u>	<u>50.6</u>	<u>63.0</u>	<u>90.7</u>	<u>100.7</u>	<u>100.2</u>
Wt. %	<u>2.7</u>	<u>6.4</u>	<u>8.1</u>	<u>12.3</u>	<u>16.3</u>	<u>12.7</u>	<u>30.2</u>	<u>41.5</u>	<u>11.3</u>
Wt. Sum %	<u>2.7</u>	<u>9.1</u>	<u>17.2</u>	<u>29.5</u>	<u>45.8</u>	<u>58.5</u>	<u>88.7</u>	<u>100.0</u>	<u>100.0</u>
Specific Gravity, 60/60° F	<u>0.6723</u>	<u>0.7408</u>	<u>0.7804</u>	<u>0.8296</u>	<u>0.8594</u>	<u>0.9132</u>	<u>0.9230</u>	<u>0.996</u>	
API Gravity	<u>79.0</u>	<u>59.5</u>	<u>49.8</u>	<u>39.1</u>	<u>33.1</u>	<u>23.4</u>	<u>21.8</u>	<u>10.6</u>	
Sulfur, Wt. %	<u>0.0006</u>	<u>0.0007</u>	<u>0.0071</u>	<u>0.09</u>	<u>0.28</u>	<u>0.52</u>	<u>0.67</u>	<u>1.18</u>	
Mercaptan Sulfur, ppm	<u>3.6</u>	<u>5.0</u>	<u>9.3</u>	<u>3.4</u>					
H <sub>2</sub> S Sulfur, ppm	<u>0.0</u>	<u>1.0</u>	<u>0.8</u>	<u>0.0</u>					
Organic Cl, ppm	<u>0.8</u>	<u>0.3</u>	<u>0.8</u>	<u>1.0</u>					
Research Octane Number*	<u>68.0</u>	<u>63.7</u>	<u>47.4</u>						
Motor Octane Number*	<u>66.2</u>	<u>60.9</u>	<u>42.9</u>						
RON for C <sub>6</sub> - 375° F									
MON for C <sub>6</sub> - 375° F									
Aniline Point, °F			<u>120.2</u>	<u>141.4</u>	<u>163.6</u>	<u>193.5</u>			
Acid Number, mg KOH/g				<u>0.03</u>	<u>0.12</u>				
Cetane Index				<u>45.5</u>	<u>50.9</u>				
Naphthalenes, Vol. %				<u>4.91</u>	<u>9.58</u>				
Smoke point, mm				<u>19.3</u>	<u>15.2</u>				
Nitrogen, Wt. %				<u>0.0017</u>	<u>0.0113</u>	<u>0.127</u>	<u>0.229</u>	<u>0.485</u>	
Viscosity, cSt	<u>77° F</u>			<u>2.450</u>					
	<u>100° F</u>			<u>1.946</u>	<u>5.299</u>				
	<u>130° F</u>				<u>3.575</u>	<u>28.39</u>	<u>100.2</u>		
	<u>180° F</u>					<u>11.21</u>	<u>30.40</u>	<u>2913</u>	
	<u>210° F</u>							<u>914.5</u>	
	<u>275° F</u>								
Freezing Point, °F				<u>-33</u>					
Cloud Point, °F					<u>26</u>	<u>104</u>			
Pour Point, °F					<u>18</u>	<u>105</u>	<u>100</u>		
Ni, ppm							<u>6.71</u>	<u>25.5</u>	
V, ppm							<u>10.6</u>	<u>40.3</u>	
Fe, ppm							<u>5.85</u>	<u>19.6</u>	
Cu, ppm							<u>0.02</u>	<u>0.12</u>	
Micro Car. Res., Wt. %						<u>0.2</u>	<u>4.0</u>	<u>15.9</u>	

\* = calculated from gas chromatographic data

**GAS CHROMATOGRAPHIC ANALYSIS**  
**West Hackberry Sweet**

		Distillate fractions, ASTM D2892		
		C <sub>5</sub> -175° F Wt. %	175-250° F Wt. %	250-375° F Wt. %
* Total Paraffins		41.23	21.68	19.59
Total Iso-paraffins		34.23	23.61	31.38
Total Aromatics		5.38	10.83	22.05
Total Naphthenes		19.15	43.88	25.51
Unknowns		0.00	0.00	1.47
Paraffins	C2	0.00	0.00	0.00
	C3	0.07	0.00	0.00
	C4	1.43	0.10	0.03
	C5	21.66	0.49	0.13
	C6	17.97	2.25	0.09
	C7	0.11	14.02	0.30
	C8	0.00	4.82	5.74
	C9	0.00	0.00	7.10
	C10	0.00	0.00	5.04
	C11	0.00	0.00	1.15
	C12	0.00	0.00	0.00
Iso-paraffins	C4	0.00	0.00	0.00
	C5	13.18	0.27	0.07
	C6	18.80	1.36	0.14
	C7	2.26	11.79	0.13
	C8	0.00	10.00	4.15
	C9	0.00	0.18	10.38
	C10	0.00	0.00	12.93
	C11	0.00	0.00	3.58
	C12	0.00	0.00	0.00
Aromatics	C6	3.91	1.14	0.03
	C7	1.47	9.30	0.99
	C8	0.00	0.38	11.07
	C9	0.00	0.00	4.27
	C10	0.00	0.00	5.48
	C11	0.00	0.00	0.20
	C12	0.00	0.00	0.00
Naphthenes	C5	2.81	0.15	0.03
	C6	15.30	7.39	0.14
	C7	1.04	27.49	1.19
	C8	0.00	8.75	7.03
	C9	0.00	0.10	10.97
	C10	0.00	0.00	4.90
	C11	0.00	0.00	1.26
	C12	0.00	0.00	0.00

