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THE WILSONVILLE ADVANCED COAL LIQUEFACTION RESEARCH
AND DEVELOPMENT FACILITY

Technical Progress Report

February 1984
Date Published

Work Performed Under Contract No. AC22-82PC50041

Catalytic, Inc.
Wilsonville, Alabama

Technical Information Center
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THE WILSONVILLE
ADVANCED COAL LIQUEFACTION
RESEARCH AND DEVELOPMENT FACILITY
Wilsonville, Alabama

TECHNICAL PROGRESS REPORT
Run 243 with Illinois 6 Coal
Published: February 1984

Prepared by
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PREFACE

Operations at the Advanced Coal Liquefaction R & D Facility at Wilsonville, Alabama, are funded by the U. S. Department of Energy (DOE) and the Electric Power Research Institute (EPRI). The present contract covers the operating period from February 1983 through January 1984.

Southern Company Services, Inc. (SCS) manages the Wilsonville program on behalf of DOE and EPRI. Catalytic, Inc. operates the facility under a subcontract with SCS.

The Wilsonville R & D Facility combines three process units: a thermal hydrogenation or Solvent Refined Coal (SRC) unit, a Critical Solvent Deashing (CSD) unit, and a catalytic hydrogenation or hydrotreater (HTR) unit. The SRC unit was designed by Catalytic, Inc., using technology initially developed in Germany and later refined by the Pittsburg and Midway Coal Mining Co. The CSD unit was designed and developed by the Kerr-McGee Corporation. The HTR unit uses H-Oil technology, developed by Hydrocarbon Research, Inc. (HRI), and was constructed by Catalytic, Inc. The combined three unit processing system is generally known as a two stage liquefaction (TSL) process.

TABLE OF CONTENTS

<u>Section</u>		<u>Page</u>
	ABSTRACT.....	1
1.	INTRODUCTION.....	2
2.	CONCLUSIONS AND RECOMMENDATIONS.....	4
2.1	Conclusions.....	4
2.2	Recommendations.....	5
3.	OPERATING DATA AND PROCESS PERFORMANCE....	6
3.1	ITSL System Stability.....	6
3.2	SRC Unit.....	6
3.3	CED Unit.....	15
3.4	HTR Unit.....	21
3.5	Single Stage (SRC and CSD Units)....	24
3.6	Two Stage (SRC, CSD and HTR Units)...	27
4.	DISTILLATE PRODUCTS AND PROCESS SOLVENTS..	29
4.1	Distillate Products.....	29
4.1.1	Distillate Product Properties.....	29
4.1.2	Distillate Production.....	29
4.2	Recycle and Process Solvents.....	31
4.2.1	SRC Unit.....	31
4.2.2	CSD Unit.....	34
4.2.3	HTR Unit.....	35
5.	RESIDUAL PRODUCTS.....	36
6.	FEED COAL.....	37
7.	HYDROTREATING CATALYST.....	38
8.	MISCELLANEOUS TOPICS.....	41
8.1	Operating Journal.....	41
8.2	Maintenance.....	50
8.3	Catalyst Activity.....	50
8.4	Hydrotreater Feed Aging Study.....	51
8.5	Corrosion Measurements.....	52
8.6	Environmental Protection.....	53

TABLE OF CONTENTS (continued)

<u>Section</u>	<u>Page</u>
9. REFERENCES.....	55
APPENDIX A - Special Product Workup Calculation Procedure.....	56
APPENDIX B - Activity Test Descriptions...	58
a. Solvent Activity.....	58
b. Resid Activity.....	58
c. Catalyst Activity.....	59
APPENDIX C - Definitions.....	60

LIST OF TABLES

<u>Table</u>		<u>Page</u>
1.	Estimated Performance and Stability Data (ITSL System).....	62
2.	SRC Unit Operating Data (Part 1).....	64
3.	SRC Unit Operating Data (Part 2).....	68
4.	Estimated Performance and Stability Data (SRC Unit).....	73
5.	Hydrogen Leakage Tests.....	75
6.	SRC Unit Operating Conditions - Special Product Workup Periods.....	76
7.	CSD Unit Operating Data	79
8.	CSD Unit Analytical Data.....	83
9.	HTR Unit Operating Data (Part 1).....	87
10.	HTR Unit Operating Data (Part 2).....	91
11.	HTR Unit Analytical Data	95
12.	Estimated Performance and Stability Data (HTR Unit).....	99
13.	HTR Unit Operating Conditions and Yields - Special Product Workup Periods.....	102
14.	Feed and Product Nitrogen Distribution (HTR Unit) - Special Product Workup Periods.....	106
15.	ITSL Yield Structure.....	109
16.	Distillate Product Analyses - Special Product Workup Periods.....	113
17.	Residual Stream Analyses - Special Product Workup Periods.....	120
18.	Feed Coal Analyses - Special Product Workup Periods.....	126
19.	Sour Water Analyses - Special Product Workup Periods.....	128

LIST OF FIGURES

<u>Figure</u>		<u>Page</u>
1.	Two Stage Liquefaction (Integrated Mode)...	129
2.	SRC Unit Flowsheet.....	130
3.	CSD Unit Flowsheet.....	131
4.	HTR Unit Flowsheet.....	132
5.	Daily Two Stage Process Stability Trend Chart.....	133
6.	SRC Unit Trend Chart (Part 1).....	135
7.	SRC Unit Trend Chart (Part 2).....	138
8.	SRC Inventory Trends.....	140
9.	CSD Unit Trend Chart (Part 1).....	142
10.	CSD Unit Trend Chart (Part 2).....	144
11.	Laboratory Analyses Daily Trend Chart.....	146
12.	HTR Unit Trend Chart (Part 1).....	148
13.	HTR Unit Trend Chart (Part 2).....	150
14.	Material Balance Flow Diagram for 243A.....	152
15.	Material Balance Flow Diagram for 243B.....	153
16.	Material Balance Flow Diagram for 243C.....	154
17.	Material Balance Flow Diagram for 243D.....	155
18.	Material Balance Flow Diagram for 243E.....	156
19.	Material Balance Flow Diagram for 243F.....	157
20.	Material Balance Flow Diagram for 243G.....	158
21.	Material Balance Flow Diagram for 243H.....	159
22.	Material Balance Flow Diagram for 243I.....	160
23.	Material Balance Flow Diagram for 243J.....	161
24.	Material Balance Flow Diagram for 243K.....	162
25.	Material Balance Flow Diagram for 243L.....	163
26.	Material Balance Flow Diagram for 243M.....	164
27.	SRC Unit Distillate Solvent Yield.....	165
28.	Nitrogen, Sulfur, Hydrogen and H/C Atomic Ratio in Selected Streams.....	166
29.	Effect of Catalyst Age on Relative Activity.....	168

ABSTRACT

This report presents the operating results for Run 243 at the Advanced Coal Liquefaction R & D Facility in Wilsonville, Alabama. This run was made in an Integrated Two-Stage Liquefaction (ITSL) mode using Illinois 6 coal from the Burning Star mine. The primary objective was to demonstrate the effect of a dissolver on the ITSL product slate, especially on the net C₁-C₅ gas production and hydrogen consumption.

Run 243 began on 3 February 1983 and continued through 28 June 1983. During this period, 349.8 tons of coal was fed in 2,947 hours of operation. Thirteen special product workup material balances were defined, and the results are presented herein.

1. INTRODUCTION

Run 243 began on 3 February 1983 and continued through 28 June 1983. This run was made in the Integrated Two-Stage Liquefaction (ITSL) mode. In this mode, the thermal dissolver is utilized; the HTR unit atmospheric flash bottoms are recycled to the thermal stage; and the thermal stage distillate solvent is hydrotreated with the CSD SRC in the HTR feed (Figure 1). Figures 2, 3 and 4 show schematic flow diagrams of the individual process units.

The primary objective of Run 243 was to demonstrate, on a 2.5 tons per day pilot plant scale, the effect of a dissolver on the ITSL product slate from Illinois 6 (Burning Star) coal while minimizing C_1 - C_5 gas production and hydrogen consumption. Conversion of this coal to an "all-distillate" product slate, using the Short Contact Time Integrated Two-Stage Liquefaction (SCT-ITSL) process, has been demonstrated by C. E. Lummus (Ref. 1) and by Run 242 at this facility (Ref. 2).

Run 243 was conducted in two parts which were denoted as Phase 1 (3 February to 6 April) and Phase 2 (20 April to 28 June 1983). This distinction was made to indicate the changes in the SRC unit operations. Phase 1 used a 50% R101 Dissolver volume and a 2 inch diameter insulated transfer line between the preheater and the dissolver. During the shutdown, the transfer line was replaced with a shorter, 1 inch Dowtherm traced and insulated transfer line to reduce the heat loss between the preheater and dissolver. Phase 2 operations also utilized a 25% R101 Dissolver volume.

The following secondary objectives were set for Phase 1:

- To determine the operability and stability of the ITSL process and of the individual units with an R101 Dissolver volume of 50%.
- To obtain the effects of dissolver temperature and recycle gas flow rate on the ITSL system performance.
- To determine deactivation data for Shell 324M (Ni-Mo) catalyst while operating the ITSL process in a utility fuel product slate.
- To evaluate the effect of HTR reactor temperature on solvent activity and overall hydrogen consumption.

The secondary objectives for Phase 2 were determined to further investigate the effects of dissolver operating conditions on ITSL system performance. The objectives for Phase 2 are summarized as follows:

- To evaluate the ITSL system with an R101 Dissolver volume of 25% and to study the effects of temperature, coal feed rate and hydrogen partial pressure on overall system performance.
- To produce an "all-distillate" product slate for comparison with Run 242 by adjusting the HTR reactor temperature at similar catalyst ages (1b SRC/lb catalyst).

The planned operating conditions for Run 243 are summarized as follows:

Run	243 Phase 1	243 Phase 2
Start date, 1983	3 February	20 April
End date, 1983	6 April	28 June
Coal	Illinois 6	Illinois 6
Mine	Burning Star	Burning Star
<u>Planned Conditions</u>		
Slurry concentration, % MF	36	36
Coal, MF lb/hr	250	250(d)
Space rate, lb/hr-ft ³ (a)	27	57
Gas feed rate, scfh	3,500(b)	3,500(b)
Mscf/ton of coal	28(b)	28(b)
Hydrogen purity, mol %	85 (min)	85(e)
Coal: solvent: HTR SRC wt ratio	1:0.9:0.9 (max)	1:0.9:0.9 (max)
<u>SRC Unit</u>		
<u>R101 Dissolver</u>		
Pressure, psig	2,400	2,400(f)
Temperature, °F	800(c)	825(g)
Volume in use, %	50	25
Solids withdrawal, wt % of feed	6 (max)	6 (max)
V103 High Pressure Separator temperature, °F	700 (max)	700 (max)
HTR SRC recycle rate, lb/hr	225 (max)	225 (max)
T102 Vacuum Column bottom temperature, °F	615(h)	630 (max)
<u>Hydrotreater Unit</u>		
Reactor temperature, °F	630	720(i)
Total gas feed, scf/lb SRC	20	20
Hydrogen purity, mol %	70-75	70-75
SRC in feed blend, %	50-55	50-55
Solvent in HTR SRC, %	50	50
Catalyst	Shell 324M	Shell 324M

- (a) Based on the MF coal rate and a dissolver volume of 9.2 ft³ (50%) or 4.4 ft³ (25%).
- (b) Feed gas rate was increased to 5,000 scfh on 17 March and was decreased to 3,500 scfh on 22 April. The Mscf/ton of coal at the higher rate was 40.
- (c) R101 Dissolver temperature was decreased to 785°F on 23 March.
- (d) MF coal feed rate was reduced to 200 lb/hr on 26 May.
- (e) Hydrogen purity was lowered to 70 mole % on 3 June.
- (f) Dissolver pressure was decreased to 1,700 psig on 3 June and to 1,500 on 6 June.
- (g) R101 Dissolver temperature was decreased to 810°F on 19 May.
- (h) T102 Vacuum Column bottoms temperature was raised to 630°F on 6 February.
- (i) Based on operation with the old catalyst batch. After catalyst was replaced, initial operation was at 680°F.

2. CONCLUSIONS AND RECOMMENDATIONS

2.1. Conclusions

Run 243 demonstrated the effect of a dissolver on the ITSL process. Both a "utility fuel oil" mode and an "all-distillate" mode were achieved. The net C₁-C₅ gas production was fairly low (6 to 9% MAF coal), hydrogen utilization efficiency was moderate (from 10 to 13.6 lb distillate per lb of hydrogen) and energy rejection was acceptable (generally 20 to 26% of feed coal heating value.) The mechanical performance of the three process units was good. Consequently, Run 243 achieved a high on-stream factor.

To evaluate the impact of a dissolver on the ITSL product slate, the following major process adjustments were made:

- During Phase 1 operations (utility fuel oil mode with a 50% R101 Dissolver volume), the SRC unit temperature was decreased from 800 to 785°F. This improved the ITSL system performance. Net C₁-C₅ gas production was 5.9% of MAF coal, hydrogen utilization efficiency was 13.6 lb distillate/lb hydrogen, and energy rejection to the ash concentrate was 22 to 26% (based on feed coal heating value).
- The ITSL system performance for Phase 1 with the 800°F dissolver resulted in a net C₁-C₅ gas production of 7 to 8% MAF coal and hydrogen utilization efficiencies of 10 to 12.5 (lb distillate per lb hydrogen). The energy rejection was 20 to 32% of the feed coal heating value.
- During Phase 2 operations (all-distillate mode with a 25% dissolver volume), the HTR unit catalyst bed was replaced with fresh catalyst and the SRC unit temperature was decreased from 825 to 810°F. The C₁-C₅ gas production decreased slightly (by 0.4% MAF coal) and the ash concentrate production declined by about 3% MAF coal. The hydrogen utilization efficiency and hydrogen consumption results are suspect since HTR unit hydrogen leaks and meter problems occurred from 8 to 22 May.
- The SRC unit coal feed rate was reduced from 250 to 200 MF lb/hr to duplicate the feed rate used for Run 242. The C₁-C₅ gas production increased (by 2% MAF coal) and distillate production increased (by 6% MAF coal).
- Until the low hydrogen partial pressure tests were conducted on 3 June, the overall ITSL system results for Phase 2 operations were not significantly different than those for Phase 1 at 800°F dissolver temperature. The C₁-C₅ gas production averaged 8.2% MAF coal, hydrogen utilization efficiency averaged 11.1 (lb distillate per lb hydrogen), and energy rejection was 20 to 25% (after stable conditions were established).

- The SRC unit hydrogen partial pressure was decreased to limit the molecular hydrogen consumption in the thermal stage. This reduced the overall C₁-C₅ gas production (by 2% MAF coal) and distillate yield (by 6% MAF coal) and significantly increased the organic material rejected as ash concentrate. Hydrogen consumption decreased by 0.7% MAF.

Other conclusions for Run 243 were:

- Best SRC unit hydrogen transfer from distillate and residue components in the process solvent occurred when the HTR unit reactor operated between 660 and 720°F.
- The CSD unit feed was more soluble for Phase 1 operations with a 50% dissolver volume than for Phase 2 with a 25% dissolver volume.

2.2. Recommendations

- Run 243 demonstrated that dissolver temperature, residence time and hydrogen partial pressure have significant effects on the ITSL product slate when compared to Run 242 (short contact time). If a dissolver is desirable for plant scale-up, additional SRC unit variability studies are recommended.
- Since HTR unit temperature appeared to have a significant effect on SRC unit performance, bench scale tests are suggested to determine the effects of catalyst age and temperature on recycle solvent and residue hydrogen transfer.
- CSD unit performance with respect to deashing solvent type, vacuum column bottoms feed properties and first stage separator operating conditions should be defined.
- The effects of a disposable catalyst on the thermal dissolver performance and yield structure should be investigated.

3. OPERATING DATA AND PROCESS PERFORMANCE

During Run 243, the SRC unit operated 2,947 hours for an on-stream factor of 96%. The CSD unit processed feed for 2,878 hours and the HTR unit operated for 2,857 hours.

The operating data and process performance are discussed in this section.

3.1. ITSL System Stability

The ITSL system stability (in terms of its approach to steady state) is judged by the absolute values of the following measured operating parameters. In their relative order of importance, these parameters are:

- Overall material balance closure difference
- Inventory changes (including drum-outs) at the following locations:
 - (a) Within the primary recycle loop (flushed bottoms between the HTR and SRC units)
 - (b) Between the SRC and CSD units
 - (c) Between the CSD and HTR units
 - (d) At the flare knock-out pots

Table 1 is a summary of the above listed parameters for those run days when the total mass balance closure difference was approximately 10% or less of MAF coal. Also included in this table are preliminary estimates of the ITSL yields. The true ITSL system performance and the performance of each process unit are more accurately defined by the yields from the special product workup periods. The selection of special product workup periods is based not only on the above parameters, but also on the process stability of each individual unit, general engineering judgments (such as equipment performance) and the requirements for future detailed data analysis.

3.2. SRC Unit

Run 243 consisted of two distinct operating periods, designated as Phase 1 (3 February to 6 April 1983) and Phase 2 (22 April to 28 June). Phase 1 operations utilized a dissolver volume of 50% and an insulated 2-inch transfer line between the preheater and the dissolver. Run 243 Phase 2 operations commenced on 22 April, using a 25% dissolver volume and a new Dowtherm traced, insulated, 1-inch transfer line. Typical transfer line temperature profiles are presented later in this section.

Daily operating and analytical data are presented in Tables 2 and 3. Estimated daily performance and stability data are shown in Table 4, and plotted in Figures 5 through 8, along with other key trend data.

The planned and actual SRC unit operating conditions during Run 243 Phase 1, are summarized as follows:

Run no.
Start date, 1983
End date, 1983
Coal
Mine

243-Phase 1
3 February
6 April
Illinois 6
Burning Star

	Planned	Actual			
Run period		(2/3-2/18)	(2/19-2/24)	(2/25-3/4)	(3/5-3/10)
Slurry conc., % MF	36	35.8	35.7	35.9	35.9
Coal feed rate, MF lb/hr	250	244	243	240	245
Space rate, lb/hr-ft ³	27	26.5	26.4	26.1	26.6
Gas feed rate, scfh	3,500(a)	3,470	3,470	3,500	3,500
Mscf/ton of coal	28(a)	28.4	28.5	29.2	28.6
Hydrogen purity, mol %	85	87	87	88	88
Coal: solvent:HTR-SRC wt ratio	1.0:0.9:0.9(max)	1:1.62:0.19 to 1:0.50:0.87	1:0.85:0.93	1:0.83:0.95	1:1.84:0.93
B102 outlet temp., °F	-	814	816	826	833
<u>R101 Dissolver</u>					
Volume in use, %	50	50	50	50	50
Pressure, psig	2,400	2,400	2,400	2,400	2,400
Temperature, °F	800(b)	799	800	799	798
Solids withdrawal, %	6(max)	7	6	6	6
V103 HP Separator temperature, °F	700(max)	661	666	658	664
HTR-SRC recycle rate, lb/hr	225(max)	50-200	229	227	226
Solvent in CSD feed, %	-	9.0	8.4	7.7	7.3
T102 Vacuum Column bottoms temperature, °F	615(c)	626	630	630	630

	Actual		
Run period	(3/11-3/16)	(3/17-3/22)	(3/23-4/6)
Slurry conc., % MF	35.4	35.9	35.6
Coal feed rate, MF lb/hr	246	254	250
Space rate, lb/hr-ft ³	26.7	27.6	27.2
Gas feed rate, scfh	3,480	4,880(a)	5,000
Mscf/ton of coal	28.3	38.3(a)	40.0
Hydrogen purity, mol %	87	87	87
Coal: solvent:HTR-SRC wt ratio	1:0.94:0.86	1:0.90:0.86	1:0.88:0.91
B102 outlet temp., °F	847	838	816
<u>R101 Dissolver</u>			
Volume in use, %	50	50	50
Pressure, psig	2,400	2,400	2,400
Temperature, °F	800	800	785(b)
Solids withdrawal, %	6-7	6	5-6
V103 HP Separator temperature, °F	663	670	662
HTR-SRC recycle rate, lb/hr	215	219	228
Solvent in CSD feed, %	8.7	10.2	7.3
T102 Vacuum Column bottoms temperature, °F	631	631	630

- (a) Feed gas rate was increased to 5,000 scfh to lower the B102 Preheater outlet temperature after 17 March.
(b) R101 Dissolver outlet temperature was decreased from 800 to 785°F after 23 March.
(c) T102 bottoms temperature was increased to 630°F after 6 February.

The planned and actual SRC unit operating conditions for Run 243 Phase 2 were:

Run no.	243-Phase 2
Start date, 1983	22 April
End date, 1983	28 June
Coal	Illinois 6
Mine	Burning Star

	Planned	Actual			
Run period		(4/22-4/29)	(4/30-5/3)	(5/4-5/14)(a)	(5/15-5/18)
Slurry conc., % MF	36	35.7	36.0	35.4	35.9
Coal feed rate, MF lb/hr	250(c)	253	252	248	246
Space rate, lb/hr-ft ³	57	57.2	57.0	56.1	55.7
Gas feed rate, scfh	3,500	3,440	3,430	3,520	3,550
Mscf/ton of coal	28	27.2	27.2	28.4	28.9
Hydrogen purity, mol %	85(d)	87	87	88	88
Coal: solvent:HTR-SRC Wt ratio	1.0:0.9:0.9(max)	1:1.39:0.47 to 1:0.95:0.83	1:0.93:0.85	1:0.95:0.87	1:0.90:0.88
B102 outlet temp., °F	-	819	823	829	829
<u>R101 Dissolver</u>					
Volume in use, %	25	25	25	25	25
Pressure, psig	2,400(e)	2,400	2,400	2,400	2,400
Temperature, °F	825(b)	825	825	824	824
Solids withdrawal, %	6(max)	6	6	6	5
V103 HP Separator temperature, °F	700(max)	690	696	694	687
HTR-SRC recycle rate, lb/hr	225(max)	110-210	214	217	217
Solvent in CSD feed, %	-	8.9	7.7	9.6	9.6
T102 Vacuum Column bottoms temperature, °F	630(max)	630	629	629	630

	Actual				
Run period	(5/19-5/25)	(5/26-6/1)	(6/6-6/14)	(6/15-6/22)	(6/23-6/27)
Slurry conc., % MF	35.8	35.8	35.7	35.7	35.6
Coal feed rate, MF lb/hr	246	197(c)	192	199	196
Space rate, lb/hr-ft ³	55.7	44.6	43.4	45.0	44.3
Gas feed rate, scfh	3,480	3,470	3,420	3,360	3,360
Mscf/ton of coal	28.3	35.2	35.6	33.8	34.3
Hydrogen purity, mol %	73-90(f)	86	71(d)	71	71
Coal: solvent:HTR-SRC Wt ratio	1:0.90:0.88	1:0.92:0.88	1:0.94:0.81	1:0.95:0.84	1:0.94:0.84
B102 outlet temp., °F	811	814	825	824	826
<u>R101 Dissolver</u>					
Volume in use, %	25	25	25	25	25
Pressure, psig	2,400	2,400	1,500(e)	1,500	1,500
Temperature, °F	810(b)	810	810	810	810
Solids withdrawal, %	6	6	6	5	5
V103 HP Separator temperature, °F	677	659	658	662	663
HTR-SRC recycle rate, lb/hr	215	168	156	167	165
Solvent in CSD feed, %	7.0	8.5	9.7	10.5	8.8
T102 Vacuum Column bottoms temperature, °F	630	630	630	630	631

- (a) Fresh catalyst used since 4 May.
 (b) R101 reactor temperature decreased to 810°F after 19 May.
 (c) MF coal feed rate decreased after 26 May from 250 to 200 lb/hr.
 (d) Recycle gas hydrogen purity lowered to 70 mole % after 3 June.
 (e) Pressure reduced to 1,700 psig on 3 June and 1,500 psig on 6 June.
 (f) From 0500 hr on 20 May to 0500 hr on 21 May, the hydrogen purity was lowered to 73 mol %. Average hydrogen purity for normal conditions was 88%.

The major process variables which were adjusted and the rationale for these adjustments are summarized as follows:

Run 243 Phase 1

<u>Process Adjustment</u>	<u>Rationale</u>
● T102 Vacuum Column bottoms temperature was increased from 615 to 630°F on 6 February 1983.	To reduce the solvent content in T102 bottoms (CSD unit feed).
● T102 Vacuum Column tray 3 was initially withdrawn (about 15,800 lb from 3 February to 24 March 1983).	To remove light fractions from the distillate solvent inventory.
● Feed gas rate was increased from 3,500 to 5,000 SCFH on 17 March.	To reduce the slurry preheater outlet temperature.
● R101 Dissolver temperature was reduced from 800 to 785°F on 23 March.	To evaluate the effect of temperature on hydrogen consumption and hydrogen utilization efficiency.

Run 243 Phase 2

● R101 Dissolver temperature was decreased from 825 to 810°F on 18 May.	To evaluate the effect of temperature on hydrogen consumption and hydrogen utilization efficiency.
● MF coal feed rate was reduced from 250 to 200 lb/hr on 26 May.	To provide an HTR unit space velocity comparable to Run 242.
● R101 hydrogen partial pressure was decreased by lowering the pressure (from 2,400 to 1,700 psig) and recycle gas hydrogen content (from 85 to 70 mole %) after 3 June.	To reduce hydrogen consumption and gas yield to values similar to those obtained for Run 242.

During the start-up period of Run 243 Phase 1, a mixture of hydrotreated distillate solvent from Run 242 (55%) and thermal stage distillate solvent (T102 tray 8 material) was used to prepare the coal slurry blends.

A total of 15,800 lb of vacuum column tray 3 material was withdrawn during Phase 1 operations. From 4 to 17 February, 8,100 lb were produced. Tray 3 solvent production ceased until 11 March, when the HTR unit reactor temperature was increased to 720°F. An additional 7,700 lb were removed between 12 to 24 March. After 25 March, no significant amount of tray 3 material was produced.

Average estimated daily SRC unit yields for various stable operating conditions were as follows for Phase 1 operations:

Period, 1983	2/19-2/24	2/25-3/4	3/5-3/10	3/11-3/16	3/17-3/22(a)	3/23-4/6
<u>Dissolver</u>						
Temperature	800	799	798	800	800	785
Pressure, psig	2,400	2,400	2,400	2,400	2,400	2,400
Preheater outlet temp., °F (avg)	816	826	833	847	838	816
<u>Process solvents</u>						
H ₂ SRC, %	47	51	53	48	49	51
Hydrotreated bottoms conc., %	100	100	100	99	100	100
<u>Solvent activity, % UNF conv</u>						
Kinetic	80	86	75	82	78	86
Equilibrium	84	86	87	88	88	86
H ₂ SRC, %	8.17	8.16	8.27	8.48	8.43	8.73
H/C atomic ratio	1.11	1.12	1.13	1.14	1.14	1.17
Hydrogen consumption, % MAP coal	2.0±0.1	2.1±0.1	1.9±0.1	1.5±0.1	1.6±0.1	1.7±0.1
Coal conversion, %	92.0	91.8	92.6	94.2	93.6	93.5
Preasphaltenes in CSD feed, %	13.0	11.2	13.8	11.9	8.9	13.9
UC in CSD feed, %	4.5	4.6	4.4	3.5	3.8	3.8
SRC recovery, %	92.9	93.0	92.6	91.8	92.0	90.4
Energy rejection, % (DAS 8 to I used)	20.7	21.5	20.3	21.0	21.6	23.7
<u>Yield, % MAP coal</u>						
Water	5.9±0.2	6.3±0.2	5.5±0.4	5.0±0.6	4.5±0.4	5.1±0.5
Gas	9.4±0.4	10.3±1.0	9.6±0.6	9.6±1.2	8.6±0.4	7.3±0.7
Naphtha	3.7±0.2	4.4±0.7	4.3±1.0	4.6±0.5	5.0±0.5	3.7±0.6
Middle distillate	5.9±0.4	5.3±0.7	5.6±1.0	5.5±0.9	5.1±0.6	4.1±0.7
Distillate solvent	26.8±2.7	29.6±4.6	24.4±1.3	22.0±2.0	26.9±6.0	20.6±2.7
SRC	42.4±1.9	36.4±3.9	42.7±3.7	49.1±2.7	44.1±4.2	51.3±2.8
UC	8.3±0.5	8.4±0.5	8.4±1.2	6.4±0.5	6.8±0.8	7.2±0.7
HTR reactor temp., °F	630	660	690	720	720	720

(a) Feed gas rate averaged 4,860 SCFH for 17 to 22 March and 5,000 SCFH for 23 March to 6 April. Previous feed rate average was 3,500 SCFH.

The increase in recycle gas feed rate reduced the preheater outlet temperature by approximately 10°F.

The decrease in R101 Reactor temperature did not reduce the SRC unit hydrogen consumption. However, the distillate yield and total gas production decreased and the SRC yield increased.

Average estimated daily SRC unit yields at various HTR unit reactor temperatures were as shown on the following page for Phase 2 operations.

Period, 1983	4/30-5/3	5/4-5/14(a)	5/15-5/18	5/19-5/25	5/26-6/1(b)	6/6-6/14(c)	6/15-6/22
Dissolver							
Temperature, °F	825	824	824	810	810	810	810
Pressure, psig	2,400	2,400	2,400	2,400	2,400	1,500	1,500
Preheater outlet temp., °F	823	829	829	811	814	825	824
Process solvent							
HTR SRC, wt %	48	48	49	49	48	47	47
Hydrotreated bottoms conc, %	99	100	100	100	100	100	100
Solvent activity, % THF conv							
Kinetic	84	87	83	83	88	85	85
Equilibrium	90	90	92	91	91	88	90
Hydrogen, wt %	8.64	8.92	8.81	9.16	9.14	9.05	8.94
H/C atomic ratio	1.19	1.20	1.18	1.23	1.23	1.21	1.20
Hydrogen consumption, % MAF coal	1.6	1.3	1.3	1.3	1.5(1.2-1.6)	0.8	0.9
Coal conversion, %	93.2	93.5	93.5	92.8	92.9	91.1	90.9
Preasphaltenes in CSD feed, %	12.9	13.5	11.6	11.0	11.2	13.0	12.3
UC in CSD feed, %	4.0	3.3	3.7	3.5	4.1	4.7	5.0
SRC recovery, %	88.0	90.2	91.0	91.3	90.6	89.2	90.6
Energy rejection, % (DAS E to G used)	25.7	24.6	21.9	22.9	23.7	27.6	25.4
Yield, % MAF coal							
Water	5.6±0.5	5.2±0.4	5.8±0.3	5.2±1.3	5.6±0.8	4.2±0.8	4.5±0.3
Gas	9.6±0.0	9.6±0.2	10.0±0.4	7.3±0.1	8.9±1.1	8.6±0.4	8.8±0.6
Naphtha	3.8±0.5	5.4±0.5	4.6±0.8	3.8±0.4	4.9±0.4	4.3±0.2	4.3±0.2
Middle distillate	5.1±0.8	6.3±0.7	4.7±1.0	4.3±0.1	4.9±0.4	4.9±0.4	4.9±0.5
Distillate solvent	17.3±0.2	20.6±3.1	22.2±2.0	19.0±3.1	22.7±4.0	16.8±1.2	14.6±1.5
SRC	46.5±1.5	42.3±1.8	40.5±3.6	48.6±3.7	43.6±3.0	47.6±2.6	48.5±2.6
UC	7.5±0.7	6.5±0.3	6.5±0.0	7.3±1.3	7.2±0.8	8.4±0.5	9.1±0.8
HTR reactor temp., °F	720	680	680-720	720	720	720	730

(a) New catalyst was used in the HTR since 4 May.

(b) Coal feed rate was reduced from 250 to 200 MF lb/hr on 26 May.

(c) Dissolver pressure was 1,500 psig and the recycle gas hydrogen purity was 71 mol % from 6 June until the end of the run.

During Phase 2 operations, when R101 temperature was decreased from 825 to 810°F, hydrogen consumption was not reduced. However, the thermal stage estimated daily yields showed a significant increase in the SRC yield (8% MAF coal) and a decrease in the lighter components.

The reduction in dissolver coal feed rate on 26 May (250 to 200 lb/hr MF) increased the SRC unit hydrogen consumption. The estimated daily yields showed a definite shift in the product slate towards the lighter components.

Decreasing R101 hydrogen partial pressure caused a dramatic reduction in hydrogen consumption (from 1.5 to 0.8% MAF coal). Concurrently, the coal conversion decreased from 93 to 91 percent. Significant changes were observed in the distillate product yield, which decreased, and the SRC and UC yields which increased.

Stable SRC unit operating conditions were achieved for Phase 1 after 19 February and for Phase 2 after 30 April. Estimated daily yields are presented in Table 4.

Inspection of the estimated yields in Table 4 revealed that between 25 February and 16 March, the SRC unit hydrogen consumption decreased (about 0.6% of MAF coal) as the HTR unit reactor temperature was increased from 660 to 720°F. SRC yield increased from 36 to 49% of MAF coal, primarily from a reduction in distillate solvent yield. Analyses of V131B solvent and V1067 residue during this period showed an increase in hydrogen

content. No significant changes were noted in V131B activity or V1067 microautoclave conversion.

The hydrogen balance around the thermal stage indicated significant hydrogen transfer from the distillate and the resid components of the process solvent. Hydrogen transfer data for Run 243 are summarized as follows:

Run Period, 1983 Reactor temp., °F	243-Phase 1					
	2/19-2/24	2/25-3/4	3/5-3/10	3/11-3/16	3/17-3/22	3/23-4/6
SRC	800	799	798	800	800	785
HTR	630	660	690	720	720	720
Hydrogen consumption in thermal stage, % MAF coal						
From molecular hydrogen	2.0	2.1	1.9	1.8	1.6	1.7
From distillate solvent	0.38	0.50	0.56	0.63	0.65	0.58
From recycle HTR SRC	0.23	0.49	0.48	0.41	0.43	0.00
Total	2.6	2.1	2.9	2.5	2.7	2.3

Run Period, 1983 Reactor temp., °F	243-Phase 2						
	4/30-5/3	5/4-5/14(a)	5/15-5/18	5/19-5/25	5/26-6/1(b)	6/6-6/14(c)	6/15-6/22
SRC	825	824	824	810	810	810	810
HTR	720	680	680-720	720	720	720	730
Hydrogen consumption in thermal stage, % MAF coal							
From molecular hydrogen	1.6	1.3	1.3	1.3	1.5	0.8	0.9
From distillate solvent	0.50	0.71	0.69	0.81	0.77	0.61	0.69
From recycle HTR SRC	0.51	0.83	0.71	0.46	0.55	0.65	0.63
Total	2.6	2.8	2.7	2.6	2.8	2.1	2.2

- (a) Fresh catalyst was used in the HTR unit since 4 May.
 (b) Coal feed rate reduced from 250 to 200 MF lb/hr.
 (c) Hydrogen partial pressure reduced by lowering SRC reactor pressure to 1,500 psig and recycle gas hydrogen purity to 70 mole %.

Assumptions: SRC produced from coal in the thermal stage reaction has a hydrogen content of 6.0% (Run 240)

Hydrogen transfer from distillate solvent approximately equal to difference in hydrogen content of V1067 and V178 distillates.

Maximum HTR-SRC hydrogen transfer in the thermal stage occurred from material produced at HTR temperatures of 660 to 690°F for Phase 1 and 680°F for Phase 2. The hydrogen transfer from the distillate solvent showed a peak near 720°F. The total hydrogen transfer from the recycle distillate solvent and HTR-SRC reached a maximum during Phase 2 (1.4 to 1.6% MAF coal) with fresh catalyst and HTR reactor temperatures between 680 and 720°F. The maximum SRC unit hydrogen transfer from distillate solvent and HTR-SRC may occur at different HTR unit reactor temperatures.

Clean coil tests on 28 to 29 June showed hydrogen leakage rates of 0.8 to 1.7 lb/hr. Hydrogen leakage test results are summarized in Table 5.

Thirteen 24-hour special product workup periods (six from Phase 1) were chosen for the SRC unit (and the ITSL system).

The mass balance closures around the SRC unit for the special product workup periods were:

Errors in mass balance					
Run	lb/hr	Wt % of total input	Wt % of MAP coal feed		Remarks
Phase 1	243A	12.9	1.9	5.9	loss
	243B	7.9	1.2	3.8	loss
	243C	13.8	2.0	6.2	loss
	243D	3.6	0.5	1.6	gain
	243E	5.1	0.7	2.3	loss
	243F	17.3	2.4	7.8	loss
Phase 2	243G	12.1	1.7	5.4	loss
	243H	19.8	2.8	8.8	loss
	243I	11.5	1.7	5.3	loss
	243J	6.5	1.2	3.8	loss
	243K	1.1	0.2	0.6	loss
	243L	3.0	0.6	1.8	loss
	243M	12.0	2.1	6.7	loss

A summary of the SRC unit operating conditions during the special product workup periods is given in Table 6.

Material balances for the special product workup periods were calculated by the "process" method (Appendix A). In this method, all process stream flow rates are measured. The distillate solvent flow rate is adjusted using the difference between the total inputs and the measured outputs. SRC unit yield data using this method are tabulated on the following page.

Run Date, 1983	243 Phase 1					
	243A 21 Feb	243B 1 Mar	243C 10 Mar	243D 14 Mar	243E 22 Mar	243F 2 Apr
Coal conversion at V110	93.45	90.88	92.59	93.82	93.58	92.97
<u>Yield, % MAP coal</u>						
Hydrogen consumption(a)	2.01	2.12	1.86	1.47	1.62	1.58
C ₁	2.14	2.03	1.72	1.70	1.67	1.16
C ₂	1.83	1.92	1.70	1.70	1.62	1.22
C ₃	1.54	1.77	1.57	1.57	1.36	1.04
C ₄	0.83	1.07	0.89	0.91	0.68	0.57
C ₅ -C ₆	0.84	0.94	1.02	0.76	0.71	0.93
CO	0.12	0.41	0.0	0.0	0.01	0.11
CO ₂	0.97	1.01	0.97	1.07	1.11	1.10
NH ₃	0.41	0.39	0.25	0.28	0.30	0.20
H ₂ S	1.03	1.35	1.47	1.94	2.02	2.08
H ₂ O	5.58	6.23	5.23	5.27	4.43	4.52
Naphtha (IBP-350°F)	3.63	4.26	5.25	3.56	3.50	3.91
Middle dist. (350-450°F)	6.23	5.38	6.44	4.43	3.90	3.63
Dist. solvent (450°F-EP)	28.87	31.64	30.06	22.99	32.03	25.55
SRC	40.17	36.80	38.34	48.87	42.04	48.76
Oil	23.97	24.57	12.36	11.80	10.97	3.58
Asphaltene	2.66	2.40	20.29	25.84	23.88	23.35
Preasphaltene	13.54	9.83	5.69	11.23	7.19	21.82
Ash	11.91	12.20	12.97	13.09	12.18	12.75
UC	8.07	7.71	7.37	6.16	6.78	7.75
TOTAL YIELD	114.16	115.10	115.27	114.31	114.34	115.28
Total gas (excluding hydrogen)	9.71	10.88	9.59	9.92	9.48	8.41
Total liquid (excluding water)	38.73	41.28	41.75	30.99	39.43	33.09
<u>Elemental error, %</u>						
Carbon	-1.88	-1.97	-1.15	-1.15	-1.55	-1.43
Hydrogen	-2.77	-2.02	-0.46	-0.56	-1.47	-1.06
Ash	2.96	6.66	1.62	-2.23	4.09	7.38

Run Date, 1983	243 Phase 2						
	243G 1 May	243H 8 May	243I 23 May	243J 29 May	243K 31 May	243L 13 June	243M 19 June
Coal conversion at V110	93.13	93.59	93.53	92.57	93.02	94.30	93.33
<u>Yield, % MAP coal</u>							
Hydrogen consumption(a)	1.60	1.24	1.28	1.54	1.23	0.82	0.90
C ₁	2.16	1.92	1.29	1.97	1.94	1.70	1.32
C ₂	1.86	1.75	1.24	1.75	1.76	1.59	1.35
C ₃	1.58	1.56	1.07	1.46	1.55	1.40	1.22
C ₄	0.79	0.82	0.58	0.82	0.89	0.78	0.67
C ₅ -C ₆	1.00	0.93	1.03	1.56	1.03	0.88	0.63
CO	0.17	0.19	0.15	0.18	0.26	0.11	0.07
CO ₂	0.71	0.84	0.68	0.79	0.75	0.91	0.94
NH ₃	0.21	0.41	0.25	0.32	0.33	0.32	0.31
H ₂ S	1.23	1.46	1.10	1.32	1.19	1.58	1.57
H ₂ O	5.61	4.39	3.85	5.01	6.29	3.55	3.73
Naphtha (IBP-350°F)	3.82	4.59	3.84	4.14	4.28	4.54	4.33
Middle dist. (350-450°F)	5.50	5.66	4.59	4.69	4.88	5.48	5.26
Dist. solvent (450°F-EP)	23.55	26.77	22.01	26.05	28.59	20.44	23.26
SRC	45.49	44.03	51.16	45.05	41.09	48.47	47.39
Oil	21.87	9.45	16.97	-3.67	-5.65	15.10	13.21
Asphaltene	18.77	24.62	27.81	38.53	39.96	21.65	24.46
Preasphaltene	4.86	9.95	6.38	10.18	6.77	11.72	9.72
Ash	12.36	11.89	12.40	12.28	12.25	12.48	12.23
UC	7.94	6.47	8.21	6.74	6.73	8.44	8.76
TOTAL YIELD	113.97	113.67	113.45	114.13	113.81	112.67	113.06
Total gas (excluding hydrogen)	9.72	9.89	7.40	10.18	9.71	9.26	8.09
Total liquid (excluding water)	32.86	37.01	30.44	34.88	37.75	30.46	32.86
<u>Elemental error, %</u>							
Carbon	-1.50	-1.93	-1.72	-1.20	-0.21	-0.91	-1.14
Hydrogen	-0.82	-1.75	0.24	-0.38	-0.35	-1.81	-1.37
Ash	0.46	4.54	-1.71	2.63	2.67	-5.37	-0.26

(a) Calculated using the ethylene injection method.

