SGS Gulf Ltd.
Oil, Gas and Chemicals

CRUDE ASSAY REPORT
SONANGOL P&P IRAQ

WHEN YOU NEED TO BE SURE SGS

CRUDE ASSAY REPORT

ASSAY CONDUCTED FOR : Sonangol P&P, IRAQ
SAMPLE DESCRIPTION : Qaiyarah Crude Oil
JOB NUMBER : JO21-00409.001

AUTHORISED SIGNATORY

Jithin Thampi
Crude Assay Chemist

APPROVED SIGNATORY

BJ Pattena
Assistant Lab Manager

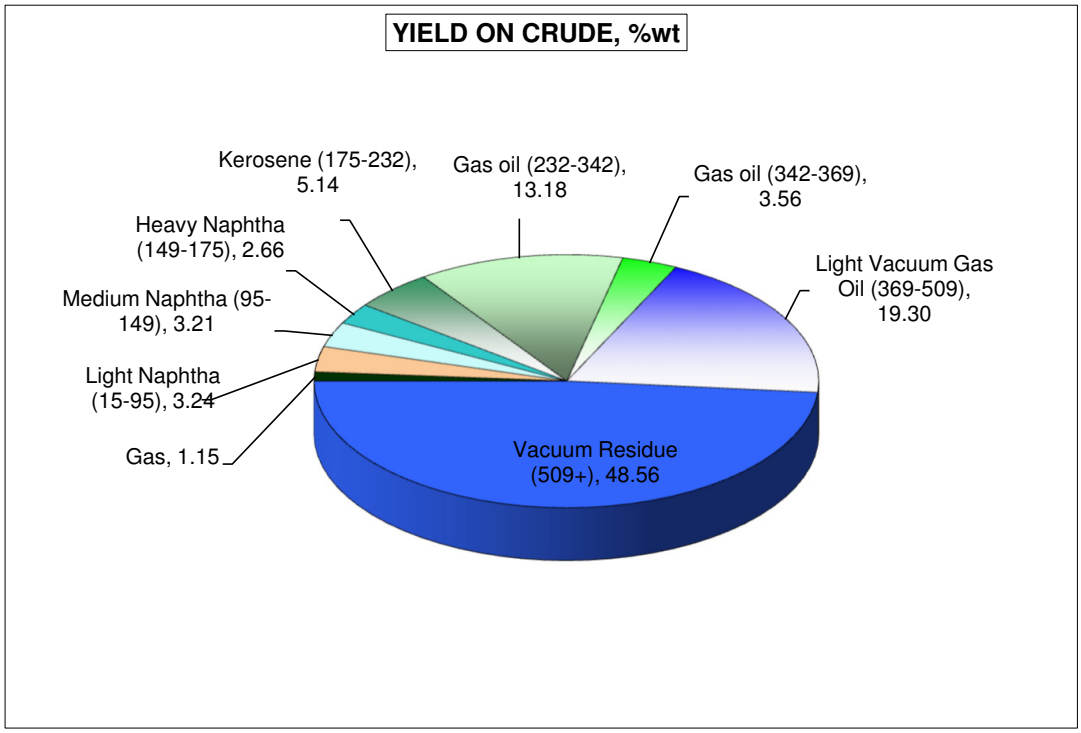
TABLE OF CONTENT

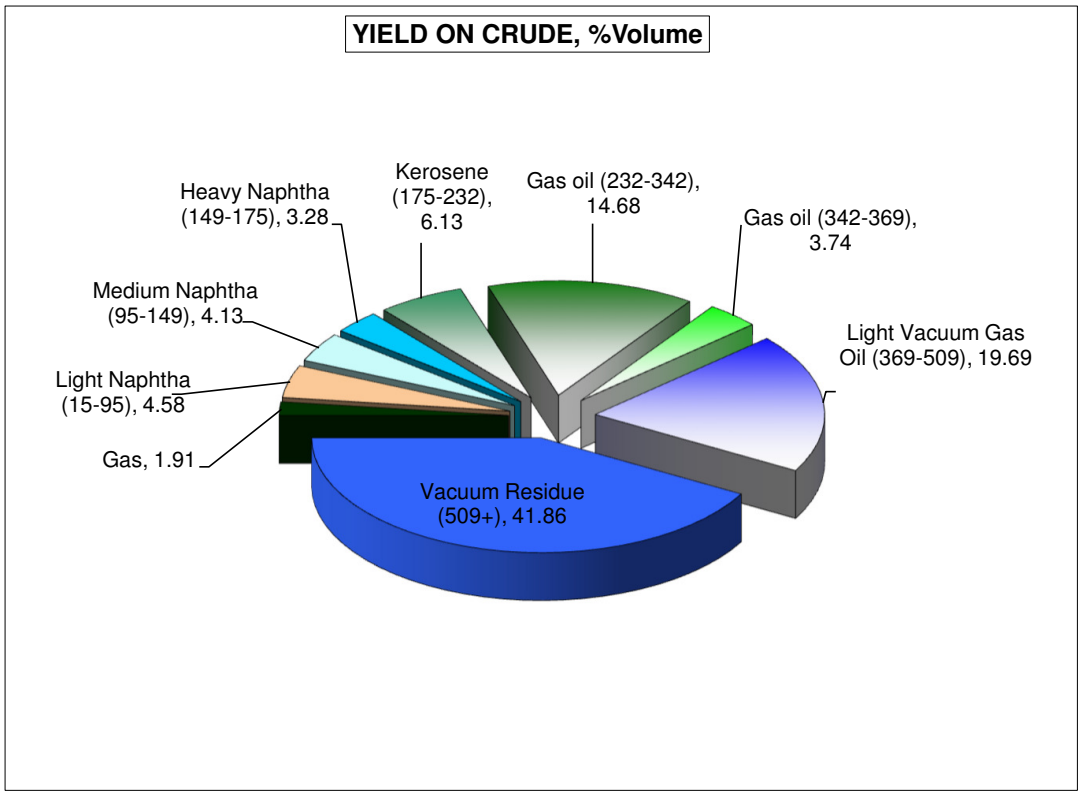
SUMMARY OF PRODUCT CUT POINTS AND YIELDS