**Debutanization Fraction**

Component	Wt. %
Methane	0.00
Ethane	0.90
Propane	22.90
i-Butane	14.63
n-Butane	53.62
2,2-dimethylpropane	0.15
i-Pentane	5.72
n-Pentane	1.97
C <sub>6</sub> +	0.11

**From PIANO analysis of whole crude**

Component	Wt. % of crude
Benzene	0.30
Toluene	0.78
Ethylbenzene	0.22
m-Xylene	0.46
p-Xylene	0.14
o-Xylene	0.30

\* The modified D 5134 gas chromatographic PIAN method used provides for elution and identification of components up to a nominal n-C<sub>12</sub> (420° F).

**SPR CRUDE OIL COMPREHENSIVE ANALYSIS**

Sample ID WEST HACKBERRY SOUR Date of Assay 9/18/2000

Crude					
Specific Gravity, 60/60° F	0.8575	Ni, ppm	7.74	RVP, psi @ 100° F	4.48
API Gravity	33.5	V, ppm	33.6	Acid number, mg KOH/g	0.11
Sulfur, Wt. %	1.41	Fe, ppm	0.325	Mercaptan Sulfur, ppm	26.2
Nitrogen, Wt. %	0.137	Org. Cl, ppm	0.4	H <sub>2</sub> S Sulfur, ppm	75
Micro Car. Res., Wt. %	4.11	UOP "K"	11.86	Viscosity: 77° F	8.278 cSt
Pour Point, °F	-5			100° F	5.632 cSt

Fraction	Gas	1	2	3	4	5	6	Residuum	Residuum
Cut Temp.	C <sub>2</sub> - C <sub>4</sub> 175° F	C5 - 250° F	175° - 250° F	250° - 375° F	375° - 530° F	530° - 650° F	650° - 1050° F	1050° F+	650° F+ 1050° F+
Vol. %	1.4	6.2	7.0	16.4	15.8	10.2	29.1	43.1	14.0
Vol. Sum %	1.4	7.6	14.6	31.0	46.7	56.9	86.0	100.0	100.0
Wt. %	0.9	4.8	5.9	14.8	15.1	10.2	31.4	48.2	16.8
Wt. Sum %	0.9	5.7	11.7	26.4	41.5	51.7	83.1	99.9	99.9
Specific Gravity, 60/60° F	0.6654	0.7281	0.7717	0.8194	0.8610	0.9263	0.9583	1.025	
API Gravity	81.2	62.8	51.9	41.2	32.8	21.3	16.2	6.6	
Sulfur, Wt. %	0.0061	0.0119	0.0523	0.39	1.09	2.03	2.55	3.53	
Molecular Weight	97	111	135	184	245	411			
Hydrogen, Wt. %	16.11	14.96	na				12.15	9.97	
Mercaptan Sulfur, ppm	28.7	56.6	110.6	45.2					
H <sub>2</sub> S Sulfur, ppm	4.8	9.2	7.9	0.5					
Organic Cl, ppm	0.8	0.6	0.8	1.6					
Research Octane Number*	64.6	53.6	34.4						
Motor Octane Number*	63.4	51.9	34.2						
Flash Point, ° F			77	170	246	302			
Aniline Point, ° F			124.3	144.9	159.1	180.8			
Acid Number, mg KOH/g				0.02	0.05				
Cetane Index				49.2	50.6				
Diesel Index		64.5		59.7	52.3				
Naphthalenes, Vol. %				3.83	10.82				
Smoke point, mm				20.2	14.8				
Nitrogen, Wt. %				0.0009	0.013	0.173	0.295	0.525	
Viscosity, cSt	77° F			2.372					
	100° F			1.900	4.934				
	130° F				3.365	36.47	173.9		
	180° F					14.07	46.73	12560	
	210° F							3128	
	275° F								340.4
Freezing Point, °F				-25.7					
Cloud Point, °F					24.1	99			
Pour Point, °F					20.7	95	47		
Ni, ppm							16.5	47.1	
V, ppm							69.3	198	
Fe, ppm							2.82	8.20	
Micro Car. Res., Wt. %							8.50	23.44	

\* = calculated from gas chromatographic data

## Compositional Analysis: West Hackberry Sour

	Gas	1	2	3
	IBP	59° F	175° F	250° F
			59° F	375° F
<b>Paraffins, Wt.%</b>	99.90	87.18	66.75	44.59
<b>Naphthenes, Wt.%</b>	0.10	11.74	26.30	37.35
<b>Aromatics, Wt.%</b>	0.00	1.08	6.94	18.05
<b>Benzene Precursor Index</b>	0.03	8.47	3.48	0.01