The new transfer line installed after Phase 1 operations showed a significant reduction in the heat losses between B102 Preheater and R101 Dissolver. Typical temperature distributions for both transfer lines are compared below:

Dates, 1983	<u>Old transfer line</u> (3/3-3/6)	<u>New transfer line</u> (4/23-4/26)
<u>Instrument Point</u>		
TR401-18 (B102 outlet)	812	820
TR401-19	806	NA
TR401-20	754	810
TR401-21 (R101 inlet)	764	810
TR401-23 (R101 25% outlet)	-	825
TR401-28 (R101 50% outlet)	785	-
Dimensions:	Old transfer line- 2" Sch. 160, 100 ft, 1.5 ft ³ volume.	
	New transfer line- 1" Sch. 160, 60 ft, 0.23 ft ³ volume.	

The old transfer line was inspected and the results have been reported (Ref. 2).

A chronological operating log is presented in Section 8.1.

3.3. CSD Unit

Process performance of the CSD unit was acceptable during Run 243. Recovery of cresol soluble feed averaged 90.8% and energy rejection to the ash concentrate averaged 23.4% based on the feed coal's estimated heating value. Deashing performance was poor during the initial operating period, but process variables and DAS solvents were adjusted to alleviate the deashing problems.

Daily operating data, feed and product analyses are presented in Tables 7 and 8. Key trend and performance data are plotted in Figures 9 to 11.

During Run 243 Phase 1, certain process adjustments were made to improve process performance. The deashing solvent type (DAS) was also changed a number of times. These changes and the rationale for each are presented below.

Run 243 Phase 1

<u>Process Adjustment</u>	<u>Rationale</u>
<ul style="list-style-type: none"> First stage temperature and DAS/feed ratio were increased on 5 February. 	To improve deashing performance.
<ul style="list-style-type: none"> First stage pressure was adjusted several times between 11 and 23 February. 	To improve deashing performance and to determine operability.

● Deashing solvent type was changed from DAS A to DAS E on 13 February.	To eliminate persistent ash carry-over problems.
● First stage temperature was decreased on 14 February, 9 March, 17 March, and 28 March.	To reduce undesirable side effects associated with high temperature operation, and to investigate operating temperature limits.
● Deashing solvent was changed from DAS E to DAS F on 1 March, to DAS G on 8 March, and to DAS I on 23 March.	To improve deashing performance. The final change to DAS I was a precautionary measure (to prevent ash carry-over) associated with an HTR unit temperature change.
● Deashing solvent adjustments were made for short periods on 4 March and from 18 to 25 March.	To attempt production of fluffy ash concentrate.
● Deashing solvent to feed ratio was increased on 5 March and 10 March.	To maintain complete deashing.
● First stage level was controlled with an alternate device from 10 to 21 March.	To achieve more stable control and to test the instrument.
● First stage pressure was increased on 25 and 26 March.	To determine operability limits.
● Deashing solvent to feed ratio was decreased on 26 March.	To determine operability limits.

Run 243 Phase 2

<u>Process Adjustments</u>	<u>Rationale</u>
● DAS to feed ratio was increased on 29 April and 2 May.	To attempt an increase in soluble feed recovery and a decrease in energy rejection to the ash concentrate.

- Deashing solvent was changed from DAS I to DAS H on 5 May. To increase soluble feed recovery and to decrease energy rejection.
- First stage temperature was increased on 6 May. To improve deashing performance.
- First stage pressure was lowered on 7 May. To maintain deashing performance.
- Solvent type was changed to DAS G on 18 May, DAS F on 10 June, and DAS E on 14 June. To increase soluble feed recovery (decrease energy rejection).
- First stage pressure was decreased on 14 June. To maintain deashing after an ash carry-over incident occurred.
- First stage pressure was increased on 15 June. To return to previous conditions and to determine if the previous upset was a temporary condition.

Initial operation of the CSD unit for Run 243 Phase 1 resulted in persistent deashing problems. First stage temperature, pressure and DAS/feed ratio were adjusted in attempts to correct the ash carryover problem. The deashing solvent type was not changed during the first 10 days to determine if CSD unit performance would improve as the SRC and HTR units reached planned operating conditions. However, the deashing performance did not improve and the solvent type was changed to DAS E on 13 February.

Deashing solvent type was changed several times during Phase 1, with each solvent being progressively weaker than the previous. These solvent changes were made to minimize ash carryover occurrences. After the initial start-up period, CSD unit performance was generally good. SRC recovery averaged 91.5% and energy rejection averaged 21.5% for Phase 1.

For Phase 2 operation, the deashing solvent type was successively changed to more powerful solvents. These changes were required to improve SRC recovery and to decrease the energy rejection to the ash concentrate. Apparently, the SRC unit operation at a 25% dissolver volume had an effect on CSD unit performance. Also, the energy rejection deteriorated after the hydrogen partial pressure was reduced in the SRC unit. Average SRC recovery was 90.1% and average energy rejection was 24.8% for Phase 2.

Two incidents of first stage separator plugging occurred during Run 243. The first incident on 11 February was corrected by flushing with SRC and replacing certain letdown system components. The second pluggage on 2 June required a shutdown to disassemble the first stage separator.

DAS solvent adjustments (4 March and 18-25 March) occasionally produced a powdery ash concentrate, but consistent results were not obtained. The ash concentrate was extruded for most of Run 243. Consistent production of powdery ash did not occur until 14 June, after DAS type was changed to a more powerful solvent.

Data highlighting the periods of stable CSD unit operations are given below. Additional information can be found in Tables 7 and 8.

Run 243 Phase 1 CSD Unit Performance

<u>Date, 1983</u>	<u>Type DAS</u>	<u>% Recovery (avg)(1)</u>	<u>% Energy Rejection (avg)(1)</u>
4-13 Feb	A	90.4 (9)	21.1 (4)
14-28 Feb	E	92.3 (15)	20.6 (10)
1-8 Mar	F	92.8 (8)	20.5 (6)
9-14 Mar	G	91.8 (6)	21.1 (4)
15-23 Mar	H	92.0 (9)	21.5 (6)
24-Mar-6 Apr(2)	I	90.3 (14)	23.7 (8)

- (1) Parentheses indicate the number of data points used for the calculation.
 (2) Thermal stage dissolver temperature was lowered from 800 to 785°F after 23 March.

Run 243 Phase 2 CSD Unit Performance

<u>Date, 1983</u>	<u>Type DAS</u>	<u>% Recovery(1)</u>	<u>% Energy Rejection(1)</u>
23 Apr-5 May	I	88.6 (13)	25.4 (11)
6-18 May	H	90.5 (12)	23.4 (9)
19-26 May	G	91.8 (8)	23.2 (8)
27 May-2 June(2)	G	91.0 (7)	23.1 (3)
7-10 June(3)	G	88.7 (4)	30.1 (3)
11-14 June	F	89.9 (4)	25.6 (3)
15-28 June	E	91.0 (13)	25.2 (9)

- (1) Parentheses indicate the number of data points used for the calculation.
 (2) Coal feed rate was reduced from 250 to 200 lb/hr after 26 May.
 (3) RI01 Reactor pressure was lowered to 1,500 psig after 6 June. Feed gas purity was decreased to 70% hydrogen.

Thirteen 24-hour special product workup periods were selected for the CSD unit. CSD unit material balances, along with forced ash balance recoveries and elemental balance errors, are presented on the following pages.

Run Date, 1983 DAS Type	Run 243, Phase 1					
	243A	243B	243C	243D	243E	243F
	21 Feb E	1 Mar F	10 Mar G	14 Mar G	22 Mar H	2 Apr I
<u>Input, % T102 btms</u>						
Distillate solvent	8.4	7.8	8.5	8.8	9.8	5.8
SRC	91.6	92.2	91.5	91.2	90.2	94.2
Oil	34.0	36.4	28.6	34.6	33.8	27.2
Asphaltene	37.4	37.6	46.6	39.4	38.0	41.5
Preasphaltene	8.8	7.1	4.3	6.5	7.2	14.5
UC	4.5	4.3	4.2	3.4	3.8	4.2
Ash	6.9	6.8	7.8	7.3	7.4	6.8
<u>Yield, % T102 btms</u>						
Ash concentrate	17.9	17.5	19.2	17.2	17.2	19.2
Distillate solvent	0.4	0.3	0.4	0.2	0.1	0.3
Oil	1.7	1.5	1.3	1.7	1.0	0.5
Asphaltene	0.8	0.4	1.0	0.5	0.7	0.5
Preasphaltene	2.3	2.7	2.6	3.1	3.1	6.2
UC	5.9	5.9	6.3	4.7	5.1	5.2
Ash	6.8	6.8	7.7	7.0	7.2	6.7
SRC	82.1	82.5	80.8	82.8	82.8	80.8
Distillate solvent	8.3	6.1	8.3	9.9	6.4	11.7
Oil	35.0	32.9	24.6	32.4	33.9	25.3
Asphaltene	32.7	36.5	45.6	31.3	38.7	37.2
Preasphaltene	5.8	6.8	1.8	8.3	3.3	6.3
UC	0.3	0.1	0.4	0.7	0.4	0.3
Ash	0.0	0.1	0.1	0.2	0.0	0.0
<u>Recovery, % cresol solubles in T102 bottoms ("As is" SRC by forced ash balance)</u>						
	92.6	92.7	91.6	91.8	92.8	90.2
<u>Energy rejection, (as % of coal heating value)</u>						
	21.1	21.9	21.6	20.6	18.7	27.2
<u>Elemental balance errors, %</u>						
Carbon	0.11	0.51	-0.05	-0.14	-0.02	-0.06
Hydrogen	0.03	-0.49	-0.04	-0.03	-0.19	-0.23
Nitrogen	10.55	14.12	-1.42	-4.87	-3.18	-11.24
Sulfur	-0.52	-6.26	0.83	-2.21	-10.35	-9.92
Oxygen	-12.14	-38.77	6.02	-11.57	3.49	5.18
Ash	0.91	-0.76	-0.29	1.62	1.75	2.02

Run 243, Phase 2							
Run	243G	243H	243I	243J	243K	243L	243M
Date, 1983	1 May	8 May	23 May	29 May	31 May	12 June	13 June
DAS Type	I	H	G	G	G	F	E
<u>Input, % T102 btms</u>							
Distillate solvent	8.3	8.9	5.6	8.5	9.1	9.1	11.5
SRC	91.7	91.1	94.4	91.5	90.9	90.9	88.5
Oil	36.0	37.8	41.1	30.35	29.91	36.2	32.1
Asphaltene	38.3	37.0	37.3	43.75	44.69	35.1	37.4
Preasphaltene	5.9	5.8	4.7	6.4	5.3	8.2	7.5
UC	4.5	3.7	4.5	3.9	3.9	4.6	4.8
Ash	7.0	6.8	6.8	7.1	7.1	6.8	6.7
<u>Yield, % T102 btms</u>							
Ash concentrate	20.1	18.9	17.9	18.4	18.8	20.3	19.9
Distillate solvent	0.1	0.1	0.1	0.1	0.6	0.3	0.1
Oil	1.1	2.3	1.2	1.3	1.0	1.6	2.1
Asphaltene	1.0	0.6	0.7	1.3	1.7	0.6	1.8
Preasphaltene	4.9	3.5	3.7	3.3	3.0	3.4	1.0
UC	6.2	5.6	5.7	5.3	5.6	7.9	8.3
Ash	6.9	6.8	6.5	7.1	6.9	6.5	6.6
<u>SRC</u>							
Distillate solvent	79.9	81.1	82.1	81.6	81.2	79.7	80.1
Oil	10.1	8.1	6.7	7.7	8.3	10.1	9.3
Asphaltene	25.7	39.0	31.6	29.1	28.0	29.4	29.1
Preasphaltene	38.2	33.6	43.0	40.8	41.8	31.8	38.9
UC	5.7	0.5	0.7	3.9	3.1	8.3	2.7
Ash	0.2	0.0	0.1	0.1	0.0	0.1	0.1
Ash	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<u>Recovery, % cresol solubles in T102 bottoms ("As is" SRC by forced ash balance)</u>							
	89.8	90.8	91.7	91.7	90.7	88.8	90.0
<u>Energy rejection, (as % of coal heating value)</u>							
	25.3	24.0	22.6	20.0	23.6	27.0	25.4
<u>Elemental balance errors, %</u>							
Carbon	0.13	0.24	-0.10	0.11	0.05	0.07	-0.01
Hydrogen	-0.61	-0.07	-0.29	0.11	-0.23	0.02	0.07
Nitrogen	-5.57	7.96	9.12	1.31	-13.59	30.3	-32.08
Sulfur	-2.22	0.80	-7.60	12.15	-8.68	-3.41	9.45
Oxygen	-8.76	-35.24	-12.84	-8.22	-1.05	-36.01	3.36
Ash	1.87	-1.24	4.16	0.01	3.02	4.45	1.37

The continuous ash removal system at the CSD unit was not used during Run 243.

A chronological operating log is presented in Section 8.1.

3.4. HTR Unit

Shell 324M catalyst (1/32 inch nickel-molybdenum) was used as the hydrotreating catalyst for Runs 12-243 and 13-243.

Tray 8 solvent from the T102 Vacuum Column was used as the process solvent in the hydrotreater feed.

Daily operating data, feed and product and analyses are presented in Tables 9 to 11. Key trend and performance data are plotted in Figures 12 and 13.

Planned and actual operating conditions for this run were:

HTR Run Date, 1983	12-243 (Phase 1)				12-243 (Phase 2)	
	6-23 Feb 9-18	25 Feb- 4 Mar 20-27	6-10 Mar 29-33	12 Mar- 5 Apr 35-59	24-26 Apr 64-66	28 Apr- 2 May 68-72
Days of run						
Operating conditions	Planned	Actual				
Reactor temp., °F	630 ^(c)	630	660	690	720	690
Total gas/feed, SCF/lb	20	15-17	15-18	15-16	14-16	14-16
CSD-SRC feed rate, avg. lb/hr	-	249±40	267±15	285±5	306±20	262±30
SRC in feed blend, %	55	54-56	54-56	54-56	54-56	52-55
Solvent in flashed bottoms, %	50	47-49	45-47	47-49	48-52	47-54
SRC in flashed bottoms, lb/hr	-	204±32	230±15	232±7	306±12	207±38
Catalyst		-----Shell 324M, 1/32" Ni-Mo, 410 lb-----				

HTR Run Date, 1983	13-243 (Phase 2)				
	5 May- 11 May ^(a) 2-8	18-25 May 15-22	28 May- 14 June 25-42	16-22 June 44-50	24-27 June 52-55
Days of run					
Operating conditions	Planned	Actual			
Reactor temp., °F	720 ^(d)	680	720	720 ^(b)	730
Total gas/feed, SCF/lb	20	13-15	14-15	18-20	18-19
CSD-SRC feed rate, avg. lb/hr	-	278±14	290±7	235±8	253±7
SRC in feed blend, %	55	53-55	55-57	54-56	54-55
Solvent in flashed bottoms, %	50	451-53	50-53	51-54	52-55
SRC in flashed bottoms, lb/hr	-	213±11	216±8	164±6	170±8
Catalyst		-----Shell 324M, 1/32" Ni-Mo, 410 lb-----			

(a) Catalyst replaced on 3-4 May.

(b) SRC unit coal rate reduced from 250 to 200 MF lb/hr on 26 May.

(c) Initial temperature for Phase 1.

(d) Target temperature with the old catalyst batch. Fresh catalyst used after 4 May.

During the run, certain process variables were adjusted to maintain or test process stability. These adjustments and the rationale for each change are listed as follows:

<u>Process Adjustment</u>	<u>Rationale</u>
<ul style="list-style-type: none"> Reactor temperature was increased to 660°F on 24 February. 	To bring the ITSL system hydrogen consumption to 4% of MAF coal.
<ul style="list-style-type: none"> Reactor temperature was increased to 690°F on 5 March and to 720°F on 11 March. 	To attempt to increase the hydrogen donor quality of the atmospheric flash bottoms recycle stream.
<u>Run 243 Phase 2</u>	
<ul style="list-style-type: none"> Reactor temperature was increased to 720°F on 27 April (Catalyst batch 12-243). 	To achieve an all-distillate operating mode and to stabilize the SRC and CSD units after start-up.
<ul style="list-style-type: none"> Replaced the catalyst batch with fresh pre-sulfided Shell 324M during 3-4 May. Initial operation was at 680°F (Catalyst batch Run 13-243). 	To obtain catalyst deactivation data with fresh catalyst. The initial temperature of 680°F was chosen to prevent over-conversion of SRC with the fresh catalyst.
<ul style="list-style-type: none"> Reactor temperature was increased to 700°F on 15 May and to 720°F on 17 May. 	To maintain an all-distillate product slate.
<ul style="list-style-type: none"> SRC unit coal feed rate was decreased which lowered the HTR reactor WHSV from 1.25 to 1.0 on 26 May. 	To obtain an all-distillate mode with a catalyst age profile similar to Run 242.
<ul style="list-style-type: none"> Reactor temperature was increased to 730°F on 15 June. 	To maintain an all-distillate product mode.
<ul style="list-style-type: none"> Reactor temperature was decreased to 720°F on 23 June. 	To age the catalyst for a future extended run.

During Phase 1 operations, when R1235 Reactor temperature was increased to 660°F, the ITSL hydrogen consumption increased from 3.3 to 4.0 wt % of MAF coal. As the reactor temperature was increased from 660°F to 680°F and to 720°F, the hydrogen transfer from the recycle pasting solvent increased in the SRC unit. Estimated values have been reported in Section 3.2. However, no

significant changes were noted in the laboratory results for V131B activity or V1067 residue activity. The hydrogen content in V131B solvent gradually increased from 8.0 to 8.6% as the reactor temperature was increased. The hydrogen content in the V1067 residue increased slightly (from 6.9 to 7.1 wt %) as the temperature was increased from 690 to 720°F.

Phase 2 HTR unit operations were resumed on 23 April at 690°F with the aged catalyst batch. The temperature was adjusted to 720°F after stable operating conditions were established in the three process units.

After determining that CSD unit ash carryover was not a problem with Phase 2 SRC unit operating conditions, the catalyst batch was replaced with a fresh presulfided catalyst batch. Initial operations were at 680°F.

The HTR reactor temperature was adjusted during the run to obtain an all-distillate mode. As catalyst activity declined, temperatures were adjusted at catalyst ages (lb SRC/lb catalyst) comparable to those obtained for Run 242. However, this constraint led to CSD SRC drumouts due to:

- Equipment surge capacity limitations
- An initial HTR reactor space velocity of 1.25 (versus 1.00 for Run 242) due to a higher SRC unit coal rate before 26 May.

The hydrotreater temperature was reduced to 720°F on 23 June to age the catalyst for a future extended run (approximately 1,000 lb SRC feed/lb cat).

Daily HTR unit performance and yield data are shown in Table 12. The ratio of the measured total output to total input ranged between 0.97 to 1.02. This ratio does not include the solvent collected at the flare knock-out pot which was between 0.3 and 2.5% of the SRC feed. This material is excluded since both product and feed tanks vent to this knock-out pot.

The hydrogen consumptions for 10 to 22 May are possibly 0.5 wt % higher than the actual values. This discrepancy was caused by leaks in the recycle gas piping and calibration problems with the fresh hydrogen meter on the C1205 suction line.

Data which summarize the operating periods are as follows:

Run	Period	R1235 Temp., °F	Avg. SRC conversion, %	H ₂ cons. % SRC	Closure, Total Output Total Input
12-243 Phase 1	9-18 Feb	630	6.6	1.3	1.00
	25 Feb-4 Mar	660	8.3	2.0	1.00
	6-10 Mar	690	11.3	2.3	1.01
	12 Mar-5 Apr	720	18.5	2.7	0.99
12-243 Phase 2	24-26 Apr	690	12.9	2.6	1.00
	28 Apr-2 May	720	18.1	3.2	1.01
	5-11 May	680	13.4	3.4	1.00
13-243 Phase 2	18-25 May	720	19.4	3.4	1.01
	28 May-14 June	720	22.8	2.8	1.00
	16-22 June	730	25.2	3.3	1.01
	24-27 June	720	22.8	3.1	1.00

There were three unscheduled hydrotreater outages during Run 243. These events were as follows:

- On 17 March, the HTR unit was down for 9 hours after the reactor effluent condenser (E-1212) plugged. Solvent was used to remove the blockage.
- For 12 and 13 May, the HTR unit was off-line to repair leaks in the recycle gas system and to clear a restriction in the piping from the B1201 Recycle Gas Heater.
- Between 2 and 3 June, the HTR unit was down for 22 hours due to problems at the CSD unit.

Operating conditions and yield data for the special product workup periods are presented in Table 13.

The distribution of total feed nitrogen among the various products (nitrogen balance) was estimated for the thirteen special product workup periods. Nitrogen analyses were determined with C/H/N and Kjeldahl apparatus. The results are presented in Table 14.

A chronological operating log is presented in Section 8.1.

3.5. Single Stage (SRC and CSD Units)

The single stage yield structures were calculated for the thirteen special product workup periods (Runs 243A through M). The results are summarized on the following pages.

Input Data Run Date, 1983	Run 243 Phase 1					
	243A 21 Feb	243B 1 Mar	243C 10 Mar	243D 14 Mar	243E 22 Mar	243F 2 Apr
<u>Coal feed rate, lb/hr</u>						
As-is	251.0	238.5	257.0	254.8	259.7	256.8
MF	245.6	234.9	252.2	249.5	253.5	251.5
MAF	219.0	207.9	222.4	221.1	224.9	221.2
<u>Net input, % MAF coal</u>						
Hydrogen consumption(a)	2.01	2.12	1.86	1.47	1.62	1.58
Makeup DAS(b)	4.80	3.87	6.37	5.58	5.56	5.89
Coal ash	12.15	12.99	13.40	12.84	12.72	13.70
TOTAL NET INPUT	18.96	18.98	21.63	19.89	19.90	21.17
<u>Yield, % MAF coal</u>						
<u>Gases</u>	9.71	10.89	9.59	9.93	9.48	8.41
CO	0.12	0.41	0.0	0.0	0.01	0.11
CO ₂	0.97	1.01	0.97	1.07	1.11	1.10
NH ₃	0.41	0.39	0.25	0.28	0.30	0.20
H ₂ S	1.03	1.35	1.47	1.94	2.02	2.08
C ₁ -C ₅	7.18	7.73	6.90	6.64	6.04	4.92
<u>Liquids</u>	31.58	34.91	36.11	23.48	29.49	30.60
H ₂ O	5.58	6.23	5.23	5.27	4.43	4.52
Total recovered dist.	23.68	27.29	26.84	15.04	21.95	22.28
Naphtha	3.63	4.26	5.25	3.56	3.50	3.91
Middle dist.	6.23	5.38	6.45	4.43	3.90	3.63
Recovered dist. solv.	13.81	17.65	15.14	7.05	14.55	14.74
Non-product DAS loss	2.33	1.39	4.05	3.17	3.11	3.80
<u>Ash concentrate</u> <u>(CSD Stage 1)</u>	32.24	32.13	34.13	31.43	31.34	36.03
Deashing solvent	0.23	0.67	0.31	0.28	0.66	0.11
Distillate solvent	0.64	0.55	0.78	0.31	0.25	0.47
Non-distillable oil	2.98	2.70	2.25	3.11	1.79	0.87
Asphaltenes	1.50	0.64	1.67	0.94	1.19	0.90
Preasphaltenes	4.12	4.82	4.54	5.63	5.52	11.53
UC	10.55	10.60	10.99	8.55	9.03	9.69
Ash	12.22	12.14	13.58	12.60	12.91	12.47
<u>Net SRC product</u> <u>(CSD Stage II and III)</u>	45.48	41.03	41.82	55.04	49.57	46.16
Deashing solvent	2.24	1.80	2.01	2.13	1.79	1.98
Distillate solvent	14.80	10.93	14.51	17.96	11.50	21.72
Non-distillable oil	25.75	18.21	5.39	7.84	11.17	-0.16
Asphaltenes	-5.76	0.29	18.59	11.15	25.18	15.35
Preasphaltenes	8.74	9.80	2.01	14.53	0.92	7.02
UC	0.12	-0.03	-0.08	1.15	0.01	0.51
Ash	-0.42	0.03	-0.62	0.27	-1.00	-0.33
TOTAL YIELD (less net input)	119.01 (100.05)	118.96 (99.98)	121.65 (100.02)	119.88 (99.99)	119.88 (99.98)	121.21 (100.04)
<u>Elemental error, %</u>						
Carbon	-1.42	-0.66	-1.17	-0.67	-1.44	-1.49
Hydrogen	-2.49	-2.73	-0.40	-0.24	-1.66	-1.51
Ash	0.19	3.66	0.69	-1.45	3.79	8.93

(a) Calculated by the ethylene injection method.

(b) Makeup required, in addition to recovered DAS, due to DAS losses in the CSD unit product stream and leakage.

Input Data Run Date, 1983	Run 243 Phase 2						
	243G 1 May	243H 8 May	243I 23 May	243J 29 May	243K 31 May	243L 13 Jun	243M 19 Jun
<u>Coal feed rate, lb/hr</u>							
As-is	253.2	256.4	249.0	197.0	195.0	193.0	206.0
MF	251.6	252.0	244.0	194.1	192.9	188.4	201.6
MAF	223.9	224.1	217.5	172.4	171.3	168.4	179.7
<u>Net input, % MAF coal</u>							
Hydrogen consumption (a)	1.60	1.24	1.28	1.54	1.23	0.82	0.90
Makeup DAS (b)	5.76	6.23	6.97	7.59	8.09	7.19	5.27
Coal ash	12.37	12.45	12.18	12.59	12.61	11.88	12.19
TOTAL NET INPUT	19.73	19.92	20.43	21.72	21.93	19.89	18.36
<u>Yield, % MAF coal</u>							
<u>Gases</u>	9.71	9.88	7.39	10.17	9.70	9.27	8.08
CO	0.17	0.19	0.15	0.18	0.26	0.11	0.07
CO ₂	0.71	0.84	0.88	0.79	0.75	0.91	0.94
NH ₃	0.21	0.41	0.25	0.32	0.33	0.32	0.31
H ₂ S	1.23	1.46	1.10	1.32	1.19	1.58	1.57
C ₁ -C ₅	7.39	6.98	5.21	7.56	7.17	6.35	5.19
<u>Liquids</u>	27.22	29.64	24.60	30.59	34.46	22.01	18.15
H ₂ O	5.61	4.39	3.85	5.01	6.29	3.55	3.73
Total recovered dist.	18.21	21.45	20.23	20.19	22.04	13.76	11.86
Naphtha	3.82	4.59	3.83	4.14	4.28	4.54	4.34
Middle dist.	5.50	5.65	4.60	4.69	4.88	5.48	5.26
Recovered dist. solv.	8.89	11.21	11.80	11.35	12.89	3.73	2.27
Non-product DAS loss	3.39	3.79	0.52	5.39	6.13	4.70	2.56
<u>Ash concentrate</u> <u>(CSD Stage I)</u>	36.00	33.42	33.30	32.36	32.51	37.55	37.44
Deashing solvent	0.50	0.40	0.70	0.74	0.26	0.41	0.94
Distillate solvent	0.18	0.10	0.20	0.19	0.97	0.53	0.23
Non-distillable oil	1.95	4.11	2.13	2.17	1.75	2.92	3.89
Asphaltenes	1.73	1.04	1.30	2.20	2.96	1.13	3.30
Preasphaltenes	8.60	6.05	6.66	5.69	5.11	6.27	1.91
UC	10.94	9.76	10.46	9.13	9.59	14.42	15.16
Ash	12.10	11.96	11.85	12.23	11.87	11.87	12.02
<u>Net SRC product</u> <u>(CSD Stage II and III)</u>	46.81	46.94	55.13	48.60	45.24	51.05	54.63
Deashing solvent	1.86	2.03	5.75	1.46	1.70	2.08	1.77
Distillate solvent	17.87	14.08	12.13	13.25	14.34	18.55	17.00
Non-distillable oil	3.62	11.54	-0.19	-5.84	-8.92	2.62	7.68
Asphaltenes	18.38	18.61	38.30	33.61	35.05	15.51	26.99
Preasphaltenes	4.86	0.79	-0.93	5.99	3.34	12.18	1.11
UC	0.32	-0.06	0.03	1.15	-0.10	0.12	0.19
Ash	-0.09	-0.06	0.03	-0.01	-0.17	-0.01	-0.10
TOTAL YIELD (less net input)	119.73 (100.00)	119.87 (99.95)	120.42 (99.99)	121.73 (100.01)	121.91 (99.98)	119.88 (99.99)	118.31 (99.95)
<u>Elemental error, %</u>							
Carbon	-1.04	-1.17	-1.25	-0.74	0.02	-0.62	-1.01
Hydrogen	-2.22	-1.70	0.30	0.10	-0.87	-1.48	-0.76
Ash	1.02	2.19	0.42	0.34	4.83	-1.72	-1.41

(a) Calculated by the ethylene injection method.

(b) Makeup required, in addition to recovered DAS, due to DAS losses in the CSD unit product stream and leakage.

3.6. Two Stage (SRC, CSD and HTR Units)

The two stage yield structure was calculated for the thirteen special product workup periods. Estimated yield and stability data for forty-nine 24-hr performance periods are presented in Table 1.

The overall ITSL yield structures were calculated for the thirteen special product workup periods. Detailed results are presented in Table 15. The material balance flow diagrams (based on MF coal) are presented in Figures 14 to 26. Results are summarized as follows:

Run 243 - Phase 1						
MB Run Date, 1983	243A 21 Feb	243B 1 Mar	243C 10 Mar	243D 14 Mar	243E 22 Mar	243F 2 Apr
<u>Reactor temp., °F</u>						
SRC	800	800	798	800	799	785
HTR	628	659	688	720	716	720
<u>Space rate</u>						
SRC, lb/hr-ft ³ (a)	26.7(19.3)	25.5(18.5)	27.4(19.9)	27.1(19.6)	27.6(20.0)	2.3(19.8)
HTR, WHSV, hr ⁻¹	1.2	1.1	1.2	1.3	1.3	1.3
Feed gas rate (SRC), SCFH	3,250	3,360	3,290	3,410	4,860	4,580
Hydrogen partial pressure, (SRC), psia(d)	1,500	1,560	1,550	1,760	1,810	1,760
Catalyst age (HTR), lb SRC/lb cat	161	279	412	478	603	782
<u>Yield, % MAF coal</u>						
<u>Total Gases</u>	10.76	12.41	11.31	12.35	12.20	10.96
C ₁ -C ₅	(7.40)	(8.14)	(7.44)	(7.62)	(7.49)	(5.93)
H ₂ S	(1.52)	(1.76)	(1.88)	(2.37)	(2.13)	(2.59)
CO, CO ₂	(1.09)	(1.42)	(0.97)	(1.07)	(1.12)	(1.21)
NH ₃	(0.75)	(1.09)	(1.02)	(1.29)	(1.46)	(1.23)
Water	8.34	11.03	9.18	10.91	9.27	6.93
<u>Total Distillate</u>	38.95	42.24	53.28	47.64	52.60	54.45
Naphtha	(4.43)	(6.07)	(8.08)	(7.73)	(7.30)	(8.18)
Mid. Dist.	(6.68)	(6.29)	(8.04)	(7.05)	(6.36)	(5.77)
Dist. Solv.	(27.84)	(29.88)	(37.16)	(32.86)	(38.94)	(40.50)
<u>Residue</u>	25.39	19.87	10.08	15.45	12.51	9.45
Dist. Solv.	(2.55)	(1.47)	(1.03)	(1.85)	(0.97)	(1.37)
SRC(c)	(22.84)	(18.40)	(9.05)	(13.60)	(11.54)	(8.08)
<u>Ash Concentrate</u>	19.86	18.47	20.42	18.31	17.96	22.22
<u>Total</u>	103.30	104.02	104.27	104.66	104.54	104.01
H ₂ consumption, % MAF	3.30	4.02	4.27	4.66	4.54	4.01
lb Dist/lb H ₂	11.80	10.51	12.48	10.22	11.59	13.58
Hydrogen Balance Error, % MAF	0.6(gain)	0.7(gain)	0.1(gain)	0.1(gain)	0.4(gain)	0.5(gain)

- (a) Based on 9.20 cu ft of dissolver volume (50% use). Data in parentheses were calculated based on total reaction volume, 12.7 cu ft including 2.0 cu ft of the preheater and 1.5 cu ft of the transfer line.
 (b) Based on 4.42 cu ft of dissolver volume (25% use). Data in parentheses were calculated based on total reaction volume, 7.05 cu ft including 2.4 cu ft of the preheater and 0.23 cu ft of the transfer line.
 (c) Laboratory defined SRC.
 (d) Calculated from hydrogen consumption data obtained by the ethylene injection method.

MB Run	Run 243-Phase 2						
	243G	243H	243I	243J	243K	243L	243M
Date, 1983	1 May	8 May	23 May	29 May	31 May	13 Jun	19 Jun
<u>Reactor temp., °F</u>							
SRC	825	824	809	810	810	810	810
HTR	719	680	718	719	718	719	728
<u>Space rate</u>							
SRC, lb/hr-ft ³ (b)	57.0(35.7)	57.0(35.7)	55.2(34.6)	43.9(27.5)	43.7(27.4)	42.8(26.8)	45.5(28.5)
HTR, WHSV, hr ⁻¹	1.3	1.2	1.2	1.0	1.0	1.0	1.0
Feed gas rate (SRC), SCFH	3,330	3,380	3,300	3,310	3,420	3,240	3,320
Hydrogen partial pressure, (SRC), psia(d)	1,690	1,800	1,760	1,780	1,880	970	920
Catalyst age (HTR), lb SRC/lb cat	963	69	273	354	380	529	608
<u>Yield, % MAF coal</u>							
Total Gases	12.00	11.42	10.34	13.15	13.59	12.39	11.71
C ₁ -C ₅	(8.13)	(7.31)	(6.55)	(9.23)	(9.63)	(7.96)	(7.32)
H ₂ S	(1.82)	(1.95)	(1.73)	(1.82)	(1.71)	(2.15)	(2.16)
CO, CO ₂	(0.88)	(1.03)	(0.83)	(0.97)	(1.01)	(1.02)	(1.01)
Mi _g	(1.17)	(1.13)	(1.23)	(1.13)	(1.24)	(1.26)	(1.22)
Water	8.07	8.18	7.73	10.40	11.82	10.01	7.85
Total Distillate	51.13	50.14	49.92	53.57	57.01	48.76	59.87
Naphtha	(7.79)	(8.21)	(9.43)	(9.99)	(9.60)	(9.40)	(10.30)
Mid. Dist.	(8.09)	(7.01)	(7.60)	(7.13)	(7.49)	(7.95)	(8.49)
Dist. Solv.	(35.25)	(34.92)	(32.89)	(36.45)	(39.92)	(31.41)	(41.08)
Residue	10.35	13.82	16.52	8.85	2.77	8.29	1.36
Dist. Solv.	(1.31)	(1.37)	(1.34)	(0.83)	(0.28)	(1.05)	(0.16)
SRC(c)	(9.04)	(12.45)	(15.18)	(8.02)	(2.49)	(7.14)	(1.20)
Ash Concentrate	23.13	20.57	20.42	19.03	19.64	25.26	24.31
Total	104.68	104.13	104.93	105.00	104.83	104.71	105.10
H ₂ consumption, % MAF	4.68	4.13	4.93	5.00	4.83	4.71	5.10
lb Dist/lb H ₂	10.93	12.14	10.13	10.71	11.80	10.35	11.74
Hydrogen Balance Error, % MAF	0.3(gain)	0.4(gain)	0.2(loss)	0.1(gain)	0.5(gain)	0.4(gain)	0.3(gain)

- (a) Based on 9.20 cu ft of dissolver volume (50% use). Data in parentheses were calculated based on total reaction volume, 12.7 cu ft including 2.0 cu ft of the preheater and 1.5 cu ft of the transfer line.
- (b) Based on 4.42 cu ft of dissolver volume (25% use). Data in parentheses were calculated based on total reaction volume, 7.05 cu ft including 2.4 cu ft of the preheater and 0.23 cu ft of the transfer line.
- (c) Laboratory defined SRC.
- (d) Calculated from hydrogen consumption data obtained by the ethylene injection method.

In Table 15, inventory changes between units were used to obtain the steady-state CSD SRC product rate. Depleted solvent accumulation at the SRC unit (T102 tray 8 material) was considered a thermal stage product.

4. DISTILLATE PRODUCTS AND PROCESS SOLVENTS

4.1. Distillate Products

The primary products of Run 243 were distillates produced in the thermal and catalytic stages.

The thermal stage product was split into two fractions with an approximate cut point of 450°F. The -450°F fraction (naphtha and middle distillate) was recovered as the overhead stream of T104 Solvent Recovery Column. The +450°F fraction (distillate solvent) was recovered as side draw-offs from trays 3 and 8 of T102 Vacuum Column. Although both tray 3 and tray 8 solvents are considered to be +450°F cuts, the former has a significantly lower boiling range.

The catalytic stage distillate product was recovered as flashed overhead condensate from various HTR unit vessels. The net flashed overhead distillate was measured in V1078 Distillate Measuring Pot and sent to T105 Fractionation Column for separation. The column splits the flashed overhead distillate into naphtha/middle distillate (-450°F) and distillate solvent (+450°F). During the initial operating period of Run 243, the T105 Fractionation Column was operated as a stripping column and the tower bottoms were recycled to the feed tank. This practice was discontinued and the tower was operated only when solvent was required for operations. Occasionally, T105 bottoms product was mixed with vacuum distilled HTR flashed bottoms for use as a flush solvent for the R1235 Reactor catalyst withdrawal tube.

4.1.1. Distillate Product Properties

The analyses of +450°F and -450°F distillate products from the SRC unit and the flashed overhead distillate product from the HTR unit during the special product workup periods are summarized in Table 16. A comparison of the distillate product properties from Run 243 with those from Run 242 indicated both the thermal and the hydrotreated product properties were similar.

4.1.2. Distillate Production

The net production of distillates in the SRC unit during stable operating periods of Run 243 are summarized on the following page.

SRC Unit

SRC Unit

Run	243 Phase 1				
	17 Feb	1 Mar	5 Mar	11 Mar	23 Mar
From	28 Feb	4 Mar	10 Mar	22 Mar	4 Apr
To	798	800	799	800	785
R101 outlet temp., °F	26.10	26.6	26.6	27.1	27.2
Space rate, lb/hr-ft ³	223.4	234.3	226.3	216.3	227.1
HTR SRC addition, lb/hr					
Distillate yield, bbl/ton MF coal					
Naphtha & middle distillate (IBP-450°F)	0.582	0.556	0.614	0.599	0.476
Distillate solvent (450°F-EP)	1.278	1.173	1.151	1.093	1.046
Total	1.360	1.729	1.765	1.692	1.522

SRC Unit

Run	243 Phase 2					
	24 Apr	5 May	19 May	26 May	4 Jun	16 Jun
From	2 May	18 May	23 May	31 May	15 Jun	27 Jun
To	825	824	810	810	810	810
R101 outlet temp., °F	57.6	56.3	55.5	42.8	43.5	44.5
Space rate, lb/hr-ft ³	198.1	216.8	216.3	168.5	161.6	167.7
HTR SRC addition, lb/hr						
Distillate yield, bbl/ton MF coal						
Naphtha & middle distillate (IBP-450°F)	0.517	0.630	0.451	0.520	0.528	0.541
Distillate solvent (450°F-EP)	1.089	1.077	0.784	1.088	0.969	0.808
Total	1.606	1.707	1.235	1.608	1.497	1.349

The daily production rates are given in Table 3. The reported production rates were calculated from the measured tank inventory changes. In Figure 27, the SRC unit solvent yields by V178B and inventory methods are presented. V178B method shows less scatter in the data than the inventory method.

HTR Unit

The net production of distillates for the HTR unit during stable operating periods are summarized as follows:

HTR Unit

HTR Run	12-243 (Phase 1)					
From	17 Feb	1 Mar	5 Mar	11 Mar	18 Mar	
To	23 Feb	4 Mar	10 Mar	16 Mar	3 Apr	
R1235 Temp., °F	629	659	688	718	718	
<u>Distillate yield, bbl/ton MF coal</u>						
Naphtha & middle distillate (IBP-450°F)	0.040	0.067	0.234	0.369	0.368	
Distillate solvent (450°F-EP)	0.110	0.108	0.294	0.719	0.554	
Total	0.150	0.175	0.528	1.088	0.922	
HTR Run	12-243 Phase 2			13-243 Phase 2		
From	28 Apr	5 May	18 May	26 May	6 June	16 June
To	2 May	10 May	23 May	31 May	15 June	22 June
R1235 Temp., °F	719	676	719	719	719	728
<u>Distillate yield, bbl/ton MF coal</u>						
Naphtha & middle distillate (IBP-450°F)	0.291	0.219	0.547	0.479	0.415	0.522
Distillate solvent (450°F-EP)	0.711	0.482	0.432	0.890	0.754	0.793
Total	1.002	0.701	0.999	1.369	1.169	1.315

The daily production rates of flashed overhead distillate from the HTR unit are presented in Table 9.