Sample ID: JO21-00409.001
Crude Description: **Qaiyarah Crude Oil**

Cut Number	Cut Point (℃)	Product	Yield (% wt)	Yield (%volume)	Density @ 15℃ (kg/L)
1	Gas	Gas	1.1	1.9	0.5805
2	15-95	Light Naphtha(15-95)	3.2	4.6	0.6820
3	95-149	Medium Naphtha (95-149)	3.2	4.1	0.7473
4	149-175	Heavy Naphtha (149-175)	2.7	3.3	0.7801
5	175-232	Kerosene(175-232)	5.1	6.1	0.8052
6	232-342	Gas oil(232-342)	13.2	14.7	0.8627
7	342-369	Gas oil(342-369)	3.6	3.7	0.9131
8	369-509	Vacuum Gas Oil(369-509)	19.3	19.7	0.9433
9	509+	Vacuum Residue (509+)	48.6	41.9	1.1078
10	369+	Atmospheric Residue (369+)	67.9	61.6	1.0556

PIE CHARTS FOR PERCENT YIELD ON CRUDE



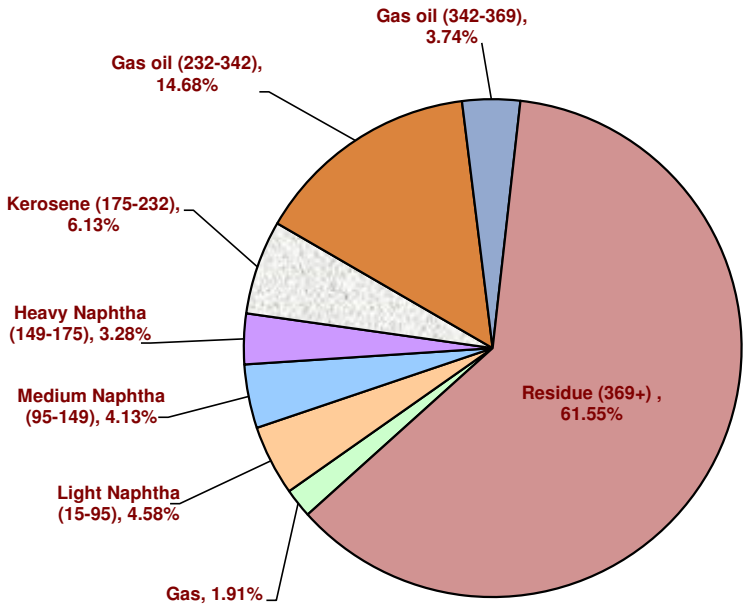


TRUE BOILING POINT DATA

SAMPLE WEIGHT (g) : 12708
VOLUME @ 15 ℃ (mL) : 13224
Density @ 15 ℃ (g/ml): 0.9610