### **Composition, Wt.%**

Ethane	0.22	-	-	-
Propane	13.03	0.00	0.00	0.00
N-Butane	56.08	1.24	0.00	0.00
I-Butane	12.98	0.06	0.00	0.00
N-Pentane	6.21	21.31	0.05	0.00
I-Pentane	10.78	11.90	0.01	0.00
Cyclopentane	0.10	2.21	0.03	0.00
N-Hexane	0.08	20.77	3.88	0.00
2-Methylpentane	0.14	12.60	0.73	0.00
3-Methylpentane	0.06	8.55	0.75	0.00
2,2-Dimethylbutane	0.01	0.23	0.00	0.00
2,3-Dimethylbutane	0.02	1.69	0.07	0.00
Methylcyclopentane	0.02	6.14	1.76	0.00
Cyclohexane	0.00	2.90	2.83	0.00
Benzene	0.00	1.31	1.18	0.00
N-Heptane	0.00	1.78	19.29	0.19
2-Methylhexane	0.00	1.57	5.52	0.02
3-Methylhexane	0.00	1.38	6.17	0.03
2,2-Dimethylpentane	0.00	0.33	0.27	0.00
2,3-Dimethylpentane	0.00	0.96	3.26	0.01
2,4-Dimethylpentane	0.00	0.36	0.34	0.00
3,3-Dimethylpentane	0.00	0.13	0.26	0.00
2,3,3-Trimethylbutane	0.00	0.05	0.05	0.00
3-Ethylpentane	0.00	0.06	0.32	0.00
1,1-Dimethylcyclopentane	0.00	0.02	0.06	0.00
1,Cis-2-DimethylcyC5	0.00	0.04	0.50	0.01
1,Cis-3-DimethylcyC5	0.00	0.35	1.52	0.01
1-Trans-2-DimethcyC5	0.00	0.56	2.51	0.01
1-Trans-3-DimethcyC5	0.00	0.49	1.89	0.01
Ethylcyclopentane	0.00	0.06	1.34	0.03
Methylcyclohexane	0.00	0.59	8.87	0.12
Toluene (Methylbenzene)	0.00	0.12	5.73	0.29
N-Octane	0.00	0.04	6.69	2.69
I-Octane	0.00	0.14	14.47	2.12
Methyl-Ethylcyclopentane	0.00	0.06	6.12	0.90
Dimethylcyclohexane	0.00	0.00	0.67	0.98
P-Xylene	0.00	0.00	0.39	0.91
M-Xylene	0.00	0.00	0.00	0.00
O-Xylene	0.00	0.00	0.00	0.00
Ethylbenzene	0.00	0.00	0.42	0.73
N-Nonane	0.00	0.00	0.00	0.00
C9 isoparaffins	0.00	0.01	1.90	4.05

## SPR CRUDE OIL COMPREHENSIVE ANALYSIS

Sample ID BAYOU CHOCTAW SWEET Date of Assay 9/18/2000

<b>Crude</b>					
Specific Gravity, 60/60° F	0.8447	Ni, ppm	3.50	RVP, psi @ 100° F	4.62
API Gravity	36.0	V, ppm	5.49	Acid number, mg KOH/g	0.084
Sulfur, Wt. %	0.36	Fe, ppm	0.844	Mercaptan Sulfur, ppm	7.021
Nitrogen, Wt. %	0.114			H <sub>2</sub> S Sulfur, ppm	0
Micro Car. Res., Wt. %	2.22	Org. Cl, ppm	0.3	Viscosity: 77° F	6.874 cSt
Pour Point, °F	31	UOP "K"	11.94	100° F	4.623 cSt

Fraction	Gas	1	2	3	4	5	6	Residuum	Residuum
Cut Temp.	C <sub>2</sub> - C <sub>4</sub>	C <sub>5</sub> - 175° F	175° - 250° F	250° - 375° F	375° - 530° F	530° - 650° F	650° - 1050° F	650° F+	1050° F+
Vol. %	1.7	7.3	8.1	14.2	16.3	10.0	31.8	42.4	10.7
Vol. Sum %	1.7	9.0	17.1	31.3	47.6	57.6	89.3	100.0	100.0
Wt. %	1.2	5.8	7.1	13.1	15.9	10.1	34.3	47.0	12.7
Wt. Sum %	1.2	7.0	14.1	27.1	43.0	53.1	87.4	100.0	100.0
Specific Gravity, 60/60° F	0.6730	0.7396	0.7763	0.8240	0.8526	0.9116	0.9349	1.004	
API Gravity	78.8	59.8	50.8	40.2	34.5	23.7	19.9	9.4	
Sulfur, Wt. %	0.0043	0.0040	0.0123	0.07	0.21	0.57	0.69	1.04	
Molecular Weight	97	111	136	184	246	425			
Hydrogen, Wt. %	15.89	14.65	na				12.99	10.61	
Mercaptan Sulfur, ppm	14.6	10.1	22.5	17.4					
H <sub>2</sub> S Sulfur, ppm	0.03	0.8	0.7	0.02					
Organic Cl, ppm	2.1	0.5	0.5	0.6					
Research Octane Number*	68.4	61.1	42.3						
Motor Octane Number*	66.5	58.6	40.0						
Flash Point, °F			77	171	246	303			
Aniline Point, °F			122.4	144.1	164.3	193.3			
Acid Number, mg KOH/g				0.03	0.10				
Cetane Index				47.1	53.2				
Diesel Index			62.2	58.0	56.6				
Naphthalenes, Vol. %				4.42	8.20				
Smoke point, mm				20.3	16.8				
Nitrogen, Wt. %				0.0015	0.006	0.108	0.240	0.603	
Viscosity, cSt	77° F			2.473					
	100° F			1.951	4.795				
	130° F				3.312	37.03	95.3		
	180° F					14.22	28.28	5671	
	210° F							1722	
	275° F							249.3	
Freezing Point, °F				-28.54					
Cloud Point, °F					24.0	106			
Pour Point, °F					19.9	102	75		
Ni, ppm							7.539	26.2	
V, ppm							11.81	41.0	
Fe, ppm							3.856	13.87	
Micro Car. Res., Wt. %							5.07	18.17	