About 8,079 lb of tray 3 solvent was collected during the initial part of Run 243 (3 to 17 February 1983) when T102 tray 8 material was used to prepare coal slurry batches. After 17 February, tray 3 solvent was not produced until 11 March when the HTR reactor temperature was increased from 690 to 720°F. The solvent content

in the V131B recycle increased from 47 to 52% after this change. Between 12 and 27 March, an additional 7,724 lb of tray 3 solvent was collected. After 27 March, negligible amounts were produced.

A total of 265,059 lb of distillate was produced during Run 243. A breakdown of this production is given below:

	-450°F distillate lb	+450°F distillate lb	IBP-850°F distillate lb
<u>SRC Unit</u>			
T104 overhead	60,376	-	-
Tray 3 of T102	-	15,803	-
Tray 8 of T102	-	111,534	-
<u>HTR Unit</u>			
T105 feed	-	-	43,626
T105 overhead	24,069	-	-
Distillate solvent	-	9,651	-
Total	84,445	136,988	43,626

4.2. Recycle and Process Solvents

4.2.1. SRC Unit

The SRC unit process solvent for Run 243 was the atmospheric flashed bottoms stream from the HTR unit. Approximately 50% of this stream consisted of hydrotreated SRC residue, and approximately 90% boiled above 650°F. When a sufficient quantity of this stream was not available to prepare the coal slurry at a solvent-to-coal ratio of 1.8, additional solvent from tray 8 of the T102 Vacuum Column was used. This occurred primarily during the start-up periods (3 to 19 February and 22 April to 6 May 1983) when the recycle stream flow rate was gradually increased.

The daily analytical data for the process solvent components (thermal distillate solvent, hydrotreated distillate solvent and hydrotreated SRC), flow rates and solvent activities are presented in Tables 2 and 3.

Daily trends of relevant solvent properties are shown in Figures 11 and 28. Hydrogen microautoclave conversions of V1067 residue during Phase 1 operation were about 70% initially (Figure 11). The microautoclave conversions gradually rose to 75% as the SRC unit reached planned operating conditions and the HTR reactor temperature was raised to 660°F. Residue activity appeared to decline when the SRC unit feed gas rate and the dissolver temperature were changed near the end of March. During Run 243 Phase 2, microautoclave conversions of V1067 residue were approximately 75 percent. The hydrogen content in V1067 residue followed trends similar to the microautoclave conversions, but no changes were noted when SRC unit conditions were adjusted in March.

Process solvent (V131B) equilibrium activity increased during Phase 1 operations as the HTR unit temperatures were raised. Kinetic activity was relatively constant until the SRC unit

conditions were adjusted in March. This appeared to increase the kinetic activity from 80 to 90%. Equilibrium activity during Run 243 Phase 2 was fairly constant, about 90%. Hydrogen content of V131B solvent increased during Phase 1, but decreased during Phase 2 operations with the old catalyst. After the fresh catalyst was placed in the reactor, hydrogen content of V131B solvent increased until the SRC unit hydrogen partial pressure was reduced in June. A steady decline was noted for the remainder of the run.

The daily trend charts for hydrogen content of thermal stage distillate solvent (V178) show trends which are similar to those of V131B solvent. Analyses of tray 8 (V178) distillate solvent for the special product workup periods were as follows:

Run 243 Phase 1						
Date, 1983 Run	21 Feb 243A	1 Mar 243B	10 Mar 243C	14 Mar 243D	22 Mar 243E	2 Apr 243F
<u>Boiling fractions, wt %</u>						
(TRP, °F)	(461.9)	(462.8)	(462.4)	(465.8)	(465.8)	(462.8)
IBP-450°F	0.1	0.1	0.0	0.0	0.0	0.1
450-550°F	8.6	10.1	10.3	8.2	6.4	6.3
550-650°F	10.4	19.2	16.0	14.0	15.5	11.3
650°F-EP	69.9	67.6	70.7	74.8	75.1	79.3
Residual, >EP(a)	3.0	3.0	3.0	3.0	3.0	3.0
(EP, °F)	(1,018.6)	(937.4)	(1,056.7)	(1,054.3)	(958.1)	(1,048.7)
Hydrogen	9.61	9.33	9.43	9.26	9.35	10.02
Carbon	87.55	88.19	87.21	87.76	88.10	88.02
H/C atomic rate	1.308	1.259	1.288	1.257	1.265	1.356
Specific gravity	1.019	1.030	1.018	NA	NA	NA
<u>Activity, % THF conversion</u>						
Kinetic test	NA	83.5	86.5	87.5	83.2	84.4
Equilibrium test	73.2	74.7	75.1	76.3	75.7	76.6
<u>T102 Vacuum Column</u>						
Bottoms temp., °F	628	631	632	631	630	630
Pressure, psia	0.4	0.4	0.4	0.4	0.4	0.4

Run 243 Phase 2							
Date, 1983 Run	1 May 243G	8 May 243H	23 May 243I	29 May 243J	31 May 243K	13 June 243L	19 June 243M
<u>Boiling fractions, wt %</u>							
(IBP, °F)	(460.0)	(460.0)	(461.3)	(460.0)	(462.7)	(460.0)	(461.4)
IBP-450°F	0.3	0.3	0.1	0.2	0.1	0.2	0.1
450-550°F	14.2	12.7	10.7	11.2	9.5	11.9	7.6
550-650°F	20.8	19.8	17.7	18.2	16.9	19.9	15.7
650°F-EP	61.7	64.2	68.5	67.4	70.4	65.0	72.6
Residual, >EP(a)	3.0	3.0	3.0	3.0	3.0	3.0	3.0
(EP, °F)	(937.4)	(1,019.6)	(1,002.2)	(1,017.7)	(1,017.4)	(937.4)	(1,047.8)
Hydrogen	9.56	9.75	9.78	9.78	10.07	9.91	9.75
Carbon	87.82	88.32	88.18	88.04	88.39	88.34	88.44
H/C atomic rate	1.297	1.315	1.322	1.324	1.357	1.337	1.314
Specific gravity	1.020	1.009	1.009	NA	1.004	NA	1.007
<u>Activity, % THF conversion</u>							
Kinetic test	75.0	78.1	71.9	78.7	78.9	70.4	69.5
Equilibrium test	70.9	71.3	71.6	69.2	62.8	68.8	72.7
<u>T102 Vacuum Column</u>							
Bottoms temp., °F	631	631	630	630	629	630	631
Pressure, psia	0.4	0.3	0.4	0.4	0.4	0.4	0.4

(a) G. C. analysis of "as is" sample. Residual, >EP, is assumed to be 3.0 wt %.

Analyses of the recycle process solvent, which is composed of hydrotreated SRC and hydrotreated distillate, during the special product workup periods are summarized below:

Run 243 Phase 1							
Date, 1983	21 Feb	1 Mar	10 Mar	14 Mar	22 Mar	2 Apr	
Run	243A	243B	243C	243D	243E	243F	
Boiling fractions, wt %							
(IBP, °F)	(492.0)	(474.2)	(477.0)	(492.0)	(485.1)	(465.8)	
IBP-450°F	0.0	0.1	0.1	0.0	0.2	0.3	
450-550°F	2.2	2.7	2.7	2.6	1.9	1.8	
550-650°F	7.6	7.6	7.5	6.3	5.8	4.6	
650°F-EP	40.2	36.6	39.9	42.0	40.7	40.8	
Residual, >EP	50.1	53.0	49.8	49.1	51.4	52.5	
(EP, °F)	(1,076.9)	(1,018.2)	(1,084.4)	(1,082.8)	(1,057.2)	(1,058.9)	
Hydrogen, % (a)	8.24(9.82)	8.15(9.90)	8.49(10.04)	8.52(10.06)	8.40(9.82)	9.00(10.17)	
Carbon, %	87.50(88.18)	88.78(87.96)	87.98(88.04)	89.01(88.62)	88.74(89.25)	88.92(88.60)	
H/C atomic rate	1.122(1.327)	1.094(1.341)	1.150(1.359)	1.140(1.353)	1.128(1.311)	1.206(1.368)	
Specific gravity @ 212°F	1.047	1.068	1.064	1.045	1.065	1.034	
Activity, % THP conv.							
Kinetic test	84.6(80.5)	84.4(89.0)	80.8(81.3)	82.7(80.1)	77.7(70.0)	73.9(67.0)	
Equilibrium test	82.3(80.2)	85.6(86.4)	88.2(87.8)	88.9(88.4)	87.7(84.7)	88.7(78.6)	

Run 243 Phase 2							
Date, 1983	1 May	8 May	23 May	29 May	31 May	13 Jun	19 Jun
Run	243G	243H	243I	243J	243K	243L	243M
Boiling fractions, wt %							
(IBP, °F)	(465.8)	(465.8)	(477.2)	(465.8)	(465.8)	(474.6)	(463.7)
IBP-450°F	0.2	0.0	0.1	0.3	0.3	0.2	0.3
450-550°F	3.7	3.6	3.6	3.0	2.8	2.8	2.9
550-650°F	9.5	8.6	8.3	7.3	6.8	6.1	6.9
650°F-EP	39.0	38.7	39.7	41.4	39.2	43.8	45.9
Residue, >EP	47.6	49.1	48.3	48.0	50.9	47.1	44.0
(EP, °F)	(937.4)	(1,051.5)	(1,001.0)	(1,052.5)	(1,079.2)	(1,006.9)	(1,123.9)
Hydrogen, % (a)	8.56(10.32)	8.69(10.28)	9.17(10.62)	9.12(10.57)	9.23(10.70)	8.90(10.60)	8.86(10.52)
Carbon, %	88.91(88.66)	89.13(88.58)	89.22(89.02)	89.31(88.91)	89.74(88.88)	89.43(89.01)	89.45(89.08)
H/C atomic rate	1.147(1.387)	1.162(1.383)	1.225(1.421)	1.217(1.401)	1.225(1.434)	1.185(1.419)	1.180(1.407)
Specific gravity @ 212°F	1.040	NA	1.018	1.031	1.031	1.068	1.038
Activity, % THP conv.							
Kinetic test	84.0(81.1)	87.6(83.3)	79.4(81.1)	87.3(84.1)	88.2(83.7)	87.7(88.6)	87.8(84.4)
Equilibrium test	89.6(83.3)	89.2(84.3)	90.5(85.6)	88.8(88.8)	91.5(83.3)	88.3(88.8)	90.9(89.3)

(a) The values in parentheses are for the distillate portion of the sample. Distillate is obtained by distilling the sample in a flask at 600°F and 0.10 mm Hg.

4.2.2 CSD Unit

The CSD unit uses proprietary deashing solvents (DAS) to deash and extract soluble coal products from the T102 Vacuum Column bottoms stream. The DAS which is used is dependent on the properties of this stream. During Run 243, six different deashing solvents were utilized. During initial Phase 1 operations, DAS A was used until persistent ash carryover required a change in solvent type. Solvent type was successively changed to less powerful DAS solvents during Phase 1 operations. For Phase 2, the SRC unit conditions required the adjustment of DAS type to stronger solvents to achieve acceptable CSD unit performance.

<u>Deashing Solvent</u>	<u>Period Used</u>
<u>Run 243 Phase 1</u>	
DAS A	4-13 February
DAS E	14-18 February
DAS F	1-8 March
DAS G	9-14 March
DAS H	15-23 March
DAS I	24 March-6 April
<u>Run 243 Phase 2</u>	
DAS I	23 April-5 May
DAS H	6 May-18 May
DAS G	19 May-10 June
DAS F	11-14 June
DAS E	15-28 June
DAS I < DAS H < DAS G < DAS F < DAS E < DAS A	
less powerful ————— more powerful	

Although DAS is totally recycled within the CSD unit and does not react with the feed material, a certain fraction of the DAS inventory is continuously lost and must be replaced. A summary of DAS losses and their distribution is presented below:

<u>DAS Type</u>	A	E	F	G	H	I
<u>Total DAS losses</u>						
lb/hr	9.9	11.4	11.1	11.8	14.1	12.9
% of feed	3.6	3.3	3.0	3.3	3.6	3.2

<u>Product losses</u>						
lb/hr	4.2	4.7	4.6	5.9	5.5	5.0
% of feed	1.5	1.4	1.3	1.6	1.4	1.2
% of total loss	42.4	41.2	41.4	50.0	39.0	38.8

<u>Non-product losses</u>						
lb/hr	5.7	6.7	6.5	5.9	8.6	7.9
% of feed	2.1	2.0	1.7	1.7	2.2	2.0
% of total loss	57.6	58.8	58.6	50.0	60.1	61.2

4.2.3. HTR Unit

The process solvent for the HTR unit was T102 Vacuum Column tray 8 (V178) solvent from the SRC unit. The properties of this stream during the special product workup periods were presented in Section 4.2.1.

5. RESIDUAL PRODUCTS

Although distillates were the primary products of Run 243, and the residual materials (CSD SRC and HTR SRC) were more or less internal streams, the ITSL process can make residual products by using less severe hydrotreater conditions. In other words, if all the thermal stage product (less that rejected with the ash concentrate) was not converted in the HTR unit, a net residual product could be obtained immediately after the CSD unit or after the HTR unit. Properties of the residual streams for the special product workup periods are presented in Table 17. Daily trends in residual stream properties are plotted in Figure 28.

The recycle HTR SRC had an average hydrogen content of 7% for Phase 1 and 7.5% for Phase 2. Sulfur content averaged 0.3 and 0.2%, respectively. Several changes were noted as the ITSL operating conditions were adjusted. These were:

- At 720°F HTR reactor temperature during Phase 1, the hydrogen content of the flashed bottoms residue increased from 7.1 to 7.3% (avg) when the SRC unit temperature was decreased to 785°F. Sulfur content increased from 0.23 to 0.38% (avg).
- At 720°F HTR reactor temperature with catalyst batch 13-243, the hydrogen content of the flashed bottoms residue increased from 7.2 to 7.6% when the SRC unit temperature was decreased to 810°F. Sulfur content increased from 0.2 to 0.3%. Flashed bottoms hydrogen content decreased to 7.4% (avg) after the SRC unit hydrogen partial pressure was reduced. After the reduction in partial pressure, the sulfur content averaged 0.2%.

The preasphaltene content of the HTR flashed bottoms averaged 1.7% for Phase 1 and 1.3% for Phase 2.

The CSD SRC hydrogen content averaged 6.4% for Phase 1 and 6.5% for Phase 2. Sulfur contents were 0.5 and 0.4%, respectively. As ITSL operating conditions were changed, the following results were noted:

- During Phase 1 operation, the hydrogen content increased from 6.4 to 6.8% when the SRC unit reactor temperature was decreased to 785°F. Sulfur content increased from 0.4 to 0.5%.
- During Phase 2, the reduction in SRC unit reactor temperature increased the hydrogen content from 6.4 to 6.7%. The sulfur content was unchanged.
- The reduction in the SRC unit hydrogen partial pressure decreased the CSD SRC hydrogen content to 6.5% and the sulfur content decreased slightly.

6. FEED COAL

Pulverized coal, ground to 95% less than 200 mesh, was fed to the SRC unit. Coal was mixed with process solvent in a 1/1.8 ratio in V101A Slurry Blend Tank (see Figure 2). The process solvent used for slurry preparation was HTR flashed bottoms.

Detailed analyses of Illinois 6 feed coal (Burning Star mine) during the special product workup periods are presented in Table 18. Average data for the run are presented below:

Run	243
Period	3 Feb - 28 Jun 1983
<u>Coal analyses, wt %</u>	
Water (as is)	1.69±0.47
Ash (MF)	11.12±0.39
<u>Total sulfur (MF)</u>	
Pyritic	0.9-1.35
Sulfate	0.02-0.20
Sulfide	<0.01-0.02
Organic	1.87-2.27
Chlorine (MF)	0.02-0.09
Volatile matter (as is)	35.20-35.74
Ferric oxide in ash, %	16.17-18.62
H/C ratio	0.76-0.82
Reactivity, % THF conversion (by the equilibrium test)	74.2-80.0

A coal sample from each tote bin was analyzed for moisture, ash and sulfur content (Table 2).

Illinois 6 coal has been used in the Wilsonville pilot plant facility since Run 236 (5 January 1982). The total sulfur content has been fairly constant, around 3.4%. However, the sulfate content has shown some variation from <0.01% (Run 236) to 0.2% (Runs 242 and 243). Pyritic sulfur is usually 1.0% or higher and coal reactivity is usually 78 to 80% THF conversion. Values outside these ranges are noted in the above table.

7. HYDROTREATING CATALYST

The HTR catalyst used during Run 243 was Shell 324M nickel-molybdenum catalyst (1/32 inch). Two batches of this catalyst were used for Run 243. Batch 12-243 was used for Phase 1 and the initial portion of Phase 2. Batch 13-243 was used for the remainder of the run.

Four hundred and ten pounds of catalyst was charged to the reactor on 31 January for Run 12-243. On 29-30 January, 510 lb of catalyst was sulfided (Batch 13-243). This batch provided catalyst for the latter part of the run. The additional 100 lb was used to replace the catalyst samples which were removed. The wet catalyst was stored in sealed drums at room temperature.

The catalyst is sulfided to an active state in the HTR reactor before the run begins. Exposure of the catalyst to reaction conditions before sulfiding would result in some loss of activity. The catalyst is sulfided with dimethyl disulfide (DMDS) in a recirculating solvent (1% initial concentration). The reactor is heated to 400°F at a rate of 75 to 100°F/hr and held at that temperature until hydrogen sulfide "breakthrough" occurs, indicating the end point of the sulfiding procedure at that temperature. During the sulfiding, hydrogen is recycled. The reactor temperature is then increased at the above rate to 600°F and held for two hours. Catalyst bed ebullation is initiated when the reactor temperature reaches 500°F. The temperature is then reduced to about 400°F and held at this level until feed is available.

Wilsonville laboratory analyses indicated there were significant differences between the fresh sulfided catalyst batches. These results are summarized as follows:

Batch Sample date	12-243		13-243
	1 Feb	3 Feb	30 Jan
Component, wt % (a)			
Carbon	5.13	4.7	5.6
Hydrogen	1.05	0.95	1.2
Sulfur	4.59	4.9	6.0
Nitrogen	0.80	0.90	0.91
Ash	88.44	85.7	86.8

(a) Samples were toluene extracted.

Aged catalyst samples were analyzed by the HRI laboratory (Lawrenceville, NJ). The results were as follows:

HTR Run	<u>12-243</u>	<u>13-243</u>
Date, 1983	4 April	16 June
Laboratory	HRI	HRI
Catalyst Age,	815	568
1b SRC/lb Cat		
<u>Component, wt % (a)</u>		
Carbon (b)	11.29/11.21	10.59/10.54
Hydrogen (b)	1.29/1.17	1.14/1.10
Nitrogen	0.557	0.514
Sulfur	5.74	5.58
Sodium	0.14	0.077
Nickel	2.18	2.12
Molybdenum	10.3	10.4
Titanium	0.64	0.47
Calcium	0.157	0.102
Iron	1.12	0.572
Pore volume, as % of fresh catalyst		
Toluene washed	31.9	37.2
Regenerated (air)	75.8	76.4

(a) Toluene extracted and dried.

(b) Duplicate carbon and hydrogen analyses were obtained.

Since the fresh catalyst pore size distribution is regarded as proprietary information by Shell, detailed comparisons of pore volume distributions will not be made. General observations based on the HRI data are:

- Significant differences are noted in the sodium, titanium, calcium and iron contents of the aged samples.
- Pore volumes for the toluene washed catalyst samples were 32 and 37 percent of the fresh catalyst pore volume. Mean pore diameter was reduced by a factor of 3, as compared to the fresh catalyst sample.
- The regenerated catalyst pore volume distributions were nearly identical, in spite of the differences in metals deposition.
- The cumulative pore volumes of the aged and regenerated samples were considerably lower than those obtained during Run 242 (Ref. 2).

During Phase 1, catalyst samples were withdrawn at intervals of approximately 100 lb SRC per lb catalyst. For Phase 2, the initial interval was 30 lb SRC per lb catalyst until 17 May. Samples were then removed at 70 lb per lb intervals until 16 June, when the catalyst addition block valves froze. Bench scale catalyst activity information is presented in Section 8.3.

Catalyst recovery by ash balance was 92% for Run 12-243 and 98% for Run 13-243.

Daily catalyst age data (lb SRC per lb catalyst and process time in days) are presented in Table 10. The catalyst age for Run 12-243 was 983 lb SRC per lb catalyst. Run 13-243 was aged to 716 lb SRC per lb catalyst.

8. MISCELLANEOUS TOPICS

8.1. Operating Journal

The daily operating log for Run 243 (from 3 February to 28 June 1983) is presented in this section. Daily listings are omitted when no operating problems occurred.

February 1983

- 3 • At the SRC unit, a hydrogen static leak test, a B102 clean coil test and a hydrogen leak test with solvent circulation were completed.
- Coal feed to the SRC unit commenced at 2150 hr.
- 4 • The CSD unit began processing the SRC product at 0715 hr.
- 5 • Incomplete deashing occurred at the CSD unit. the DAS solvent/feed ratio and the first stage settler temperature were increased to obtain complete deashing.
- 6 • Run 12-243 for the HTR unit began at 0430 hr.
- 7 • The HTR reactor catalyst withdrawal tube flush line plugged with catalyst after the purge pump malfunctioned.
- Coal feed ended at 1805 hr.
- The HTR unit feed ceased at 1830 hr.
- Catalyst withdrawal began.
- 8 • Feed to the CSD unit was stopped at 0200 hr.
- The catalyst withdrawal was completed.
- The purge line to the catalyst withdrawal tube was cleared and reinstalled and the catalyst was returned to the reactor.
- The SRC unit was on-line at 2230 hr.
- 9 • CSD operation resumed at 0400 hr.
- The CSD unit feed rate was increased at 0755 hr.
- Incomplete deashing occurred at 2200 hr.
- The DAS solvent/feed ratio and the first stage settler temperature were increased to achieve complete deashing.

- The HTR unit began operating at 0530 hr.
- 10 • Incomplete deashing occurred. The DAS solvent/feed ratio was increased.
- 11 • Incomplete deashing occurred. The DAS solvent/feed ratio was increased to achieve complete deashing.
- The underflow line from the CSD unit first stage settler plugged. Feed to the unit ended at 1225 hr.
- Coal feed to the SRC unit ceased at 1800 hr.
- 12 • The first stage settler underflow system was flushed to clear the plug.
- The CSD unit began operating at 0240 hr.
- The HTR unit was on-line at 1040 hr.
- Ash carryover was noted. The first stage settler operating pressure was lowered in 25 psi increments until complete deashing occurred.
- 13 • The deashing solvent was changed from "DAS A" to "DAS F" when incomplete deashing occurred.
- 14 • Incomplete deashing occurred with "DAS F". The first stage settler pressure was lowered.
- A catalyst sample was removed and an equivalent amount of fresh catalyst was returned to the R1235 Reactor.
- 18 • The CSD unit first stage settler pressure was increased. When incomplete deashing resulted, the pressure was returned to previous conditions.
- 21 • A catalyst sample was withdrawn and an equivalent amount of fresh catalyst was added.
- 24 • The HTR unit reactor temperature (R1235) was increased from 630 to 660°F.
- 27 • A wall build-up was suspected in the CSD unit first stage settler.
- Feed to the CSD unit was stopped and the first stage settler was flushed with SRC.

- Incomplete deashing was noted after six hours of operation. The DAS solvent/feed ratio was increased to achieve complete deashing.
- 28 • A catalyst sample was obtained and an equivalent amount of fresh catalyst was added to the reactor.

March

- 5 • The HTR unit reactor temperature was increased from 660 to 690°F.
- The CSD unit feed was halted and the first stage settler was flushed with SRC.
- A series of electrical power blips occurred and the Dowtherm heater at the CSD unit tripped out repeatedly. The fluctuations in Dowtherm temperature caused ash carryover.
- The DAS solvent/feed ratio was increased to achieve complete deashing.
- 6 • Ash carryover was noticed.
- 7 • The deashing solvent was changed from "DAS F" to "DAS G".
- 8 • Feed was stopped at the CSD unit and the first stage settler was flushed with SRC.
- 11 • The R1235 Reactor temperature was increased from 690 to 720°F.
- 12 • At the SRC unit, tray 3 distillate solvent was produced.
- 14 • The deashing solvent was changed from "DAS G" to "DAS H".
- 17 • The recycle gas rate at the SRC unit was increased from 3,500 to 5,000 scfh.
- The HTR unit feed was stopped at 0630 hr.
- A restriction in the system between the V1247 High Pressure Separator and the V1249 Overhead Separator was flushed clear.
- HTR unit Run 12-243 resumed at 1525 hr.
- 21 • The CSD unit first stage settler was flushed with SRC.

- A catalyst sample was withdrawn and an equivalent amount of fresh catalyst was added.
- 23 • The SRC unit dissolver outlet temperature was lowered from 800 to 785°F.
- The CSD unit deashing solvent was changed to "DAS I".
- 25 • T102 Vacuum Column tray 3 production ended.
- The CSD unit first stage settler pressure was increased 125 psi in 25 psi increments.
- 26 • The first stage settler pressure was increased an additional 25 psi.
- 28 • The first stage settler temperature was lowered 15°F in 3° increments.
- A catalyst sample was obtained and an equivalent amount of fresh catalyst was added.
- 29 • The first stage settler temperature was lowered 8°F.
- The DAS solvent/feed ratio was decreased and incomplete deashing occurred approximately 30 minutes later. The DAS solvent/feed ratio was returned to previous conditions.
- 31 • The first stage settler was flushed with SRC.

April

- 3 • At the HTR unit, the P1222 Ebullating Pump shut down. The pump restarted without problems and resulted in only a minor upset in the catalyst bed height.
- 4 • A catalyst sample was withdrawn and an equivalent amount of fresh catalyst was added.
- 5 • Feed to the HTR unit stopped at 0930 hr.
- After feed was stopped, all catalyst was withdrawn from the R1235 Reactor.
- 6 • Coal feed to the SRC unit ended at 1915 hr.
- CSD unit feed stopped at 2050 hr.
- Run 243 Phase 1 concluded.

- 7- • New transfer lines were installed between the B102 Slurry Preheater and the R101 Dissolver.
- 14 • Equipment inspections were performed on:
- V131B Pasting Solvent Surge Tank
 - V101A and B Coal Slurry Tanks
 - R101 Dissolver
 - V103 High Pressure Separator
 - C104 Hydrogen Compressor
 - C102 Recycle Gas Compressor
 - T102 Vacuum Column
 - The CSD Melt Tanks
 - CSD First Stage Settler
 - DAS Solvent Tanks
 - R1235 Reactor
 - P1222 Ebullating Pump
 - E1215 Exchanger
 - C1205 Hydrogen Compressor
 - C1206 Recycle Gas Compressor
 - B202 Boiler
- 15 • SRC unit pressure tests began.
- 17 • HTR unit pressure tests were performed.
- 18 • CSD unit pressure tests commenced.
- 19 • Catalyst batch 12-243 was added to the reactor.
- The HTR unit pressure was increased with hydrogen. Solvent circulation began.
 - A final nitrogen pressure test of the SRC unit was completed.
 - Preliminary testing of the CSD unit with DAS solvent was started.

- 20 • A final SRC unit hydrogen pressure test was completed.
- Run 12-243 resumed at the HTR unit at 2230 hr. ITSL Run 243 Phase 2 began.
- 21 • The clean coil test on the B102 Slurry Preheater was completed.
- 22 • A low feed inventory stopped the operation of the HTR unit at 0935 hr.
- Coal feed began at 2215 hr.
- 23 • CSD unit feed commenced at 0510 hr.
- Feed to the HTR unit resumed at 0800 hr.
- 27 • The R1235 reactor temperature was increased from 690 to 720°F.

May

- 2 • A catalyst sample was withdrawn and an equivalent amount of fresh catalyst was added.
- 3 • Coal feed to the SRC unit was stopped at 0730 hr.
- The HTR unit was shut down at 0735 hr to replace the catalyst.
- Feed to the CSD unit ceased at 0748 hr.
- The CSD unit was cooled and depressurized. The first stage settler was disassembled for inspection. A total of 19 lb of solid material was removed from the first stage settler, which had not been dissolved with the SRC flushes.
- 4 • A fresh batch of presulfided catalyst (13-243) was added to the HTR unit reactor.
- Run 13-243 began at the HTR unit at 0757 hr.
- The initial R1235 Reactor temperature was 680°F.
- The SRC unit began coal feed at 0800 hr.
- CSD unit feed resumed at 0840 hr.
- 5 • The deashing solvent was changed from "DAS I" to "DAS H".

- 6 • A catalyst sample was withdrawn and an equivalent amount of fresh catalyst added.
- 8 • A catalyst sample was obtained and an equivalent amount of fresh catalyst was returned to R1235.
- 10 • A catalyst sample was withdrawn and an equivalent amount of fresh catalyst was added.
- 12 • A catalyst sample was obtained and an equivalent amount of fresh catalyst was returned to the reactor.
- HTR unit feed was stopped at 1415 hr to clear a restriction in the outlet piping from the B1201 Recycle Gas Preheater and to repair leaks on the recycle gas flow meter connections.
- The SRC and CSD units were shut down at 1455 hr.
- 14 • The SRC unit received coal feed at 0105 hr.
- The CSD unit was on-line at 0310 hr.
- Run 13-243 resumed at the HTR unit at 0300 hr.
- 15 • The HTR unit reactor temperature was increased from 680 to 700°F.
- A catalyst sample was obtained and an equivalent amount of fresh catalyst was added.
- 17 • The HTR unit reactor temperature was increased from 700 to 720°F.
- A catalyst sample was withdrawn and an equivalent amount of catalyst was returned to the R1235 Reactor.
- 18 • The SRC unit dissolver outlet temperature was lowered from 825 to 810°F.
- The deashing solvent was changed from "DAS H" to "DAS G".
- 23 • A catalyst sample was obtained and an equivalent amount of catalyst was added to the R1235 Reactor.
- 24 • Coal feed was stopped at 1236 hr because of a leak in the piping between V110 Flash Vessel and the T102 Vacuum Flash Column.
- Feed to the HTR unit was stopped at 1235 hr.
- Feed to the CSD unit was stopped at 1300 hr.

- Coal feed was introduced at 1652 hr.
- The HTR unit resumed operations at 1810 hr.
- Feed to the CSD unit began at 1830 hr.
- 26 • The SRC unit MF coal feed rate was decreased from 250 lb/hr to 200 lb/hr.
- 27 • A catalyst sample was withdrawn and an equivalent amount of catalyst was returned to the R1235 Reactor.

June

- 1 • A catalyst sample was withdrawn and an equivalent amount of catalyst was added.
- 2 • Incomplete deashing occurred at 1030 hr.
- The first stage settler pressure was lowered by 50 psi at 1130 hr to obtain deashing.
- The CSD unit feed was stopped at 1210 hr to reprocess the SRC.
- Normal feed to the CSD unit resumed at 1345 hr.
- The CSD unit first stage letdown valve failed and the unit was taken off-feed.
- After the valve was repaired, the heavy phase was emptied from the first stage settler and feed to the CSD unit resumed at 1505 hr.
- The first stage settler plugged at 1600 hr. The first stage was disassembled for cleaning.
- Coal feed was discontinued at 1920 hr.
- The HTR unit was shut down at 1945 hr.
- 3 • CSD unit operations resumed at 1655 hr.
- Coal feed to the SRC unit began at 1655 hr.
- The SRC unit operating pressure was controlled at 1,700 psig.
- The SRC unit recycle gas purity was held at 70% mole % hydrogen.
- The HTR unit was on-line at 1730 hr.

- 6 • The SRC unit dissolver pressure was lowered from 1,700 to 1,500 psig.
- A catalyst sample was withdrawn and an equivalent amount of fresh catalyst was added.
- 9 • The deashing solvent was changed from "DAS G" to "DAS F".
- 11 • A catalyst sample was obtained and an equivalent amount of fresh catalyst was returned to the R1235 Reactor.
- 13 • The deashing solvent was changed from "DAS F" to "DAS E".
- 14 • The first stage settler was flushed with SRC.
- The second stage settler temperature was increased 20°F to reduce the LSRC production rate.
- A controller malfunction contaminated the deashing solvent.
- 15 • The HTR unit reactor temperature was increased to 730°F.
- 16 • A catalyst sample was withdrawn. The catalyst addition Everlasting block valves would not operate and the 22 lb of catalyst which was removed could not be returned to the R1235 Reactor. (Normal practice was to take a sample, add an equivalent amount of fresh presulfided catalyst, and return the withdrawn material.)
- 20 • A mechanical problem with the B102 Slurry Preheater shut the SRC unit down.
- At the CSD unit, feed was stopped and the first stage settler was flushed with SRC. There was an indication of a build-up in the first stage settler heavy phase area.
- 23 • The R1235 Reactor temperature was lowered to 720°F from 730°F.
- 28 • HTR Run 13-243 ceased at 0001 hr.
- Run 243 at the SRC unit ended at 0427 hr.
- CSD unit feed was stopped at 0800 hr.

The first stage settler was flushed with SRC. The first stage settler was disassembled and inspected. A 3/4 to 1-1/2" build-up of material was observed in the heavy phase area. The first stage settler was cleaned and assembled.

8.2. Maintenance

The maintenance and repairs required for Run 243 were:

SRC Unit

- New transfer lines were installed between the B102 Slurry Preheater and the R101 Dissolver on 7 to 14 April.
- Piping between the V110 Flash Vessel and the T102 Vacuum Column was replaced on 24 May.
- The B102 Slurry Preheater flame detector instruments were repaired on 20 June.

CSD Unit

- The first stage settler underflow system plugged on 11 February and was cleared by flushing.
- The first stage settler letdown valve was replaced on 2 June and the first stage was disassembled for cleaning.

HTR Unit

- The catalyst withdrawal tube flush line plugged on 7 February and was cleaned.
- The piping between V1247 HP Separator and V1249 Overhead Separator plugged on 17 March and was flushed to clear the blockage.
- The outlet piping from B1201 Recycle Gas Preheater was cleared by flushing and leaks on the recycle gas flow meter flange were repaired on 12 May.

8.3 Catalyst Activity

Catalyst samples, withdrawn from R1235 Hydrogenation Reactor, were tested for relative activity in the hydrogen microautoclave reactor. The catalyst activity test is described in Appendix B (method C).

The effect of catalyst age on relative activity is presented on the following page. These results are also shown in Figure 29.

Catalyst Batch

12-243			13-243		
Date, 1983	Catalyst age, lb SRC/lb cat.	Relative activity	Date, 1983	Catalyst age, lb SRC/lb cat.	Relative activity
3 Feb	0	1.00	3 May	0	1.00
7 Feb	12	0.83	4 May	10	0.68
14 Feb	69	0.56	6 May	38	0.49
21 Feb	161	0.46	8 May	69	0.39
28 Feb	265	0.32	10 May	97	0.39
14 Mar	478	0.25	12 May	119	0.37
28 Mar	698	0.26	15 May	147	0.40
4 Apr	815	0.29	23 May	273	0.29
25 Apr	869(1)	0.29	1 Jun(2)	392	0.42
2 May	979	0.17	6 Jun	442	0.32
			16 Jun	568	0.39

(1) Plant shutdown between 6 and 22 April.

(2) MF coal rate reduced on 26 May.

Dissolver pressure and recycle gas hydrogen purity reduced on 3 June.

For each batch, the relative catalyst activity declined rapidly until the catalyst age approached 300 lb SRC processed per lb catalyst. Relative activities for the two catalyst batches were approximately 30% at this catalyst age, versus 42% for Run 242. Batch 12-243, used for Phase 1 and initial Phase 2 operation, exhibited a stable relative activity until 900 lb SRC/lb catalyst. The final relative activity (17%) was comparable to Run 242 at 700 lb SRC/lb catalyst.

Catalyst batch 13-243 showed an increase in relative activity after 300 lb SRC/lb catalyst. This increase occurred after the SRC plant operating conditions were adjusted as follows:

- The coal feed rate was reduced to provide an HTR space velocity similar to that of Run 242.
- The hydrogen consumption in the SRC unit was reduced to approach Run 242 conditions by decreasing system pressure and feed gas hydrogen purity.

A more detailed analysis of catalyst activity will be published in Topical Report No. 14, "Catalyst Activity Trends in Two-Stage Coal Liquefaction".

8.4 Hydrotreater Feed Aging Study

From 5 to 21 April, the V1064 Hydrotreater Feed Tank was maintained at approximately 380°F. Samples were periodically withdrawn to determine viscosity and solvent content with respect to time.

This vessel contained approximately 55% deashed SRC and 45% thermal solvent. The results of this study were as shown on the following page.

Date, 1983	Storage time, days	Average temp, °F	Viscosity, cp ⁽¹⁾	Solvent, % (by distillation)
5 Apr	0	-	-	44.8
6 Apr	1	-	660(ND)	-
7 Apr	2	-	582(58)	-
8 Apr	3	-	596(62)	-
9 Apr	4	-	638(68)	-
10 Apr	5	380	594(54)	-
11 Apr	6	385	572(54)	-
12 Apr	7	380	654(64)	42.3
13 Apr	8	380	-	47.1
14 Apr	9	380	664(62)	-
15 Apr	10	375	590(58)	47.3
16 Apr	11	380	-	-
17 Apr	12	390	-	-
18 Apr	13	390	734(74)	44.7
19 Apr	14	385	714(72)	47.7
20 Apr	15	390	660(66)	44.6
21 Apr	16	385	-	45.7

(1) Constant shear rate of 8.4 sec^{-1} . First value is at 230°F. Value in parentheses is at 300°F.

The data show no significant increase in viscosity in contrast to the results obtained for a coal-derived blend (equivalent to a No. 6 fuel oil) prepared for ICRC(Ref. 3) and aged at 230°F in an open beaker.

Possible explanations for these conflicting results are:

- The hydrotreater feed tank is blanketed with nitrogen. A recent investigation(Ref. 4) demonstrated that coal liquids exhibit a rapid viscosity increase when exposed to oxygen rather than nitrogen.
- The ICRC fuel oil blend contained 15% preasphaltenes versus approximately 3% for this study. Undesirable degradation reactions may be caused by preasphaltenes.

8.5. Corrosion Measurements

Corrosion rates were determined at several locations in the SRC and CSD units. The data were obtained by electrical resistance corrosion probes. The results of these tests and the measurement points were as shown on the following page.

From	4 Jun 82	7 Feb 83	25 Apr 83	25 Apr 83
To	6 Jun 83	4 Apr 83	6 Jun 83	22 Jul 83

Equipment	Probe Location	Corrosion Rates, Mils/yr (2)			
T102 Vacuum Column	Vapor space	-	-	2.1	1.6
	Tray 3	-	-	4.4	3.9
	Tray 8 top	-	-	2.7	5.3
	Tray 8 btm	-	-	0	0
	Packing	-	24	10	10
T104 Light Organics Column	Top	1.2	-	-	1.0
	Bottom	4.6	-	-	2.0
T105 Fractionation Column	(Note 1)	0	-	-	-
E172 Heavy Solvent Cooler		-	-	4.4	2.8
CSD Unit Solvent Separator No. 3	Top	-	-	-	0
	Bottom	-	-	-	5

Note 1: Trays 1, 8, 10, 12, 15, and 17.

Note 2: Corrosion rates determined by Type 1010 carbon steel corrosimeter probes except T102 tray 8 btm (Type 420 SS).

High corrosion rates (10 to 24 mils/yr) were measured in the packed section of T102 Vacuum Column, between trapout trays 3 and 8.

8.6. Environmental Protection

The average wastewater treatment data during this period are provided below. During Run 243, all effluent qualities were within permit limits.

Component	Allowable daily average	Allowable daily maximum	Actual performance 3 February to 28 June 1983
BOD, mg/l	30.0	60.0	3.1
Phenol, mg/l	0.25	0.5	0.006
Oil and grease, mg/l	10.0	15.0	3.1
Total suspended solids, mg/l	30.0	60.0	3.14
Settleable solids, ml/l	1.0	1.0	<0.1
pH	6.0-9.0	6.0-9.0	7.5
Temperature, °F	95	100	72.4

The State of Alabama Department of Environmental Management (ADEM) issued a new National Pollutant Discharge Elimination System (NPDES) permit (valid for five years) which became effective on July 1, 1983. The new discharge limitations are presented as follows:

<u>Component</u>	<u>Allowable daily average</u>	<u>Allowable daily maximum</u>
BOD, mg/l	30	45
Phenol, mg/l	0.25	0.50
Total suspended solids, mg/l	30	45
Sulfides, mg/l	0.10	0.20
pH	6-9	6-9

The facility was inspected in March by the ADEM water pollution staff and was found to be in compliance with the new regulations.

During Run 243, 350 and 50 lb of activated carbon were added to bio-reactors A and B, respectively. This was done to reduce shock loading caused by organic components in the influent.