CUT NO.	CUT RANGE (℃)	METHOD	YIELD ON CRUDE						DENSITY @ 15℃ (kg/L)
			WEIGHT (g)	WEIGHT %		VOLUME (mL)	VOLUME %		
				CUT	CUM		CUT	CUM	
1	C4	*ASTM D2892	146.0	1.1	1.1	252.0	1.9	1.9	0.5805
2	15-35		49.0	0.4	1.5	78.0	0.6	2.5	0.6266
3	35-50		59.0	0.5	2.0	91.0	0.7	3.2	0.6479
4	50-60		96.0	0.8	2.8	143.0	1.1	4.3	0.6694
5	60-70		29.0	0.2	3.0	42.0	0.3	4.6	0.6885
6	70-80		51.0	0.4	3.4	72.0	0.5	5.1	0.7065
7	80-95		128.0	1.0	4.4	179.0	1.4	6.5	0.7170
8	95-110		153.0	1.2	5.6	209.0	1.6	8.1	0.7320
9	110-130		87.0	0.7	6.3	117.0	0.9	8.9	0.7451
10	130-140		66.0	0.5	6.8	87.0	0.7	9.6	0.7567
11	140-149		102.0	0.8	7.6	133.0	1.0	10.6	0.7661
12	149-160		136.0	1.1	8.7	176.0	1.3	11.9	0.7745
13	160-175		202.0	1.6	10.3	258.0	2.0	13.9	0.7838
14	175-185		111.0	0.9	11.1	140.0	1.1	15.0	0.7914
15	185-200		164.0	1.3	12.4	205.0	1.6	16.5	0.7994
16	200-210		94.0	0.7	13.2	117.0	0.9	17.4	0.8052
17	210-220		129.0	1.0	14.2	159.0	1.2	18.6	0.8104
18	220-232		155.0	1.2	15.4	190.0	1.4	20.0	0.8170
19	232-240		101.0	0.8	16.2	122.0	0.9	20.9	0.8260
20	240-250		141.0	1.1	17.3	169.0	1.3	22.2	0.8324
21	250-260		131.0	1.0	18.3	156.0	1.2	23.4	0.8399
22	260-270		147.0	1.2	19.5	173.0	1.3	24.7	0.8492
23	270-290		323.0	2.5	22.0	376.0	2.8	27.6	0.8580
24	290-300		156.0	1.2	23.3	180.0	1.4	28.9	0.8667
25	300-320		327.0	2.6	25.8	373.0	2.8	31.7	0.8752
26	320-330		156.0	1.2	27.1	176.0	1.3	33.1	0.8853
27	330-342		193.0	1.5	28.6	216.0	1.6	34.7	0.8949
28	342-350		131.0	1.0	29.6	145.0	1.1	35.8	0.9040
29	350-360		170.0	1.3	30.9	186.0	1.4	37.2	0.9130
30	360-369		151.0	1.2	32.1	164.0	1.2	38.4	0.9212
31	369-420	ASTM D 5236	947.6	7.5	39.6	1019.3	7.7	46.2	0.9311
32	420-450		533.5	4.2	43.8	569.4	4.3	50.5	0.9391
33	450-475		481.8	3.8	47.6	505.7	3.8	54.3	0.9516
34	475-509		489.7	3.9	51.4	509.6	3.9	58.1	0.9631
35	509+		6171.4	48.6		5535.8	41.9		1.1078
36	369+		8624.0	67.9		8139.7	61.6		1.0556

PIE CHARTS FOR CRUDE FRACTIONS (%volume)



ANALYSIS FOR CRUDE OIL

TEST	UNIT	METHOD	RESULT
Density @15℃	kg/L	ASTM D5002*	0.9610
Specific Gravity @60/60℉	-	Calculation	0.9616
API Gravity	°API	Calculation	15.6
Sulphur	%mass	ASTM D4294*	6.30 #
Hydrogen Sulfide	mg/kg	UOP 163	110
Mercaptan Sulphur	mg/kg	UOP 163	354
Nitrogen Content	mg/kg	ASTM D5762	1700
Total Acid Number	mg KOH/g	ASTM D664*	0.8
Kinematic Viscosity @ 20℃	cSt	ASTM D445	782.3
Kinematic Viscosity @ 30℃	cSt	ASTM D445	383.0
Kinematic Viscosity @ 40℃	cSt	ASTM D445	213.1
Kinematic Viscosity @ 50℃	cSt	ASTM D445	128.9
Salt Content	PTB	ASTM D3230	2
Water Content	%volume	ASTM D4006	0.35
Sediment Content	%mass	ASTM D473	0.02
Pour point	℃	ASTM D5853	-21
Wax Content	%mass	UOP 46 $	<5
Asphaltenes Content	%mass	IP 143	14.1
Ash Content	%mass	ASTM D482	0.023
Vanadium	mg/kg	ASTM D7691	113.0
Nickel	mg/kg	ASTM D7691	44.0
Sodium	mg/kg	ASTM D7691	<1
Reid Vapour Pressure	psi	ASTM D6377	2.10
H2S Content in Vapour	ppm	ASTM D5705	>4000
Gross Calorific Value	MJ/KG	Calculation	41.47

$ - Obsolete Method.

#- Above results are beyond the precision study of test method.

ANALYSIS FOR LPG

TEST	UNIT	METHOD	RESULT
Yield	%volume	ASTM D2892*	1.9
Yield	%mass	ASTM D2892*	1.1
Relative Density@15.6℃	-	ASTM D2598	0.5805
Hydrocarbons Compositions			
Methane	%mol	ASTM D2163	0.0
Ethane	%mol	ASTM D2163	0.0
Propane	%mol	ASTM D2163	11.3
i-Butane	%mol	ASTM D2163	16.3
n-Butane	%mol	ASTM D2163	56.6
i-Pentane	%mol	ASTM D2163	9.0
n-Pentane	%mol	ASTM D2163	6.2
Hexanes	%mol	ASTM D2163	0.6
Heptane	%mol	ASTM D2163	0.0