\* = calculated from gas chromatographic data

## Compositional Analysis: Bayou Choctaw Sweet

	Gas	1	2	3
	IBP 59° F	59 - 175° F	175° - 250° F	250° - 375° F
<b>Paraffins, Wt.%</b>	99.86	79.54	53.27	21.05
<b>Naphthenes, Wt.%</b>	0.14	18.79	38.53	45.28
<b>Aromatics, Wt.%</b>	0.00	1.67	8.19	33.67
<b>Benzene Precursor Index</b>	0.03	11.04	5.71	0.02

### **Composition, Wt.%**

Ethane	0.00	-	-	-
Propane	9.25	0.00	0.00	0.00
N-Butane	61.31	1.45	0.00	0.00
I-Butane	12.86	0.06	0.00	0.00
N-Pentane	5.60	20.62	0.04	0.00
I-Pentane	10.56	12.51	0.01	0.00
Cyclopentane	0.14	3.20	0.04	0.00
N-Hexane	0.06	16.63	3.12	0.01
2-Methylpentane	0.12	11.68	0.68	0.00
3-Methylpentane	0.05	7.18	0.64	0.00
2,2-Dimethylbutane	0.00	0.00	0.00	0.00
2,3-Dimethylbutane	0.02	1.26	0.05	0.00
Methylcyclopentane	0.02	9.49	2.73	0.01
Cyclohexane	0.01	5.43	5.33	0.02
Benzene	0.00	2.05	1.85	0.01
N-Heptane	0.00	1.26	13.74	0.28
2-Methylhexane	0.00	1.21	4.27	0.03
3-Methylhexane	0.00	1.06	4.77	0.04
2,2-Dimethylpentane	0.00	0.26	0.21	0.00
2,3-Dimethylpentane	0.00	0.74	2.52	0.02
2,4-Dimethylpentane	0.00	0.28	0.27	0.00
3,3-Dimethylpentane	0.00	0.10	0.20	0.00
2,3,3-Trimethylbutane	0.00	0.03	0.03	0.00
3-Ethylpentane	0.00	0.04	0.25	0.00
1,1-Dimethylcyclopentane	0.00	0.03	0.07	0.00
1,Cis-2-Dimethylcyc5	0.00	0.05	0.66	0.02
1,Cis-3-Dimethylcyc5	0.00	0.45	2.00	0.02
1-Trans-2-Dimethylcyc5	0.00	0.73	3.29	0.03
1-Trans-3-Dimethylcyc5	0.00	0.64	2.48	0.02
Ethylcyclopentane	0.00	0.08	1.75	0.07
Methylcyclohexane	0.00	1.12	16.94	0.47
Toluene (Methylbenzene)	0.00	0.14	6.69	0.68
N-Octane	0.00	0.03	4.93	3.98
I-Octane	0.00	0.12	12.51	3.68
Methyl-Ethylcyclopentane	0.00	0.04	4.17	1.23
Dimethylcyclohexane	0.00	0.00	0.76	2.24
P-Xylene	0.00	0.00	0.26	1.22
M-Xylene	0.00	0.00	0.38	1.95
O-Xylene	0.00	0.00	0.04	0.42
Ethylbenzene	0.00	0.00	0.36	1.23
N-Nonane	0.00	0.00	0.05	1.17
C9 isoparaffins	0.00	0.01	1.82	7.83
Isobutylcyclopentane	0.00	0.00	0.03	0.14