Analyses of sour water from the SRC and HTR units for the special product workup periods are presented in Table 19.

The Wilsonville facility continues to operate under Resource Conservation and Recovery Act (RCRA) regulations with a Part A Interim Status Permit. All RCRA-classified hazardous wastes are buried at an Environmental Protection Agency (EPA) approved landfill operated by Chemical Waste Management, Inc. at Emelle, Alabama. The ash concentrate is not considered hazardous under RCRA regulations. Nevertheless, this material is being disposed of at the Emelle facility. Spent solvents are sold to EPA-licensed reclaimers.

9. REFERENCES

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APPENDIX A

Special Product Workup Calculation Procedure

Special product workup calculations for each unit are determined individually. The results are then combined to obtain the overall two stage and the single stage yields. Two dependent flow rates, the CSD feed and HTR feed streams, are measured. However, these streams are adjusted, based on the measured rates of all product streams, in order to close the mass balances in the CSD and HTR units.

For the SRC unit, all process stream flow rates are measured. The distillate solvent rate is adjusted by taking the difference between the measured inputs and the total outputs.

At the CSD unit, the daily average rates for the three product streams (ash concentrate, SRC and LSRC) are added together to obtain the feed rate. Allowances are made for inventory changes within the CSD unit. All streams are calculated on a DAS-free basis.

For the HTR unit, calculation of the heavy distillate yield is dependent on the amount of solvent added to the unit. The solvent addition rate is determined from the daily addition rate, plus the catalyst withdrawal tube flush rate, less the feed tank inventory change times the percent solvent in the feed tank. This rate is exact during steady operation when the feed tank composition does not change. The distillate solvent yield (Table 12) is adjusted for the solvent in the HTR feed and the solvent in the HTR SRC product. Thus, the yield is determined on the basis of distillates generated from the laboratory-defined SRC.

The primary differences between the daily and the special product workup results for the HTR unit are due to the sour water rate calculation. The daily values are based on the observed or estimated sour water rates. For the special product workup results, the sour water rate is calculated from a sulfur and oxygen elemental balance and ammonia is estimated. The elementally balanced sour water rate is higher than the daily result. Thus, the solvent yield is decreased, usually by about 2% of the SRC feed. Measured sour water rates cannot be expected to be better than ± 4 lb/hr.

For the HTR unit special product workup calculations, the outlet streams are determined from the daily average rates. The injected water stream rate is adjusted to close the oxygen and sulfur balances. This method assumes that the difference between outlet and inlet sulfur is contained in the sour water. The ammonia rate is estimated. The hydrogen makeup rate is calculated from an elemental hydrogen balance. The total solvent plus SRC is obtained from the difference between the total measured outlet streams and the sum of the hydrogen, injected water withdrawal tube flush, and seal oil rates. The SRC feed rate is

then obtained from a solvent balance around the V1064 Hydro-treater Feed Tank. The nitrogen balance is not used to adjust stream rates due to the possible errors in the analytical methods. (See Table 14 for a comparison of Kjeldahl and elemental analyses results.) The carbon balance is not closed.

APPENDIX B

Activity Test Descriptions

a. Solvent Activity

Solvent activity is determined in the Wilsonville laboratory as follows:

Standard coal (Indiana V) and solvent are charged to a 30 cc microautoclave unit to which a mixing ball is added. The slurry is mixed and heated to a specific temperature ($\pm 5^{\circ}\text{F}$) within a two minute period and is maintained for a specific period of time. The microautoclave is quenched in water and the reaction products are washed and extracted with tetrahydrofuran (THF).

The ratio of the amount of reacted coal to the original sample weight is expressed as a percentage conversion which is referred to as "solvent activity".

The conditions used for both microautoclave tests are listed below.

<u>Test type</u>	<u>Temp, °F</u>	<u>Solvent-to- coal ratio</u>	<u>Reaction time, min.</u>
Kinetic	750	8:1	10
Equilibrium	750	2:1	30

The kinetic test gives a relative indication of the hydrogen transfer rate and hydrogen shuttling ability of the solvent. The equilibrium test gives a relative indication of the concentration of donatable hydrogen in solvent.

Low solvent activity (around 60%), is an indication that operating problems can occur. Preheater coking has been noted at Wilsonville when solvent activity was low (Ref. 5).

b. Resid Activity

Resid activity is determined in the Wilsonville laboratory as follows:

Standard coal (Indiana V) and solvent are charged to a 22 cc microautoclave reactor to which a 1/4 inch diameter x 3/4 inch long stainless steel mixing rod is added. The pressure is increased to 1,000 psig (cold) with hydrogen. The slurry is mixed and heated to 750°F ($\pm 5^{\circ}\text{F}$) within a two minute period and is maintained for 10 minutes. The microautoclave is quenched in water and depressured. The reaction products are washed and extracted with tetrahydrofuran (THF).

The ratio of the amount of reacted coal to the original sample weight is expressed as a percentage conversion which is referred to as "Resid Activity" or "hydrogen microautoclave conversion".

The conditions used for the test are listed below:

Solvent	5 gm of 1-methylnaphthalene 1 gm of residual
Coal	3 gm of Indiana V
Solvent/coal ratio	2
Temperature, °F	750
Hydrogen pressure, psig	1,000
Agitation, strokes/min	1,000
Reaction time, min	10

The test gives a relative indication of the residual's ability to convert coal to THF soluble products, in addition to the hydrogen transfer rate and hydrogen shuttling ability of the solvent.

c. Catalyst Activity

Catalyst activity is determined in the Wilsonville laboratory as follows:

The catalyst sample is washed thoroughly with toluene, then tetrahydrofuran (THF). The washed sample is then sonicated in THF for two hours. Fresh THF is added to the sample after sonication. A constant volume of the catalyst (equivalent to 7.0 inches when stacked in a capillary tube) is used for the test.

Two grams of 10% naphthalene in hexadecane is hydrogenated in the presence of the catalyst in a microautoclave at the following conditions:

Temperature, °F	720
Hydrogen pressure, psig	1,000 (cold)
Agitation, strokes/min	800 (no ball or rod added)
Reaction time, min	15

The reaction is quenched with cold water and the contents are filtered. The concentrations of tetralin and decalin, which are the products of naphthalene hydrogenation, and naphthalene are determined by gas chromatography. The hydrogen consumption in the microautoclave is determined by stoichiometric calculations and is used as a measure of catalyst activity.

The test determines hydrogen consumption during the hydrogenation of a model compound, naphthalene, in the presence of the catalyst. This gives an indication of relative catalyst activity, independent of HTR reactor and/or TSL system performances.

The test also may be used for assuring the completeness of catalyst presulfiding.

APPENDIX C

Definitions

Ash	Residual mineral matter obtained by muffle furnace burning at 900°C for 3 hours (adapted ASTM D-482).
Ash concentrate	A product of the Kerr-McGee CSD unit first stage separator that is rich in cresol insolubles (ash and UC) with lesser amounts of SRC and solvent.
CSD SRC	A low preasphaltene, ash, and UC product of the CSD unit second stage separator.
Deashing solvent (DAS)	A solvent used to deash the vacuum column bottoms which are fed to the CSD unit.
Distillate solvent	A coal-derived distillate fraction with a boiling range between 450°F at 760 mm Hg (GC and ASTM D-86) and 600°F at 0.1 mm Hg in the laboratory (flask).
Energy rejection	The heating value lost to the ash concentrate as a fraction of the feed coal heating value.
HTR conversion	<p>The fraction of the SRC feed to the HTR unit that is converted to gases and liquids:</p> $\text{Percent conversion} = \frac{\text{HTR SRC in} - \text{HTR SRC out}}{\text{HTR SRC in}} \times 100$
HTR SRC	The hydrotreated solvent refined coal product of the HTR unit.
Light solvent refined coal (LSRC)	A low preasphaltene SRC product of the CSD unit third stage separator.

APPENDIX C (continued)

Definitions

Middle distillate	A coal-derived distillate fraction with a boiling range between 350 and 450°F at 760 mm Hg (GC and ASTM D-86).
Naphtha	A coal-derived distillate fraction with a boiling range from that of C ₅ up to but less than 350°F at 760 mm Hg (GC and ASTM-86).
Process solvent	Feed solvent to the SRC unit or the HTR unit, which may be the distillate solvent or a blend of distillate solvent with light SRC and/or HTR SRC in variable concentrations.
Solvent refined coal (SRC)	A cresol-soluble product of the coal liquefaction process which is non-distillable at 600°F and 0.1 mm Hg in the laboratory.
T102 Vacuum Column bottoms (CSD feed)	A residual mixture of SRC, solvent, ash, and UC.
UC	Organic material that is insoluble in boiling cresol.

Table 1
Estimated Performance and Stability Data (ITSL System)

Date, 1983	Yield, % MAF coal (a)								Mass balance closure error, % MAF coal	Inventory change (d), % MAF coal					
	Net H ₂ cons(b)	Water	Gas	Naph	Mid dist	Dist solv	CSD SRC	Ash conc(c)		SRC/ CSD(e)	CSD/ HTR(f)	Flare liquids(g)	HTR SRC(h)	K125(i)	Absolute sum(j)
February															
20	-3.4	7.7	9.0	4.2	6.4	25.2	31.1	19.8	3.0	4.0	22.8	0.6	4.3	0	31.7
21	-3.3	7.4	10.0	4.5	6.6	24.7	30.2	19.9	2.4	0.7	22.5	0.5	6.3	0	30.0
23	-3.3	8.5	9.6	4.2	5.6	27.6	29.0	17.2	4.9	19.1	27.0	0.7	0.5	0	37.3
26	-3.9	8.2	9.0	6.6	6.0	31.0	24.5	18.6	4.5	15.3	8.3	0.6	3.2	0	27.4
27	-4.3	8.1	10.1	5.2	5.5	32.8	27.2	15.4	0.3	17.2	5.2	0.9	6.4	0	29.7
March															
1	-4.4	10.4	11.4	6.0	6.1	27.8	24.2	18.5	1.4	5.3	20.1	0.9	4.4	5.6	26.3
2	-4.4	8.6	10.6	6.3	6.8	28.9	23.5	19.7	4.7	-1.9	46.2	1.0	-9.6	0	58.7
3	-4.6	12.5	11.8	5.6	5.7	30.5	19.4	19.1	4.0	-0.8	37.7	1.0	-12.3	0	51.8
4	-4.3	10.4	11.6	5.7	6.7	26.3	22.9	20.7	2.7	-0.4	29.9	0.9	-3.6	0	34.8
10	-4.4	10.0	10.0	8.0	8.1	34.6	13.3	20.4	2.0	-1.1	15.7	0.8	-1.3	0	18.9
12	-5.6	9.5	11.1	8.2	7.9	38.4	10.7	19.8	4.0	2.6	0.9	1.2	5.4	0	10.1
13	-5.0	9.9	9.5	8.0	8.7	35.3	14.0	19.6	0.3	0.2	3.7	1.0	7.2	0	12.1
14	-5.1	9.5	10.8	8.9	7.8	35.7	14.1	18.3	3.1	2.7	5.4	0.8	4.6	0	13.5
15	-5.5	9.0	10.2	9.0	7.4	36.4	13.5	20.0	1.3	-2.9	21.4	0.6	-4.1	0	29.0
16	-5.1	9.2	8.8	9.2	7.2	40.4	10.6	19.7	2.4	-0.6	19.1	0.7	-5.6	0	26.0
18	-5.1	8.7	9.5	8.1	7.5	40.9	13.3	17.1	5.0	-1.2	-7.6	0.9	16.4	0	26.1
19	-5.4	8.7	9.4	8.1	6.4	48.2	5.3	19.3	3.7	1.9	10.0	0.5	-4.4	0	16.8
20	-5.0	8.7	9.6	8.0	6.9	42.8	8.6	20.4	10.4	-1.1	4.9	0.7	3.2	0	9.9
22	-5.0	9.0	9.5	8.1	7.3	41.7	12.0	17.4	6.3	-2.4	15.3	0.5	-1.0	0	19.2
24	-4.9	9.1	7.0	8.6	6.6	34.0	17.9	21.7	0.9	-4.2	19.2	0.7	1.6	0	25.7
26	-4.6	9.7	8.5	7.0	6.8	31.9	19.9	20.8	3.3	2.2	17.8	0.5	2.5	0	23.0
29	-4.9	10.2	8.1	8.6	6.8	41.3	9.5	20.4	4.7	5.2	10.8	0.6	-4.8	0	22.4
30	-4.8	10.2	8.1	9.6	8.2	36.3	11.0	21.4	4.6	1.2	12.5	0.7	-1.7	0	16.1
April															
1	-4.4	9.3	8.8	6.7	5.8	35.8	16.5	21.5	0.4	-18.4	17.1	0.9	11.0	0	47.4
2	-4.7	9.3	9.4	8.0	6.0	39.3	10.3	22.1	6.9	-3.4	13.9	0.6	-0.6	0	18.5
3	-5.0	10.1	9.2	10.5	7.5	31.9	12.7	23.1	2.0	-4.9	18.3	0.8	-1.1	0	25.1

- (a) Unaccounted losses were treated in two stage distillate solvent yields.
 (b) Calculated using the ethylene injection method.
 (c) Mineral matter free basis.
 (d) A negative inventory change indicates a gain to the process.
 (e) Between SRC and CSD units.
 (f) Between CSD and HTR units.
 (g) At flare knock out pot (V2021).
 (h) Net change in HTR SRC inventory. HTR SRC is laboratory defined SRC.
 (i) Solidifier between SRC and CSD units.
 (j) Net absolute change in inventory.

(Table continued)

Table 1 (continued)
Estimated Performance and Stability Data (ITSL System)

Date, 1983	Yield, % MAF coal(a)								Mass balance closure error, % MAF coal	Inventory change (d), % MAF coal					
	Net H ₂ cons(b)	Water	Gas	Naph	Mid dist	Dist solv	CSD SRC	Ash conc(c)		SRC/ CSD(e)	CSD/ HTR(f)	Flare liquids(g)	HTR SRC(h)	K125(i)	Absolute sum(j)
May															
1	-5.4	12.6	10.4	8.1	3.3	32.2	10.7	23.1	2.5	3.3	-1.3	0.7	7.0	0	12.3
2	-5.6	11.8	10.3	7.1	5.8	36.7	9.5	24.4	5.4	-1.5	6.8	0.4	2.8	0	11.5
6	-5.3	8.6	10.0	8.3	7.7	40.3	11.0	19.4	2.9	6.3	18.0	0.6	-8.9	0	33.8
8	-4.8	8.1	10.0	8.5	5.8	36.0	14.9	20.5	8.8	1.9	11.0	0.4	1.7	0	15.0
17	-4.7	9.9	10.8	11.8	7.0	31.9	13.0	20.3	4.7	3.6	0	2.2	6.2	2.5	14.5
18	-4.9	9.7	10.9	10.2	3.3	32.0	14.3	19.5	1.7	-2.9	13.9	1.0	2.2	0	20.0
23	-5.2	9.1	8.7	9.2	7.4	32.8	17.6	20.4	7.6	-3.6	25.2	0.7	3.5	0	33.0
26	-5.1	7.9	9.0	10.2	3.1	45.6	2.2	22.1	5.2	2.2	-7.3	1.0	4.7	1.8	17.0
28	-5.3	9.5	9.7	9.2	3.1	43.5	-5.0	20.3	4.7	-2.7	6.3	1.3	0.6	0	10.9
29	-5.0	9.5	11.6	10.2	7.3	39.7	7.6	19.1	7.8	1.6	5.7	1.0	8.4	0	16.7
31	-4.9	12.5	11.8	9.6	7.3	41.8	2.3	19.6	0.1	-1.1	6.9	0.8	-2.6	0	11.4
Jun															
7	-4.1	7.4	11.2	10.4	3.9	33.0	7.0	26.2	10.0	6.4	6.9	0.6	-3.5	0	17.4
8	-4.1	6.1	10.6	10.8	7.9	38.4	2.2	28.1	3.5	5.0	-7.0	0.8	3.5	0	16.3
9	-4.2	8.5	10.0	9.1	7.9	37.4	7.0	24.5	11.7	-6.3	3.6	0.8	5.8	0	16.5
11	-4.1	8.3	9.9	9.2	7.7	30.8	13.9	24.3	8.0	-2.8	7.2	0.7	6.3	0	17.0
12	-4.3	8.7	9.8	8.9	7.0	36.7	9.2	24.0	7.0	-4.3	9.6	0.5	2.2	0	16.6
13	-4.2	8.5	10.6	10.8	8.7	32.9	7.6	25.1	4.9	0.7	8.2	0.8	-0.8	0	10.5
17	-5.2	11.2	11.2	10.8	8.5	39.3	-0.3	24.6	10.5	-0.6	4.1	0.7	-2.5	0	7.9
18	-4.8	10.0	11.0	9.8	8.3	33.9	7.6	24.2	9.4	-2.8	7.2	0.7	1.8	0	12.5
19	-5.0	9.1	10.0	10.3	8.7	38.9	3.6	24.4	6.7	2.5	6.0	0.7	-2.8	0	12.0
21	-5.1	9.8	9.9	9.7	8.4	34.5	8.0	24.8	2.6	2.5	3.0	0.8	2.7	0	9.0
22	-5.1	10.2	10.3	10.1	7.9	37.3	5.4	23.9	7.1	-3.4	8.8	0.7	-0.5	0	13.4

- (a) Unaccounted losses were treated in two stage distillate solvent yields.
 (b) Calculated using the ethylene injection method.
 (c) Mineral matter free basis.
 (d) A negative inventory change indicates a gain to the process.
 (e) Between SRC and CSD units.
 (f) Between CSD and HTR units.
 (g) At flare knock out pot (V2021).
 (h) Net change in HTR SRC inventory. HTR SRC is laboratory defined SRC.
 (i) Solidifier between SRC and CSD units.
 (j) Net absolute change in inventory.

Table 2
SRC Unit Operating Data (Part 1)

Date, 1983	Coal feed, MF lb/hr	Coal feed hr	Slurry conc, MF coal, %	HTR SRC added, lb/hr	Solvent, lb/hr		Coal, % MF			Feed gas		B102 Slurry Preheater			R101 Dissolver			Solids withdrawal % total feed (b)
					SRC	HTR	Ash	Sulfur	H ₂ O(a)	H ₂ , %	Total scfh	Inlet temp., °F	Outlet temp., °F	Inlet press, psig	Outlet press, psig	Temperature		
																Btm, °F	Outlet, °F	
Feb																		
3	220	2.9	34.3	98.0	199.0	119.0	-	3.4	-	-	-	-	-	-	-	-	-	-
4	247	24	35.9	107.0	196.1	130.3	11.2	3.4	2.2	86	3,030	204	825	2,473	2,400	793	799	-
5	215	24	35.1	97.2	178.7	117.7	11.2	3.4	2.2	87	3,490	194	832	2,467	2,400	790	796	-
6	255	24	35.4	48.1	342.7	69.6	11.1	3.4	1.6	88	3,550	201	812	2,467	2,400	793	801	-
7	254	18	35.7	68.9	276.0	68.9	10.9	3.4	1.9	89	3,630	185	804	2,484	2,400	790	800	-
8	270	1.5	36.0	88.0	264.4	122.5	10.6	3.4	1.9	-	-	-	-	2,480	2,400	-	-	-
9	275	24	35.8	92.2	270.8	124.1	10.7	3.4	1.7	88	3,540	200	803	2,493	2,400	792	800	-
10	245	24	35.8	120.5	165.3	147.1	10.6	3.4	2.1	87	3,500	182	810	2,493	2,400	792	799	4.7
11	252	16.6	35.9	128.7	164.3	149.5	11.0	3.4	2.3	87	3,490	191	810	2,481	2,400	793	800	-
12	230	19.5	35.8	134.7	120.6	151.7	11.0	3.4	1.8	-	-	206	810	2,469	2,400	794	798	6.6
13	248	24	35.8	177.4	70.6	191.0	10.9	3.4	2.1	87	3,500	200	813	2,469	2,400	794	800	6.6
14	199	24	35.9	170.3	11.7	170.6	10.8	3.5	1.9	87	3,500	195	829	2,459	2,400	794	800	6.8
15	253	24	36.6	161.2	114.7	157.2	10.9	3.5	1.8	87	3,490	207	812	2,470	2,400	793	801	7.7
16	262	24	36.0	164.5	136.4	159.5	11.1	3.5	1.7	87	3,500	217	810	2,472	2,405	792	799	8.2
17	248	24	35.8	179.7	84.5	176.6	10.8	3.5	1.7	87	3,450	222	809	2,470	2,400	791	800	6.0
18	236	24	35.9	204.6	15.5	196.0	11.0	3.5	1.9	87	3,530	229	817	2,474	2,400	791	798	5.1
19	230	24	35.6	211.5	2.3	195.6	11.0	3.5	2.1	87	3,480	236	818	2,463	2,400	793	800	5.1
20	238	24	35.5	223.0	0.7	204.0	10.8	3.5	2.1	87	3,460	245	814	2,472	2,400	793	799	7.7
21	246	24	35.6	227.9	0	209.9	10.8	3.5	2.1	87	3,470	244	817	2,473	2,400	794	800	6.0
22	243	24	35.9	224.4	0	205.9	11.0	3.2	1.8	87	3,460	252	818	2,458	2,400	794	800	6.0
23	255	24	35.7	255.4	0	255.4	11.0	3.2	1.4	87	3,490	246	812	2,466	2,400	793	800	6.1
24	246	24	35.8	232.3	0	205.8	10.7	3.2	1.7	87	3,480	245	819	2,467	2,400	794	799	6.1
25	224	24	36.0	210.5	0	185.5	11.0	3.2	1.6	88	3,520	231	827	2,464	2,400	794	798	6.0
26	246	24	36.2	227.4	0	203.4	11.3	3.2	1.5	88	3,540	225	828	2,473	2,400	794	798	6.0
27	238	24	36.0	223.3	0	196.4	11.2	3.2	1.6	88	3,560	233	828	2,478	2,400	794	798	6.5
28	230	24	35.3	218.7	10.6	187.8	11.4	3.2	1.6	88	3,530	219	835	2,475	2,400	795	799	6.2
Mar																		
1	235	24	35.3	226.0	10.6	190.0	11.5	3.2	1.5	87	3,460	222	827	2,460	2,400	796	800	6.0
2	245	24	35.8	236.3	2.3	195.8	11.2	3.2	1.7	88	3,490	240	820	2,466	2,400	795	800	6.1
3	246	24	35.7	239.2	0	198.6	10.8	3.3	1.5	87	3,440	244	821	2,469	2,402	793	799	6.1
4	253	24	36.7	235.5	0	206.8	10.9	3.3	1.5	87	3,430	248	820	2,466	2,400	794	799	5.6
5	252	24	35.9	238.0	0	207.4	10.8	3.3	1.5	87	3,400	240	828	2,460	2,400	796	799	-
6	253	24	36.3	229.5	0	209.5	10.8	3.3	1.7	88	3,480	237	828	2,459	2,400	795	800	6.6
7	241	24	35.9	221.9	0	205.9	10.8	3.3	1.7	87	3,460	240	827	2,461	2,400	796	799	5.9
8	224	24	35.1	215.1	0	195.5	10.8	3.3	1.4	88	3,520	229	835	2,475	2,400	795	798	5.3
9	245	24	35.8	226.3	0	206.8	11.7	3.5	2.1	88	3,560	240	837	2,479	2,400	796	798	5.3
10	252	24	36.3	226.7	0	211.0	11.8	3.6	1.9	88	3,570	234	844	2,480	2,402	796	797	5.8
11	239	24	34.5	212.6	32.2	206.1	11.6	3.4	1.9	88	3,550	214	849	2,474	2,400	795	801	6.9
12	243	24	35.7	213.1	6.5	213.4	11.8	3.4	1.9	87	3,500	225	850	2,475	2,405	799	801	6.3
13	248	24	36.1	209.8	0.5	223.5	11.3	3.4	1.8	88	3,460	227	848	2,463	2,405	799	800	6.6
14	250	24	35.8	214.8	0	227.4	11.4	3.4	2.1	87	3,470	233	844	2,461	2,404	798	800	5.1
15	242	24	34.8	221.7	0	231.8	11.6	3.4	2.3	87	3,450	238	846	2,457	2,404	798	800	7.3
16	251	24	35.6	219.7	0	229.0	11.4	3.4	1.9	87	3,430	239	846	2,457	2,403	798	799	7.3
17	256	24	35.7	218.6	0	235.5	11.9	3.4	2.3	87	4,240(c)	215	845	2,470	2,414	798	800	6.0

(Table continued)

Table 2 (continued)
SRC Unit Operating Data (Part 1)

Date, 1983	Coal feed, MF lb/hr	Coal feed hr	Slurry conc, MF coal, %	HTR SRC added, lb/hr	Solvent, lb/hr		Coal, % MF			Feed gas		B102 Slurry Preheater			R101 Dissolver			
					SRC	HTR	Ash	Sulfur	H ₂ O(a)	H ₂ , %	Total scfh	Inlet temp., °F	Outlet temp., °F	Inlet press, psig	Outlet press, psig	Temperature		Solids withdrawal % total feed (b)
																Btm, °F	Outlet, °F	
Mar (cont.)																		
18	251	24	35.9	215.4	0	227.1	12.1	3.4	2.1	87	4,920	221	837	2,475	2,410	798	800	6.4
19	252	24	35.9	218.7	0	222.9	11.9	3.5	2.6	87	4,990	227	835	2,479	2,408	797	800	7.0
20	255	24	36.0	216.0	0	232.0	12.5	3.5	2.5	87	4,970	224	837	2,480	2,410	796	799	6.6
21	254	24	35.9	219.0	0	227.6	11.4	3.5	2.6	87	4,940	218	838	2,482	2,410	796	800	6.9
22	254	24	36.1	224.7	0	217.3	11.3	3.5	2.4	87	5,080	219	835	2,476	2,408	796	799	4.2
23	246	24	34.9	227.0	0	225.5	11.6	3.5	2.5	88	5,080	223	820	2,495	2,410	785	788(d)	5.4
24	248	24	35.7	216.3	0	222.9	11.5	3.5	2.6	87	5,040	213	820	2,470	2,410	782	784	4.9
25	248	24	35.8	216.0	0	223.0	11.4	3.5	2.2	87	5,040	227	820	2,462	2,425	782	785	9.0
26	252	24	35.9	223.6	0	221.0	11.6	3.6	2.2	87	5,000	224	820	2,472	2,421	782	784	6.9
27	248	24	36.0	227.6	0	210.1	11.7	3.7	1.5	87	4,970	228	818	2,460	2,400	782	785	6.6
28	252	24	36.0	235.7	0	208.5	11.8	3.7	1.7	87	4,990	235	816	2,475	2,400	782	785	5.8
29	254	24	36.0	237.0	0	210.0	12.0	3.7	1.4	87	5,040	227	814	2,478	2,400	782	785	4.9
30	252	24	36.1	225.1	0	218.8	11.5	3.7	1.1	87	5,010	236	813	2,475	2,400	781	785	6.0
31	255	24	36.1	227.1	0	223.2	11.6	3.7	1.3	87	4,970	240	811	2,469	2,400	782	786	5.3
Apr																		
1	249	24	35.7	226.1	0	216.4	11.1	3.7	1.8	86	4,900	238	815	2,466	2,400	782	785	-
2	252	24	35.2	235.1	0	223.0	12.0	3.7	2.0	87	5,010	234	826	2,476	2,400	783	785	5.1
3	246	24	34.8	227.5	0	230.2	11.2	3.7	1.5	87	4,970	233	814	2,480	2,400	784	785	5.4
4	247	24	34.9	228.1	0	228.3	11.0	3.1	1.4	87	4,980	237	811	2,473	2,400	782	785	6.0
5	253	24	35.6	232.3	0	223.8	11.3	3.1	1.2	87	4,930	244	810	2,463	2,400	782	785	5.2
6	248	19.3	35.8	227.0	0	215.0	11.2	3.1	1.2	-	-	239	814	2,464	2,400	781	784	-

- (a) Analysis data with as-is coal.
(b) Amount collected in V102 calibration pot by making periodic withdrawals from the dissolver bottoms.
(c) Feed gas rate increased from 3,500 to 5,000 SCFH after 17 March.
(d) Dissolver temperature decreased from 800 to 785°F after 23 March.

(Table continued)

Table 2 (continued)
SRC Unit Operating Data (Part 1)

Date, 1983	Coal feed, MF lb/hr	Coal feed hr	Slurry conc, MF coal, %	HTR SRC added lb/hr	Solvent, lb/hr		Coal, % MF			Feed gas		B102 Slurry Preheater			R101 Dissolver			
					SRC	HTR	Ash	Sulfur	H ₂ O(a)	H ₂ %	Total scfh	Inlet temp., °F	Outlet temp., °F	Inlet press, psig	Outlet press, psig	Temperature		Solids withdrawal % total feed(b)
																Inlet °F	Outlet, °F	
Apr																		
22	229	1.7	33.9	107.0	180.0	156.0	11.2	3.1	1.4	-	-	-	-	-	-	-	-	-
23	239	24	34.8	113.1	168.7	162.5	11.3	3.1	1.6	88	3,460	234	822	2,460	2,400	812	826	6.1
24	259	23(c)	35.9	137.1	140.4	183.4	11.4	3.1	1.1	87	3,420	235	819	2,480	2,400	809	825	5.0
25	255	24	35.7	181.3	67.8	206.0	11.4	3.1	1.3	87	3,470	240	819	2,470	2,400	809	825	3.4
26	258	24	35.9	200.0	47.5	208.7	11.5	3.1	1.3	87	3,440	240	821	2,480	2,400	808	825	4.2
27	252	24	35.9	205.0	45.2	195.4	11.6	3.1	1.6	87	3,440	238	817	2,470	2,400	803	824	6.7
28	254	24	35.9	210.3	29.2	212.0	11.0	3.3	1.3	87	3,440	237	818	2,470	2,400	805	825	8.6
29	255	24	35.8	207.2	24.4	223.4	11.0	3.3	0.9	86	3,380	248	819	2,470	2,400	808	825	6.8
30	254	24	35.9	211.2	15.5	224.6	11.0	3.3	0.9	87	3,420	244	821	2,470	2,400	808	825	5.6
May																		
1	252	24	35.9	215.1	3.2	229.8	11.0	3.3	0.6	87	3,420	244	824	2,470	2,400	812	825	5.2
2	252	24	35.9	215.6	0.6	231.5	10.9	3.3	1.1	87	3,420	246	823	2,460	2,400	811	825	6.9
3	250	7.5	36.1	212.6	0	228.3	11.0	3.3	0.7	88	3,460	-	822	2,450	2,400	811	825	-
4	228	15.9	27.8	195.0	188.0	209	11.0	3.3	0.9	89	3,600	226	831	2,450	2,400	821	821	6.0
5	249	24	35.1	211.8	12.9	232.6	11.1	3.3	1.4	87	3,500	236	819	2,450	2,400	808	825	7.0
6	257	24	35.6	219.1	1.6	240.4	11.0	3.3	1.6	88	3,510	246	822	2,450	2,400	811	824	7.4
7	243	24	34.6	214.3	0.1	241.3	11.0	3.4	1.4	87	3,490	246	831	2,450	2,400	819	825	6.8
8	252	24	35.4	217.2	0	236.7	11.1	3.5	1.7	88	3,430	241	830	2,450	2,400	819	824	6.0
9	252	24	35.8	217.3	0	231.7	10.9	3.5	1.4	88	3,500	228	831	2,450	2,400	820	826	5.5
10	248	24	35.8	216.5	0	225.6	11.1	3.5	1.3	88	3,480	244	831	2,450	2,400	820	825	6.4
11	250	24	35.9	216.8	0	227.2	10.9	3.5	1.3	89	3,500	245	830	2,450	2,400	819	824	5.8
12	251	14.4	35.8	217.3	0	230.1	11.0	3.5	1.8	88	3,690	239	828	2,440	2,400	816	825	-
14	247	22.9	35.0	218.8	0	238.2	11.0	3.5	1.5	89	3,470	242	832	2,430	2,400	823	825	-
15	247	24	36.3	206.9	0	223.9	10.8	3.5	0.9	88	3,340	236	830	2,450	2,400	818	825	5.2
16	246	24	35.7	218.9	0	220.7	11.0	3.4	1.1	88	3,520	216	834	2,450	2,400	821	824	5.2
17	247	24	35.7	222.9	0	219.1	11.1	3.4	1.4	87	3,460	217	829	2,450	2,400	818	825	5.9
18	245	24	35.7	220.6	0	216.0	11.1	3.4	1.4	88	3,570	226	823	2,450	2,400	812	821	4.3
19	245	24	36.0	218.2	0	214.6	11.1	3.4	0.9	90	3,660	224	814	2,450	2,400	802	810	4.3
20	245	24	36.0	210.9	0	224.2	11.1	3.4	0.3	80(d)	3,340	231	811	2,450	2,400	799	810	-
21	245	24	35.7	211.9	0	226.2	11.0	3.4	0.8	83(d)	3,480	239	811	2,450	2,400	800	809	-
22	247	24	35.5	222.1	0	222.8	10.9	3.4	1.5	87	3,440	238	811	2,450	2,400	800	810	6.8

See notes on next page.

(Table continued)

Table 2 (continued)
SRC Unit Operating Data (Part 1)

Date, 1983	Coal feed, MF lb/hr	Coal feed hr	Slurry conc, MF coal, %	HTR SRC added, lb/hr	Solvent, lb/hr		Coal, % MF			Feed gas		B102 Slurry Preheater			R101 Dissolver			Solids withdrawal % total feed (h)
					SRC	HTR	Ash	Sulfur	H ₂ O(a)	H ₂ , %	Total scfh	Inlet temp., °F	Inlet press, psig	Outlet temp., °F	Outlet press, psig	Temperature		
																Inlet °F	Outlet, °F	
May																		
23	244	24	35.6	218.3	0	222.8	10.9	3.4	2.0	87	3,440	241	2,450	813	2,400	804	809	5.6
24	247	19.7	35.8	216.7	0	221.5	10.9	3.4	1.8	88	3,530	235	2,450	810	2,400	800	810	6.0
25	248	24	36.2	213.0	0	220.8	11.2	3.4	1.9	88	3,500	234	2,450	805	2,400	796	810	6.1
26	218(c)	24	35.9	185.9	0	199.8	11.6	3.4	1.5	88	3,460	238	2,450	808	2,400	798	810	7.1
27	195	24	35.6	169.5	0	178.6	11.2	3.4	2.0	88	3,500	225	2,450	811	2,400	800	810	4.4
28	195	24	35.8	165.4	0	180.8	11.6	3.4	1.6	88	3,460	231	2,450	812	2,400	801	810	4.6
29	194	24	35.9	162.3	0	180.7	11.2	3.4	1.5	87	3,440	229	2,450	814	2,400	803	810	7.6
30	191	24	35.9	162.1	0	176.4	11.0	3.4	1.4	87	3,450	227	2,450	815	2,400	804	810	7.8
31	193	24	35.8	165.8	0	178.3	11.2	3.4	1.1	88	3,520	231	2,450	815	2,400	804	810	-
Jun																		
1	193	24	35.8	166.7	0	176.0	11.2	3.4	1.3	87	3,440	232	2,450	814	2,400	801	810	5.3
2	193	19.3	35.8	166.3	0	177.0	11.5	3.4	1.7	88	3,480	231	2,450	814	2,400	801	810	-
3	193	7.1	36.1	166.0	0	174.0	11.7	3.4	0.8	91	3,770	203	2,060	831	1,900(g)	816	798	-
4	194	24	35.9	164.2	0	179.9	11.6	3.4	1.2	73(f)	3,480	245	1,750	822	1,700	808	809	6.2
5	196	24	35.9	159.2	0	188.4	11.1	3.4	1.6	71	3,540	234	1,750	822	1,700	809	810	7.0
6	193	24	35.8	156.3	0	184.5	10.7	3.4	2.0	70	3,510	239	1,760	821	1,600(g)	806	810	6.0
7	196	24	35.8	161.1	0	187.1	10.5	3.4	2.3	71	3,410	233	1,550	828	1,500	813	810	5.9
8	189	24	35.5	156.5	0	180.1	10.6	3.4	3.5	71	3,420	232	1,550	827	1,500	812	811	5.6
9	192	24	35.8	156.5	0	184.2	10.7	3.4	1.7	72	3,490	233	1,560	826	1,500	809	811	6.2
10	190	24	35.8	158.0	0	180.6	10.7	3.4	1.7	72	3,450	242	1,560	825	1,500	810	809	5.4
11	191	24	35.8	159.5	0	179.0	10.8	3.4	1.8	71	3,410	237	1,560	824	1,500	811	809	5.8
12	189	24	35.8	162.7	0	172.8	10.7	3.4	1.9	71	3,360	242	1,560	826	1,500	812	810	5.9
13	189	24	35.6	164.1	0	172.5	10.6	3.4	2.4	70	3,360	236	1,560	827	1,500	810	810	6.2
14	196	24	35.6	170.7	0	178.6	10.9	3.4	2.3	70	3,390	231	1,560	825	1,500	809	810	6.6
15	196	24	35.6	170.1	0	180.1	10.9	3.3	2.7	71	3,310	240	1,560	824	1,500	808	809	5.2
16	196	24	35.6	169.5	0	183.0	10.7	3.1	1.8	72	3,350	243	1,560	822	1,500	809	810	4.5
17	199	24	35.8	166.8	0	186.8	10.9	3.1	1.7	72	3,340	245	1,560	822	1,500	811	810	3.1
18	204	24	35.8	167.4	0	196.0	11.0	3.1	1.8	71	3,340	244	1,560	826	1,500	809	808	4.5
19	201	24	35.5	167.4	0	192.8	10.8	3.1	2.2	71	3,400	246	1,560	823	1,500	810	810	5.7
20	199	21.9	35.6	164.0	0	191.9	10.7	3.1	1.9	-	3,410	245	1,560	826	1,500	810	810	4.7
21	202	24	35.7	168.0	0	191.1	11.0	3.1	1.7	72	3,370	238	1,560	825	1,500	808	811	4.9
22	198	24	35.7	164.8	0	188.1	11.2	3.1	1.5	71	3,350	242	1,560	824	1,500	808	810	5.7
23	196	24	35.7	164.7	0	183.6	11.0	3.1	1.8	72	3,360	245	1,560	824	1,500	808	810	4.3
24	190	24	35.5	160.7	0	180.6	10.6	3.3	2.0	71	3,380	248	1,560	825	1,500	809	810	5.4
25	189	24	35.8	158.5	0	177.3	10.4	3.3	1.7	72	3,370	242	1,560	822	1,500	805	809	5.2
26	177(h)	24	31.0(h)	184.5	0	208.0	10.4	3.3	1.3	70	3,380	247	1,560	830	1,500	813	809	4.3
27	208	24	35.5	175.5	0	199.8	10.4	3.3	1.6	71	3,330	231	1,560	828	1,500	811	810	4.7
28	208	4.5	36.1	170.0	0	193.0	10.4	3.3	1.7	-	-	240	1,600	823	1,500	810	810	-

(a) Analysis data with as-is coal.

(b) Amount collected in V102 calibration pot by making periodic withdrawals from the dissolver bottoms.

(c) Change from Central Standard to Daylight Savings Time.

(d) Hydrogen purity was lowered between 0500 hr on 20 May to 0500 hr on 21 May.

(e) MF coal feed rate was decreased from 250 to 200 lb/hr after 26 May.

(f) Hydrogen purity of feed gas was reduced to 70 mole % after 3 June.

(g) Reactor system pressure was reduced from 2,400 to 1,700 psig after 3 June, and further reduced to 1,500 psig after 6 June.

(h) Due to problems in coal batch blending.