ANALYSIS FOR NAPHTHA

TEST	UNIT	METHOD	RESULT		
			15-95	95-149	149-175
Yield	%volume	ASTM D2892*	4.6	4.1	3.3
Yield	%mass	ASTM D2892*	3.2	3.2	2.7
Density @15°C	kg/L	ASTM D4052	0.6820	0.7473	0.7801
Specific Gravity @60/60°F	-	Calculation	0.6821	0.7475	0.7804
API Gravity	°API	Calculation	75.9	57.7	49.8
Sulphur	%mass	ASTM D4294	0.186	0.394	0.602
Hydrogen Sulphide	mg/kg	UOP 163	720	1071	1063
Mercaptan Sulphur	mg/kg	ASTM D3227	628	1126	732
Copper Corrosion	Rating	ASTM D130	4a	4a	4b
Nitrogen Content	mg/kg	ASTM D4629	<1	<1	1.0
Total Acid Number	mg KOH/g	ASTM D664	0.5	0.7	0.8
Total Paraffins	%mass	ASTM D6730	82.76	62.36	59.79
Total Naphthenes	%mass	ASTM D6730	15.02	25.25	18.26
Total Aromatics	%mass	ASTM D6730	2.10	11.99	21.52
Normal Paraffins	%mass	ASTM D6730	35.01	17.99	8.96
Research Octane Number	Rating	Calculation	62	49	44
IBP	°C	ASTM D86	x	98.0	147.8
T 5 % VOLUME	°C	ASTM D86	x	113.0	152.0
T 10 % VOLUME	°C	ASTM D86	x	118.0	154.4
T 20 % VOLUME	°C	ASTM D86	x	120.1	156.7
T 30 % VOLUME	°C	ASTM D86	x	122.0	158.1
T 40 % VOLUME	°C	ASTM D86	x	124.0	159.8
T 50 % VOLUME	°C	ASTM D86	x	126.1	161.4
T 60 % VOLUME	°C	ASTM D86	x	128.6	163.4
T 70 % VOLUME	°C	ASTM D86	x	131.5	165.6
T 80 % VOLUME	°C	ASTM D86	x	135.3	168.4
T 90 % VOLUME	°C	ASTM D86	x	141.6	171.8
T FINAL BOILING POINT	°C	ASTM D86	x	152.1	178.8
% Residue	%volume	ASTM D86	x	1.0	1.0

x-Analysis not required

ANALYSIS FOR KEROSENE

TEST	UNIT	METHOD	RESULT
			175-232
Yield	%volume	ASTM D2892*	6.1
Yield	%mass	ASTM D2892*	5.1
Density @15℃	kg/L	ASTM D4052	0.8052
Specific Gravity @60/60℉	-	Calculation	0.8056
API Gravity	°API	Calculation	44.1
Sulphur	% mass	ASTM D4294	0.892
Hydrogen Sulphide	mg/kg	UOP 163	138
Mercaptan Sulphur	mg/kg	ASTM D3227	223
Copper Corrosion	Rating	ASTM D130	4a
Nitrogen Content	mg/kg	ASTM D4629	1.4
Total Acid Number	mg KOH/g	ASTM D664	0.2
Kinematic Viscosity @ 40℃	cSt	ASTM D445	1.159
Kinematic Viscosity @ 60℃	cSt	ASTM D445	0.883
Smoke Point	mm	ASTM D1322	21.6
Aromatics	%volume	IP 391	24.0
IBP	℃	ASTM D86	177.4
T 5 % VOLUME	℃	ASTM D86	188.8
T 10 % VOLUME	℃	ASTM D86	190.4
T 20 % VOLUME	℃	ASTM D86	192.9
T 30 % VOLUME	℃	ASTM D86	195.6
T 40 % VOLUME	℃	ASTM D86	198.2
T 50 % VOLUME	℃	ASTM D86	201.8
T 60 % VOLUME	℃	ASTM D86	205.6
T 70 % VOLUME	℃	ASTM D86	210.2
T 80 % VOLUME	℃	ASTM D86	214.6
T 90 % VOLUME	℃	ASTM D86	219.8
T FINAL BOILING POINT	℃	ASTM D86	230.6
% Residue	%volume	ASTM D86	1.1
Cetane Index	Rating	ASTM D976	43.2
Freezing Point	℃	ASTM D7153	-54.0