## SPR CRUDE OIL COMPREHENSIVE ANALYSIS

Sample ID Bayou Choctaw Sour

Date of Assay

10/10/2001

Sediment by Extraction, wt. %	0.011	Crude	Water, wt. %	0.04	Salt, wt. %	0.007
Specific Gravity, 60/60° F	0.8639	Ni, ppm	11.0	RVP, psi @ 100° F	4.28	
API Gravity	32.3	V, ppm	37.4	Acid number, mg KOH/g	0.26	
Sulfur, Wt. %	1.38	Fe, ppm	0.83	Mercaptan Sulfur, ppm	27.1	
Nitrogen, Wt. %	0.150	Cu, ppm	0.13	HS Sulfur, ppm	25	
Micro Car. Res., Wt. %	3.9	Org. Cl, ppm	0.7	Viscosity: 77° F	9.724	cSt 57.8 SUS
Pour Point, °F	20	UOP "K"	11.8	100° F	6.633	cSt 47.6 SUS

Fraction	Gas	1	2	3	4	5	6	Residuum	Residuum
Cut Temp.	C <sub>2</sub> - C <sub>4</sub>	C5 - 175° F	175° - 250° F	250° - 375° F	375° - 530° F	530° - 650° F	650° - 1050° F	650° F+	1050° F+
Vol. %	2.6	5.5	7.2	12.8	16.2	12.2	29.7	43.8	14.2
Vol. Sum %	2.6	8.1	15.3	28.1	44.3	56.5	86.2	100.3	100.4
Wt. %	1.8	4.2	6.1	11.4	15.4	12.3	31.9	48.8	16.9
Wt. Sum %	1.8	6.0	12.1	23.5	38.9	51.2	83.1	100.0	100.0
Specific Gravity, 60/60° F	0.6647	0.7289	0.7744	0.8248	0.8663	0.9268	0.9609	1.028	
API Gravity	81.4	62.6	51.2	40.1	31.8	21.2	15.8	15.8	6.146
Sulfur, Wt. %	0.0113	0.0132	0.0553	0.37	1.20	1.94	2.25	2.25	3.17
Mercaptan Sulfur, ppm	33.7	39.8	44.2	8.2					
H <sub>2</sub> S Sulfur, ppm	9.0	21.6	35.6	0.0					
Organic Cl, ppm	2.6	1.5	1.7	1.8					
Research Octane Number*	64.5	58.9	49.0						
Motor Octane Number*	63.4	56.7	44.1						
RON for G - 375° F									
MON for G - 375° F									
Aniline Point, °F			124.0	143.6	159.1	181.4			
Acid Number, mg KOH/g				0.07	0.20				
Cetane Index				47.3	48.9				
Naphthalenes, Vol. %				4.04	10.70				
Smoke point, mm				19.2	14.8				
Nitrogen, Wt. %				0.0005	0.0173	0.147	0.271	0.500	
Viscosity, cSt	77° F			2.372					
	100° F			1.888	5.329				
	130° F				3.595	35.62	255.9		
	180° F					13.17	64.19	23840	
	210° F							5294	
	275° F								
Freezing Point, °F				-33					
Cloud Point, °F					24	100			
Pour Point, °F					15	95	55		
Ni, ppm							22.4	65.7	
V, ppm							79.2	222	
Fe, ppm							6.11	16.1	
Cu, ppm							0.06	0.17	
Micro Car. Res., Wt. %						0.4	7.7	22.5	

\* = calculated from gas chromatographic data

**GAS CHROMATOGRAPHIC ANALYSIS**  
**Bayou Choctaw Sour**

	Distillate fractions, ASTM D2892																																									
	C <sub>5</sub> -175° F	175-250° F	250-375° F																																							
	Wt. %	Wt. %	Wt. %																																							
* Total Paraffins	45.82	27.75	21.75																																							
Total Iso-paraffins	39.26	36.33	32.70																																							
Total Aromatics	2.64	8.54	22.17																																							
Total Naphthenes	12.27	27.35	21.64																																							
Unknowns	0.00	0.02	1.74																																							
Paraffins	C2 C3 C4 C5 C6 C7 C8 C9 C10 C11 C12	0.00 0.00 1.66 22.78 21.23 0.16 0.00 0.00 0.00 0.00 0.00	0.00 0.00 0.09 0.44 2.89 17.55 6.79 0.00 0.00 0.00 0.00	<table border="1"> <thead> <tr> <th colspan="2">Debutanization Fraction</th> </tr> <tr> <th>Component</th> <th>Wt. %</th> </tr> </thead> <tbody> <tr> <td>Methane</td> <td>0.00</td> </tr> <tr> <td>Ethane</td> <td>1.73</td> </tr> <tr> <td>Propane</td> <td>25.41</td> </tr> <tr> <td>i-Butane</td> <td>15.25</td> </tr> <tr> <td>n-Butane</td> <td>52.42</td> </tr> <tr> <td>2,2-dimethylpropane</td> <td>0.17</td> </tr> <tr> <td>i-Pentane</td> <td>3.70</td> </tr> <tr> <td>n-Pentane</td> <td>1.21</td> </tr> <tr> <td>C<sub>6</sub>+</td> <td>0.10</td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th colspan="2">From PIANO analysis of whole crude</th> </tr> <tr> <th>Component</th> <th>Wt. % of crude</th> </tr> </thead> <tbody> <tr> <td>Benzene</td> <td>0.18</td> </tr> <tr> <td>Toluene</td> <td>0.74</td> </tr> <tr> <td>Ethylbenzene</td> <td>0.22</td> </tr> <tr> <td><i>m</i>-Xylene</td> <td>0.43</td> </tr> <tr> <td><i>p</i>-Xylene</td> <td>0.16</td> </tr> <tr> <td><i>o</i>-Xylene</td> <td>0.27</td> </tr> </tbody> </table>	Debutanization Fraction		Component	Wt. %	Methane	0.00	Ethane	1.73	Propane	25.41	i-Butane	15.25	n-Butane	52.42	2,2-dimethylpropane	0.17	i-Pentane	3.70	n-Pentane	1.21	C <sub>6</sub> +	0.10	From PIANO analysis of whole crude		Component	Wt. % of crude	Benzene	0.18	Toluene	0.74	Ethylbenzene	0.22	<i>m</i> -Xylene	0.43	<i>p</i> -Xylene	0.16	<i>o</i> -Xylene	0.27
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Iso-paraffins	C4 C5 C6 C7 C8 C9 C10 C11 C12	0.10 12.28 23.68 2.84 0.36 0.00 0.00 0.00	0.01 0.37 1.41 16.39 17.56 0.60 0.00 0.00																																							
Aromatics	C6 C7 C8 C9 C10 C11 C12	2.64 0.00 0.00 0.00 0.00 0.00 0.00	0.82 7.44 0.28 0.00 0.00 0.00 0.00																																							
Naphthenes	C5 C6 C7 C8 C9 C10 C11 C12	2.14 9.44 0.69 0.00 0.00 0.00 0.00 0.00	0.06 4.73 17.56 4.47 0.53 0.00 0.00 0.00																																							