Table 3
SRC Unit Operating Data (Part 2)

Date, 1983	V103 HP Separator	T102 Vacuum Temperature	Column Press	T104 OH		Process solvent		Distillate solvent		Makeup H ₂ , lb/hr	Flare gas(d)		H ₂ con- sumed, % MAF(e)	Water produced, lb/hr(f)
	btm temp, °F	btm °F	top, psia	Flow, lb/hr	+450°F; wt % (a)	Solvent activity, % THF conv(b)		+650°F, wt %	Specific gravity		Total, lb/hr	H ₂ wt %		
						V131B	V178	V131B(c)	V178					
Feb														
3	-	-	-	-	-	74.6(i)	-	-	-	-	-	-	-	-
4	636	609	0.5	12.5	1.6	-	-	72.9	1.00	-	5.4	-	1.4	19.6
5	642	621	0.5	12.6	7.1	-	-	88.7	80.1	1.01	5.6	17.3	1.8/1.8	16.8
6	662	630(g)	0.4	21.5	3.7	81.9, 74.4(j)	-	91.2	83.3	1.01	6.9	-	1.7	20.9
7	668	626	0.4	24.5	3.7	71.7, 74.3(j)	-	86.4	-	1.02	6.6	17.3	1.6/1.5	19.8
8	-	-	0.4	-	-	-	-	-	-	-	-	-	-	-
9	679	629	0.4	12.5	3.2	-	-	87.4	82.0	1.02	6.8	19.2	1.8/1.5	20.1
10	666	625	0.4	17.1	5.3	-	-	87.2	81.7	1.02	7.2	-	1.8	20.6
11	665	628	0.4	19.8	5.1	79.0	-	90.9	85.7	1.02	7.2	17.4	1.6/1.5	20.4
12	656	626	0.4	13.5	0.0	-	-	-	77.1	1.02	5.7	-	1.4	17.1
13	661	628	0.4	27.7	4.3	75.3	72.9	85.1	80.9	1.02	6.4	19.9	1.8/1.4	18.7
14	640	626	0.4	27.9	13.6	-	73.6	87.3	74.0	1.02	39.1	7.4	2.0	16.3
15	673	629	0.4	27.3	12.1	-	-71.0	87.6	75.4	1.02	7.2	19.3	1.7/1.3	19.0
16	674	628	0.4	28.4	9.9	72.2/85.2	79.1	88.6	75.8	1.02	4.3	6.7	1.8	19.1
17	672	629	0.4	19.6	5.1	81.5	77.4	88.3	77.8	1.02	7.1	19.4	1.9/1.4	18.0
18	666	629	0.4	25.4	7.9	-	-	-	75.8	1.02	8.2	-	2.5(h)	16.9
19	663	628	0.4	29.3	29.3	-784.3	-	90.9	71.3	1.02	23.3	8.0	16.5	2.5/1.9
20	666	629	0.4	24.7	14.6	-783.3	-	91.6	69.6	1.02	27.7	8.5	-	2.5
21	664	628	0.4	25.3	14.6	84.6/82.3	-73.2	-	72.9	1.02	10.3	8.5	18.4	2.4/2.0
22	664	630	0.4	25.2	14.7	-784.9	-	36.7	73.3	1.02	10.3	8.6	-	2.4
23	673	631	0.4	22.0	10.5	-	-	39.5	71.9	1.02	5.9	9.0	17.0	2.6/2.0
24	666	632	0.4	22.4	8.0	75.0	-	90.3	74.7	1.03	33.5	6.8	-	2.3
25	647	628	0.4	16.9	4.1	-	-	88.3	78.2	1.02	13.7	7.8	18.2	2.5/2.1
26	655	630	0.4	23.3	2.6	-	-	-	74.3	1.02	14.3	7.2	-	2.1
27	661	629	0.4	20.0	12.0	-	-	88.8	75.6	1.03	25.4	7.4	15.9	2.2/2.0
28	643	627	0.4	24.6	4.1	-787.1	-	89.9	74.8	1.03	23.1	7.8	-	2.4

- (a) Analysis by gas chromatograph (GC).
 (b) Microautoclave conversion by the kinetic test/equilibrium test.
 (c) Samples are distilled first and then analyzed by GC. Actual residue is added to the +650°F fraction.
 (d) Determined by the ethylene injection method and GC analysis of flare gas.
 (e) By the gas disappearance method/by the ethylene injection method. No hydrogen leaks to the atmosphere were corrected in calculation.
 (f) Determined by the water production separated in the V105B tank.
 (g) The Vacuum Column bottoms temperature was increased from 610 to 630°F after 6 February 1983.
 (h) With the new orifice plate in C104 makeup hydrogen flowmeter (FR1144) since 18 February 1983, hydrogen consumption was increased by about 1.0 lb/hr.
 (i) Data from startup solvent mixed with 55% V131B and 45% V178.
 (j) With V1067 as-is samples.

(Table continued)

Table 3 (continued)
SRC Unit Operating Data (Part 2)

Date, 1983	V103 HP Separator btm temp, °F	T102 Vacuum Column Temperature btm °F	Press top, psia	T104 OH		Process solvent				Distillate solvent			Makeup H ₂ , lb/hr	Flare gas(d)		H ₂ con- sumed, % MAF(e)	Water produced, lb/hr(f)	
				Flow, lb/hr	+450°F; wt % (a)	Solvent activity, % THF conv(b)		+650°F wt %		Specific gravity V178	Inven- tory, lb/hr	Total, lb/hr		H ₂ wt %				
						V131B	V178	V131B(c)	V178									
Mar																		
1	658	631	0.4	22.7	13.7	84.4/85.6	83.5/74.7	89.6	70.6	1.03	26.8	8.6	22.4	18.6	2.5/2.1	17.0		
2	666	632	0.4	23.9	7.2	87.0	-	90.1	72.8	1.03	16.2	9.0	-	-	2.4	17.4		
3	668	631	0.4	19.9	5.0	-/84.4	-	90.1	68.6	1.03	25.0	8.7	24.1	16.6	2.4/2.1	17.1		
4	667	630	0.4	23.1	5.7	-	-	89.8	70.9	1.03	18.9	8.8	-	-	2.4	17.1		
5	663	627	0.4	25.2	10.1	-	-	89.7	70.9	1.03	11.8	8.3	21.4	18.8	2.2/1.9	17.1		
6	665	632	0.4	20.6	20.6	-/86.9	-	89.7	71.9	1.03	9.9	9.1	-	-	2.2	17.1		
7	669	631	0.4	26.5	6.3	74.5	-	88.6	68.6	1.02	19.7	9.0	24.8	18.2	2.3/2.0	15.3		
8	655	630	0.4	25.8	11.2	-/84.6	-	90.0	72.6	1.03	32.8	8.5	-	-	2.5	13.5		
9	665	630	0.4	25.7	12.0	-/87.1	-	90.2	-	1.02	21.8	8.3	20.2	15.8	2.0/1.9	16.3		
10	664	632	0.4	28.0	5.2	-/88.2	86.5/75.1	89.7	73.7	1.02	17.8	7.4	-	-	1.8	17.0		
11	658	632	0.4	28.2	11.0	80.8	-	88.9	74.0	1.02	9.3	7.3	-	-	1.9	15.9		
12	659	630	0.4	24.3	17.6	-	-	90.4	75.9	1.03	3.9	8.0	24.2	17.8	2.0/1.8	15.5		
13	665	631	0.4	26.0	15.8	-/88.0	-	91.1	74.3	1.03	7.8	8.9	-	-	2.1	17.1		
14	668	631	0.4	22.1	-	-/88.9	87.5/76.3	-	77.8	1.03	17.3	9.2	19.8	20.3	2.1/1.5	16.7		
15	670	630	0.4	22.2	2.8	-/87.9	-	91.7	76.7	1.03	-1.1	8.6	-	-	1.9	14.5		
16	660	631	0.4	22.5	4.3	82.3	-	91.6	76.9	1.03	4.8	6.8	17.4	20.9	1.4/1.4	14.5		
17	661	630	0.4	27.9	3.7	-/88.3	-	91.4	77.4	1.03	-4.5	7.4	-	-	1.7	17.5		
18	677	631	0.4	24.9	10.5	-	-	-	78.9	1.03	16.3	7.5	20.3	20.5	2.0/1.7	15.8		
19	676	631	0.4	21.4	5.0	-	-	-	78.0	1.03	24.6	7.5	-	-	2.0	15.6		
20	674	630	0.4	22.6	3.6	-/88.4	-	-	78.0	1.03	0.5	7.2	21.2	18.4	1.9/1.5	16.2		
21	671	631	0.4	24.9	4.7	78.4	83.5	92.2	77.7	1.03	8.6	7.5	-	-	1.8	16.5		
22	662	630	0.4	22.3	8.3	-/88.5	-/75.7	92.2	78.1	1.03	27.4	7.9	18.5	19.0	1.9/1.6	16.3		
23	656	630	0.4	17.4	3.3	-/80.2	-	92.3	79.8	1.03	0.6	7.3	-	-	1.9	15.1		
24	656	631	0.4	19.5	2.8	-/88.1	-	92.4	81.1	1.03	22.7	6.6	13.1	20.6	1.9/1.7	16.7		
25	658	630	0.4	17.8	8.5	-	-	92.6	-	1.02	-16.3	6.8	-	-	1.8	15.4		
26	655	632	0.4	18.5	8.9	-	-	92.3	79.4	1.02	16.1	6.7	16.3	23.2	1.6/1.5	15.8		
27	657	630	0.4	19.1	7.2	-/83.4	-/75.1	88.8	80.6	1.02	17.6	7.6	-	-	1.8	16.0		
28	659	629	0.4	17.0	5.0	81.9	-	88.2	79.7	1.02	21.7	7.5	-	-	1.9	14.6		
29	663	630	0.4	19.7	5.1	87.2	-	93.8	82.7	1.02	21.8	7.5	15.9	26.5	1.9/1.6	15.8		
30	665	630	0.4	22.7	4.6	-/88.7	-	-	-	1.02	45.8	6.8	-	-	1.9	15.2		
31	667	630	0.4	20.8	5.9	-	-	92.7	81.9	1.02	19.0	7.5	15.8	24.5	1.6/1.6	14.6		
Apr																		
1	664	629	0.3	16.4	6.3	-	-	-	83.3	1.01	12.0	7.7	-	-	2.0	15.4		
2	669	630	0.4	19.2	11.5	-	-/76.6	92.1	82.2	1.02	8.5	7.5	-	-	1.6	15.5		
3	663	631	0.3	21.6	8.5	89.9	-	92.3	73.7	1.02	13.3	6.6	-	-	1.9	15.1		
4	667	630	0.3	16.3	-	-/89.8	-	90.5	80.9	1.02	34.0	6.5	14.1	16.1	1.9/1.8	15.3		
5	667	630	0.4	12.3	3.2	-	-	91.5	80.6	1.02	-	6.4	-	-	1.8	14.7		
6	666	631	0.4	23.1	-	-	-	-	-	-	-	-	15.5	15.9	-	14.6		

See notes on previous page

(Table continued)

Table 3 (continued)
SRC Unit Operating Data (Part 2)

Date, 1983	V103 HP	T102 Vacuum Column	Press top, psia	T104 OH		Process solvent				Distillate solvent				Flare gas(d) Total, lb/hr	H ₂ con- sumed, % MAF(e)	Water produced, lb/hr(f)
	Separator	Temperature		Flcw, lb/hr	+450°F; wt % (a)	Solvent activity, % THF conv(b)		+650°F wt %	Specific gravity	Inven- tory, lb/hr	Makeup H ₂ lb/hr	H ₂ wt %				
	btm temp, °F	btm °F				V131B	V178						V131B(c)			
Apr																
22	-	-	-	-	-	-	-	87.2	69.5	-	-	-	-	-	-	-
23	687	627	0.4	0.	-	-	-	-	-	-	14.5	7.8	24.0	16.6	1.4	13.3
24	680	629	0.4	15.3	3.1	85.6	75.8	85.7	67.5	1.01	15.4	8.3	-	-	1.9	14.3
25	686	630	0.3	28.1	10.5	82.0	72.9	86.7	65.5	1.01	7.6	8.1	24.0	16.6	1.9/1.6	14.7
26	690	631	0.4	23.4	13.3	-	-	-	63.8	1.01	41.6	8.3	-	-	1.8	15.1
27	694	631	0.4	14.5	8.0	87.9/90.1	80.4	88.6	70.0	1.01	9.8	8.2	22.7	17.9	1.8/1.5	15.4
28	697	631	0.4	21.4	9.5	88.5	-	88.5	64.3	1.01	13.0	7.5	-	-	1.4	14.8
29	696	632	0.4	26.5	9.6	-	-	87.9	63.7	1.01	-6.5	7.6	19.6	16.5	2.1/1.5	14.3
30	697	630	0.4	24.7	8.5	-	-	86.9	65.4	1.01	7.5	8.2	-	-	1.9	14.7
May																
1	694	631	0.4	23.4	6.6	84.0/89.6	75.0/70.8	86.6	62.6	1.02	13.2	8.3	23.1	22.3	1.8/1.6	14.3
2	695	631	0.4	19.0	4.8	-	-	87.9	64.2	1.02	26.0	8.2	-	-	1.6	14.5
3	696	625	0.3	-	3.1	84.8	-	87.1	63.2	1.02	-	8.0	-	-	1.7	14.8
4	695	621	0.3	-	-	-	-	80.1	-	1.02	-	6.4	-	-	1.6	14.4
5	696	631	0.3	21.5	6.2	86.2/-	-	80.4	70.0	1.01	5.3	8.0	23.1	23.9	1.8/1.6	14.6
6	697	629	0.4	28.4	7.3	-/91.3	-	89.3	64.7	1.00	-2.7	7.6	-	-	1.7	14.4
7	694	631	0.3	26.1	7.2	-	-	88.2	65.7	1.01	21.5	7.5	21.7	20.2	1.7/1.3	15.6
8	693	631	0.3	24.2	3.6	87.6/84.2	78.1	87.8	64.1	1.01	11.6	8.3	-	-	1.7	15.3
9	690	630	0.3	27.6	4.6	87.6	-	86.2	65.5	1.01	-5.0	8.5	23.0	22.2	1.6	15.1
10	695	629	0.4	32.3	5.1	-/90.2	74.7	87.3	65.8	1.01	12.9	8.5	-	-	1.8/1.3	14.1
11	695	631	0.4	28.1	7.2	85.8	-	87.9	62.6	1.01	-1.8	7.5	22.6	22.1	2.1/1.3	13.3
12	693	626	0.3	28.8	-	-	-	87.5	64.5	1.01	-	7.3	-	-	1.5	14.3
14	691	630	0.3	12.8	10.7	-	-	-	-	-	-	6.7	23.9	23.7	-	14.3
15	690	630	0.3	18.1	3.8	-	-	79.9	63.2	1.02	11.6	7.8	-	-	1.4/1.3	16.0
16	682	629	0.4	17.4	4.9	-/92.0	-	-	58.7	1.02	12.8	8.0	-	-	1.4	15.0
17	687	631	0.4	23.0	4.4	-	-	-	59.3	1.01	21.3	7.9	23.0	21.8	1.3/1.2	14.5
18	687	630	0.3	24.4	6.7	83.4	-	87.6	63.3	1.02	15.2	8.1	-	-	1.4	14.4
19	670	629	0.4	19.3	6.2	84.3	-	86.0	64.1	1.01	1.8	6.4	15.8	21.9	1.5/1.3	14.3
20	676	630	0.4	17.6	5.9	-/91.0	-	86.9	-	1.01	-11.0	4.7(g)	14.3	16.3	1.5/1.3	11.4
21	678	630	0.4	15.2	5.8	-	-	88.6	63.5	1.01	12.8	6.9	16.5	20.7	1.7/1.3	13.9
22	678	630	0.4	16.8	3.3	-	-	-	-	1.01	8.9	7.6	16.8	25.6	1.9/1.3	11.4

- (a) Analysis by gas chromatograph (GC).
 (b) Microautoclave conversion by the kinetic test/equilibrium test.
 (c) Samples are distilled first and then analyzed by GC. Actual residue is added to the +650°F fraction.
 (d) Determined by the ethylene injection method and GC analysis of flare gas.
 (e) By the gas disappearance method/by the ethylene injection method. No hydrogen leaks to the atmosphere were corrected in calculation.
 (f) Determined by the water production separated in the V105E tank.
 (g) Hydrogen purity in the feed gas was lowered between 0500 hr on 20 May to 0500 hr on 21 May.
 (h) MF coal feed rate was decreased from 250 to 200 LB/HR after 26 May.
 (i) Hydrogen purity in the feed gas was reduced to 70 mole % after 3 June.
 (j) Reactor pressure was reduced to 1,700 psig after 3 June and 1,500 psig after 6 June.

(Table continued)

Table 3 (continued)
SRC Unit Operating Data (Part 2)

Date, 1983	V103 HP Separator btm temp, °F	T102 Vacuum Temperature btm °F	Column Press top, psia	T104 OH		Process solvent				Distillate solvent			Makeup H ₂ , lb/hr	Flare gas(d)		H ₂ con- sumed %MAF(e)	Water produced lb/hr(f)
				Flow, lb/hr	+450°F; wt % (a)	Solvent activity, % THF conv(b)		+650°F, wt %		Specific gravity	Inven- tory, lb/hr	Total, lb/hr		H ₂ wt %			
						V131B	V178	V131B(c)	V178								
May																	
23	679	630	0.4	18.7	7.3	82.0	77.7/71.6	88.1	71.5	1.01	8.3	6.5	-	-	1.6	13.9	
24	680	631	0.4	17.0	4.5	-/90.5	79.3	88.7	64.3	1.01	-	5.9	16.3	19.7	1.5/1.3	16.6	
25	681	631	0.4	18.2	3.9	82.7	-	80.4	69.5	1.00	7.3	5.8	-	-	1.4	16.5	
26	670	630	0.4	20.6	4.8	-/91.2	-	89.0	72.1	1.00	37.8	6.0	-	-	1.6(h)	12.8	
27	656	628	0.4	17.2	4.1	-/89.7	-	90.6	69.1	-	40.1	5.5	13.4	18.7	1.7/1.6	11.8	
28	660	630	0.4	15.7	5.2	-	-	88.4	72.2	1.01	4.9	5.4	-	-	1.6	12.0	
29	656	630	0.4	16.2	7.2	87.3	78.7	89.4	-	1.01	8.0	5.4	17.5	19.4	1.6/1.5	11.5	
30	657	630	0.4	13.5	-	-	-	89.2	71.8	1.01	8.6	5.3	-	-	1.5	11.8	
31	656	629	0.4	16.4	4.3	88.2/91.5	78.9/64.4	90.1	73.4	1.01	22.0	5.3	17.0	21.7	1.5/1.2	13.3	
Jun																	
1	655	630	0.4	16.0	4.4	74.5	-	90.7	73.6	1.01	42.1	5.4	-	-	1.6	14.1	
2	656	630	0.4	-	-	76.1	-	90.6	73.7	1.01	-	6.4	-	-	1.5	-	
3	636	617	0.4	-	10.3	-	-	-	-	-	-	3.2	-	-	0.7(i)	-	
4	657	630	0.4	13.8	7.3	-	-	-	75.3	1.01	9.0	3.1	-	-	0.7	10.4	
5	668	631	0.4	15.9	3.7	-	-	90.5	61.6	1.01	6.3	3.2	12.4	8.0	1.5/1.3	10.7	
6	669	631	0.4	14.2	3.6	79.6	-	-	70.4	1.01	11.5	3.1	-	-	1.2(j)	10.7	
7	657	630	0.4	15.9	2.3	-/86.9	81.1	85.5	70.9	1.00	-3.8	2.4	11.8	7.9	0.6/0.8	11.5	
8	654	630	0.4	16.6	3.1	36.5	-	89.7	67.2	1.00	-9.2	2.6	-	-	0.7	11.3	
9	655	630	0.4	16.4	4.2	-/89.3	-	-	72.6	1.00	3.3	2.5	11.5	8.1	0.7/0.8	11.6	
10	659	632	0.4	15.6	3.6	85.2	-	90.1	66.1	1.01	-8.4	2.7	-	-	0.8	10.9	
11	657	631	0.4	16.6	3.3	-	-	90.0	62.0	1.01	10.4	2.6	11.3	7.6	0.7/0.9	10.8	
12	655	631	0.4	14.8	4.9	-	-	81.4	73.8	1.01	-6.8	2.4	-	-	0.6	11.2	
13	658	630	0.4	16.9	2.9	84.3	-/68.8	90.9	77.5	1.01	3.3	2.5	12.8	8.9	0.7/0.8	11.0	
14	655	632	0.4	16.7	3.0	87.7	-	90.1	71.4	1.01	10.0	2.6	-	-	0.9	11.0	
15	663	630	0.4	16.1	3.5	90.9	-	89.4	75.3	-	-2.5	2.5	12.6	6.4	0.9/0.9	11.1	
16	663	631	0.4	17.7	3.4	-/89.1	-	91.6	72.6	-	-2.9	2.6	-	-	0.8	11.3	
17	665	630	0.4	15.6	4.0	84.6	-	92.0	73.6	1.01	-9.2	2.7	13.9	8.8	0.9/0.8	11.2	
18	663	630	0.4	17.1	4.3	-	-	91.2	72.9	1.01	3.1	2.6	-	-	0.9	11.6	
19	661	631	0.4	18.2	3.3	-	-	89.9	75.6	1.01	-20.4	2.7	11.2	8.83	0.9/0.9	11.6	
20	663	632	0.4	15.1	3.7	87.8/90.9	-	90.6	76.8	-	-2.7	2.4	-	-	0.8	10.7	
21	662	630	0.4	17.3	4.1	84.0	-	-	72.0	-	-10.8	2.7	12.3	8.0	0.9/0.9	11.7	
22	659	630	0.4	17.1	1.0	79.7	-	-	76.4	-	-11.2	2.5	-	-	0.9	11.1	
23	659	631	0.4	15.1	3.9	-/88.6	-	91.1	64.7	-	7.1	2.6	11.1	7.5	0.8/0.9	10.8	
24	661	630	0.4	14.4	6.4	78.0	-	87.6	76.2	-	-19.4	2.6	-	-	0.9	11.1	
25	661	630	0.4	17.9	5.9	-	-	92.1	76.0	1.01	12.8	2.7	13.5	9.4	1.0/0.7	11.6	
26	669	631	0.4	16.5	5.0	-	-	90.0	75.7	1.00	-21.4	2.2	-	-	0.7	10.8	
27	667	631	0.4	16.2	3.5	88.4	-	88.3	73.4	1.00	-1.8	2.3	12.3	8.1	0.7/0.8	12.9	
28	698	625	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	

(Table continued)

Table 3 (continued)
SRC Unit Operating Data (Part 2)
Illinois 6 Burning Star

- (a) Analysis by gas chromatograph (GC).
- (b) Microautoclave conversion by the kinetic test/equilibrium test.
- (c) Samples are distilled first and then analyzed by GC. Actual residue is added to the +650°F fraction.
- (d) Determined by the ethylene injection method and GC analysis of flare gas.
- (e) By the gas disappearance method/by the ethylene injection method. No hydrogen leaks to the atmosphere were corrected in calculation.
- (f) Determined by the water production separated in the V105B tank.
- (g) Hydrogen purity in the feed gas was lowered between 0500 hr on 20 May to 0500 hr on 21 May.
- (h) MF coal feed rate was decreased from 250 to 200 LB/HR after 26 May.
- (i) Hydrogen purity in the feed gas was reduced to 70 mole % after 3 June.
- (j) Reactor pressure was reduced to 1,700 psig after 3 June and 1,500 psig after 6 June.

Table 4
Estimated Performance and Stability Data (SRC Unit)

Date	Estimated daily performance % MAF coal								Total yield
	Hydrogen consumption (a)	H ₂ O	Gas	Naphtha	Middle distillate	Distillate solvent	SRC	UC	
Feb 4	-1.6	6.4	8.0	3.2	2.5	26.2	52.4	6.3	103.3
6	-1.5	7.4	7.7	4.6	4.5	14.9	50.3	4.8	92.8
13	-1.4	6.1	9.3	5.7	6.3	25.3	36.5	8.5	96.3
15	-1.3	6.4	8.9	4.1	6.6	24.0	44.1	5.9	98.6
16	-1.3	6.3	8.0	4.2	6.7	22.8	37.7	7.2	91.6
18	-1.5	5.9	8.9	4.9	6.3	28.3	35.2	8.0	95.9
19(b)	-1.9	6.0	9.1	4.0	6.1	32.3	34.2	7.1	96.8
20	-1.9	5.8	8.9	3.9	6.0	27.7	42.4	8.1	101.1
21	-2.0	5.8	9.7	3.7	6.2	22.7	39.8	8.1	94.0
22	-2.0	5.9	9.7	3.8	6.1	28.1	43.4	8.0	103.0
23	-2.0	6.3	9.2	3.4	5.3	28.6	44.1	9.1	103.8
25	-2.1	6.4	9.2	3.7	4.5	24.7	43.9	8.2	98.6
26	-1.9	6.4	8.6	5.1	5.3	27.3	34.6	8.8	94.2
27	-2.0	6.1	10.0	3.6	4.7	36.9	35.4	8.1	102.8
28	-2.1	6.5	10.5	5.5	6.1	32.1	31.4	8.3	98.3
Mar 1	-2.1	6.4	10.9	4.2	5.2	27.8	36.8	7.7	97.0
2	-2.0	6.1	10.1	4.4	5.8	23.6	43.4	8.5	99.9
3	-2.1	6.1	11.4	3.8	4.8	29.9	36.6	8.9	99.5
4	-2.0	5.9	11.2	4.0	5.7	22.7	46.8	7.2	101.4
5	-1.9	5.9	9.2	4.5	5.6	25.0	44.3	7.5	100.2
6	-1.9	5.7	9.2	3.0	4.2	23.0	42.7	8.9	94.8
9	-1.9	5.0	10.4	4.5	6.0	25.9	46.3	9.8	105.9
10	-1.9	5.5	9.4	5.3	6.6	23.5	37.6	7.4	93.5
11	-1.8	5.3	11.5	4.9	7.0	21.6	45.8	6.6	100.9
12	-1.8	5.1	10.3	4.0	5.3	24.2	47.7	6.9	101.7
13	-1.5	5.7	8.8	3.8	6.1	20.7	53.3	5.6	102.5
14	-1.5	5.2	9.8	4.6	5.1	23.2	48.7	6.2	101.2
15	-1.5	4.1	9.1	5.0	5.0	18.9	51.1	6.3	97.9
16	-1.4	4.4	8.1	5.0	4.6	23.6	48.0	6.6	98.9
17	-1.3	5.2	8.1	5.7	6.2	19.2	49.3	5.6	98.0
18	-1.7	4.8	8.8	5.2	4.9	29.7	42.9	6.3	101.0
19	-1.7	4.0	8.5	4.8	4.4	35.9	38.0	7.0	100.8
20	-1.5	4.4	9.0	4.8	4.9	22.5	45.8	8.1	98.0
21	-1.5	4.3	9.0	5.1	5.5	24.5	47.6	6.9	101.3
22	-1.6	4.5	8.1	4.3	4.8	29.4	41.1	6.7	97.3
23	-1.7	4.0	6.2	3.9	3.8	20.7	52.7	7.5	97.1
24	-1.7	4.6	6.1	4.2	4.5	22.7	52.0	6.9	99.3
26	-1.5	5.3	7.6	3.3	4.3	17.9	56.1	7.8	100.9
29	-1.6	5.5	7.2	3.8	4.6	24.3	46.1	6.8	96.7
30	-1.6	5.7	7.2	4.4	5.2	16.8	52.4	7.5	97.7
Apr 1	-1.6	5.2	7.6	5.1	3.8	19.2	54.1	7.2	98.6
2	-1.6	4.7	8.0	4.0	3.7	18.0	48.5	7.7	93.1
3	-1.8	5.4	8.1	4.2	4.8	20.0	50.8	6.6	98.2
4	-1.8	5.6	7.4	3.6	3.5	22.9	50.4	5.6	97.1
5	-1.7	5.3	7.4	2.6	2.7	23.8	50.0	7.9	97.9

(a) Calculated using the ethylene injection method.

(b) Hydrogen consumption for 4 to 18 February is not comparable to later data. The orifice on the makeup hydrogen meter FR1144 was changed on 18 February. This appeared to increase the measured values by 1.0 lb/hr (0.4% MAF coal approx.).

(Table continued)

Table 4 (continued)
Estimated Performance and Stability Data (SRC Unit)

Date	Estimated daily performance % MAF coal								Total yield
	Hydrogen consumption(a)	H ₂ O	Gas	Naptha	Middle distillate	Distillate solvent	SRC	UC	
Apr 24	-1.6	5.7	10.5	2.1	4.4	21.1	45.3	7.0	94.4
27	-1.5	5.2	10.7	1.7	4.3	25.7	39.4	8.3	93.8
May 1	-1.6	5.9	9.6	4.1	5.7	17.4	45.5	7.9	94.6
2	-1.6	5.3	9.6	3.5	4.6	17.1	47.6	6.9	93.0
6	-1.5	4.8	9.5	5.6	5.9	25.3	41.0	6.7	97.2
7	-1.3	5.3	10.0	5.3	5.9	23.3	40.4	6.3	95.4
8	-1.2	4.6	9.6	4.8	5.6	17.8	44.1	6.5	91.8
9	-1.3	5.6	9.4	5.3	6.5	19.7	40.9	6.5	92.7
10	-1.3	5.6	9.4	6.3	7.6	17.5	44.6	6.9	96.6
11	-1.3	5.4	9.7	5.3	6.5	19.9	43.0	6.1	94.6
16	-1.3	5.5	10.4	3.8	3.8	21.8	42.3	6.5	92.9
17	-1.2	6.0	9.7	5.3	4.7	24.4	36.4	6.5	91.8
18	-1.2	5.5	9.8	4.8	5.7	20.4	42.9	6.5	94.4
19	-1.3	6.1	7.3	4.0	4.3	21.1	45.9	6.3	93.7
20	-1.3	6.4	7.0	3.0	4.6	16.6	50.0	7.7	93.9
21	-1.3	5.7	7.4	2.9	3.6	12.0	58.2	6.2	94.8
23	-1.3	4.3	7.4	3.5	4.4	16.8	51.2	8.2	94.5
26	-1.5	5.1	7.2	4.6	5.6	26.2	43.1	7.0	97.2
27	-1.6	4.8	8.1	4.0	4.7	23.7	38.6	8.1	90.5
28	-1.6	5.1	8.3	3.9	5.0	22.2	47.6	6.0	96.5
29	-1.5	5.3	10.0	4.3	4.9	21.6	45.1	6.7	96.4
30	-1.6	5.5	9.8	3.4	4.2	15.9	45.7	7.4	90.3
31	-1.2	6.5	9.3	4.3	4.8	28.3	41.0	6.7	99.7
Jun 1	-1.2	7.0	9.7	4.1	4.8	21.0	44.4	8.2	98.0
3	-0.8	2.7	8.4	4.4	5.2	16.5	50.3	9.2	95.9
9	-0.8	5.0	7.9	4.4	4.8	14.0	48.6	8.8	92.7
10	-0.8	4.6	8.5	4.2	4.7	15.5	50.4	8.7	95.7
11	-0.9	4.5	8.5	4.3	5.1	16.5	46.9	8.2	93.1
12	-0.9	4.6	8.4	4.1	4.1	17.2	44.4	7.9	89.8
13	-0.8	4.1	9.0	4.6	5.2	18.7	48.4	8.4	97.6
14	-0.8	3.8	9.2	4.3	5.0	19.3	43.9	7.8	92.4
17	-0.8	4.7	9.4	4.2	4.2	12.8	47.2	8.1	89.8
18	-0.8	4.5	9.4	4.4	4.6	13.8	45.5	9.2	90.6
19	-0.9	4.1	7.9	4.3	5.5	16.0	47.5	8.7	93.2
21	-0.9	4.6	8.6	4.0	5.3	15.6	51.4	9.1	97.6
22	-0.9	4.8	8.9	4.6	5.0	9.4	51.1	10.2	93.1
25	-0.7	5.1	9.9	4.7	5.3	16.7	47.4	8.9	97.4
27	-0.8	5.5	8.5	3.8	4.6	10.2	55.7	9.1	96.6

(a) Calculated using the ethylene injection method.

Table 5
Hydrogen Leakage Tests

Date, 1983	28-29 June			
Test number	1	2	3	4
<u>R101 Dissolver</u>				
Temperature, °F	689	683	685	686
Pressure, psig	1,500	1,500	2,400	2,400
Volume in use, %	50	50	50	50
Solvent flow rate, lb/hr	1,200	1,200	1,200	1,200
V103 feed gas rate, scfh	3,500	3,510	4,170	4,170
V103 feed gas, % hydrogen	98.3	98.3	98.0	98.0
C104 makeup hydrogen, lb/hr	7.32	4.65	4.57	7.45
Hydrogen to flare, lb/hr	5.71	3.92	3.55	1.73
<u>Hydrogen disappeared</u>				
lb/hr	1.61	0.75	1.02	1.73
Percent of solvent	0.13	0.06	0.09	0.14
Percent of makeup H ₂	22.0	16.1	22.3	23.2
C ₁ -C ₃ produced, lb/hr	0.7	1.0	0.8	1.0

Table 6
SRC Unit Operating Conditions - Special Product Workup Periods

For Phase 1 the dissolver operated at 785-830°F (outlet) with 50% of its volume in use. Solids withdrawal was at 6 wt. % of feed and the high pressure separator was operated in the hot mode.

Date, 1983	21 Feb	1 Mar	10 Mar	14 Mar	22 Mar	2 Apr
Run number	243A	243B	243C	243D	243E	243F
<u>Slurry feed rate, lb/hr</u>						
MF coal	246	235	252	250	254	251
Recycle distillate solvent	210	201	211	227	217	223
HTR SRC(a)	228	226	227	215	225	235
Coal(MF): distillate solvent: HTR SRC wt ratio	1:0.85:0.93	1:0.85:0.96	1:0.84:0.90	1:0.91:0.86	1:0.86:0.89	1:0.89:0.93
SRC distillate solvent in process solvent, wt %	0	3	0	0	0	0
Slurry conc., wt % of MF coal	35.7	35.3	36.3	35.8	36.1	35.2
Feed gas, scfh	3,230	3,360	3,290	3,410	4,860	4,580
Hydrogen purity, mol %	85.9	87.6	85.8	89.0	87.1	84.9
<u>Solvent activity, % THF conversion</u>						
<u>Process solvent(b)</u>						
Kinetic test	84.6	84.1	80.8	82.7	77.7	73.9
Equilibrium test	82.3	85.5	88.2	88.9	87.7	88.7
+650°F. fraction, wt %	90.3	89.5	89.7	91.1	92.1	93.3
<u>Distillate solvent(c)</u>						
Kinetic test	80.5(-)	85.0(83.5)	81.3(86.5)	80.1(87.5)	70.0(83.2)	67.0(84.4)
Equilibrium test	80.2(73.2)	86.4(74.7)	87.8(75.1)	88.4(76.3)	84.7(75.7)	78.6(76.6)
+650°F. fraction, wt %	80.5(72.9)	78.0(70.6)	79.5(73.7)	82.5(77.5)	83.7(78.1)	85.9(82.3)
Preheater outlet temp., °F	817	827	844	844	835	826
<u>Dissolver</u>						
Coal space rate, lb/hr-ft ³ (d)	26.7(19.3)	25.5(18.5)	27.4(19.9)	27.1(19.6)	27.6(20.0)	27.3(19.8)
Pressure, psig	2,400	2,400	2,400	2,400	2,410	2,400
Temperature, °F	800	800	798	800	799	785
Hydrogen partial pressure, outlet psia(e)	1,500	1,560	1,550	1,760	1,810	1,760
High pressure separator temp., °F.	664	658	654	668	662	669
Low pressure separator temp., °F.	611	592	607	617	610	608
Vacuum Column bottoms temp., °F.	628	631	632	631	630	630
Coal conversion to cresol solubles, % MAF coal(f)	92.1(93.5)	91.3(90.9)	92.8(92.6)	94.0(93.5)	93.5(93.6)	91.7(93.0)

(Table continued)

Table 6 (continued)
SRC Unit Operating Conditions -- Special Product Workup Periods

For Run 243 Phase 2 since 22 April after installing the new transfer line the dissolver operated 810-825°F (outlet) with 25% of its volume in use. Solids withdrawal was at 6 wt. % of feed and the high pressure separator was operated in the hot mode.

Date, 1983 Run number	1 May 243G	8 May 243H	23 May 243I	29 May 243J	31 May 243K	13 Jun 243L	19 Jun 243M
<u>Slurry feed rate, lb/hr</u>							
MF coal	252	252	244	194	193	189	201
Recycle distillate solvent	233	237	218	181	178	173	193
HTR SRC(a)	215	217	218	162	166	164	167
Coal(MF): distillate solvent: HTR SRC wt ratio	1:0.93:0.85	1:0.94:0.86	1:0.89:0.89	1:0.93:0.84	1:0.92:0.86	1:0.91:0.87	1:0.96:0.83
SRC distillate solvent in process solvent, wt %	1	0	0	0	0	0	0
Slurry conc., wt % of MF coal	35.7	35.5	35.6	35.9	35.8	35.6	35.6
Feed gas, scfh	3,330	3,380	3,300	3,310	3,420	3,240	3,320
Hydrogen purity, mol %	88.0	88.8	87.3	87.3	87.9	70.0	70.2
<u>Solvent activity, % THF conversion</u>							
<u>Process solvent(b)</u>							
Kinetic test	84.0	87.6	79.4	87.3	88.2	87.7	87.8
Equilibrium test	89.6	89.2	90.5	88.8	91.5	88.3	90.9
+650 °F fraction, wt %	88.5	87.8	88.0	89.5	90.1	90.9	89.9
<u>Distillate solvent(c)</u>							
Kinetic test	81.1(75.C)	83.5(78.1)	81.1(71.9)	84.1(78.7)	-(78.9)	-(70.4)	-(69.5)
Equilibrium test	83.3(70.9)	84.5(71.3)	85.6(71.6)	88.8(69.2)	83.3(62.8)	88.8(68.8)	89.3(72.7)
+650 F fraction, wt %	77.3(64.8)	76.1(67.2)	76.8(71.5)	79.7(70.4)	79.8(73.4)	82.8(68.0)	81.9(75.6)
Preheater outlet temp., °F	824	830	813	814	815	827	823
<u>Dissolver</u>							
Coal space rate, lb/hr-ft ³ (d)	57.0(37.9)	57.0(35.7)	55.2(34.6)	43.9(27.5)	43.7(27.4)	42.8(26.8)	45.5(28.5)
Pressure, psig	2,400	2,400	2,400	2,400	2,400	1,500	1,500
Temperature, °F	825	824	809	810	810	810	810
Hydrogen partial pressure, outlet psia(e)	1,690	1,800	1,760	1,780	1,880	970	920
High Pressure separator temp., °F	694	693	679	656	656	658	661
Low Pressure separator temp., °F	637	638	628	592	589	591	598
Vacuum Column bottoms temp., °F	631	631	630	630	629	630	630
Coal conversion to cresol solubles, % MAF coal(f)	92.0(93.1)	91.9(93.6)	93.2(93.5)	93.1(92.6)	93.1(93.8)	92.0(94.3)	91.3(93.3)

(Table continued)

Table 6 (continued)
SRC Unit Operating Conditions - Special Product Workup Periods

- (a) Laboratory defined SRC.
- (b) Sample from recycle process solvent storage tank, process solvent with HTR SRC mixed (V131B or V1067).
- (c) With distillate solvent from recycle process solvent. Data in parentheses were obtained with distillate solvent for HTR unit feed (V178).
- (d) Based on 4.42 cu ft of the dissolver volume (25% in use). Data in parentheses were calculated based on a total reaction volume 7.05 cu ft, including 2.4 cu ft of the preheater and 0.23 cu ft of the transfer line.
- (e) Calculated from hydrogen consumption data by the ethylene injection method.
- (f) Based on the analysis of CSD feed (Vacuum Column bottoms). Values in parentheses were based on the analysis of low pressure flash bottoms (V110).

Table 7
CSD Unit Operating Data

Date 1985	Feed time, hr(a)	Feed from T102 bottoms					Softening- fusion points, °F	Production rate	
		Rate, lb/hr(c)	Ash, %	UC, %	Solv, %(b)	Sulfur, %		Ash conc, lb/hr	SRC, lb/hr(d)
Feb 3	-	-	-	-	-	-	-	-	-
4	16.8	171.4	2.8	1.2	17.1	1.05	221-232	43.3	128.1
5	21.6	294.6	8.1	4.9	12.0	1.17	210-228	53.8	240.8
6(e)	24	209.8	10.96	5.0	10.7	1.26	239-257	63.0	146.8
7	24	260.7	11.0	8.0	6.9	1.54	221-234	74.0	186.7
8	2.0	-----Unit off-line due to lack of feed-----							
9	20	267.3	9.5	7.0	8.7	1.47	225-250	58.1	209.2
10	24	286.	9.6	8.4	9.0	1.67	232-262	67.0	219.0
11	12.5	295.5	8.7	5.2	8.9	1.20	228-260	60.8	234.7
12	21.3	274.4	8.8	5.7	10.1	1.32	210-255	65.8	208.6
13(f)	20.5	311.3	8.5	5.6	8.9	1.23	212-257	67.7	243.6
14	19.9	303.	8.1	4.7	8.4	1.04	209-254	56.0	247.0
15	22.8	345.4	7.8	4.0	9.3	1.05	217-266	66.4	279.0
16	21.3	355.5	8.9	5.1	9.1	1.27	217-264	82.5	273.1
17	24	349.4	8.4	4.2	9.0	1.20	217-266	75.4	274.0
18	24	344.3	7.3	4.8	9.0	1.03	230-248	64.8	279.5
19	24	353.6	7.1	4.2	8.8	0.94	239-257	58.6	295.0
20	24	381.6	7.0	4.5	8.2	1.14	240-260	66.8	314.8
21	24	391.6	6.9	4.5	8.4	1.00	230-248	70.3	321.3
22	24	409.6	6.8	4.4	7.6	0.98	240-250	69.0	340.6
23	24	382.	6.9	4.9	8.1	0.96	248-257	66.1	315.9
24	23.6	418.	6.9	4.4	9.4	0.93	203-230	75.7	342.3
25	24	341.7	6.7	4.6	5.4	0.86	244-262	60.1	281.6
26	22.5	374	6.9	5.0	9.0	0.92	252-282	68.2	305.8
27	21.0	393.5	7.2	4.5	9.8	0.89	257-286	62.2	331.3
28	24	370.8	6.8	4.7	9.3	0.75	230-262	60.1	310.7

- (a) Mode 1 operation using the high pressure recycle solvent system.
 (b) 600°F and 0.1 mm Hg.
 (c) Rate is the sum of SRC production (DAS free) and ash conc. production (includes DAS).
 (d) SRC rate is DAS free, by V1086 measurement, and corrected for inventory changes.
 (e) T102 bottoms temperature increased to 630°F.
 (f) Changed from DAS A to DAS E.