ANALYSIS FOR GASOIL

TEST	UNIT	METHOD	RESULT	
			232-342	342-369
Yield	%volume	ASTM D2892*	14.7	3.7
Yield	%mass	ASTM D2892*	13.2	3.6
Density @ 15℃	kg/L	ASTM D4052*	0.8627	0.9131
Specific gravity at 60/60℉	-	Calculation	0.8632	0.9136
API Gravity	°API	Calculation	32.3	23.3
Sulphur	%mass	ASTM D4294*	2.76	4.52
Hydrogen Sulphide	mg/kg	UOP 163	<1	x
Mercaptan Sulphur	mg/kg	ASTM D3227	102	x
Nitrogen content	mg/kg	ASTM D4629/D5762	70	500
Total Acid Number	mg KOH/g	ASTM D664*	0.2	0.2
Kinematic Viscosity @ 30℃	cst	ASTM D445	4.335	16.46
Kinematic Viscosity @ 50℃	cst	ASTM D445	2.899	9.018
Kinematic Viscosity @ 100℃	cst	ASTM D445	1.390	3.192
Smoke Point	mm	ASTM D1322	15.7	x
Aromatics	%volume	IP 391	33.4	x
Pour Point	℃	ASTM D97 *	-18	+6
Cloud Point	℃	ASTM D2500 *	-15	NM
CFPP	℃	IP 309	-16	+9
IBP	℃	ASTM D86	238.0	339.0
T 5 % VOLUME	℃	ASTM D86	249.0	343.0
T 10 % VOLUME	℃	ASTM D86	258.0	345.0
T 20 % VOLUME	℃	ASTM D86	268.0	346.0
T 30 % VOLUME	℃	ASTM D86	272.0	347.0
T 40 % VOLUME	℃	ASTM D86	276.0	348.0
T 50 % VOLUME	℃	ASTM D86	282.0	349.0
T 60 % VOLUME	℃	ASTM D86	289.0	350.0
T 70 % VOLUME	℃	ASTM D86	296.0	352.0
T 80 % VOLUME	℃	ASTM D86	306.0	354.0
T 90 % VOLUME	℃	ASTM D86	317.0	357.0
T FINAL BOILING POINT	℃	ASTM D86	338.0	367.0
% Residue	%volume	ASTM D86	1.2	1.2
Cetane Index	Rating	ASTM D976 *	46.2	40.9
Aniline Point	℃	ASTM D611	60.6	62.6
Wax Content	%mass	UOP 46 $	<5	<5

x-Analysis not required
$ - Obsolete method
NM - Not measureable

ANALYSIS FOR VGO

TEST	UNIT	METHOD	RESULT
			369-509
Yield	%volume	ASTM D5236	19.7
Yield	%mass	ASTM D5236	19.3
Density @ 15℃	kg/L	ASTM D4052	0.9433
Specific gravity at 60/60℉	-	Calculation	0.9439
API Gravity	°API	Calculation	18.3
Sulphur	%mass	ASTM D4294	4.95#
Nitrogen Content	mg/kg	ASTM D5762	1000
Total Acid number	mg KOH/g	ASTM D664	0.2
Kinematic Viscosity @ 30℃	cst	ASTM D445	126.1
Kinematic Viscosity @ 60℃	cst	ASTM D445	30.37
Kinematic Viscosity @ 100℃	cst	ASTM D445	8.776
Pour point	℃	ASTM D97	+27
Aniline Point	℃	ASTM D611	64.2
Wax Content	%mass	UOP 46 $	6.8

$ - Obsolete Method

#- Above results are beyond the precision study of test method.

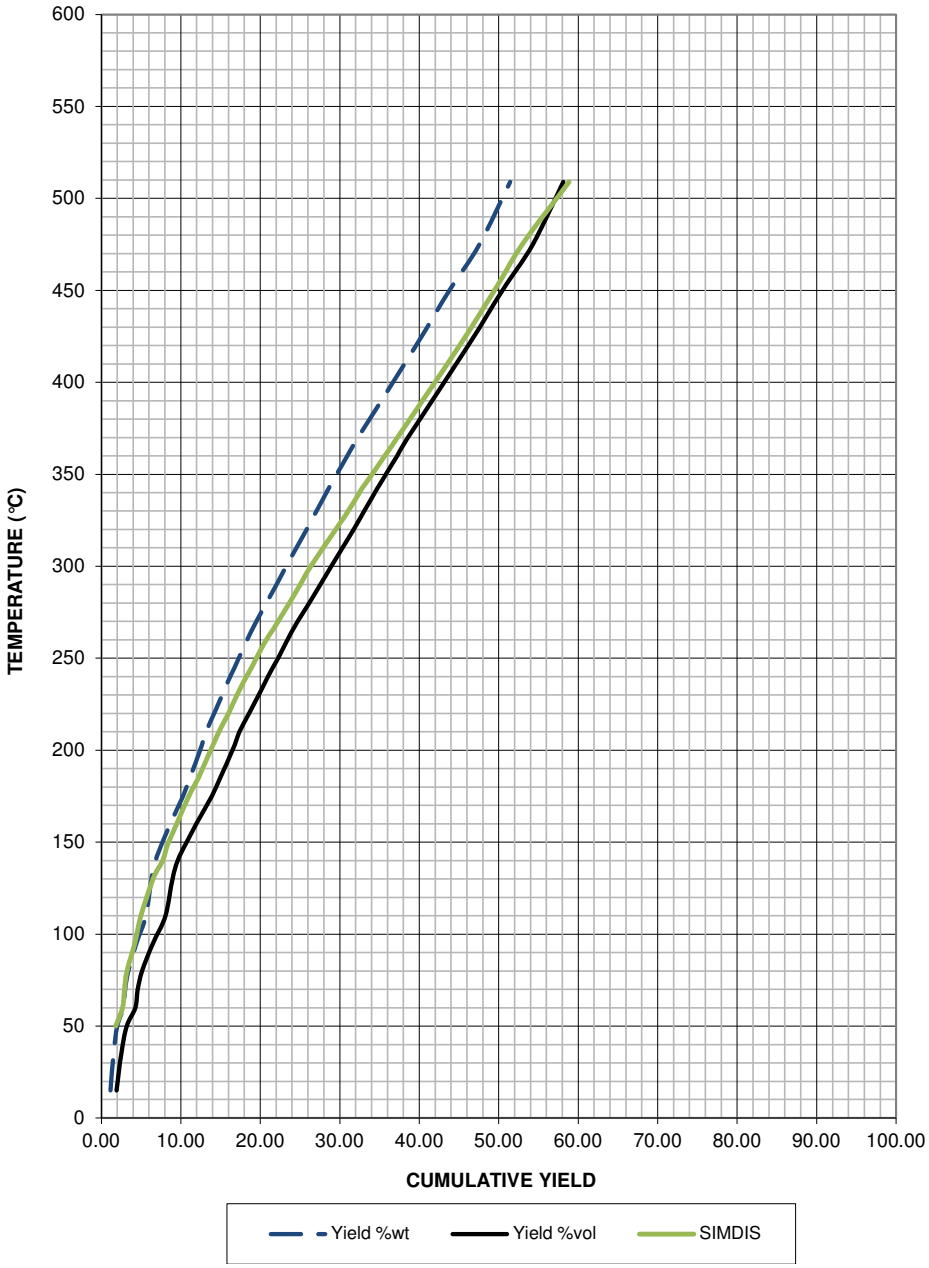
ANALYSIS FOR RESIDUAL FUEL OIL AND VACUUM RESIDUE