\* The modified D 5134 gas chromatographic PIAN method used provides for elution and identification of components up to a nominal n-C<sub>12</sub> (420° F).

**SPR CRUDE OIL COMPREHENSIVE ANALYSIS**

Sample ID **BIG HILL SWEET** Date of Assay **9/18/2000**

<b>Crude</b>					
Specific Gravity, 60/60° F	0.8451	Ni, ppm	12.1	RVP, psi @ 100° F	5.22
API Gravity	35.9	V, ppm	16.3	Acid number, mg KOH/g	0.22
Sulfur, Wt. %	0.48	Fe, ppm	4.24	Mercaptan Sulfur, ppm	10.1
Nitrogen, Wt. %	0.196			H <sub>2</sub> S Sulfur, ppm	na
Micro Car. Res., Wt. %	2.49	Org. Cl, ppm	0.6	Viscosity: 77° F	5.871 cSt
Pour Point, °F	15	UOP "K"	11.88	100° F	4.177 cSt

Fraction	Gas	1	2	3	4	5	6	Residuum	Residuum
Cut Temp.	C <sub>2</sub> - C <sub>4</sub> 175° F	C5 - 250° F	175° - 250° F	250° - 375° F	375° - 530° F	530° - 650° F	650° - 1050° F	650° F+	1050° F+
Vol. %	2.7	8.2	9.8	15.4	15.5	10.8	27.8	37.6	9.8
Vol. Sum %	2.7	10.9	20.7	36.1	51.5	62.4	90.2	100.0	100.0
Wt. %	1.8	6.6	8.6	14.3	15.2	11.1	30.3	42.2	11.8
Wt. Sum %	1.8	8.4	17.0	31.3	46.5	57.5	87.9	99.7	99.7
Specific Gravity, 60/60° F	0.6764	0.7450	0.7815	0.8305	0.8623	0.9226	0.9477	1.019	
API Gravity	77.7	58.4	49.6	38.9	32.6	21.9	17.8	7.4	
Sulfur, Wt. %	0.0020	0.0033	0.0201	0.14	0.39	0.80	0.98	1.44	
Molecular Weight	96	111	133	183	245	407			
Hydrogen, Wt. %	15.77	14.51	na				12.53	10.14	
Mercaptan Sulfur, ppm	6.2	20.2	27.1	22.1					
H <sub>2</sub> S Sulfur, ppm	< 0.1	< 0.1	< 0.1	< 0.1					
Organic Cl, ppm	7.3	1.0	< 0.1	< 0.1					
Research Octane Number*	70.0	64.7	50.4						
Motor Octane Number*	67.6	61.8	48.4						
Flash Point, °F			77	170	246	301			
Aniline Point, °F				122.8	144.0	162.2	186.0		
Acid Number, mg KOH/g					0.08	0.24			
Cetane Index					44.6	50.3			
Diesel Index				60.9	56.0	52.9			
Naphthalenes, Vol. %					4.60	9.61			
Smoke point, mm					18.1	15.0			
Nitrogen, Wt. %					0.0059	0.034	0.307	0.505	1.012
Viscosity, cSt	77° F				2.65				
	100° F				2.093	5.416			
	130° F					3.646	52.62	170.8	
	180° F						18.59	44.00	25410
	210° F								5419
	275° F								472.6
Freezing Point, °F					-26.0				
Cloud Point, °F						23.5	105		
Pour Point, °F						22.3	101	92	
Ni, ppm								30.7	107
V, ppm								38.9	134
Fe, ppm								14.8	49.5
Micro Car. Res., Wt. %								5.88	20.84

na = not available

\* = calculated from gas chromatographic data

## Compositional Analysis - Big Hill Sweet

	<b>Gas</b>	<b>1</b>	<b>2</b>	<b>3</b>
	IBP	59° F	175° F	250° F
				375° F
<b>Paraffins, Wt.%</b>	99.88	75.51	47.87	23.31
<b>Naphthenes, Wt.%</b>	0.12	22.42	43.14	52.65
<b>Aromatics, Wt.%</b>	0.00	2.07	8.99	24.04
<b>Benzene Precursor Index</b>	0.02	11.84	5.65	0.02