Table 7 (continued)
CSD Unit Operating Data

		Feed from T102 bottoms						Production rate		
Date 1983	Feed time, hr(a)	Rate, lb/hr(c)	Ash, %	UC, %	Solv %(h)	Sulfur, %	Softening- fusion points, °F	Ash conc, lb/hr	SRC, lb/hr(d)	
Mar	1(e)	24.0	351.5	6.78	4.3	7.8	0.78	248-271	62.7	288.8
	2	24.0	404.8	7.09	4.6	5.6	0.83	230-266	73.8	331.0
	3	24.0	401.9	6.8	4.9	8.3	0.91	226-248	71.0	330.9
	4	24.0	413.7	6.8	3.9	6.7	1.00	224-243	75.6	338.1
	5	21.2	419.5	6.6	4.1	7.8	1.03	217-235	66.9	352.6
	6	22.3	414.7	7.0	5.0	6.6	0.95	221-239	57.8	356.9
	7	23.5	424.6	6.6	3.6	6.3	0.90	221-230	65.2	359.4
	8(f)	19.5	434.3	7.5	4.2	8.2	1.06	223-237	83.7	350.6
	9	24	405.0	7.8	5.2	6.5	0.87	216-234	76.1	328.9
	10	24	393.6	7.8	4.2	8.5	0.96	226-232	76.4	317.2
	11	24	383.2	7.4	3.6	9.5	0.85	208-226	69.2	314.0
	12	24	391.3	7.5	3.7	9.3	0.84	210-224	70.0	321.3
	13	24	397.8	7.5	3.1	7.2	0.92	217-234	71.2	326.6
	14	24	395.3	7.3	3.4	8.8	0.83	212-224	68.5	326.8
	15	24	412.2	7.3	3.3	7.8	0.86	208-224	72.5	339.7
	16	24	409.7	7.1	3.6	9.3	0.83	208-223	73.1	336.6
	17	24	402.4	7.5	3.1	8.9	0.84	210-224	75.2	327.2
	18	24	390.7	7.2	3.6	9.0	0.88	219-230	70.0	320.7
	19	24	394.7	7.3	3.9	12.5	0.92	203-219	74.0	320.7
	20	24	409.7	7.2	4.5	9.9	-	185-203	79.6	330.1
	21	21.8	405.2	7.3	3.8	10.8	-	210-230	69.2	336.0
	22	24	408.2	7.4	3.8	9.8	-	212-230	70.0	338.2
	23(g)	24	419.1	7.0	3.8	9.0	0.87	203-220	76.0	343.1
	24	24	424.2	7.0	3.7	9.4	0.95	212-230	79.4	344.8
	25	24	413.7	8.1	3.3	8.7	0.87	226-239	75.6	338.1
	26	24	418.7	7.2	4.1	6.2	0.83	230-248	76.6	342.1
	27	24	427.8	7.5	4.2	10.4	0.92	221-239	75.2	352.6
	28	24	432.1	8.2	3.2	9.3	1.13	223-241	78.0	354.1
	29	23.8	401.5	7.3	3.7	6.5	0.87	199-235	74.5	327.0
	30	22.8	430.1	7.2	4.1	5.3	0.88	232-259	81.6	348.5
	31	21	443.6	7.1	3.4	6.0	0.96	221-241	85.1	358.5
Apr	1	24	449.6	7.1	3.9	4.4	0.86	212-230	83.0	366.6
	2	24	419.9	6.8	4.2	5.8	1.06	201-238	81.1	338.8
	3	24	424.2	7.0	3.5	7.4	1.07	214-232	81.2	343.0
	4	24	393.5	7.0	3.0	7.2	0.99	210-228	76.1	317.4
	5	23.8	422.5	6.8	4.2	7.2	1.13	212-230	80.6	341.9
	6	20.8	420.8	6.9	4.1	7.0	1.05	210-230	80.4	340.4

- (a) Mode 1 operation using the high pressure recycle solvent system.
(b) 600°F and 0.1 mm Hg.
(c) Rate is the sum of SRC production (DAS free) and ash conc. production (includes DAS).
(d) SRC rate is DAS free, by VE086 measurement, and corrected for inventory changes.
(e) Changed from DAS E to DAS F.
(f) Changed to DAS G.
(g) Changed to DAS I. SRC unit dissolver temperature reduced from 800 to 785°F.

(Table continued)

Table 7 (continued)
CSD Unit Operating Data

Date, 1983	Feed time, hr(a)	Feed from T102 bottoms						Production rate	
		Rate, lb/hr(c)	Ash, %	UC, %	Solv, %(b)	Sulfur, %	Softening- fusion points °F	Ash conc, lb/hr	SRC, lb/hr(d)
Apr 7-22		-----Unit off-line due to planned maintenance outage-----							
23	18.8	242.5	8.9	5.1	10.3	0.98	241-262	58.5	184.0
24(e)	23	298.9	9.1	5.1	8.9	1.10	237-253	72.3	226.6
25	23.7	352.1	9.3	4.7	9.7	1.04	226-246	75.9	276.6
26	24	359.5	7.9	4.3	8.0	1.10	230-253	76.9	282.6
27	24	372.7	7.7	4.9	9.9	0.86	246-266	84.7	288.0
28	24	389.1	7.1	5.3	7.9	0.82	226-255	85.6	303.5
29	24	386.1	7.1	3.6	7.3	0.93	239-257	80.7	305.4
30	24	386.8	7.3	3.7	8.0	0.91	236-255	80.4	306.4
May 1	24	389.0	7.0	4.5	8.3	0.97	230-239	79.1	309.9
2	24	403.5	7.1	3.9	8.4	-	230-240	83.0	320.5
3(f)	7.8	405.2	7.1	3.7	6.3	0.93	221-239	82.7	322.5
4	12.0	385.7	7.5	3.5	9.9	0.94	203-212	72.0	313.7
5(g)	24	395.3	6.8	4.2	8.3	0.97	223-241	77.8	317.5
6	24	381.1	7.2	3.9	9.7	1.01	223-252	70.7	310.4
7	24	388.6	6.8	3.6	10.4	0.97	216-248	67.0	321.6
8	24	388.5	6.8	3.7	8.9	0.87	214-242	74.1	314.4
9	24	378.8	7.0	3.8	9.3	0.72	212-250	74.3	304.5
10	24	399.5	7.1	3.9	8.4	-	230-250	77.2	322.3
11	24	388.3	6.6	3.5	9.6	0.80	221-257	77.2	311.1
12(h)	14.9	405.6	6.8	3.2	8.7	0.93	221-252	77.0	328.6
13	3	-	-	-	-	-	-	-	-
14	19.8	377.2	7.2	4.0	12.4	0.89	216-226	66.6	310.6
15	24	354.6	7.1	3.7	8.9	1.01	217-235	73.9	280.7
16	24	381.0	7.1	3.6	9.3	0.89	216-226	72.8	308.2
17	23.3	384.9	7.0	3.7	11.0	0.86	217-225	72.3	312.6
18(i)	24	396.4	6.9	3.6	9.0	0.94	215-226	72.3	325.9
19(j)	24	399.2	7.0	3.5	9.5	0.97	230-248	72.6	326.6
20	24	406.3	6.7	4.2	9.0	1.0	235-250	75.3	331.0
21	24	390.5	6.8	3.4	5.0	0.90	214-239	72.0	318.5
22	24	401.1	6.7	4.2	6.5	0.83	221-244	72.8	328.3

- (a) Mode 1 operation using the high pressure recycle solvent system.
(b) 600°F and 0.1 mm Hg.
(c) Rate is the sum of SRC production (DAS free) and ash conc. production (includes DAS).
(d) SRC rate is DAS free, by V1086 measurement, and corrected for inventory changes.
(e) Changed to Daylight Savings Time.
(f) HTR unit catalyst was changed 3-4 May.
(g) Changed from DAS I to DAS H.
(h) HTR unit repairs between 12-13 May.
(i) Changed to DAS G.
(j) SRC unit dissolver temperature reduced from 825 to 810°F.

(Table continued)

Table 7 (continued)
CSD Unit Operating Data

Date, 1983	Feed time, hr(a)	Feed from T102 bottoms					Softening- fusion points, °F	Production rate	
		Rate, lb/hr(c)	Ash, %	UC, %	Solv, %(b)	Sulfur, %		Ash conc, lb/hr	SRC, lb/hr(d)
May 23	24	406.0	6.8	4.5	5.6	.80	217-248	73.9	332.1
24(e)	18.4	397.5	7.0	4.1	7.4	.82	226-244	72.7	324.8
25	24	387.9	7.1	4.9	6.2	.96	-	80.5	309.4
26	24	321.1	7.5	4.1	6.3	.96	235-253	68.0	253.1
27	24	297.4	7.3	4.7	9.1	.99	226-245	56.6	240.8
28	24	310.7	7.1	3.4	8.4	.90	228-246	39.4	251.3
29	24	296.6	7.1	3.9	8.5	.92	230-248	55.3	241.3
30	24	298.3	7.1	4.1	9.0	.85	228-246	54.9	243.4
31	24	297.9	7.1	3.9	9.1	.85	235-243	56.0	241.9
Jun 1	24	298.5	6.9	4.6	9.0	.96	234-252	54.8	243.7
2(f)	14.1	295.5	6.8	4.5	7.3	.94	210-221	56.3	239.2
3(g)	6.8	281.8	-	-	-	-	-	47.4	234.4
4	24	311.9	7.0	3.5	10.8	.85	190-208	60.1	251.8
5	24	300.2	7.0	4.6	11.8	.91	198-221	62.3	237.9
6	23.9	313.5	7.3	4.7	10.0	1.01	208-230	69.4	244.1
7	24	302.7	6.6	5.1	9.6	.91	212-226	65.9	236.8
8	22	324.4	6.5	5.1	9.4	.89	210-228	71.3	253.1
9	24	314.4	6.4	5.0	9.4	.81	205-225	65.9	248.5
10(h)	24	301.9	6.8	4.8	9.8	.83	208-230	62.1	239.8
11	24	310.7	6.8	4.6	10.0	.86	220-239	64.5	246.2
12	24	310.3	6.8	4.5	10.1	.85	212-221	63.2	247.1
13	24	308.6	6.8	4.6	9.1	.94	208-220	63.0	245.6
14(i)	21	301.2	7.0	4.3	10.3	.99	-	61.4	239.8
15	24	342.3	6.8	4.4	9.0	-	-	68.3	274.0
16	23.9	317.3	6.8	4.2	11.8	-	-	63.0	254.3
17	24	321.9	5.6	-	10.7	-	221-262	66.0	255.9
18	24	335.1	5.9	5.1	11.7	-	217-235	68.6	266.5
19	24	325.4	6.7	4.8	11.5	-	-	66.6	258.8
20	21.4	333.5	6.8	5.7	10.9	-	-	67.2	266.3
21	24	328.4	6.6	4.9	10.1	.95	-	67.2	261.2
22	24	328.9	6.6	5.6	8.4	1.08	-	67.0	261.9
23	22	345.7	6.8	6.0	6.0	1.0	-	69.2	276.5
24	24	313.8	6.7	5.8	7.3	.95	212-230	62.1	251.7
25	21.8	325.1	7.0	5.0	10.3	.98	210-228	64.8	260.3
26	24	352.4	5.5	4.3	10.7	.96	215-230	66.0	286.4
27	22.5	383.4	6.2	4.8	9.9	.86	210-233	70.8	312.6
28	8	465.0	6.7	5.3	9.5	1.24	214-230	90.5	374.5

(a) Mode 1 operation using the high pressure recycle solvent system.

(b) 600°F and 0.3 mm Hg.

(c) Rate is the sum of SRC production (DAS free) and ash conc. production (includes DAS).

(d) SRC rate is DAS free, by V1086 measurement, and corrected for inventory changes.

(e) SRC unit repairs limited operation.

(f) Shutdown to clean First Stage Separator 2-3 June.

(g) R101 Dissolver pressure was reduced to 1700 psig and feed gas hydrogen purity was reduced to 70 mole %. Dissolver pressure was lowered to 1500 psig on 6 June.

(h) Changed from DAS G to DAS F.

(i) Changed to DAS E.

Table 8
CSD Unit Analytical Data

Date, 1983	Ash concentrate					SRC				Softening- fusion points, °F	Recovery(b), %	Energy reject, %(c)
	DAS-free basis											
	Ash, %	UC, %	SRC, %(a)	Solv, %(a)	DAS, %	Ash, %	Sulfur, %	Solv, %(a)	DAS, %			
Feb 3	-	-	-	-	-	-	-	-	-	-	-	-
4	36.5	41.7	16.9	4.9	0.3	0.02	0.64	21.8	1.9	162-207	96.3	-
5	38.3	39.1	19.4	3.2	1.8	0.26	0.57	15.9	1.5	180-216	90.6	-
6	37.7	41.1	18.6	2.6	1.0	0.08	0.61	12.9	1.2	184-220	86.5	21.1
7	38.0	45.9	13.1	3.0	1.0	0.01	0.65	12.7	0.8	185-215	87.7	21.7
8	Unit off-line due to lack of feed											
9	38.7	38.3	17.8	5.2	1.2	1.6	0.80	14.8	1.6	181-199	89.7	20.2
10	39.2	37.8	20.3	2.7	1.3	0.49	0.60	14.7	3.0	185-203	-	-
11	38.7	38.0	18.8	4.5	1.4	2.61	0.74	11.7	1.5	203-217	90.1	-
12	38.0	39.8	19.8	2.4	1.0	0.67	0.66	14.7	2.2	187-203	89.9	-
13	38.7	38.7	19.7	2.9	1.0	1.75	0.70	8.9	0.9	202-221	90.8	21.2
14	39.4	35.1	22.0	3.5	1.3	0.29	0.54	13.9	2.2	194-203	91.1	19.2
15	39.9	29.4	28.7	2.0	0.8	0.49	0.50	13.1	0.9	198-216	91.2	19.2
16	38.6	29.6	29.3	2.5	0.9	0.03	0.56	13.7	2.2	212-237	89.5	20.9
17	38.8	30.6	28.2	2.4	0.9	0.06	0.55	12.9	1.7	221-248	89.6	21.3
18	40.2	27.5	31.4	0.9	1.1	0.11	0.53	12.4	1.8	212-239	93.1	-
19	38.4	31.6	26.7	3.3	0.1	-	0.57	11.3	1.6	185-230	91.9	-
20	39.6	33.0	26.1	1.3	0.8	0.03	0.59	10.9	-	212-239	93.0	-
21	38.2	24.3	35.8	1.7	0.7	0.03	0.48	11.4	2.0	210-234	92.6	21.1
22	37.4	31.2	29.9	1.5	0.8	-	-	-	-	-	92.2	21.5
23	39.5	36.0	24.3	0.2	1.9	0.23	0.47	6.9	0.9	203-230	93.5	20.1
24	38.7	31.9	29.0	0.4	0.8	0.06	0.41	9.0	1.6	207-225	94.0	20.4
25	40.2	34.0	24.2	1.6	1.4	0.07	0.41	10.0	1.8	216-225	93.3	-
26	38.7	36.1	23.9	1.3	1.6	0.05	0.39	7.3	2.0	218-230	93.3	-
27	39.4	33.1	26.9	0.6	1.5	0.15	0.49	8.7	1.6	212-221	92.5	21.2
28	39.6	30.4	27.9	2.1	1.7	0.08	0.36	9.4	1.4	217-229	93.6	21.3

(a) 600°F and 0.1 mm Hg.

(b) Percent of cresol soluble feed from T102 bottoms by forced ash balance.

(c) Feed coal energy, as percent, lost to organics in ash concentrate.

(Table continued)

Table 8 (continued)
CSD Unit Analytical Data

Ash concentrate						SRC						Softening- fusion points, °F	Recovery(b), %	Energy reject, %(c)
Date, 1983	DAS free basis					Ash, %	Sulfur, %	Solv, %(a)	DAS, %					
	Ash, %	UC, %	SRC, %(a)	Solv, %(a)	DAS, %									
Mar	1	38.6	33.7	25.9	1.8	2.1	.10	.51	8.5	1.2	-	92.7	21.9	
	2	38.7	29.0	31.9	0.4	1.2	.05	.35	11.6	1.1	194-230	92.5	22.1	
	3	38.1	30.6	30.5	0.8	1.0	.08	.56	12.4	1.0	216-248	93.0	20.9	
	4	39.4	32.8	26.2	1.6	0.3	.01	.45	11.4	1.3	207-239	92.7	-	
	5	40.6	35.1	18.1	6.2	1.8	1.8	.64	10.6	1.3	198-230	93.7	-	
	6	39.4	36.5	19.9	4.2	0.5	1.4	.58	10.2	0.8	203-239	93.5	19.8	
	7	40.2	35.2	22.2	2.4	0.5	2.5	.58	6.5	1.0	208-239	93.1	18.9	
	8	38.5	41.0	19.9	0.6	1.9	1.3	.52	11.0	1.1	194-226	91.2	19.4	
	9	39.6	37.0	21.4	2.0	0.8	.05	.43	11.8	1.4	185-203	92.3	21.8	
	10	40.2	32.5	25.0	2.3	0.9	.01	.52	11.5	1.4	176-198	91.6	21.6	
	11	41.1	30.1	27.2	1.6	0.8	.02	.40	11.5	1.1	189-203	92.1	-	
	12	39.8	28.7	30.4	1.1	0.3	.05	.41	12.8	-	194-212	91.4	-	
	13	40.8	27.7	29.3	2.2	0.5	.21	.39	12.2	1.5	178-196	91.3	20.5	
	14	40.5	27.5	31.1	0.9	0.9	.27	.41	13.2	1.4	176-194	91.8	20.6	
	15	40.5	26.0	33.2	0.3	1.0	.04	.37	11.6	1.2	176-194	91.7	21.7	
	16	40.1	26.8	32.4	0.7	0.8	.03	.42	12.8	1.4	189-205	92.2	21.2	
	17	37.5	27.7	33.4	1.4	0.8	.07	.45	12.1	1.6	189-216	89.5	23.6	
	18	41.9	29.4	27.1	1.6	1.8	.02	.40	12.9	1.6	183-207	92.9	-	
	19	41.0	28.0	30.4	0.6	2.9	.04	.50	14.4	2.0	181-212	92.6	-	
	20	36.7	33.6	28.6	1.1	1.9	1.0	-	11.9	1.4	189-208	91.1	24.0	
	21	41.9	26.9	31.1	0.1	2.5	.2	-	13.8	1.7	185-207	92.9	19.9	
	22	42.1	29.4	27.7	0.8	2.1	.01	.33	9.1	-	190-207	92.8	18.7	
	23	39.4	30.3	29.1	1.2	1.0	.02	.38	11.8	1.0	190-210	92.2	-	
	24	38.6	29.2	32.2	0	2.6	.01	.49	10.6	1.3	192-203	91.7	21.9	
	25	37.5	28.7	32.3	1.5	1.5	-	.40	9.1	1.1	200-222	88.5	-	
	26	38.1	28.8	30.6	2.5	1.0	.03	.44	10.2	1.2	187-201	91.4	-	
	27	39.2	26.4	34.0	0.4	1.7	.02	.41	10.5	0.5	194-213	91.6	21.8	
	28	38.4	26.9	33.9	0.8	2.7	.03	.44	10.6	1.9	187-205	88.8	21.7	
	29	37.6	29.4	31.3	1.7	0.6	.03	.48	7.4	1.1	185-230	90.6	23.8	
	30	38.9	27.1	33.2	0.8	1.8	.02	.48	8.4	1.0	198-230	91.4	22.8	
	31	39.0	26.2	33.8	1.0	1.4	.91	.46	10.6	1.3	194-235	91.4	-	
Apr	1	32.3	26.4	36.8	4.5	0.4	.04	.49	10.8	1.5	194-234	90.8	-	
	2	34.7	27.0	37.0	1.3	0.3	.02	.44	15.6	1.9	190-217	90.2	-	
	3	35.3	28.6	35.8	0.3	1.5	.02	.45	11.7	1.1	203-239	89.6	26.1	
	4	34.8	25.5	37.8	1.9	0.5	.07	.62	11.2	1.2	201-235	87.1	26.3	
	5	35.6	29.6	33.1	1.7	0.4	.01	.67	9.9	1.1	198-201	90.9	25.5	
	6	35.6	31.6	31.6	1.2	1.8	.02	.54	12.0	0.7	181-199	90.8	-	

(a) 600°F and 0.1 mm Hg.

(b) Percent of cresol soluble feed from T102 bottoms by forced ash balance.

(c) Feed coal energy, as percent, lost to organics in ash concentrate.

(Table continued)

Table 8 (continued)
CSD Unit Analytical Data

Date, 1983	Ash concentrate					SRC					Softening- fusion points °F	Recovery(b), %	Energy reject, %(c)
	DAS free basis					Ash, %	Sulfur, %	Solv, %(a)	DAS, %				
	Ash, %	UC, %	SRC, %(a)	Solv, %(a)	DAS, %								
Apr 7-22	-----Unit off-line due to planned maintenance outage-----												
23	37.2	33.4	29.0	0.4	1.1	.02	.33	15.1	2.1	167-185	88.4	-	
24	39.4	29.5	30.7	0.4	1.3	.02	.42	13.8	2.4	176-194	89.6	21.6	
25	39.0	28.9	31.7	0.4	0.9	.02	.49	12.5	1.2	199-212	88.5	21.8	
26	37.4	28.5	33.5	0.6	1.0	.02	.35	11.2	1.2	205-219	89.8	24.5	
27	34.5	27.2	37.7	0.6	0.8	.04	.34	10.7	1.0	198-226	88.9	27.9	
28	33.3	29.1	35.5	2.1	0.2	.01	.35	13.8	1.1	194-230	89.8	-	
29	34.8	33.0	31.8	0.4	1.1	.01	.41	13.3	1.4	239-257	89.1	-	
30	33.8	28.6	36.2	1.4	0.6	.03	.43	13.6	1.6	198-234	88.1	-	
May 1	34.1	30.8	34.6	0.5	1.4	.02	.41	13.8	1.3	194-234	89.8	25.3	
2	33.6	30.6	34.5	1.3	0.2	.04	.42	10.7	0.9	203-221	88.6	-	
3	30.2	30.2	37.0	2.6	0.6	.81	.44	9.0	1.1	189-230	85.7	-	
4	32.1	28.1	37.7	2.1	0.4	.09	.57	11.7	1.3	185-194	86.1	-	
5	33.2	33.2	32.1	1.5	0.6	.03	.50	14.4	1.1	194-203	89.5	27.0	
6	35.6	33.0	31.1	0.3	0.8	.24	.44	14.6	1.9	190-208	89.7	-	
7	38.3	30.3	30.8	0.6	1.1	.21	.37	17.1	1.9	176-185	91.8	-	
8	36.2	29.6	33.9	0.3	1.2	.05	.39	11.0	1.3	176-189	90.8	24.0	
9	35.6	29.3	33.3	1.8	0.9	.04	.32	13.2	1.2	185-194	90.0	23.8	
10	35.7	28.1	35.3	0.9	1.6	-	-	-	-	-	90.0	24.6	
11	34.4	30.6	34.3	0.7	2.1	.06	.35	10.8	1.1	207-237	89.9	24.9	
12	34.5	30.0	34.9	0.6	1.3	-	.39	-	-	-	89.2	25.7	
13	-----Unit off-line due to lack of feed-----												
14	36.9	30.0	32.3	0.8	1.1	.09	.40	11.9	1.4	194-221	90.6	-	
15	36.3	27.6	36.1	-	1.4	.01	.42	10.5	-	189-221	90.2	23.0	
16	37.8	29.1	32.0	1.1	2.3	.01	.41	10.2	3.8	199-230	91.0	21.7	
17	38.2	30.2	31.3	0.3	3.5	.03	.41	11.9	2.7	198-219	91.4	21.0	
18	37.8	30.8	30.7	0.7	2.4	.04	.42	11.5	1.2	185-203	91.4	22.0	
19	37.6	30.0	31.7	0.7	2.3	.02	.45	13.2	1.3	185-208	90.9	22.0	
20	37.2	29.3	32.9	0.6	1.9	.02	.48	12.0	3.0	183-201	92.0	23.6	
21	37.0	31.5	30.1	1.4	2.5	.02	.41	11.8	4.0	184-210	90.9	22.4	
22	37.0	31.9	30.4	0.7	2.1	.14	.40	11.0	4.2	181-190	91.9	23.8	

(a) 600°F and 0.1 mm Hg.

(b) Percent of cresol soluble feed from T102 bottoms by forced ash balance.

(c) Feed coal energy, as percent, lost to organics in ash concentrate.

(Table continued)

Table 8 (continued)
CSD Unit Analytical Data

Date, 1983	Ash concentrate					SRC						Energy reject, %(c)
	DAS free basis					Softening- fusion points, °F					Recovery(b), %	
	Ash, %	UC, %	SRC, %(a)	Solv, %(a)	DAS, %	Ash, %	Sulfur, %	Solv, %(a)	DAS, %			
May 23	36.4	32.1	31.0	0.5	2.1	.02	.43	11.5	3.7	183-201	91.7	22.6
24	37.2	33.1	29.3	0.4	2.9	.03	.43	11.5	1.4	180-189	91.3	21.1
25	34.7	33.4	30.7	1.2	2.5	.02	.40	9.7	1.2	198-230	90.4	24.7
26	34.6	33.0	31.2	1.2	2.1	.04	.49	9.9	1.1	203-223	88.6	25.7
27	36.5	28.2	30.6	4.7	1.0	.05	.58	10.0	1.6	190-221	90.9	-
28	35.1	31.0	32.5	1.4	1.7	.05	.54	9.5	0.9	185-221	89.1	-
29	38.7	28.9	31.8	0.6	2.3	.03	.59	10.3	1.4	185-221	91.7	-
30	37.9	30.2	30.7	1.2	1.5	.01	.43	15.7	1.3	184-213	91.6	22.3
31	36.8	29.7	30.4	3.1	0.8	.01	.47	11.3	1.2	181-216	90.7	23.6
Jun 1	36.2	28.7	33.1	2.0	1.3	.22	.50	10.7	0.9	167-176	91.5	23.3
2	36.3	29.8	32.2	1.7	1.0	-	.51	10.5	1.5	167-185	91.5	-
3	-----Unit off-line due to First Stage plugging-----											
4	-	-	-	-	-	-	-	-	-	-	90.4	-
5	33.1	29.5	36.1	1.9	1.0	.03	.39	13.8	-	169-180	89.2	27.5
6	33.2	34.1	30.3	2.4	0.7	.07	.41	15.6	1.6	172-180	88.7	25.9
7	30.4	35.1	33.4	1.1	2.2	.08	.46	14.2	1.6	176-185	88.6	29.8
8	29.7	35.5	32.6	2.2	0.9	.04	.42	13.9	1.5	183-207	88.3	30.7
9	30.4	35.7	32.8	1.1	1.9	.03	.48	14.2	1.4	183-208	89.1	29.9
10	31.6	36.4	31.1	0.9	1.5	.06	.47	12.0	1.7	181-201	88.8	-
11	32.9	37.9	28.4	0.8	2.5	.01	.42	14.1	2.0	176-212	89.7	-
12	32.4	38.6	27.2	1.8	1.3	.07	.42	11.5	1.3	180-198	91.5	26.5
13	31.9	38.8	27.8	1.5	1.0	.04	.38	13.9	1.4	180-207	88.8	27.0
14	35.2	40.3	22.0	2.5	1.3	.02	.39	13.8	1.4	192-199	89.5	23.3
15	35.1	36.0	26.4	2.5	0.7	.03	-	13.3	1.5	187-201	90.7	24.9
16	35.5	37.6	24.5	2.4	1.6	1.3	-	11.8	.19	-	90.9	23.8
17	32.2	34.9	30.2	2.7	1.0	.02	-	13.8	1.3	180-208	-	-
18	33.7	38.2	26.0	2.1	1.7	.02	-	17.4	1.6	170-196	90.4	-
19	32.9	41.5	24.9	0.7	2.5	.03	-	12.7	1.2	172-190	90.0	25.4
20	33.5	35.6	30.2	0.7	2.1	.04	-	14.8	1.2	167-190	91.1	25.2
21	32.7	37.8	28.2	1.3	1.3	.05	.44	13.2	1.2	171-189	90.2	26.5
22	33.3	40.7	25.3	0.7	2.4	.13	.63	12.7	1.2	181-205	90.8	26.3
23	34.1	41.6	22.4	1.9	1.2	.18	.63	11.7	1.2	194-219	91.8	24.7
24	34.3	41.0	23.9	0.8	1.6	.04	.51	11.8	1.8	190-207	92.0	-
25	33.4	41.2	23.0	2.4	0.8	.03	.60	13.6	1.3	187-212	89.8	-
26	32.5	43.9	19.2	4.4	0.5	.31	.51	9.4	0.9	194-230	92.0	25.1
27	32.9	41.8	21.9	3.4	0.9	.01	.40	11.5	1.2	185-212	91.9	24.8
28	33.2	45.9	19.2	1.7	1.4	.01	.54	14.7	1.3	183-210	90.7	-

(a) 600°F and 0.1 mm Hg.

(b) Percent of cresol soluble feed from T102 bottoms by forced ash balance.

(c) Feed coal energy, as percent, lost to organics in ash concentrate.

Table 9
HTR Unit Operating Data (Part 1)

Date 1983	Feed rates				Water inject rate, lb/hr	Seal oil, lb/hr	Withdrawal tube flush, lb/hr	H ₂ to C1205, lb/hr	Recycle			Flare gases		Sour H ₂ O rate, lb/hr	Flashed overheads, lb/hr
	On feed, hr	Space velocity, lb/(hr-lb cat)	Feed inputs, lb/hr(a)	Product outputs, lb/hr					to B1201, scfh	H ₂ , %	Mole wt	H ₂ , lb/hr	C ₁ -C ₃ , lb/hr		
Jan															
29-30															
31															
Feb															
1-5															
6	19.5					5.9									
7	18.5														
8	0														
9	18.5	0.71	291	-	111.8	5.3	18.2	3.6	2,710	94.9	3.1	-	-	104	8
10	24	0.92	378	334	-	5.3	-	4.3	5,450	97.4	2.6	-	-	112	8
11	18				On solvent, CSD outage							1.0	1.0	-	11
12	13.3	1.09	248	-	-	-	-	-	-	-	-	-	-	-	10
13	24	1.00	409	411	-	5.3	-	4.2	5,508	97.2	2.6	0.7	0.4	118	16
14	24	0.73	301	294	109.5	5.3	18.2	3.3	5,513	97.4	2.6	-	-	117	14
15	24	0.77	317	327	-	5.4	-	3.3	5,554	97.5	2.5	1.2	0.6	114	15
16	24	0.88	360	362	-	5.3	-	3.4	5,615	97.6	2.5	-	-	108	16
17	24	1.07	437	427	-	4.4	-	4.0	6,090	97.9	2.5	1.2	0.8	113	18
18	24	1.12	458	466	-	5.4	18.6	4.2	6,610	97.8	2.5	-	-	110	22
19	24	1.14	466	472	-	5.4	19.4	4.7	7,053	98.1	2.4	1.0	0.3	110	24
20	24	1.14	467	475	-	4.0	21.5	4.4	7,227	98.1	2.4	-	-	114	25
21	24	1.16	477	492	108	5.4	17.4	4.4	6,900	98.2	2.4	1.4	0.6	112	26
22	24	1.15	470	478	-	5.4	-	4.3	6,559	98.2	2.4	-	-	110	24
23	24	1.17	478	485	-	5.5	-	4.3	6,648	98.5	2.3	1.2	0.9	110	24
24	24	1.15	472	483	-	4.4	-	4.8	6,551	98.0	2.5	-	-	108	28
25	24	1.12	458	462	-	3.6	-	6.0	6,469	97.5	2.5	1.2	0.7	110	32
26	24	1.14	458	492	-	4.7	-	5.8	6,554	97.4	2.4	-	-	112	32
27	24	1.17	478	477	108.2	17.2	1.9	5.9	6,210	97.4	2.6	0.7	0.4	113	31
28	24	1.19	489	514	-	-	1.8	6.0	6,308	97.3	2.6	-	-	120	30

(a) This rate includes V1C86 and V1087 transfers adjusted for V1064 inventory plus withdrawal tube flush rate.

(Table continued)

Table 9 (continued)
HTR Unit Operating Data (Part 1)

		Feed rates														Sour		Flashed overheads, lb/hr
Date		On feed, hr	Space velocity, lb/(hr-lb cat)	Feed inputs, lb/hr(a)	Product outputs, lb/hr	Water injec- rate, lb/hr	Seal oil, lb/hr	Withdrawal tube flush, lb/hr	H ₂ to C1205, lb/hr	Recycle			Flare gases		H ₂ O rate, lb/hr			
1983										B1201, scfh	H ₂ , %	Mole wt	H ₂ , lb/hr	C ₁ -C ₄ , lb/hr				
Mar	1	24	1.125	461	470	108.2	1.9	17.2	6.2	6,765	97.7	2.34	1.3	0.9	117	33		
	2	24	1.016	417	430	114.8	1.9	17.2	6.0	6,777	97.7	2.51	-	-	120	32		
	3	24	1.043	428	441	108.5	1.9	17.2	5.7	6,762	97.6	2.56	0.8	0.7	121	32		
	4	24	1.123	462	468	-	1.8	17.2	5.7	6,715	97.4	2.58	-	-	118	34		
	5	24	1.179	483	487	-	1.9	17.2	7.1	5,946	95.6	2.96	1.1	1.5	123	41		
	6	24	1.193	489	502	-	1.8	17.2	7.4	5,951	95.6	2.96	-	-	125	45		
	7	24	1.227	503	522	-	2.1	17.2	7.5	6,135	95.8	2.89	1.1	1.5	126(b)	48		
	8	24	1.199	492	511	109.0	1.9	17.2	7.3	6,223	95.8	2.82	-	-	129	47		
	9	24	1.190	488	505	-	5.2	17.2	7.0	6,139	95.9	2.95	1.2	1.2	130	46		
	10	24	1.180	484	501	104.0	5.2	17.2	6.8	6,405	95.9	2.90	-	-	131	44		
	11	24	1.270	521	527	-	5.2	17.2	8.8	6,258	94.1	3.22	1.0	1.8	130	60		
	12	24	1.324	543	539	-	5.3	17.2	9.6	6,034	93.4	3.39	-	-	138	63		
	13	24	1.317	540	542	-	5.3	17.2	9.5	5,912	93.1	3.45	-	-	139	64		
	14	24	1.308	536	536	108.0	5.4	17.5	9.4	5,147	90.0	4.49	0.9	2.3	142	63		
	15	24	1.207	495	505	98.1	5.3	17.5	9.1	6,109	93.3	3.38	-	-	133	61		
	16	24	1.216	498	505	132.0	5.3	17.5	8.8	6,173	93.5	3.38	1.0	1.6	160	65		
	17	15.1(c)	0.895	370	550	75.3	5.2	17.5	-	-	-	-	-	-	115	-		
	18	24	1.410	578	578	108.0	5.4	17.5	10.0	5,610	93.2	3.42	1.2	1.9	148	59		
	19	24	1.230	504	505	-	5.4	17.5	9.0	6,205	93.0	3.34	-	-	157	58		
	20	24	1.327	542	537	-	5.3	17.5	9.1	6,542	93.8	3.17	1.0	1.4	152	62		
	21	24	1.271	521	525	109.5	5.0	16.5	8.7	6,632	94.0	3.14	-	-	155	61		
	22	24	1.272	522	521	-	5.2	14.3	8.7	6,607	94.4	3.15	1.3	3.2	156	61		
	23	24	1.266	519	517	109.0	5.1	11.4	8.6	6,510	94.2	3.19	-	-	150	62		
	24	24	1.239	508	516	-	5.0	12.3	8.3	6,600	94.4	3.15	1.1	2.1	160	62		
	25	24	1.257	516	515	-	5.2	10.1	8.2	6,599	94.6	3.11	-	-	159	65		
	26	24	1.230	504	515	-	2.9	4.2	8.4	6,689	94.9	3.05	1.2	2.2	162	61		
	27	24	1.205	494	499	-	3.0	0	8.3	6,468	95.1	3.08	-	-	163	58		
	28	24	1.209	496	502	110.8	5.1	10.2	8.1	6,401	94.8	3.10	1.2	2.2	162	60		
	29	24	1.250	512	517	110.8	3.1	17.5	8.1	6,440	94.4	3.17	1.1	2.0	164	66		
	30	24	1.257	515	516	110.8	3.1	17.5	8.0	6,505	93.9	3.23	1.1	2.0	164	67		
	31	24	1.313	538	533	110.8	3.2	17.5	7.9	6,388	93.8	3.30	1.3	2.2	164	67		
Apr	1	24	1.379	565	572	110.8	3.1	17.5	8.2	6,192	93.4	3.48	1.3	2.2	167	65		
	2	24	1.304	535	543	110.8	3.0	17.5	8.1	6,287	93.7	3.32	1.3	2.2	172	66		
	3	24	1.280	525	529	110.8	3.1	17.5	8.1	6,293	93.7	3.36	1.1	2.5	172	69		
	4	24	1.273	522	523	103.0	3.2	16.5	8.3	6,210	93.6	3.39	1.1	2.5	174	68		
	5	9.5	1.213	498	515	103.0	3.2	16.5	8.1	6,068	93.6	3.39	1.1	2.5	176	61		
	6	-----Unit off-line for scheduled maintenance-----																

-----Unit off-line for scheduled maintenance-----

- (a) This rate includes V1086 and V10E7 transfers adjusted for V1064 inventory plus withdrawal tube flush rate.
 (b) Condensate from exchanger leaking into sour water (7 March - 5 April).
 (c) Restriction in the overhead system from V1247 to V1249.

(Table continued)

Table 9 (continued)
HTR Unit Operating Data (Part 1)

Date, 1983	Feed rates							H ₂ to C1205, lb/hr	Recycle			Flare gases		Sour H ₂ O rate, lb/hr	Flashed overheads lb/hr
	On feed, hr	Space velocity lb/(hr-lb cat)	Feed inputs, lb/hr(a)	Product outputs, lb/hr	Water inject rate, lb/hr	Seal oil, lb/hr	Withdrawal tube flush, lb/hr		to B1201, scfh	H ₂ , %	Mole wt	H ₂ , lb/hr	C ₁ -C ₅ , lb/hr		
April															
20	1.5	-	-	-	109.5	-	-	-	-	-	-	-	-	-	-
21	24.	0.941	386	374	-	1.9	17.7	5.6	5,247	94.8	3.04	-	-	-	16
22	9.6(b)	0.765	314	-	-	-	-	4.2	-	-	-	-	-	-	-
23	15.8	0.894	367	-	-	1.9	16.9	3.6	4,991	94.8	3.04	-	-	-	-
24	23.0(c)	0.979	401	413	110.3	1.9	16.9	6.4	5,025	95.2	2.99	-	-	121	30
25	24	1.112	456	462	-	1.9	16.9	7.3	5,189	95.6	2.96	1.2	1.8	115	42
26	24	1.243	510	525	-	2.0	16.9	8.2	5,719	96.1	2.96	-	-	116	52
27	24	1.164	477	499	-	2.0	16.9	8.9	4,960	93.9	3.46	1.6	1.3	123	50
28	24	1.197	491	513	-	2.0	16.9	10.1	4,550	92.7	3.61	-	-	126	55
29	24	1.254	514	534	-	2.0	16.9	10.1	4,979	93.3	3.42	1.5	2.5	126	58
30	24	1.298	532	550	-	2.0	16.9	10.2	4,952	93.6	3.31	-	-	125	62
May															
1	24	1.301	533	554	-	2.0	16.9	10.2	4,959	93.9	3.31	1.2	1.8	126	60
2	24	1.258	516	533	-	2.0	16.9	10.4	5,361	95.4	2.99	-	-	125	60
3	7.6(d)	1.124	461	-	-	-	16.9	-	-	-	-	-	-	-	-
4	16.0	1.212	497	504	114.1	1.9	15.7	-	-	-	-	-	-	116	33
5	24	1.138	467	485	-	1.9	17.7	9.8	5,012	96.4	2.85	1.2	1.0	122	36
6	24	1.123	460	470	-	1.9	17.7	9.1	4,927	96.4	2.90	-	-	122	35
7	24	1.253	516	505	-	1.9	17.7	9.4	4,856	97.3	2.76	1.9	0.8	122	34
8	24	1.209	496	505	-	2.0	17.7	10.1	4,979	97.2	2.73	-	-	122	38
9	24	1.177	483	502	122.3	1.9	17.2	11.9	4,879	98.2	2.48	-	-	128	37
10	24	1.110	455	488	-	1.9	17.2	11.9	4,740	98.6	2.36	1.9	0.8	139	36
11	24	1.073	440	471	124.3	2.0	17.2	11.5	4,106	97.7	2.64	2.1	0.8	140	33
12	13.5(e)	1.103	454	-	-	2.0	17.2	-	-	-	-	-	-	138	-
13	0	-	-	-	-	-	17.2	-	-	-	-	-	-	-	-
14	21.0	1.207	495	513	-	2.1	17.2	11.4	5,287	98.5	2.53	-	-	130	40
15	24	1.121	460	484	-	2.1	17.2	11.5	4,780	97.5	2.70	2.7	1.0	133	38
16	24	1.245	511	530	119.5	2.0	15.7	11.7	4,662	96.2	3.02	-	-	132	40
17	24	1.260	517	537	-	2.0	15.7	11.1	5,295	96.0	2.82	3.0	2.5	129	52
18	24	1.218	499	519	-	2.0	15.7	11.3	5,797	94.3	3.19	-	-	129	62
19	24	1.224	502	514	-	2.0	15.7	11.3	5,123	94.0	3.27	1.4	1.9	127	55
20	24	1.200	492	503	113.8	2.0	17.3	11.1	5,327	94.2	3.24	-	-	119	59
21	24	1.188	487	509	117.5	1.9	17.3	10.9	5,093	94.3	3.20	-	-	128	56
22	24	1.203	493	507	-	1.8	17.3	10.7	5,018	94.4	3.22	1.1	2.8	127	51

- (a) This rate includes V1086 and V1087 transfers adjusted for V1064 inventory plus withdrawal tube flush.
 (b) Shutdown due to low feed inventory.
 (c) Changed to Daylight Savings Time.
 (d) Replaced catalyst 3-4 May with batch 13-243.
 (e) Shutdown to repair piping leaks and to clear a restriction in B1201 outlet piping.