TEST	UNIT	METHOD	RESULT	
			369+	509+
Yield	%volume	ASTM D2892*/D5236	61.6	41.9
Yield	%mass	ASTM D2892*/D5236	67.9	48.6
Density @15℃	kg/L	ASTM D4052*	1.0556	1.1078
Specific Gravity @60/60℉	-	Calculation	1.0563	NM
API Gravity	°API	Calculation	2.4	NM
Sulphur	%mass	ASTM D4294*	7.92#	8.99#
Nitrogen Content	mg/kg	ASTM D5762*	2400	3000
Total Acid Number	mg KOH/g	ASTM D664 *	0.5	0.5
Kinematic Viscosity @ 60℃	cSt	ASTM D445	NM	NM
Kinematic Viscosity @ 100℃	cSt	ASTM D445	3081	NM
Kinematic Viscosity @ 120℃	cSt	ASTM D445	857.0	NM
Pour Point	℃	ASTM D97 *	+48	>102
Wax Content	%mass	UOP 46 $	5.4	7.6
Asphaltene	%mass	IP 143	21.8	29.2
Vanadium	mg/kg	IP 501*	170	237
Nickel	mg/kg	IP 501*	63	88
Sodium	mg/kg	IP 501*	<1	<1

Note : Only residual fuel oil cover under the scope of accreditation
NM - Not measureable
$ - Obsolete Method
#- Above results are beyond the precision study of test method.