### Composition, Wt.%

Ethane	0.28	-	-	-
Propane	18.90	0.00	0.00	0.00
N-Butane	56.25	1.82	0.00	0.00
I-Butane	12.30	0.08	0.00	0.00
N-Pentane	4.16	20.94	0.04	0.00
I-Pentane	7.71	12.47	0.01	0.00
Cyclopentane	0.12	3.82	0.05	0.00
N-Hexane	0.04	15.21	2.72	0.01
2-Methylpentane	0.08	11.01	0.61	0.00
3-Methylpentane	0.02	4.48	0.38	0.00
2,2-Dimethylbutane	0.00	0.16	0.00	0.00
2,3-Dimethylbutane	0.01	1.09	0.04	0.00
Methylcyclopentane	0.02	12.03	3.31	0.01
Cyclohexane	0.00	5.27	4.93	0.02
Benzene	0.00	2.55	2.19	0.01
N-Heptane	0.00	1.16	12.05	0.30
2-Methylhexane	0.00	1.14	3.83	0.03
3-Methylhexane	0.00	1.00	4.28	0.05
2,2-Dimethylpentane	0.00	0.24	0.18	0.00
2,3-Dimethylpentane	0.00	0.70	2.26	0.02
2,4-Dimethylpentane	0.00	0.26	0.24	0.00
3,3-Dimethylpentane	0.00	0.09	0.18	0.00
2,3,3-Trimethylbutane	0.00	0.03	0.03	0.00
3-Ethylpentane	0.00	0.04	0.22	0.00
1,1-Dimethylcyclopentane	0.00	0.04	0.10	0.00
1,Cis-2-DimethylcyC5	0.00	0.08	0.92	0.03
1,Cis-3-DimethylcyC5	0.00	0.66	2.78	0.03
1-Trans-2-DimethylcyC5	0.00	1.06	4.58	0.05
1-Trans-3-DimethylcyC5	0.00	0.93	3.45	0.03
Ethylcyclopentane	0.00	0.12	2.44	0.12
Methylcyclohexane	0.00	1.11	16.07	0.55
Toluene (Methylbenzene)	0.00	0.16	7.47	0.94
N-Octane	0.00	0.02	3.60	3.59
I-Octane	0.00	0.13	12.94	4.70
Methyl-Ethylcyclopentane	0.00	0.06	6.43	2.34
Dimethylcyclohexane	0.00	0.00	0.50	1.83
P-Xylene	0.00	0.00	0.00	0.00
M-Xylene	0.00	0.00	0.00	0.00
O-Xylene	0.00	0.00	0.00	0.00
Ethylbenzene	0.00	0.00	0.00	0.00
N-Nonane	0.00	0.00	0.00	0.00
C9 isoparaffins	0.00	0.00	0.95	5.07

# SPR CRUDE OIL COMPREHENSIVE ANALYSIS

Sample ID BIG HILL SOUR Date of Assay 5/29/1998

<b>Crude</b>					
Specific Gravity, 60/60° F	0.8725	Ni, ppm	11.9	RVP, psi @ 100° F	3.92
API Gravity	30.7	V, ppm	38.4	Acid number, mg KOH/g	0.11
Sulfur, Wt. %	1.41	Fe, ppm	2.14	Mercaptan Sulfur, ppm	10.0
Nitrogen, Wt. %	0.154			H <sub>2</sub> S Sulfur, ppm	na
Micro Car. Res., Wt. %	4.60	Org. Cl, ppm	0.6	Viscosity: 77° F	12.46 cSt
Pour Point, °F	11	UOP "K"	11.82	100° F	8.200 cSt