(Table continued)

Table 9 (continued)
HTR Unit Operating Data (Part 1)

Date, 1983	Feed rates										Recycle			Feed gases		Sour H ₂ O rate, lb/hr	Flashed overheads lb/hr
	On feed, hr	Space velocity, lb/(hr-lb cat)	Feed inputs, lb/hr (±)	Product outputs, lb/hr	Water inject rate, lb/hr	Seal oil, lb/hr	Withdrawal tube flush lb/hr	H ₂ to C1205, lb/hr	to B1201, scfh	H ₂ %	Mole wt	H ₂ , lb/hr	C ₁ -C ₃ , lb/hr				
May																	
23	24	1.199	492	499	117.5	7.2	17.3	10.6	5,079	94.3	3.22	1.1	2.8	127.7	55		
24	18.4 (b)	1.231	505	-	-	-	-	-	-	-	-	-	-	-	-	-	
25	24	1.218	499	511	115.5	8.0	-	8.9	5,074	94.5	3.20	1.4	3.8	124.5	62		
26	24	1.120	459	462	-	4.9	-	8.8	5,877	94.3	3.19	-	-	121.2	65		
27	24	0.964	395	396	-	5.4	-	7.9	6,291	94.7	3.04	1.6	2.5	122.3	60		
28	24	1.011	415	422	-	6.6	-	8.0	6,040	94.2	3.18	-	-	123.3	61		
29	24	1.054	432	432	-	5.4	-	8.1	6,060	94.7	3.21	1.5	3.1	123.5	58		
30	24	1.010	414	417	-	5.4	-	7.8	5,761	93.5	3.43	-	-	123.8	57		
31	24	0.950	389	396	113.5	4.3	17.4	7.5	6,031	94.3	3.22	1.4	4.1	123.4	54		
June																	
1	24	0.976	400	403	-	4.4	-	7.4	6,064	93.7	3.28	-	-	122.8	55		
2	19.8 (c)	0.960	393	-	-	-	-	7.5	6,389	94.3	3.17	-	-	-	-	-	
3	6.5	1.011	415	-	-	-	-	-	-	-	-	-	-	-	-	-	
4	24	0.996	408	416	-	4.2	-	8.0	6,307	94.9	3.04	1.4	2.9	120.2	54		
5	24	0.967	396	-	-	2.2	-	7.6	6,056	94.9	3.13	-	-	103.5	45		
6	24	0.952	390	395	-	4.3	-	8.3	6,308	95.5	2.92	-	-	119.4	58		
7	24	0.948	389	395	-	5.2	-	8.0	6,199	95.0	3.11	2.4	4.0	119.1	58		
8	24	1.005	412	419	-	5.4	-	8.2	6,073	94.8	3.10	-	-	119.4	59		
9	24	1.025	420	420	113.9	5.4	17.3	8.0	6,097	93.8	3.27	1.8	3.8	120.0	60		
10	24	1.009	414	426	119.8	5.2	-	8.1	6,169	94.2	3.20	-	-	128.6	62		
11	24	0.986	404	409	-	5.2	-	7.7	6,294	94.1	3.18	2.0	2.6	126.8	60		
12	24	0.966	396	409	-	5.2	-	7.7	6,292	93.9	3.16	-	-	127.0	58		
13	24	0.968	397	398	-	4.9	-	7.7	6,344	94.2	3.19	-	-	127.1	58		
14	24	0.968	397	398	-	3.1	-	7.7	6,282	94.5	3.13	-	-	127.1	57		
15	24	1.026	421	429	-	4.6	-	8.5	6,255	94.0	3.23	1.4	2.2	127.6	54		
16 (d)	24	1.103	440	449	-	3.5	-	9.0	6,473	94.4	3.18	-	-	129.1	57		
17	24	1.063	424	437	-	3.4	-	8.8	6,315	93.7	3.36	1.3	3.0	131.1	66		
18	24	1.075	429	434	-	2.2	-	8.6	6,388	93.7	3.25	-	-	129.9	65		
19	24	1.066	425	435	-	2.2	-	8.7	6,366	94.0	3.21	1.5	3.7	128.5	66		
20	24	1.131	451	466	-	2.3	17.5	8.8	6,304	93.7	3.27	-	-	130.7	59		
21	24	1.090	435	448	116.8	2.2	-	9.0	6,144	93.4	3.32	1.3	2.4	126.4	68		
22	24	1.050	419	433	-	4.6	-	8.7	5,941	93.2	3.38	-	-	126.3	67		
23	24	1.058	422	439	116.8	7.4	17.5	8.3	6,470	94.8	3.08	1.2	2.3	126.5	63		
24	24	1.060	423	438	-	8.4	-	8.2	6,235	94.4	3.22	-	-	127.7	63		
25	24	0.987	394	402	-	5.7	-	7.8	6,122	94.5	3.24	1.3	3.7	125.1	59		
26	24	1.003	400	412	-	4.3	-	7.8	5,898	93.7	3.48	-	-	-	-		
27	24	1.097	438	446	-	5.8	-	8.2	6,302	94.9	3.03	1.0	1.7	125.3	60		
28	-----End of run-----																

- (a) This rate includes V1086 and V1087 transfers adjusted for V1064 inventory plus withdrawal tube flush.
 (b) Shutdown due to SRC unit piping leak.
 (c) Shutdown due to CSD unit.
 (d) Catalyst charge reduced to 599 lb.

Table 10
HTR Unit Operating Data (Part 2)

Date, 1983	Reactor		Within bed temp max- min, °F	Flashed bottoms		Catalyst (cat) age			Conversion, %
	Avg temp, °F	Avg max- min, °F(a)		Rate, lb/hr	Solvent free SRC rate, lb/hr	SRC/cat, lb/lb(b)	Feed/cat, lb/lb	Time, days	
Feb									
6	625	162	-	-	-	8	13	0.8	-
7	629	204	13	-	-	12	22	1.6	-
8(c)	-	-	-	-	-	-	-	-	-
9	625	121	-	268	-	22	38	2.4	-
10	631	15	2	376	181	33	59	3.4	8.1
11(d)	-	203	-	-	-	40	73	4.1	-
12	-	233	-	-	-	48	86	4.7	-
13	630	9	11	389	194	60	109	5.7	9.5
14	630	3	5	293	150	69	126	6.7	3.9
15	630	8	8	308	157	79	143	7.7	5.9
16	627	10	10	342	171	90	163	8.7	9.5
17	630	7	6	425	219	104	188	9.7	4.7
18	631	13	5	440	228	118	213	10.7	4.7
19	627	3	10	443	233	132	240	11.7	6.6
20	630	7	9	446	232	147	266	12.7	6.5
21	628	3	8	461	242	161	292	13.7	3.4
22	629	5	7	448	234	176	319	14.7	4.1
23	630	4	10	456	241	191	346	15.7	5.6
24	634	19	7	450	240	205	373	16.7	5.5
25	658	15	9	425	222	220	398	17.7	8.0
26	657	7	15	443	234	234	425	18.7	5.5
27	657	8	18	442	237	249	452	19.7	7.7
28	657	8	19	479	259	265	479	20.7	2

(a) Range of average bed temperature.

(b) SRC without solvent.

(c) Off-line to clean catalyst withdrawal flush line.

(d) CSD outage forced a shutdown.

(Table continued)

Table 10 (continued)
HTR Unit Operating Data (Part 2)

Date, 1983	Reactor		Within bed temp max- min, °F	Flashed bottoms		Catalyst (cat) age			Conversion, % based on feed
	Avg temp, °F	Avg max- min, °F (a)		Rate, lb/hr	Solvent free SRC rate, lb/hr	SRC/cat, lb/lb(b)	Feed/cat, lb/lb	Time, days	
Mar 1	659	8	19	429	235	279	505	21.7	6.6
2	659	5	16	393	216	292	529	22.7	3.7
3	659	3	16	396	212	306	553	23.7	7.5
4	659	4	16	424	227	320	579	24.7	5.4
5	685	35	22	432	226	335	606	25.7	11.9
6	689	5	22	441	227	351	634	26.7	15.0
7	689	7	24	456	240	366	662	27.7	10.7
8	688	6	24	445	234	381	690	28.7	9.5
9	687	8	23	449	236	397	717	29.7	9.4
10	688	3	24	447	224	412	745	30.7	12.1
11	715	35	30	457	224	428	774	31.7	20.1
12	719	5	31	466	225	445	805	32.7	23.5
13	719	7	31	468	226	462	836	33.7	20.3
14	720	6	30	463	225	478	866	34.7	21.4
15	719	4	30	434	213	494	894	35.7	19.0
16	718	6	30	430	207	509	922	36.7	21.1
17 (c)	-	-	-	-	-	520	943	37.3	-
18	720	6	29	509	252	538	975	38.3	16.5
19	719	9	27	437	209	553	1,004	39.3	19.3
20	716	5	34	465	223	570	1,035	40.3	22.0
21	717	8	33	454	235	587	1,064	41.3	19.2
22	716	8	31	449	223	603	1,094	42.3	19.1
23	718	6	30	446	221	619	1,123	43.3	17.8
24	718	5	30	444	220	634	1,152	44.3	17.1
25	718	8	30	440	219	650	1,181	45.3	19.0
26	717	13	30	444	229	666	1,211	46.3	15.5
27	718	9	29	432	227	682	1,240	47.3	17.9
28	716	10	27	433	233	698	1,268	48.3	14.4
29	719	3	24	441	226	715	1,297	49.3	19.6
30	719	4	23	440	221	731	1,326	50.3	18.8
31	719	5	23	456	236	748	1,357	51.3	21.6
Apr 1	718	6	24	497	250	766	1,389	52.3	16.6
2	720	4	23	467	234	782	1,419	53.3	15.7
3	720	6	24	450	225	798	1,449	54.3	17.9
4	720	5	24	446	233	815	1,478	55.3	17.5
5	719	7	25	444	232	821	1,489	55.7	12.2
6	-----Unit off-line for scheduled maintenance-----								

(a) Range of average bed temperature.

(b) SRC without solvent.

(c) Plugging in HTR unit overhead system from V1247 to V1249.

(Table continued)

Table 10 (continued)
HTR Unit Operating Data (Part 2)

Date, 1983	Reactor		Within bed temp max- min, °F	Flashed bottoms		Catalyst (cat) age			Conversion, % based on feed
	Avg temp, °F	Avg max- min, °F (a)		Rate, lb/hr	Solvent free SRC rate, lb/hr	SRC/cat, lb/lb(b)	Feed/cat, lb/lb	Time, days	
April 20	-	-	-	-	-	822	1,491	55.8	-
21	672	90	8	348	157	833	1,512	56.8	-
22(c)	-	-	-	-	-	836	1,519	57.2	-
23	-	-	-	-	-	843	1,533	57.9	-
24	690	9	10	372	172	855	1,554	58.9	14.7
25	691	7	12	415	203	869	1,580	59.9	15.7
26	690	5	14	467	248	885	1,609	60.9	8.4
27	705	37	14	437	210	899	1,636	61.9	14.5
28	719	3	16	442	208	914	1,664	62.9	19.5
29	718	3	16	460	226	930	1,693	63.9	18.0
30	719	7	16	474	225	946	1,723	64.9	18.0
May 1	719	7	16	478	231	963	1,753	65.9	17.9
2	719	6	16	458	222	979	1,782	66.9	18.4
3(d)	-	-	-	-	-	983	1,790	67.2	-
4	-	-	-	470	230	10	19	0.7	-
5	680	5	22	440	206	24	45	1.7	14.4
6	677	17	19	430	199	38	71	2.7	17.3
7	669	42	19	472	229	54	100	3.7	14.3
8	680	5	23	464	221	69	128	4.7	11.8
9	676	7	20	459	220	83	155	5.7	13.5
10	679	10	20	435	213	97	181	6.7	11.0
11	678	7	19	422	205	111	206	7.7	11.5
12(e)	-	-	-	430	202	119	220	8.3	-
13	-	-	-	-	-	-	-	-	-
14	-	-	-	467	221	133	245	9.2	17.1
15	690	29	23	437	221	147	271	10.2	10.2
16	699	7	24	477	243	163	300	11.2	10.4
17	706	28	25	472	236	179	329	12.2	14.5
18	719	4	31	447	225	195	357	13.2	14.8
19	720	8	29	452	215	210	386	14.2	20.1
20	718	5	28	440	209	226	413	15.2	20.9
21	719	5	28	443	223	242	441	16.2	17.9
22	718	7	25	446	226	257	469	17.2	15.8

- (a) Range of average bed temperature.
(b) SRC without solvent.
(c) Shutdown due to low feed inventory.
(d) Replaced catalyst batch.
(e) Repaired and cleaned HTR unit piping 12-13 May.

(Table continued)

Table 10 (continued)
HTR Unit Operating Data (Part 2)

Date, 1983	Reactor		Within bed temp max- min, °F	Flashed bottoms		Catalyst (cat) age			Conversion, % based on feed
	Avg temp, °F	Avg max- min, °F(a)		Rate, lb/hr	Solvent free SRC rate, lb/hr	SRC/cat, lb/hr(b)	Feed, cat lb, lb	Time, days	
May 23	718	4	25	433	211	273.1	496.5	18.2	22.2
24 (c)	-	-	-	-	-	285.3	518.3	19.0	-
25	716	5	24	440	205	301.1	546.5	20.0	24.4
26	720	3	25	391	195	315.6	572.4	21.0	20.8
27	719	11	22	330	155	328.0	594.5	22.0	27.4
28	718	6	22	353	167	341.0	617.8	23.0	24.6
29	719	4	21	366	177	354.4	642.1	24.0	22.8
30	719	4	22	352	172	367.4	665.3	25.0	22.6
31	718	10	20	332	161	379.6	687.1	26.0	22.5
June 1	720	13	19	338	167	392.4	709.5	27.0	23.6
2	-	-	-	-	-	402.5	727.6	27.8	-
3 (d)	-	-	-	-	-	405.8	733.9	28.1	-
4	719	8	24	355	160	418.4	756.8	29.1	25.8
5	719	9	22	343	161	430.4	779.0	30.1	21.2
6	719	4	22	331	154	442.2	800.8	31.1	23.5
7	719	5	21	332	155	454.1	822.5	32.1	23.5
8	719	2	22	355	162	466.7	845.6	33.1	24.7
9	719	3	21	354	166	479.5	869.2	34.1	23.6
10	720	3	22	355	168	492.2	892.4	35.1	22.6
11	718	2	21	342	170	504.6	915.1	36.1	19.6
12	719	4	21	344	166	516.6	937.2	37.1	18.8
13	719	4	22	334	163	528.8	959.4	38.1	21.9
14	719	4	22	334	161	541.1	981.7	39.1	23.7
15	-	-	-	-	-	554.1	1,005.3	40.1	24.3
16 (e)	729	6	24	373	174	568.0	1,030.7	41.1	24.2
17	729	4	23	360	162	581.4	1,055.2	42.1	27.1
18	728	5	23	359	171	595.0	1,080.0	43.1	24.3
19	728	3	23	361	162	608.4	1,104.5	44.1	27.3
20	727	5	24	386	184	622.7	1,130.6	45.1	22.8
21	729	5	24	371	173	636.5	1,155.7	46.1	24.7
22	728	3	22	357	164	649.8	1,179.8	47.1	25.7
23	-	-	-	-	-	663.1	1,204.1	48.1	21.8
24	717	3	21	365	172	676.5	1,228.5	49.1	22.8
25	716	2	20	335	160	689.2	1,251.1	50.1	24.2
26	717	1	19	346	160	701.8	1,274.1	51.1	24.1
27	716	3	21	377	184	715.6	1,299.4	52.1	20.2
28	-----End of run-----								

- (a) Range of average bed temperature.
 (b) SRC without solvent.
 (c) Shutdown due to SRC unit outage.
 (d) Shutdown due to CSD unit outage.
 (e) Catalyst charge reduced from 410 to 399 lb. Catalyst addition valves were inoperable.

Table 11
HTR Unit Analytical Data

Date, 1983	Feed				CSD-deashed SRC							Hydrotreated flashed bottoms				
	Solv, %	Ash, %	UC, %	S, %	Solv, %	Ash, %	S, %	N, %	C, %	H, %	BI %	Solv, % < 650°F	Total Solv, %	Ash, %	UC, %	BI %
Feb																
6	41.4	-	-	-	-	-	-	-	-	-	11.5	-	52.0	-	-	1.2
7	43.8	0.17	0.23	0.32	12.3	0	0.65	1.62	86.52	6.36	-	12.9	53.9	0.64	0.29	-
8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	43.7	-	-	-	-	-	-	-	-	-	-	-	56.5	-	-	-
10	45.4	0.58	0.42	0.52	13.1	0.61	0.60	1.38	85.78	6.38	-	13.7	52.0	0.55	0.45	-
11	46.8	0.38	0.32	0.39	12.3	1.07	0.74	-	-	-	-	8.1	52.3	0.55	0.28	-
12	46.9	-	-	-	12.2	0.61	0.66	-	-	-	-	-	-	-	-	-
13	45.2	0.66	0.31	0.39	9.2	0.83	0.70	1.41	86.62	6.47	-	12.3	50.2	0.7	0.41	-
14	44.8	0.96	1.04	0.37	10.3	2.1	0.54	1.32	85.71	6.28	14.7	10.4	48.9	0.87	0.63	2.8
15	44.2	0.83	0.84	0.33	8.9	0.3	0.50	-	-	-	15.0	12.2	49.1	1.00	0.5	3.4
16	44.9	0.59	0.41	0.29	12.0	0.31	0.56	1.60	86.74	6.46	9.8	11.4	50.1	0.80	0.60	3.0
17	45.2	0.22	0.18	0.37	9.5	0.40	0.55	1.36	86.13	6.46	11.7	9.2	48.5	-	0.6	3.7
18	45.6	0.69	0.27	0.42	11.0	0.35	0.53	-	-	-	12.3	10.7	48.1	0.21	0.10	1.6
19	44.2	0.41	0.34	0.50	11.4	1.38	0.57	-	-	-	11.4	9.2	47.5	0.26	0.20	3.1
20	44.2	0.43	0.22	0.40	10.4	0.39	-	-	-	-	12.3	9.4	47.9	0.47	0.33	1.4
21	45.6	0.17	0.08	0.37	-	-	0.50	1.48	86.89	6.32	10.0	8.9	47.6	0.25	0.25	1.6
22	46.1	0.20	-	0.39	11.0	0.64	-	1.40	86.45	6.31	9.5	10.0	47.8	0.22	0.15	3.3
23	44.5	0.31	0.21	0.34	11.9	-	1.57	1.57	86.77	6.34	9.1	8.9	47.1	0.33	0.46	2.1
24	44.1	0.21	0.17	0.34	11.4	0.04	0.39	1.42	87.50	6.30	14.2	9.5	46.6	0.66	0.37	3.3
25	45.2	0.10	0.02	0.31	10.9	0.11	0.40	-	-	-	9.0	9.6	47.8	0.22	0.12	1.1
26	45.0	0.66	0.02	0.26	10.0	0.08	0.40	-	-	-	7.2	10.1	47.1	0.05	0.14	1.3
27	44.3	0.66	0.02	0.35	10.4	0.21	0.34	1.34	87.37	6.24	15.1	9.2	46.4	0.13	0.11	0.5
28	43.9	0.11	0.17	0.24	8.5	0.22	0.38	1.54	87.64	6.30	13.7	9.1	45.9	0.16	0.18	1.7

(Table continued)

Table 11 (continued)
HTR Unit Analytical Data

Date, 1983		Feed				CSD Deashed SRC							Hydrotreated flashed bottoms				
		Solv, %	Ash, %	UC, %	S, %	Solv, %	Ash, %	S, %	N, %	C, %	H, %	BI, %	Solv % <650°F	Total solv,	Ash, %	UC, %	BI, %
March	1	43.3	0.11	0.07	0.29	11.1	0.06	0.38	1.36	87.30	6.36	7.4	8.2	45.2	0.06	0.09	1.00
	2	44.0	0.03	0.06	0.22	11.1	0.05	0.40	0.95	87.38	6.35	6.5	10.6	45.1	0.13	0.04	0.79
	3	44.1	0.01	0.10	0.29	10.9	0.04	0.43	1.58	87.02	6.16	4.1	9.7	46.4	0.05	0.03	0.27
	4	45.9	0.05	-	0.38	10.0	0.08	0.45	-	-	-	10.8	10.3	46.4	0.02	0.06	0.48
	5	45.0	0.07	0.07	0.35	10.9	0.81	0.57	-	-	-	10.1	10.4	47.7	0.02	0.08	0.68
	6	43.5	0.64	0.33	0.21	9.4	1.10	0.55	1.44	86.79	6.29	10.2	10.0	48.6	0.80	0.93	2.23
	7	44.8	0.93	0.49	0.39	10.3	1.90	0.50	1.38	85.98	6.24	16.3	9.4	47.5	1.63	1.03	3.59
	8	45.4	0.60	0.30	0.24	9.4	0.50	0.43	1.38	86.27	6.38	12.0	9.9	47.3	0.74	1.46	2.07
	9	44.6	0.43	0.17	0.28	9.9	0.45	0.50	1.48	87.39	6.40	12.9	9.9	47.4	0.86	0.48	2.14
	10	45.4	0.17	0.12	0.20	12.1	0.08	0.49	1.27	87.52	6.26	13.1	8.7	49.9	0.39	0.37	1.29
	11	44.4	0.09	0.01	0.29	10.6	0.09	0.37	-	-	-	10.7	10.4	51.1	0.41	0.20	0.92
	12	44.1	0.01	0.03	0.28	12.3	0.01	0.53	-	-	-	6.9	9.6	51.8	0.08	0.02	0.66
	13	45.5	0.03	0.01	0.16	9.6	0.03	0.35	1.55	87.64	6.35	10.5	8.7	51.8	0.06	0.10	0.40
	14	44.8	0.02	0.04	0.35	9.0	0.30	0.29	0.99	87.90	6.20	9.5	8.3	51.4	0.07	0.04	0.62
	15	44.5	0.08	0.02	0.24	8.3	0.19	0.32	1.26	88.12	6.36	7.4	8.5	50.9	0.33	0.02	0.81
	16	45.4	0.05	0.11	0.30	12.2	0.08	0.37	1.57	88.06	6.41	6.8	8.6	51.8	0.26	0.20	0.67
	17	45.5	0.02	0.03	0.33	13.5	0.09	0.39	1.12	88.27	6.43	-	8.3	58.5	0.04	0.06	-
	18	46.3	0.07	0.21	0.28	14.6	0.09	0.36	-	-	-	13.6	8.1	50.6	0.05	0.15	1.06
	19	46.8	0.05	0.06	0.32	12.5	0.03	0.47	-	-	-	12.2	9.0	52.2	0.67	0.26	1.98
	20	45.5	0.02	0.11	-	13.0	0.17	-	1.28	87.90	6.32	11.5	7.7	52.0	0.17	0.21	1.01
	21	42.3	0.19	0.11	-	11.1	0.72	-	1.26	88.12	6.44	6.02	8.3	48.2	0.33	0.15	0.80
	22	45.8	0.25	0.11	0.20	13.2	0.02	0.42	1.13	88.14	6.46	0.38	7.9	50.5	0.52	0.37	1.16
	23	46.6	0.11	0.01	0.25	17.6	0.08	0.29	-	-	-	2.59	8.5	50.3	0.20	0.14	0.34
	24	46.5	0.04	-	0.35	14.1	0.17	0.50	1.17	87.87	6.69	2.91	7.6	50.5	0.07	0.10	1.45
	25	45.3	0.01	0.01	0.27	12.6	-	0.41	-	-	-	1.43	5.8	50.1	0.06	0.06	1.92
	26	45.8	-	-	0.24	10.9	0.02	0.33	-	-	-	-	7.4	48.4	0.04	0.06	-
	27	44.0	0.01	0.01	0.32	10.3	0.04	0.54	1.19	87.46	6.76	3.91	6.4	47.4	0.19	0.12	2.34
	28	43.8	-	-	0.38	13.1	0.08	0.57	0.94	88.06	6.83	4.20	6.0	46.1	0.08	0.03	2.40
	29	43.1	0.02	0.05	0.23	11.8	0.07	0.53	1.13	87.70	6.98	9.14	8.5	48.6	0.16	0.09	1.72
	30	45.3	0.04	0.04	0.34	10.7	0.05	0.46	1.17	87.42	6.94	10.20	7.2	49.7	0.07	-	1.98
	31	42.3	0.01	0.09	0.32	9.6	0.11	0.53	-	-	-	-	6.9	48.4	0.15	0.10	-
April	1	45.2	0.02	0.05	0.34	10.9	0.05	-	-	-	-	-	6.7	49.6	0.05	0.07	-
	2	46.4	0.02	0.04	0.40	13.1	0.08	0.43	-	-	-	-	7.2	50.0	0.06	0.04	-
	3	46.0	0.02	0.03	0.43	8.2	0.08	0.49	1.21	87.75	6.70	-	7.5	50.0	0.06	0.04	-
	4	44.0	-	-	0.46	-	-	0.72	-	-	-	10.60	7.5	47.6	0.01	0.35	3.09
	5	45.1	-	-	-	-	-	-	-	-	-	7.98	-	47.7	-	-	-
-----Planned shutdown-----																	

(Table continued)

Table 11 (continued)
HTR Unit Analytical Data

Date, 1983	Feed				CSD Deashed SRC							Hydrotreated flashed bottoms				
	Solv %	Ash %	UC %	S %	Solv %	Ash %	S %	N %	C %	H %	BI %	Solv % <650°F	Total Solv %	Ash %	UC %	BI %
April 20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	47.7	0.02	0.05	0.41	-	-	-	-	-	-	-	18.5	54.8	0.15	0.12	-
22	47.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23	47.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24	47.6	0.01	0.01	-	15.2	0.01	0.49	1.38	87.06	6.47	13.50	10.6	53.8	0.01	0.04	0.74
25	45.1	0.03	0.05	0.32	13.7	0.04	0.41	1.37	87.37	6.57	10.80	11.0	51.1	0.01	0.08	5.54
26	45.1	0.01	0.09	0.32	16.5	0.01	0.39	1.41	87.78	6.58	16.70	9.9	46.9	0.04	0.04	0.86
27	46.5	0.01	0.07	0.30	12.9	0.03	0.36	1.30	87.80	6.49	9.50	10.2	51.8	0.02	0.06	1.32
28	45.4	0.02	0.04	0.26	12.9	0.08	0.38	1.31	87.29	6.34	8.70	10.8	52.9	0.03	0.03	2.80
29	44.7	0.01	0.04	0.26	13.6	0.03	0.35	-	-	-	0.10	11.6	51.0	0.02	0.07	2.40
30	46.7	0.01	0.04	0.27	16.8	0.01	0.41	-	-	-	9.30	13.1	52.5	0.11	0.03	2.40
May 1	45.6	0.01	0.03	0.36	16.1	0.01	0.44	1.33	88.32	6.20	10.00	11.6	51.7	0.06	0.04	2.70
2	45.5	0.01	0.06	0.27	10.6	0.03	0.40	1.31	87.72	6.26	15.20	13.4	51.5	0.05	0.08	2.33
3	45.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	46.2	-	-	-	-	-	-	-	-	-	-	-	51.0	-	-	-
5	46.4	0.02	0.02	0.25	13.8	0.08	0.44	1.42	88.05	6.41	3.95	10.6	53.2	0.25	0.11	0.13
6	45.7	0.01	0.05	0.35	14.9	0.30	0.47	-	-	-	14.20	12.4	53.8	0.01	0.01	0.09
7	46.5	0.06	0.02	0.32	14.8	0.17	0.38	-	-	-	8.89	13.5	51.6	-	-	0.04
8	47.5	0.06	0.14	0.27	11.1	0.35	0.39	1.23	87.54	6.32	8.11	11.9	52.3	0.07	0.03	0.12
9	45.5	0.15	0.05	0.30	13.5	0.06	0.39	1.36	87.80	6.36	9.14	14.0	52.2	0.02	0.0	0.34
10	45.3	0.02	0.07	-	12.8	0.05	-	1.40	88.16	6.35	11.30	-	51.0	0.03	0.06	0.01
11	45.1	0.01	0.04	0.30	12.9	0.37	0.39	1.27	88.02	6.23	5.80	11.9	51.3	0.01	0.03	0.09
12	45.0	0.01	0.07	0.27	11.4	0.15	0.35	-	-	-	8.65	12.9	53.0	0.01	0.01	0.07
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	44.3	-	-	-	-	-	-	-	-	-	12.20	-	52.8	-	-	-
15	44.4	0.01	0.05	0.35	9.4	0.19	0.42	1.45	87.95	6.32	0.73	8.0	49.4	0.09	0.05	0.02
16	45.2	0.03	0.08	0.30	15.4	0.02	0.40	1.44	88.08	6.36	3.60	8.7	49.1	0.10	0.07	0.78
17	44.8	0.02	0.02	0.25	14.4	0.01	0.37	1.27	87.97	6.33	7.06	10.4	49.9	-	-	-
18	45.3	0.01	0.03	0.35	13.5	0.01	0.46	1.42	87.96	6.38	4.80	10.5	49.6	0.13	0.10	0.71
19	44.7	0.01	0.01	0.33	9.9	0.03	0.49	1.27	87.78	6.59	3.98	12.1	52.5	0.06	0.05	1.52
20	44.4	0.01	0.01	0.38	9.4	0.01	0.45	-	-	-	6.30	11.8	52.5	0.12	-	0.66
21	42.3	0.01	0.04	0.32	10.2	0.02	0.33	-	-	-	2.92	11.7	49.7	0.07	0.05	0.84
22	43.7	0.01	0.03	0.27	9.4	0.01	0.42	1.18	87.66	6.68	0.41	11.4	49.4	0.06	0.06	0.83

(Table continued)

Table 11 (continued)
HTK Unit Analytical Data

Date, 1983	Feed				CSD deashed SRC							Hydrotreated flashed bottoms				
	Solv %	Ash %	C %	S %	Solv %	Ash %	S %	N %	C %	H %	BI %	Solv % <650°F	Total Solv %	Ash %	UC %	BI %
May 23	42.9	0.01	0.04	0.25	9.6	0.06	0.50	1.34	87.30	6.69	10.4	12.9	51.4	<0.01	0.05	0.45
24	44.2	0.02	0.02	0.30	13.0	<0.01	0.41	-	-	-	9.1	10.8	49.9	0.01	0.03	0.65
25	43.8	0.02	0.04	0.35	12.0	0.04	0.38	1.01	87.53	6.78	3.1	12.2	53.5	0.06	0.03	1.72
26	44.3	<0.01	-	0.33	10.9	0.02	0.38	1.18	87.70	6.68	5.69	8.8	50.2	0.01	0.04	1.22
27	43.6	0.02	-	0.43	11.4	0.04	0.60	-	-	-	3.56	10.8	53.1	0.01	0.05	0.82
28	44.4	0.02	0.01	0.31	14.6	0.07	0.48	-	-	-	2.11	9.8	52.8	0.02	0.04	0.92
29	44.8	<0.01	-	0.34	11.1	0.04	0.51	-	-	-	1.12	11.2	51.7	0.03	0.04	0.74
30	43.9	-	-	0.36	11.3	0.09	0.44	1.38	87.52	6.74	3.44	10.3	51.1	0.04	0.10	0.87
31	44.0	<0.01	0.02	0.26	9.3	<0.01	0.50	1.16	88.14	6.76	-	7.6	51.4	0.09	0.05	-
June 1	42.8	0.01	0.01	0.34	13.6	0.01	0.53	1.38	88.22	6.81	8.56	10.3	50.5	0.08	0.02	1.42
2	44.6	0.03	0.02	0.41	10.5	0.14	0.43	-	-	-	4.13	9.2	52.0	0.01	0.09	1.57
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	45.0	0.09	0.01	0.30	13.6	-	0.36	-	-	-	5.5	16.6	55.1	0.22	0.15	1.8
5	46.0	<0.01	0.02	0.23	13.3	-	0.28	0.97	87.95	6.61	10.2	-	53.0	0.21	0.01	2.34
6	45.9	<0.01	0.04	0.36	14.7	0.15	0.44	0.96	88.42	6.57	-	10.4	53.4	0.05	0.45	-
7	45.4	<0.01	0.04	0.39	15.2	0.15	0.42	1.30	88.49	6.57	10.6	10.9	53.3	0.06	0.06	1.74
8	45.4	-	-	0.36	-	-	0.45	1.13	87.16	6.44	2.14	-	54.2	-	-	1.68
9	45.9	0.01	0.04	0.32	12.5	-	0.45	0.94	88.53	6.53	3.31	10.4	53.0	0.07	0.09	1.78
10	45.1	0.01	0.03	0.32	12.8	0.08	0.42	-	-	-	7.28	9.5	52.6	0.22	0.20	1.60
11	45.3	0.02	0.04	0.33	13.2	-	0.45	-	-	-	2.65	8.5	50.3	0.05	0.09	1.68
12	45.9	0.01	0.06	-	11.5	-	-	1.19	88.34	6.38	1.89	8.9	51.6	0.07	0.07	1.54
13	45.1	0.02	0.0	-	10.2	-	0.39	1.06	88.23	6.45	4.68	17.7	51.2	0.03	0.07	1.39
14	44.6	<0.01	<0.01	0.29	10.6	-	0.38	1.02	88.48	6.42	10.2	12.2	51.9	0.18	0.19	2.63
15	44.4	0.07	0.01	-	11.6	-	-	1.09	88.10	6.39	2.0	9.4	52.4	0.20	0.26	1.07
16	45.6	-	-	-	11.4	-	-	1.05	88.42	6.46	4.8	10.0	53.2	0.19	0.23	0.66
17	45.3	0.01	0.02	-	10.5	0.01	-	-	-	-	4.3	9.5	54.9	0.03	-	0.21
18	45.2	<0.01	<0.01	-	10.3	0.01	-	-	-	-	5.2	5.5	52.5	0.19	0.22	0.63
19	45.3	<0.01	0.03	-	10.4	0.02	-	0.99	88.45	6.53	6.1	5.7	55.0	0.07	0.01	0.53
20	45.1	0.02	0.10	-	13.0	0.04	-	-	-	-	13.5	2.5	52.4	0.02	0.01	3.24
21	45.0	0.01	0.05	-	12.4	0.05	0.48	1.09	88.50	6.52	11.0	3.5	53.4	0.01	0.03	-
22	45.0	0.02	0.03	-	13.7	0.02	-	1.22	88.48	6.49	11.4	3.7	54.0	0.02	0.02	1.22
23	45.2	0.01	0.03	0.47	-	0.08	0.46	1.00	88.76	6.48	13.4	3.4	52.7	0.03	0.02	1.21
24	45.0	0.02	0.02	0.39	12.7	0.07	0.45	-	-	-	10.1	3.0	52.8	0.03	0.02	1.97
25	44.0	0.02	0.02	0.35	13.3	0.06	0.42	-	-	-	13.5	11.2	52.3	0.12	0.03	0.83
26	45.3	0.02	0.0	0.35	10.3	0.04	0.44	1.12	88.36	6.54	19.9	9.3	53.8	0.07	0.02	1.07
27	45.2	0.02	0.01	0.33	13.2	0.03	0.44	1.21	88.42	6.52	24.6	10.3	51.3	0.02	0.06	2.14

Table 12
Estimated Performance and Stability Data (HTR Unit)

Date,	Total out./in,	Feed Solvent free SRC, lb/hr	Solvents input, lb/hr	Distillate product, % feed SRC by fraction			HTR SRC, % SRC	Sour water, % SRC	C ₁ -C ₃ gas, % SRC	Hydrogen consumption, % SRC	Flare Knockout liquids % SRC
				<550°F	350-450°F	>450°F					
Feb											
17	1.01	230	187	0.6	0.4	13.3	95.3	2.2	0.4	1.2	1.1
18	1.00	239	195	0.6	0.8	12.4	95.3	2.1	0.3	1.3	1.5
19	1.00	249	198	0.7	0.4	11.4	93.5	2.0	0.1	1.5	1.2
20	1.00	248	200	0.3	0.3	13.3	93.5	1.7	0.1	1.4	0.9
21	1.01	250	205	0.8	0.4	13.0	96.6	1.6	0.2	1.2	0.9
23	1.00	255	201	0.7	0.3	11.7	94.4	2.0	0.4	1.2	1.4
26	1.01	248	200	1.4	0.7	12.9	94.6	1.7	0.4	1.9	1.0
27	0.98	257	199	1.4	0.7	10.8	92.2	1.7	0.2	2.0	1.6
Mar											
1	1.01	252	194	1.6	0.8	10.0	93.4	3.4	0.4	2.0	1.5
2	1.01	224	187	1.7	0.8	13.2	96.3	2.2	0.4	2.1	2.0
3	1.01	229	179	1.5	0.8	12.8	92.5	5.4	0.3	2.1	1.9
4	1.00	240	191	1.6	0.9	13.6	94.6	4.0	0.3	2.0	1.7
5	1.00	256	202	1.5	0.9	14.3	88.1	5.7	0.6	2.3	0.8
6	1.01	267	202	2.0	1.4	17.2	85.0	6.0	0.6	2.4	1.7
7	1.01	268	210	2.2	1.7	15.7	89.3	3.7	0.6	2.4	2.5
8	1.00	259	208	2.1	1.5	14.4	90.5	3.9	0.6	2.4	1.2
9	1.01	261	205	2.3	1.5	14.8	90.6	3.8	0.5	2.2	1.1
10	1.01	255	202	2.4	1.3	20.0	87.9	3.9	0.5	2.2	1.3
11	0.99	280	216	2.3	1.4	22.1	79.9	3.6	0.6	2.8	1.8
12	0.98	294	224	3.2	2.0	20.5	76.5	3.4	0.6	2.9	1.7
13	0.98	283	222	3.5	2.1	22.3	79.7	3.5	0.6	3.0	1.6
14	0.98	286	222	3.5	2.2	20.0	78.6	3.5	0.8	3.0	1.3
15	1.00	263	201	3.2	1.9	23.7	81.0	3.8	0.9	3.1	1.0
16	0.99	263	204	3.4	2.0	24.4	78.9	3.8	0.6	3.0	1.2
17	-	192	153	-	-	-	-	-	-	-	2.1
18	0.98	301	241	2.5	2.2	18.7	83.5	3.3	0.6	2.9	1.3
19	0.98	259	206	2.7	1.6	24.8	80.7	3.9	0.7	3.0	0.9
20	0.97	286	223	2.6	1.6	22.1	78.0	3.5	0.5	2.8	1.0
21	0.99	291	218	2.6	1.9	15.0	80.8	3.4	0.5	2.6	0.9
22	0.98	275	218	3.1	2.0	18.6	80.9	3.6	1.2	2.7	0.8
23	0.99	270	204	3.3	2.1	23.0	82.2	3.7	1.2	2.7	1.0
24	1.00	265	205	3.8	1.7	23.0	82.9	3.8	0.8	2.7	1.2
25	1.00	271	206	4.2	2.1	20.8	81.0	3.7	0.8	2.6	1.0
26	1.00	271	202	3.2	2.1	21.0	84.5	3.7	0.8	2.7	0.8
27	1.00	277	195	3.0	1.9	18.5	82.1	3.6	0.8	2.6	0.8
28	1.00	273	187	3.7	1.8	14.5	85.6	3.7	0.8	2.5	0.9
29	0.99	282	212	3.6	1.7	17.8	80.4	3.6	0.7	2.5	0.9
30	0.99	272	212	4.1	2.3	19.2	81.2	3.7	0.7	2.5	1.1
31	0.98	301	225	3.4	1.6	14.7	78.2	3.3	0.7	2.2	1.1
Apr											
1	1.00	300	237	2.9	1.6	19.4	83.4	3.3	0.7	2.3	1.3
2	1.00	277	227	3.4	1.8	20.0	84.3	3.6	0.8	2.5	0.9
3	1.00	274	222	5.0	2.0	18.2	82.1	3.6	0.9	2.6	1.3
4	0.99	283	224	3.7	2.1	12.8	82.5	3.5	0.9	2.5	1.3
5	1.01	264	215	-	-	-	87.8	3.8	0.9	2.7	1.4
6				-----Planned shutdown-----							

(Table continued)

Table 12 (continued)
Estimated Performance and Stability Data (HTR Unit)