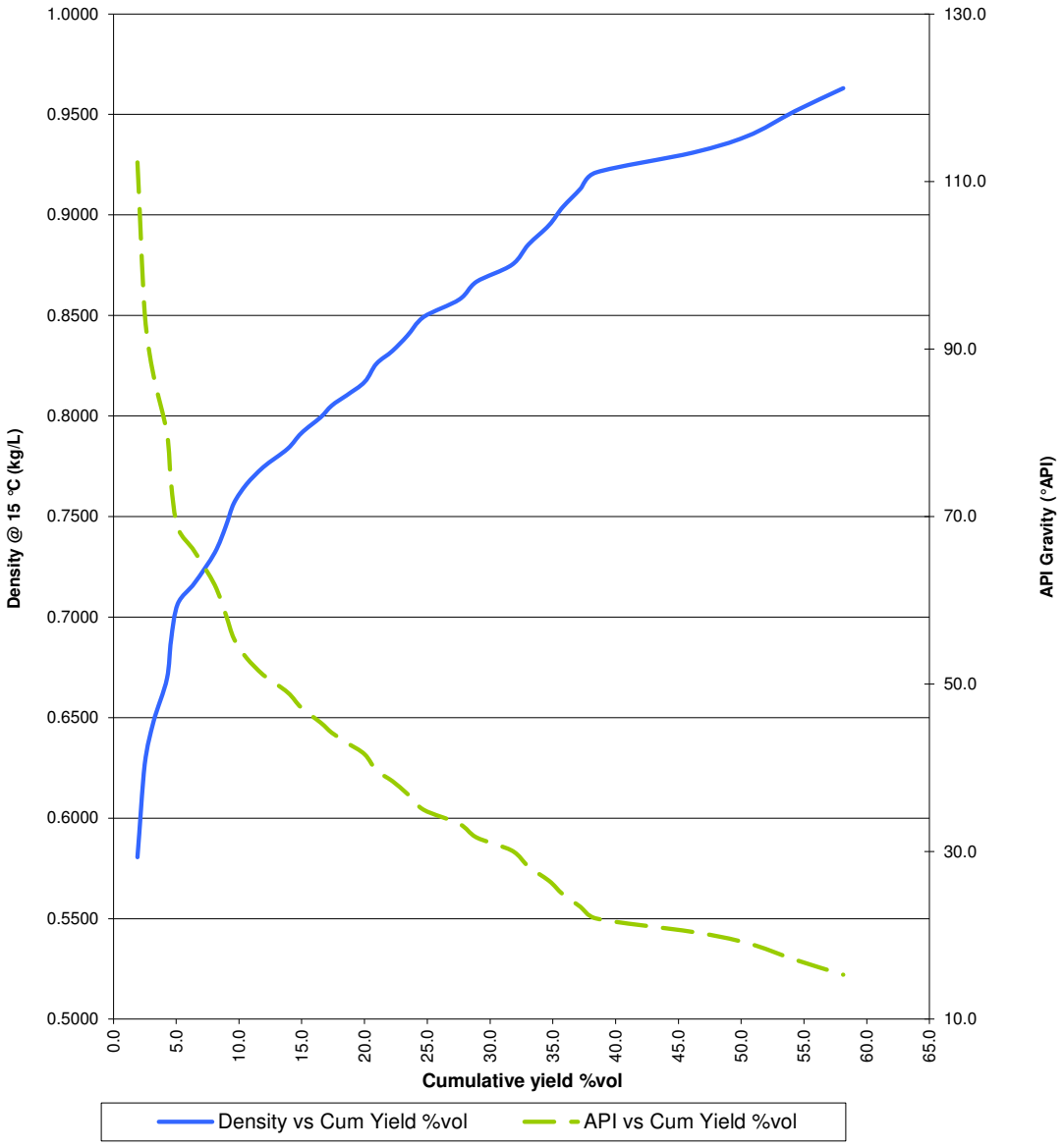
APPENDIX 1

YIELD in % weight vs YIELD in %Volume



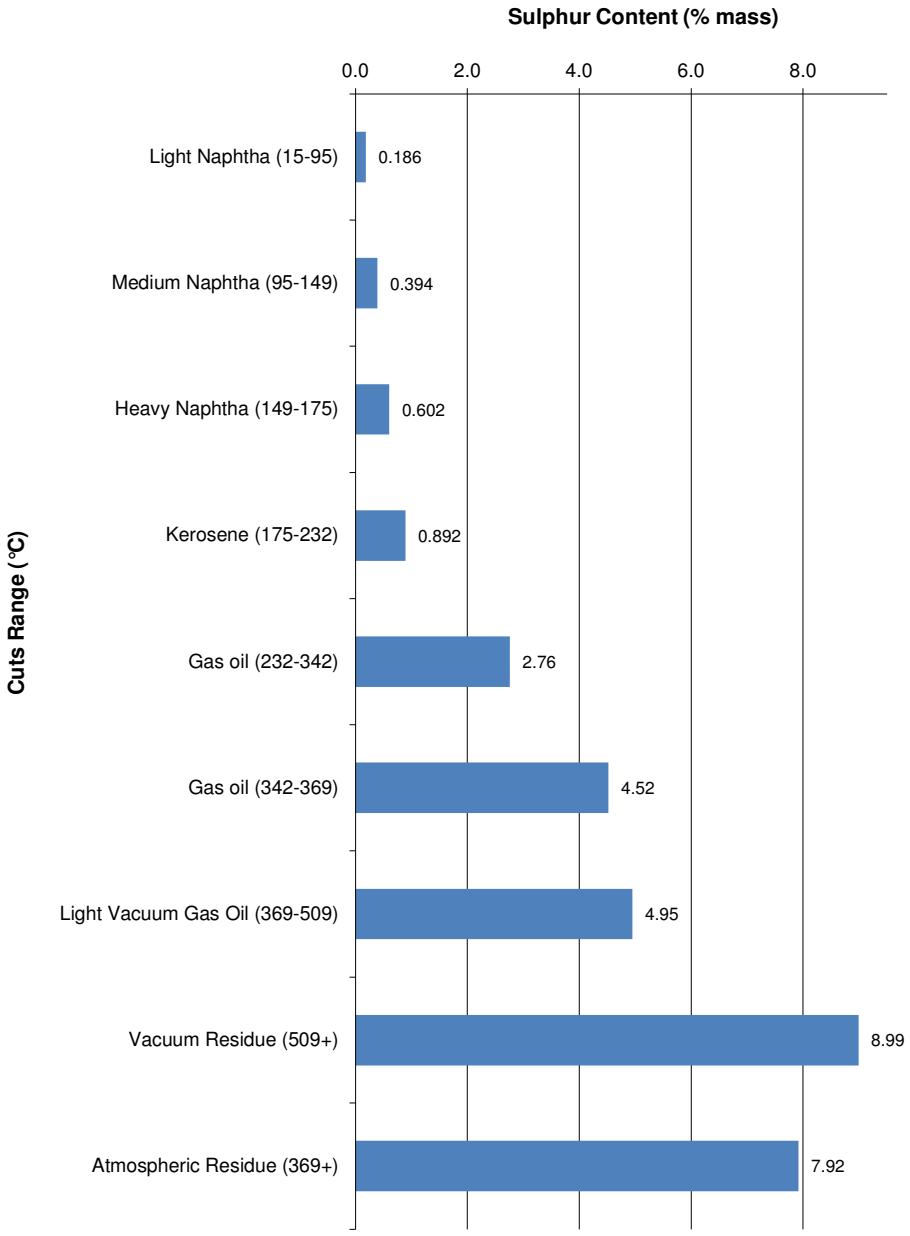
APPENDIX 2

Density & API vs Cumulative Yield %vol



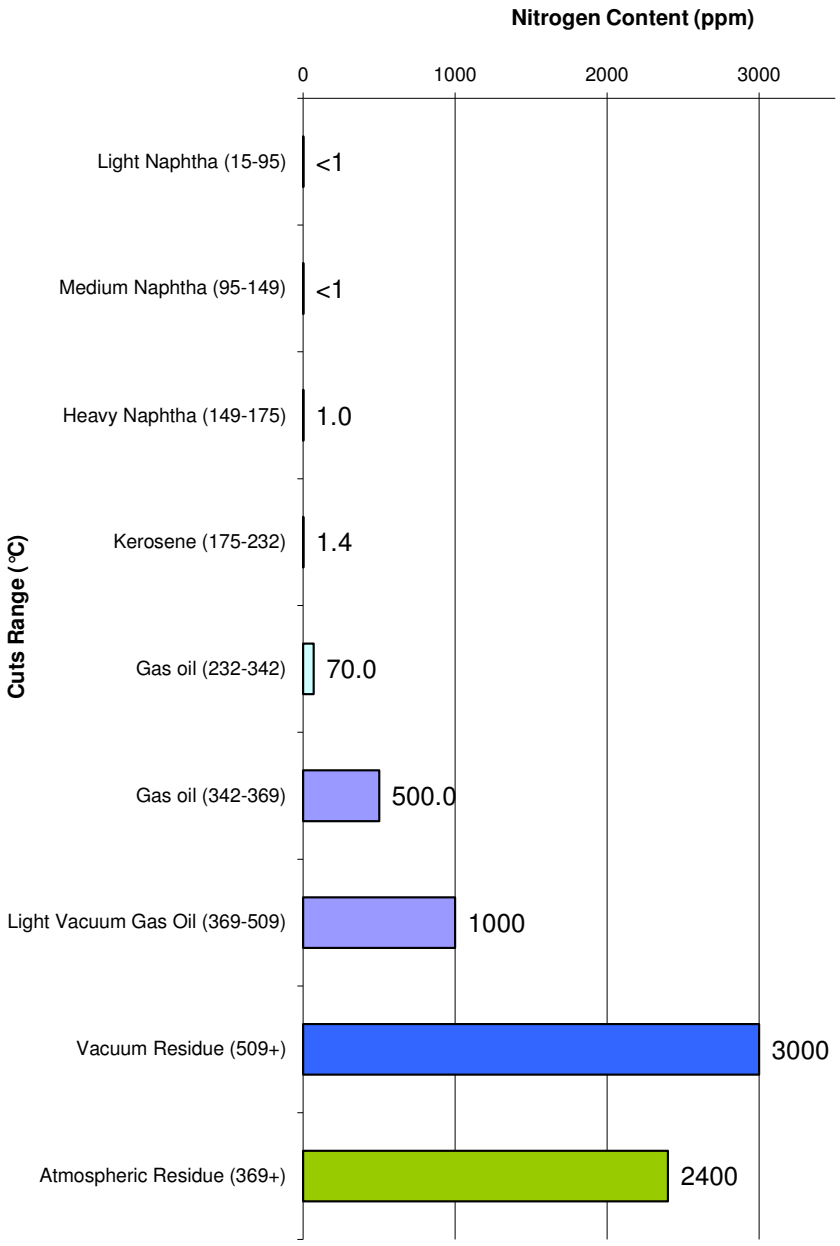
APPENDIX 3

Sulphur Content per Cuts Range



APPENDIX 4

Nitrogen Content per Cuts Range



APPENDIX 5

Simulated Distillation Data
ASTM D7169

Boiling Point (°C)	Recovered Mass %
50.000	1.80
60.000	2.66
70.000	2.91
80.000	3.22
95.000	4.21
110.000	4.97
130.000	6.49
140.000	7.70
149.000	8.36
160.000	9.47
175.000	10.99
185.000	12.20
200.000	13.74
210.000	14.80
220.000	15.98
232.000	17.27
240.000	18.27
250.000	19.51
260.000	20.74
270.000	22.26
290.000	25.01
300.000	26.36
320.000	29.48
330.000	31.07
342.000	32.77
350.000	34.08
360.000	35.66
369.000	37.12
420.000	45.07
450.000	49.46
475.000	52.98
509.000	58.86
550.000	68.20
600.000	77.74
650.000	86.61
700.000	94.67
720.000	97.98