Fraction	Gas	1	2	3	4	5	6	Residuum	Residuum
Cut Temp.	C <sub>2</sub> - C <sub>4</sub>	C <sub>5</sub> - 175° F	175° - 250° F	250° - 375° F	375° - 530° F	530° - 650° F	650° - 1050° F	650° F+	1050° F+
Vol. %	1.1	5.3	6.2	14.7	14.8	11.6	30.9	46.3	15.4
Vol. Sum %	1.1	6.4	12.5	27.2	42.0	53.7	84.6	100.0	100.0
Wt. %	0.7	4.1	5.2	13.2	14.0	11.6	33.1	51.3	18.3
Wt. Sum %	0.7	4.8	9.9	23.1	37.1	48.7	81.7	100.0	100.0
Specific Gravity, 60/60° F	0.6694	0.7345	0.7803	0.8249	0.8670	0.9340	0.9664	1.031	
API Gravity	79.9	61.1	49.8	40.0	31.7	20.0	14.9	5.7	
Sulfur, Wt. %	0.0047	0.0080	0.0631	0.42	1.00	1.89	2.40	3.40	3.32
Molecular Weight	97	111	134	184	244	402			
Hydrogen, Wt. %	15.98	14.71	na				11.86	9.76	
Mercaptan Sulfur, ppm	11.8	31.5	57.5	19.4					
H <sub>2</sub> S Sulfur, ppm	1.6	3.5	1.9	0.0					
Organic Cl, ppm	2.7	0.9	1.8	1.8					
Research Octane Number*	65.9	55.8	36.8						
Motor Octane Number*	64.5	53.8	36.5						
Flash Point, °F			77	171	246	301			
Aniline Point, °F			125.7	142.6	156.0	178.6			
Acid Number, mg KOH/g				0.03	0.07				
Cetane Index				47.2	48.8				
Diesel Index			62.7	57.1	49.5				
Naphthalenes, Vol. %				4.27	11.18				
Smoke point, mm				19.2	13.7				
Nitrogen, Wt. %				0.0013	0.010	0.179	0.310	0.548	
Viscosity, cSt	77° F			2.416					
	100° F			1.913	5.066				
	130° F				3.451	48.00	284.6		
	180° F					17.32	67.71	127800	
	210° F							7125	
	275° F							194.5	
Freezing Point, °F				-25.5					
Cloud Point, °F				24.3	100				
Pour Point, °F				20.0	96	43			
Ni, ppm						23.3	66.1		
V, ppm						73.0	206		
Fe, ppm						6.73	19.0		
Micro Car. Res., Wt. %						8.88	24.29		

na = not available

\* = calculated from gas chromatographic data

## Compositional Analysis: Big Hill Sour

	Gas	1	2	3
	IBP	59 -	175° -	250° -
	59° F	175° F	250° F	375° F
<b>Paraffins, Wt.%</b>	99.88	84.32	61.18	26.03
<b>Naphthenes, Wt.%</b>	0.12	13.99	29.58	34.13
<b>Aromatics, Wt.%</b>	0.00	1.69	9.24	39.83
<b>Benzene Precursor Index</b>	0.04	9.52	4.12	0.01

### Composition, Wt.%

Ethane	0.30	-	-	-
Propane	12.41	0.00	0.00	0.00
N-Butane	55.92	1.14	0.00	0.00
I-Butane	12.79	0.06	0.00	0.00
N-Pentane	6.50	20.63	0.04	0.00
I-Pentane	11.19	11.43	0.01	0.00
Cyclopentane	0.13	2.55	0.03	0.00
N-Hexane	0.08	19.35	3.57	0.00
2-Methylpentane	0.14	12.23	0.70	0.00
3-Methylpentane	0.07	8.39	0.73	0.00
2,2-Dimethylbutane	0.01	0.26	0.00	0.00
2,3-Dimethylbutane	0.03	1.77	0.07	0.00
Methylcyclopentane	0.02	7.45	2.11	0.00
Cyclohexane	0.01	3.49	3.37	0.00
Benzene	0.00	2.06	1.83	0.00
N-Heptane	0.00	1.71	18.36	0.04
2-Methylhexane	0.00	1.54	5.35	0.00
3-Methylhexane	0.00	1.35	5.97	0.01
2,2-Dimethylpentane	0.00	0.33	0.26	0.00
2,3-Dimethylpentane	0.00	0.95	3.16	0.00
2,4-Dimethylpentane	0.00	0.35	0.33	0.00
3,3-Dimethylpentane	0.00	0.13	0.25	0.00
2,3,3-Trimethylbutane	0.00	0.04	0.04	0.00
3-Ethylpentane	0.00	0.06	0.31	0.00
1,1-Dimethylcyclopentane	0.00	0.02	0.06	0.00
1,Cis-2-DimethylcyC5	0.00	0.04	0.50	0.00
1,Cis-3-DimethylcyC5	0.00	0.35	1.51	0.00
1-Trans-2-DimethylcyC5	0.00	0.56	2.48	0.00
1-Trans-3-DimethylcyC5	0.00	0.49	1.87	0.00
Ethylcyclopentane	0.00	0.06	1.32	0.01
Methylcyclohexane	0.00	0.84	12.48	0.04
Toluene (Methylbenzene)	0.00	0.16	7.88	0.09
N-Octane	0.00	0.04	6.26	0.55
I-Octane	0.00	0.12	11.97	0.39
Methyl-Ethylcyclopentane	0.00	0.06	5.88	0.19
Dimethylcyclohexane	0.00	0.00	0.05	0.02
P-Xylene	0.00	0.00	0.00	0.00
M-Xylene	0.00	0.00	0.00	0.00
O-Xylene	0.00	0.00	0.00	0.00
Ethylbenzene	0.00	0.00	0.00	0.00
N-Nonane	0.00	0.00	0.00	0.00
C9 isoparaffins	0.00	0.00	0.92	0.43