Date, 1983	Total out/in,	Feed	Solvents input, lb/hr	Distillate product, % feed SRC by fraction			HTR SRC, % SRC	Sour water, % SRC	C ₁ -C ₅ gas, % SRC	Hydrogen consumption, % SRC	Flare knockout liquids, % SRC
		Solvent free SRC, lb/hr		<350°F	350-450°F	>450°F					
April 20	-	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-	-	-
23	-	-	-	-	-	-	-	-	-	-	-
24	1.00	201	174	2.2	1.4	20.3	85.3	5.2	0.9	2.6	0.3
25	0.99	241	193	2.0	1.2	18.2	84.3	1.9	0.7	2.5	0.7
26	1.00	271	212	2.0	1.1	16.3	91.6	2.3	0.7	2.6	<0.1
27	1.02	245	195	2.2	1.5	26.4	85.5	5.3	0.5	3.0	0.3
28	1.01	259	200	3.1	1.4	27.1	80.5	6.2	0.5	3.3	1.5
29	1.01	275	215	4.0	2.3	19.6	82.0	5.6	0.9	3.1	0.3
30	1.01	275	221	2.8	1.9	25.3	82.0	5.4	0.9	3.2	0.3
May 1	1.01	281	221	3.4	2.2	22.3	82.1	5.7	0.6	3.2	1.1
2	1.00	272	211	3.1	1.1	24.4	81.6	5.5	0.7	3.4	0.6
3	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-
5	1.00	241	189	2.9	1.5	25.7	85.6	3.4	0.4	3.6	0.6
6	1.00	240	191	2.4	1.5	24.3	82.7	3.3	0.4	3.3	1.0
7	0.97	267	216	2.4	0.9	16.9	85.7	3.0	0.3	2.8	0.8
8	1.00	251	206	3.3	1.1	22.3	88.2	3.2	0.3	3.3	0.8
9	1.01	254	198	2.4	0.5	25.7	86.5	2.3	0.3	3.9	0.7
10	1.01	240	187	3.4	0.7	22.0	89.0	3.3	0.3	-	0.8
11	1.01	232	181	2.2	0.6	24.1	88.5	3.0	0.3	-	0.9
12	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-
14	1.01	265	206	-	-	-	82.9	2.0	0.4	3.3	0.6
15	1.02	246	183	3.2	1.2	21.6	89.8	3.6	0.4	3.6	0.5
16	1.01	271	206	3.0	1.2	18.4	89.6	4.5	0.4	3.3	0.3
17	1.00	276	213	5.5	1.9	16.8	85.5	3.3	0.9	2.9	-
18	1.01	265	204	4.5	2.2	21.0	85.2	3.5	0.9	3.1	1.6
19	1.00	269	203	4.5	2.1	24.1	79.9	2.6	0.7	3.7	1.6
20	1.00	264	199	5.0	2.3	23.6	79.1	1.8	0.7	3.7	1.3
21	1.02	271	197	4.3	1.8	20.7	82.1	5.2	0.7	3.5	1.4
22	1.01	268	206	4.3	2.0	15.3	84.2	5.0	1.0	3.6	1.2

(Table continued)

Table 12 (continued)
Estimated Performance and Stability Data (HTR Unit)

Date, 1983	Total out/in,	Feed	Solvents input, lb/hr	Distillate product, % feed SRC by fraction			HTR SRC % SRC	Sour water, % SRC	C ₁ -C ₃ gas, % SRC	Hydrogen consumption, % SRC	Flare knockout liquids % SRC
		Solvent Free SRC, lb/hr		<350°F	350-450°F	>450°F					
May											
23	0.99	271	214	4.4	2.3	14.3	77.8	3.8	1.0	3.1	1.1
24	-	-	-	-	-	-	-	-	-	-	-
25	1.00	271	209	3.6	2.1	23.8	75.6	3.3	1.4	2.8	1.8
26	0.99	246	192	4.6	2.0	19.5	79.2	2.3	1.5	3.0	1.5
27	0.98	213	167	3.8	1.8	23.5	72.6	3.2	1.2	3.0	1.3
28	0.99	221	174	4.1	2.4	23.7	75.4	3.5	1.1	2.9	2.0
29	0.99	229	181	4.8	1.9	20.0	77.2	3.5	1.4	2.8	1.5
30	0.99	223	173	5.0	2.0	18.9	77.4	3.7	1.4	2.8	1.1
31	1.00	208	159	4.2	2.1	22.9	77.5	4.8	2.0	2.9	1.2
Jun											
1	0.99	219	172	3.8	1.8	17.1	76.4	4.2	1.9	2.7	1.0
2	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-
4	1.00	215	169	3.0	1.1	31.9	74.2	3.1	1.3	3.1	0.9
5	-	-	-	-	-	-	-	-	-	-	-
6	0.99	202	160	6.2	2.0	26.6	76.5	2.9	1.4	3.4	1.1
7	1.00	203	165	5.3	3.4	23.2	76.5	2.8	2.0	2.8	1.0
8	1.00	216	168	5.2	2.3	28.2	75.3	2.7	1.9	2.7	1.2
9	0.99	218	178	3.9	2.6	23.1	76.4	2.8	1.7	2.8	1.2
10	1.01	218	172	4.5	2.6	25.5	77.4	4.0	1.7	2.9	1.4
11	0.99	212	170	4.2	2.2	20.4	80.4	3.3	1.2	2.7	1.1
12	1.01	205	165	4.0	2.4	25.2	81.2	3.5	1.3	2.8	0.9
13	0.99	208	165	5.0	2.8	20.2	78.1	3.5	1.3	2.7	1.3
14	0.99	210	173	6.9	2.8	16.1	76.3	3.5	1.2	2.7	1.0
15	-	-	-	-	-	-	-	-	-	-	-
16	1.00	230	186	7.7	3.1	22.3	75.8	4.0	1.0	3.3	1.1
17	1.01	223	176	5.1	3.3	29.5	72.9	5.1	1.3	3.4	1.1
18	1.00	226	177	4.4	3.0	25.7	75.7	4.5	1.3	3.2	1.0
19	1.01	223	177	4.6	2.6	30.9	72.7	3.9	1.7	3.2	1.2
20	1.01	238	184	5.1	2.9	27.6	77.2	4.6	1.6	3.1	1.2
21(a)	1.01	230	179	4.6	2.4	29.6	75.3	4.2	1.0	3.4	1.2
22	1.01	221	175	4.3	2.3	30.8	74.3	4.3	1.1	3.4	1.1
23	-	-	-	-	-	-	-	-	-	-	-
24	1.00	223	181	5.8	2.2	24.6	77.2	4.9	1.0	3.1	1.4
25	1.00	211	169	4.0	2.1	23.9	75.8	3.9	1.8	3.1	1.0
26	1.00	211	169	4.0	2.3	28.2	75.9	3.6	1.8	3.1	1.0
27	0.99	230	185	4.4	2.4	21.9	79.8	3.7	0.7	3.1	1.1
28	-----End of run-----										

(a) Began using V1074 solvent for ebullating pump instrument purges.

Table 13
HTR Unit Operating Conditions and Yields - Special Product Workup Periods

Date, 1983 MB Run	21 Feb 12-243A	1 March 12-243B	10 March 12-243C	14 March 12-243D	22 March 12-243E	2 April 12-243F
<u>Flashed bottoms lab distillate</u>						
H/C atomic ratio	1.33	1.34	1.36	1.35	1.31	1.37
<u>Fraction, wt %</u>						
<450°F	0	0.2	0.1	0	0.3	0.6
450-650°F	19.5	21.9	20.3	17.5	16.0	13.6
>650°F	80.5	77.9	79.6	82.5	83.7	85.8
<u>Activity, % THF conversion</u>						
Kinetic test	80.5	89.0	81.3	80.1	70.0	67.0
Equilibrium test	80.2	86.4	87.8	88.4	84.7	78.6
<u>Operating conditions</u>						
CSD SRC rate, lb/hr (% solvent)	283.2(9.6)	277.1(7.4)	289.2(10.2)	311.8(9.0)	301.0(9.7)	309.6(10.4)
Feed rate, lb/hr	471	453	476	514	502	518
Concentration, wt % SRC	54.4	56.7	54.6	55.2	54.2	53.6
Recycle gas, Mscf/ton SRC	53.9	52.7	49.3	36.3	48.6	45.3
Hydrogen purity, mole %	98.2	97.7	95.9	90.0	94.4	93.7
Water injection rate, lb/lb feed	0.22	0.23	0.25	0.24	0.28	0.31
Seal oil, % SRC feed	2.1	2.1	2.0	1.9	1.9	1.1
<u>Reaction</u>						
Space velocity, (lb feed/hr)/lb cat	1.19	1.14	1.20	1.29	1.25	1.30
Temperature, °F average	628	659	688	720	716	720
Hydrogen partial press., psi (inlet)	2,720	2,734	2,679	2,565	2,640	2,600
Catalyst age, lb SRC/lb catalyst	161	279	412	478	603	782
<u>Results</u>						
SRC conversion, %	5.6	8.3	13.8	20.7	18.2	15.8
Hydrogen consumption, % feed SRC(a)	1.2(1.2)	1.6(2.0)	2.0(2.2)	2.6(3.0)	2.4(2.7)	2.2(2.5)
Sulfur, % of SRC product(b)	-	-	0.25	-	-	-

(Table continued)

Table 13 (continued)
HTR Unit Operating Conditions and Yields - Special Product Workup Periods

Date, 1983 MB Run	21.Feb 12-243A	1.March 12-243B	10 March 12-243C	14 March 12-243D	22 March 12-243E	2 April 12-243F
<u>Yields, % of feed SRC</u>						
<u>Gases</u>						
NH ₃ , H ₂ S	0.7	0.9	1.0	1.2	1.1	1.2
C ₁ -C ₃	0.2	0.4	0.5	0.8	1.2	0.8
<u>Liquids</u>						
Water	2.5	4.0	3.3	4.6	4.0	1.9
Naphtha	0.7	1.5	2.4	3.4	3.1	3.4
Middle distillate	0.4	0.8	1.3	2.1	2.0	1.7
Distillate solvent	2.2	2.3	7.3	11.2	9.2	8.9
<u>SRC (solvent free)(c)</u>						
Non-distillable oil	33.6	34.4	32.0	41.6	40.4	37.3
Asphaltenes	58.6	54.9	52.0	37.1	36.0	42.8
Preasphaltenes	1.5	2.1	0.9	0.5	4.0	3.7
UC	0.4	0.2	0.7	0.1	0.6	0.1
Ash	0.4	0.1	0.6	0.1	0.8	0.3

- (a) By elemental balance. Values in parentheses are determined by compressor suction meter less hydrogen in flare.
 (b) Galbraith lab. analysis.
 (c) Soxhlet extraction analyses have not been consistent on TSL products.

(Table continued)

Table 13 (continued)
HTR Unit Operating Conditions and Yields - Special Product Workup Periods

Date, 1983	1 May	8 May	23 May	29 May	31 May	13 June	19 June
MB Run	12-243G	13-243H	13-243I	13-243J	13-243K	13-243L	13-243M
<u>Flashed bottoms lab distillate</u>							
H/C atomic ratio	1.34	1.39	1.44	1.43	1.47	1.41	1.40
<u>Fraction, wt %</u>							
<450°F	0.2	0.1	0.3	0.5	0.6	0.3	0.6
450-650°F	13.2	23.8	22.9	19.8	19.6	16.9	17.5
>650°F	86.6	76.1	76.8	79.7	79.8	82.8	81.9
<u>Activity, % THF conversion</u>							
Kinetic test	81.1	83.3	81.1	84.1	63.7	68.6	84.4
Equilibrium test	83.3	84.3	85.6	88.8	83.3	88.8	89.3
<u>Operating conditions</u>							
CSD SRC rate, lb/hr (% solvent)	313.8(10.4)	292.0(13.4)	279.6(4.5)	248.7(8.8)	229.5(8.8)	230.7(10.0)	252.0(10.3)
Feed rate, lb/hr	517	482	471	411	374	378	412
Concentration, wt % SRC	54.4	52.5	57.1	55.2	56.0	54.9	54.7
Recycle gas, Mscf/ton SRC	35.3	39.4	38.0	53.4	57.6	61.1	56.3
Hydrogen purity, mole %	93.9	97.2	94.3	94.7	94.3	94.2	94.0
Water injection rate, lb/lb feed	0.23	0.22	0.25	0.27	0.30	0.30	0.29
Seal oil, % SRC feed	2.9	3.0	2.7	2.4	2.0	2.4	1.0
<u>Reaction</u>							
Space velocity, (lb feed/hr)/lb cat	1.30	1.22	1.19	1.04	0.95	0.96	1.05
Temperature, °F average	719	680	718	719	718	719	728
Hydrogen partial press., psi (inlet)	2,686	2,755	2,694	2,697	2,684	2,684	2,680
Catalyst age, lb SRC/lb catalyst	963	69	273	354	380	529	608
<u>Results</u>							
SRC conversion, %	18.0	12.6	21.1	22.0	22.8	21.6	28.2
Hydrogen consumption, % feed SRC(a)	2.6(3.2)	2.6(3.3)	2.9(3.1)	2.9(2.8)	2.9(2.9)	3.1(2.7)	3.2(3.2)
Sulfur, % of SRC product(b)	-	0.21	-	-	0.25	-	-

See notes next page.

(Table continued)

Table 13 (continued)
HTR Unit Operating Conditions and Yields - Special Product Workup Periods

Date, 1983 MB Run	1 May 12-243G	8 May 13-243H	23 May 13-243I	29 May 13-243J	31 May 13-243K	13 June 13-243L	19 June 13-243M
<u>Yields, % of feed SRC</u>							
<u>Gases</u>							
NH ₃ , H ₂ S	1.3	1.1	1.3	1.1	1.1	1.2	1.2
C ₁ -C ₅	0.6	0.3	1.0	1.4	2.0	1.3	1.6
<u>Liquids</u>							
Water	2.1	3.4	3.0	4.5	4.4	5.2	3.2
Napththa	3.4	3.3	4.4	4.8	4.3	3.9	4.6
Middle distillate	2.2	1.2	2.4	2.0	2.1	2.0	2.5
Distillate solvent	10.9	5.9	11.9	11.1	11.9	11.1	18.4
<u>SRC (solvent free)(c)</u>							
Non-distillable oil	35.6	51.1	45.5	46.5	45.6	41.2	35.0
Asphaltenes	41.8	36.1	31.6	30.7	29.7	34.5	33.7
Preasphaltenes	4.5	0	1.7	0.7	1.6	2.5	2.9
UC	0.1	0.05	0.1	0.06	0.08	0.12	0.01
Ash	0.1	0.12	0	0.05	0.15	0.05	0.11

- (a) By elemental balance. Values in parentheses are determined by compressor suction meter less hydrogen in flare.
 (b) Galbraith lab. analysis.
 (c) Soxhlet extraction analyses have not been consistent on TSL products.

Table 14
Feed and Product Nitrogen Distribution (HTR Unit) - Special Product Workup Periods

Date, 1983 Run	21 February 12-243A				1 March 12-2433				10 March 12-243C			
	Analyses		Nitrogen rate		Analyses		Nitrogen rate		Analyses		Nitrogen rate	
	Kjeldahl, %	C/H/N, %	Kjeldahl, lb/hr	C/H/N, lb/hr	Kjeldahl, %	C/H/N, %	Kjeldahl, lb/hr	C/H/N, lb/hr	Kjeldahl, %	C/H/N, %	Kjeldahl, lb/hr	C/H/N, lb/hr
Input												
Withdrawal tube flush	-	0.13	(0.02)	0.02	-	0	-	-	-	0.26	(0.04)	0.04
Feed blend, V1064	1.40	1.10	6.44	5.06	1.11	1.07	4.93	4.75	1.17	1.25	5.46	5.83
Total			6.46	5.08							5.50	5.87
Output												
Flashed liquids	-	0.19	(0.05)	0.05	0.37	0.07	0.12	0.02	0.24	0.07	0.11	0.03
Flashed bottoms	1.03	0.92	4.75	4.24	0.97	1.02	4.16	4.38	0.90	0.73	4.02	3.26
Sour water	0.574	-	0.64	(0.64)	-	-	-	-	1.078	-	1.42	(1.42)
Total			5.44	4.93							5.55	4.71
Out/In			0.84	0.97							1.01	0.80

Date, 1983 Run	14 March 12-243D				22 March 12-243E				2 April 12-243F			
	Analyses		Nitrogen rate		Analyses		Nitrogen rate		Analyses		Nitrogen rate	
	Kjeldahl, %	C/H/N, %	Kjeldahl, lb/hr	C/H/N, lb/hr	Kjeldahl, %	C/H/N, %	Kjeldahl, lb/hr	C/H/N, lb/hr	Kjeldahl, %	C/H/N, %	Kjeldahl, lb/hr	C/H/N, lb/hr
Input												
Withdrawal tube flush	-	0.19	-	0.03	-	0.14	-	0.02	-	0.22	-	0.04
Feed blend, V1064	-	0.69	-	3.58	-	0.86	-	4.36	-	0.95	-	4.91
Total				3.61				4.38				4.95
Output												
Flashed liquids	-	0.26	-	0.16	-	0.03	-	0.02	-	0	-	0
Flashed bottoms	-	0.61	-	2.82	-	0.5	-	2.25	-	0.39	-	1.82
Sour water	1.37	-	-	1.94	1.09	-	-	1.70	0.88	-	-	1.51
Total				4.92				3.96				3.33
Out/In			-	1.36			-	0.90			-	0.67

(Table continued)

Table 14 (continued)
Feed and Product Nitrogen Distribution (HTR Unit) - Special Product Workup Periods

Date, 1983 Run	1 May 12-243G				8 May 13-243H				23 May 13-243I			
	Analyses		Nitrogen rate		Analyses		Nitrogen rate		Analyses		Nitrogen rate	
	Kjeldahl, %	C/H/N, %	Kjeldahl, lb/hr	C/H/N, lb/hr	Kjeldahl, %	C/H/N, %	Kjeldahl, lb/hr	C/H/N, lb/hr	Kjeldahl, %	C/H/N, %	Kjeldahl, lb/hr	C/H/N, lb/hr
Input												
Withdrawal tube flush	-	0.15	-	0.03	-	0.20	0.04	0.04	-	0.18	-	0.03
Feed blend, V1064	-	1.20	-	6.20	0.92	1.31	4.39	6.21	-	1.02	-	4.84
Total				6.23			4.43	6.25				4.87
Output												
Flushed liquids	-	0	-	0	0.2	0.06	0.08	0.02	-	0.17	-	0.09
Flushed bottoms	-	0.54	-	2.58	0.67	0.52	3.11	2.41	-	0.49	-	2.12
Sour water	1.30	-	-	1.64	1.15	-	1.35	1.35	1.33	-	-	1.70
Total				4.22			4.54	3.78				3.91
Out/In			-	0.68			1.02	0.60			-	0.80

Date, 1983 Run	29 May 13-243J				31 May 13-243K				13 June 13-243L			
	Analyses		Nitrogen rate		Analyses		Nitrogen rate		Analyses		Nitrogen rate	
	Kjeldahl, %	C/H/N, %	Kjeldahl, lb/hr	C/H/N, lb/hr	Kjeldahl, %	C/H/N, %	Kjeldahl, lb/hr	C/H/N, lb/hr	Kjeldahl, %	C/H/N, %	Kjeldahl, lb/hr	C/H/N, lb/hr
Input												
Withdrawal tube flush	-	0.08	-	0.01	-	0.48	0.08	0.08	-	0.48	-	0.88
Feed blend, V1064	-	0.79	-	3.28	0.87	0.70	3.24	2.60	-	1.41	-	5.35
Total				3.29			3.32	2.68				5.43
Output												
Flushed liquids	-	0.08	-	0.05	0.11	0.09	0.06	0.05	-	0.06	-	0.03
Flushed bottoms	-	0.48	-	1.76	0.56	0.70	1.86	2.33	-	0.88	-	2.93
Sour water	1.02	-	-	1.26	1.19	-	1.47	1.47	1.05	-	-	1.33
Total				3.07			3.39	3.85				4.29
Out/In			-	0.93			1.02	1.44			-	0.79

(Table continued)

Table 14 (continued)
Feed and Product Nitrogen Distribution (HTR Unit) - Special Product Workup Periods

Date, 1983
Run

	19 June 13-243M			
	Analyses		Nitrogen rate	
	Kjeldahl, %	C/H/N, %	Kjeldahl, lb/hr	C/H/N, lb/hr
<u>Input</u>				
Withdrawal tube flush	-	0.20	-	0.03
Feed blend, V1064	-	0.77	-	3.14
Total				<u>3.17</u>
<u>Output</u>				
Flashed liquids	-	0.10	-	0.07
Flashed bottoms	-	0.64	-	2.31
Sour water	1.12	-	-	1.44
Total				<u>3.82</u>
Out/In			-	1.21

Table 15
ITSL Yield Structure(a)

Input Data Run Date, 1983	234A 21 Feb	243B 1 Mar	243C 10 Mar	243D 14 Mar	243E 22 Mar	243F 2 Apr
<u>Coal feed rate, lb/hr</u>						
As-is	251.0	238.5	257.0	254.8	259.7	256.8
MF	245.6	234.9	252.2	249.5	253.5	251.5
MAF	219.0	207.9	222.4	221.1	224.9	221.2
<u>Net input % MAF coal</u>						
Hydrogen consumption (b)	2.01	2.12	1.86	1.47	1.62	1.58
Makeup DAS (c)	4.80	3.87	6.37	5.58	5.56	5.89
HTR unit hydrogen consump (b)	1.29	1.90	2.41	3.19	2.92	2.43
Coal ash	12.15	12.99	13.40	12.84	12.72	13.70
TOTAL NET INPUT	20.25	20.88	24.04	23.08	22.82	23.60
<u>Yield, % MAF coal (a)</u>						
<u>Gases</u>	9.71	10.89	9.59	9.93	9.48	8.41
CO	0.12	0.41	0.	0.	0.01	0.11
CO ₂	0.97	1.01	0.97	1.07	1.11	1.10
NH ₃	0.41	0.39	0.25	0.28	0.30	0.20
H ₂ S	1.03	1.35	1.47	1.94	2.02	2.08
C ₁ -C ₅	7.18	7.73	6.90	6.64	6.04	4.92
C ₁	2.14	2.03	1.72	1.70	1.67	1.16
C ₂	1.83	1.92	1.70	1.70	1.62	1.22
C ₃	1.54	1.77	1.57	1.57	1.36	1.04
C ₄	0.83	1.07	0.89	0.91	0.68	0.57
C ₅	0.84	0.94	1.02	0.76	0.71	0.93
<u>Liquids</u>	43.38	41.89	45.09	35.60	41.58	36.85
H ₂ O	5.58	6.23	5.23	5.27	4.43	4.52
Total recovered distillate	35.48	34.27	35.82	27.16	34.04	28.53
Naphtha	3.63	4.26	5.25	3.56	3.50	3.91
Middle distillate	6.23	5.38	6.45	4.43	3.90	3.63
Recovered distillate solvent	25.61	24.63	24.12	19.17	26.64	20.99
Non-product DAS loss	2.33	1.39	4.05	3.17	3.11	3.80
<u>Ash concentrate (CSD stage I)</u>	32.24	32.13	34.13	31.43	31.34	36.03
Deashing solvent	0.23	0.67	0.31	0.28	0.66	0.11
Distillate solvent	0.64	0.55	0.78	0.31	0.25	0.47
Non-distillable oil	2.98	2.70	2.25	3.11	1.79	0.87
Asphaltenes	1.50	0.64	1.67	0.94	1.19	0.90
Preasphaltenes	4.12	4.82	4.54	5.63	5.52	11.53
UC	10.55	10.60	10.99	8.55	9.03	9.69
Ash	12.22	12.14	13.58	12.60	12.91	12.47
<u>CSD SRC (CSD stage II)</u>	25.78	20.11	10.22	15.67	12.66	9.58
Deashing solvent	0.39	0.24	0.14	0.22	0.15	0.13
Distillate solvent	2.55	1.47	1.03	1.85	0.97	1.37
Non-distillable oil	10.83	7.92	3.08	6.05	5.15	2.95
Asphaltenes	10.10	8.79	5.69	5.83	5.88	4.36
Preasphaltenes	1.80	1.65	0.22	1.55	0.50	0.73
UC	0.10	0.02	0.05	0.13	0.	0.04
Ash	0.01	0.02	0.01	0.04	0.01	0.
DAS loss from CSD SRC	1.85	1.56	1.87	1.91	1.64	1.85
<u>HTR Unit Total Yield</u>	7.34	14.28	21.44	28.53	26.10	30.91
<u>Gases</u>	1.05	1.52	1.72	2.42	2.72	2.55
CO	0.	0.	0.	0.	0.	0.
CO ₂	0.	0.	0.	0.	0.	0.
NH ₃	0.34	0.70	0.77	1.01	1.16	1.03
H ₂ S	0.49	0.41	0.41	0.43	0.11	0.51
C ₁ -C ₅	0.22	0.41	0.54	0.98	1.45	1.01
C ₁	0.07	0.09	0.11	0.23	0.22	0.18
C ₂	0.07	0.11	0.13	0.30	0.36	0.21
C ₃	0.05	0.09	0.08	0.20	0.36	0.23
C ₄	0.02	0.04	0.	0.15	0.20	0.09
C ₅	0.01	0.08	0.22	0.10	0.31	0.30

(Table continued)

Table 15 (continued)
ITSL Yield Structure (a)

<u>Liquids</u>	6.29	12.76	21.44	26.11	23.38	28.36
H ₂ O	2.76	4.80	3.95	5.64	4.84	2.41
<u>Total recovered distillate</u>	3.53	7.96	17.49	20.47	18.58	25.95
Naphtha	0.80	1.81	2.83	4.17	3.80	4.27
Middle distillate	0.45	0.91	1.59	2.62	2.46	2.14
Recovered distillate solvent	2.28	5.24	13.07	13.68	12.28	19.54
<u>TOTAL YIELD</u>	120.30	120.86	124.06	123.07	122.80	123.63
(less net input)	(100.05)	(99.98)	(100.02)	(99.99)	(99.98)	(100.03)

(a) Combined SRC, CSD, and HTR units by the process method (Appendix A).

(b) Calculated by ethylene injection.

(c) Makeup DAS due to product losses and leaks.

Note: Inventory changes between units are used to adjust for the steady state CSD-SRC product rates.
SRC unit depleted solvent accumulation (T102 Tray 8 material) is considered a thermal stage product.

(Table continued)

Table 15 (continued)
ITSL Yield Structure(a)

Input Data Run Date, 1983	243G 1 May	243H 8 May	243I 23 May	243J 29 May	243K 31 May	243L 13 Jun	243M 19 Jun
<u>Coal feed rate, lb/hr</u>							
As-is	253.2	256.4	249.0	197.0	195.0	193.0	206.0
MF	251.6	252.0	244.0	194.1	192.9	188.4	201.6
MAF	223.9	224.1	217.5	172.4	171.3	168.4	179.7
<u>Net input % MAF coal</u>							
Hydrogen consumption (b)	1.60	1.24	1.28	1.54	1.23	0.82	0.90
Makeup DAS (c)	5.76	6.23	6.97	7.59	8.09	7.19	5.27
HTR unit hydrogen consump (b)	3.08	2.89	3.65	3.46	3.60	3.89	4.20
Coal ash	12.37	12.45	12.18	12.59	12.61	11.88	12.19
TOTAL NET INPUT	22.81	22.81	24.08	25.18	25.53	23.78	22.56
<u>Yield, % MAF coal (a)</u>							
<u>Gases</u>	9.71	9.88	7.39	10.17	9.70	9.29	8.08
CO	0.17	0.19	0.15	0.18	0.26	0.11	0.07
CO ₂	0.71	0.84	0.68	0.79	0.75	0.91	0.94
NH ₃	0.21	0.41	0.25	0.32	0.33	0.32	0.31
H ₂ S	1.23	1.46	1.10	1.32	1.19	1.58	1.57
C ₁ -C ₅	7.39	6.98	5.21	7.56	7.17	6.35	5.19
C ₁	2.16	1.92	1.29	1.97	1.94	1.70	1.52
C ₂	1.86	1.75	1.24	1.75	1.76	1.59	1.35
C ₃	1.58	1.56	1.07	1.46	1.55	1.40	1.22
C ₄	0.79	0.82	0.58	0.82	0.89	0.78	0.67
C ₅	1.00	0.93	1.03	1.56	1.03	0.88	0.63
<u>Liquids</u>	39.22	46.62	39.76	43.43	49.44	35.75	35.36
H ₂ O	5.61	4.39	3.85	5.01	6.29	3.55	3.73
Total recovered distillate	30.21	38.43	35.39	33.03	37.02	27.50	29.07
Naphtha	3.82	4.59	3.83	4.14	4.28	4.54	4.54
Middle distillate	5.50	5.65	4.60	4.69	4.88	5.48	5.26
Recovered distillate solvent	20.89	28.19	26.96	24.19	27.87	17.47	19.48
Non-product DAS loss	3.39	3.79	0.52	5.39	6.13	4.70	2.56
<u>Ash concentrate (CSD stage I)</u>	36.00	33.42	33.30	32.36	32.51	37.55	37.44
Deashing solvent	0.50	0.40	0.70	0.74	0.26	0.41	0.94
Distillate solvent	0.18	0.10	0.20	0.19	0.97	0.53	0.23
Non-distillable oil	1.95	4.11	2.13	2.17	1.75	2.92	3.89
Asphaltenes	1.73	1.04	1.30	2.20	2.96	1.13	3.30
Preasphaltenes	8.60	6.05	6.66	5.69	5.11	6.27	1.91
UC	10.94	9.76	10.46	9.13	9.59	14.42	15.16
Ash	12.10	11.96	11.85	12.23	11.87	11.87	12.02
<u>CSD SRC (CSD stage II)</u>	10.49	14.02	17.15	8.94	2.80	8.41	1.38
Deashing solvent	0.14	0.20	0.63	0.09	0.03	0.12	0.02
Distillate solvent	1.31	1.37	1.34	0.83	0.28	1.05	0.16
Non-distillable oil	3.32	6.64	6.37	3.15	0.95	3.06	0.49
Asphaltenes	4.95	5.72	8.66	4.43	1.43	3.31	0.66
Preasphaltenes	0.74	0.08	0.14	0.43	0.11	0.86	0.05
UC	0.03	0.	0.01	0.01	0.	0.01	0.
Ash	0.	0.01	0.	0.	0.	0.	0.
DAS loss from CSD SRC	1.72	1.83	5.12	1.37	1.67	1.96	1.75
<u>HTR Unit Total Yield</u>	25.68	17.00	21.35	28.91	29.39	30.83	38.49
<u>Gases</u>	2.29	1.54	2.95	2.98	3.89	3.10	3.63
CO	0.	0.	0.	0.	0.	0.	0.
CO ₂	0.	0.	0.	0.	0.	0.	0.
NH ₃	0.96	0.72	0.98	0.81	0.91	0.94	0.91
H ₂ S	0.59	0.49	0.63	0.50	0.52	0.57	0.59
C ₁ -C ₅	0.74	0.33	1.34	1.67	2.46	1.59	2.13
C ₁	0.21	0.11	0.28	0.42	0.49	0.46	0.40
C ₂	0.20	0.08	0.28	0.37	0.52	0.39	0.49
C ₃	0.17	0.07	0.22	0.33	0.51	0.28	0.43
C ₄	0.03	0.	0.05	0.16	0.28	0.05	0.24
C ₅	0.13	0.07	0.51	0.39	0.66	0.41	0.57

(Table continued)

Table 15 (continued)
ITSL Yield Structure (a)

<u>Liquids</u>	23.39	15.46	18.40	25.93	25.50	27.73	34.86
H ₂ O	2.46	3.79	3.88	5.39	5.53	6.46	4.12
<u>Total recovered distillate</u>	20.93	11.67	14.52	20.54	19.97	21.27	30.74
Naphtha	3.97	3.62	5.60	5.85	5.32	4.86	5.96
Middle distillate	2.59	1.36	3.00	2.44	2.61	2.47	3.23
Recovered distillate solvent	14.37	6.73	5.92	12.24	12.04	13.94	21.55
<u>TOTAL YIELD</u>	122.82	122.77	124.07	125.18	125.51	123.77	122.50
(less net input)	(100.01)	(99.96)	(99.99)	(100.00)	(99.98)	(99.99)	(99.94)

- (a) Combined SRC, CSD, and HTR units by the process method (Appendix A).
(b) Calculated by ethylene injection.
(c) Makeup DAS due to product losses and leaks.

Note: Inventory changes between units are used to adjust for the steady state CSD-SRC product rates.
SRC unit depleted solvent accumulation (T102 Tray 8 material) is considered a thermal stage product.

Table 16
Distillate Product Analyses - Special Product Workup Periods

Date, 1983	21 February			1 March		
Run	243A			243B		
Product	Naphtha and middle distillate		Distillate solvent	Naphtha and middle distillate		Distillate solvent
	SRC	HTR(a)	SRC	SRC	HTR(a)	SRC
<u>Elemental Analysis, wt. %</u>						
Carbon	83.77	87.40	87.55	82.95	87.58	88.19
Hydrogen	11.41	11.38	9.61	11.59	11.65	9.33
Nitrogen	0.05	0.19	0.38	0.18	0.07	0.63
Sulfur(b)	0.41(0.63)	0.01	0.20(0.28)	0.47(0.65)	0.10	0.13(0.39)
Oxygen (by difference)	4.36	1.02	2.26	4.81	0.60	1.72
<u>G.C. analysis</u>						
<u>boiling Fraction, wt. %</u>						
(IBP, °F)	(69)	(176)	(462)	(68)	(156)	(463)
IBP-200°F	13.9	1.2	0.	17.8	1.9	0
200-350°F	18.0	6.5	0	20.8	10.1	0
350-450°F	53.2	5.9	0.1	47.6	7.0	0.1
450-550°F	14.9	27.4	8.6	13.8	28.9	10.1
550-650°F	0	32.0	18.4	0	28.5	19.2
650-°F-EP	0	27.0	72.9	0	23.6	70.6
(EP, °F)	(482)	(878)	(1019)	(496)	(880)	(937)
API gravity, degrees	36.6	20.8	7.6	32.1	20.5	6.4
Kjeldahl nitrogen, wt % (c)	-	-	-	-	0.37	-
Sodium, ppm	-	-	<3	-	-	8
Titanium, ppm	-	-	<3	-	-	<5

- (a) Naphtha, middle distillate and distillate solvent product combined.
(b) Values in parenthesis are from Galbraith Lab.
(c) Galbraith Lab analysis.

(Table continued)

Table 16 (continued)
Distillate Product Analyses - Special Product Workup Periods

Date, 1983	10 March			14 March		
Run	243C			243D		
Product	Naphtha and middle distillate		Distillate solvent	Naphtha and middle distillate		Distillate solvent
	SRC	HTR(a)	SRC	SRC	HTR(a)	SRC
<u>Elemental analysis, wt. %</u>						
Carbon	83.86	83.13	87.21	82.88	88.07	87.76
Hydrogen	11.56	11.45	9.43	11.40	11.65	9.26
Nitrogen	0.28	0.07	0.67	0.12	0.26	0.58
Sulfur(b)	0.58(0.66)	0.09(0.05)	0.15(0.27)	0.57	0.02	0.08
Oxygen (by difference)	3.72	0.26	2.53	5.03	0.	2.32
<u>C.C. analysis</u>						
<u>boiling fraction, wt. %</u>						
(IBP, °F)	(69)	(132)	(462)	(68)	(133)	(466)
IBP-200°F	16.9	3.1	0	17.3	3.5	0
200-350°F	25.4	10.7	0	25.2	11.0	0
350-450°F	52.5	8.2	0.1	50.2	9.2	0
450-550°F	5.2	31.6	10.3	7.3	25.3	8.2
550-650°F	0	30.8	16.0	0	26.7	14.0
650°F-EP	0	15.6	73.6	0	24.3	77.8
(EP, °F)	(466)	(775)	(1057)	(466)	(849)	(1054)
API gravity, degrees	33.0	22.0	0.7	35.4	14.8	6.0
Kjeldahl, nitrogen, wt % (c)	-	0.24	-	-	-	-
Sodium, ppm	-	-	<5	-	-	-
Titanium, ppm	-	-	<6	-	-	-

(a) Naphtha, middle distillate and distillate solvent product combined.

(b) Values in parenthesis are from Galbraith Lab.

(c) Galbraith Lab analysis.

Table 16 (continued)
Distillate Product Analyses - Special Product Workup Periods

Date, 1983	22 March			2 April		
Run	243E			243F		
Product	Naphtha and middle distillate		Distillate solvent	Naphtha and middle distillate		Distillate solvent
	SRC	HTR(a)	SRC	SRC	HTR(a)	SRC
<u>Elemental analysis, wt. %</u>						
Carbon	84.10	88.28	88.10	83.88	87.98	88.02
Hydrogen	11.62	11.43	9.35	12.30	11.98	10.02
Nitrogen	0	0.03	0.32	0.11	0	0.21
Sulfur (b)	0.37	0.05	0.10	0.44	0.04	0.15
Oxygen (by difference)	3.91	0.21	2.13	3.27	0	1.60
<u>G.C. analysis</u>						
<u>boiling fraction, wt. %</u>						
(IBP, °F)	(69)	(97)	(466)	(69)	(97)	(463)
IBP-200 °F	16.4	3.4	0	16.4	3.8	0
200-350 °F	26.7	9.9	0	29.5	10.5	0
350-450 °F	48.6	8.6	0	42.5	8.2	0.1
450-550 °F	8.3	20.7	6.4	11.3	17.8	6.3
550-650 °F	0	23.9	15.5	0.1	22.3	11.3
650 °F-EP	0	33.5	78.1	0.2	37.4	82.3
(EP, °F)	(496)	(870)	(958)	(496)	(869)	(1049)
API gravity, degrees	35.0	23.5	-	34.8	10.3	8.3
Kjeldahl; nitrogen, wt. % (c)	-	-	-	-	-	-
Sodium, ppm	-	-	-	-	-	-
Titanium, ppm	-	-	-	-	-	-

- (a) Naphtha, middle distillate and distillate solvent product combined.
(b) Values in parenthesis are from Galbraith Lab.
(c) Galbraith Lab analysis.

(Table continued)

Table 16 (continued)
Distillate Product Analyses - Special Product Workup Periods

Date, 1983	1 May			8 May		
Run	243G			243H		
Product	Naphtha and middle distillate		Distillate solvent	Naphtha and middle distillate		Distillate solvent
	SRC	HTE(a)	SRC	SRC	HTE(a)	SRC
<u>Elemental analysis, wt %</u>						
Carbon	82.81	88.03	87.82	83.66	87.94	88.32
Hydrogen	11.45	11.94	9.56	11.88	11.96	9.61
Nitrogen	0.38	0	0.61	0.02(0.14)	0.06	0.28(0.48)
Sulfur(b)	0.55	0.03	0.21	0.58(0.78)	0.04(0.005)	0.19(0.26)
Oxygen (by difference)	4.81	-	1.80	5.86	0.	1.60
<u>G.C. analysis</u>						
<u>boiling fraction, wt. %</u>						
(IBP, °F)	(68)	(97)	(460)	(70)	(133)	(460)
IBP-200°F	14.4	3.5	0	16.2	3.7	0
200-350°F	24.9	11.8	0	28.5	18.1	0
350-450°F	54.1	10.1	0.3	51.7	9.9	0.4
450-550°F	6.6	27.9	14.2	3.6	37.4	12.7
550-650°F	0	24.2	20.8	0	26.7	19.8
650°F-EP	0	22.5	64.7	0	4.2	67.1
(EP, °F)	(466)	(902)	(937)	(466)	(694)	(1,020)
API gravity, degrees	32.3	24.0	7.2	35.6	25.2	9.0
Kjeldahl, nitrogen, wt %(c)	-	-	-	-	-	-
Sodium, ppm	-	-	-	-	-	4
Titanium, ppm	-	-	-	-	-	-

(a) Naphtha, middle distillate and distillate solvent product combined.

(b) Values in parentheses are from Galbraith Lab.

(c) Galbraith Lab analysis.

(Table continued)

Table 16 (continued)
Distillate Product Analyses - Special Product Workup Periods

Date, 1983	23 May			29 May		
Run	243I			243J		
Product	Naphtha and middle distillate		Distillate solvent	Naphtha and middle distillate		Distillate solvent
	SRC	HTR(a)	SRC	SRC	HTR(a)	SRC
<u>Elemental analysis, wt %</u>						
Carbon	83.6	87.88	88.18	83.88	88.13	88.04
Hydrogen	11.48	11.72	9.78	11.58	11.74	9.78
Nitrogen	0.52	0.17	0.40	0.46	0.08	0.29
Sulfur(b)	0.48	0.04	0.19	0.37	0.05	0.19
Oxygen (by difference)	3.92	0.19	1.45	3.71	-	1.7
<u>G.C. analysis</u>						
<u>boiling fraction, wt. %</u>						
(IBP, °F)	(69)	(97)	(461)	(67)	(97)	(460)
IBP-200°F	16.5	4.8	0	15.1	4.6	0
200-350°F	27.4	16.4	0	28.1	14.2	0
350-450°F	52.8	10.8	0.1	49.6	8.0	0.2
450-550°F	3.3	30.3	10.7	7.2	31.1	11.2
550-650°F	0	24.1	17.7	0	26.8	18.2
650°F-EP	0	13.6	71.5	0	15.3	70.4
(EP, °F)	(463)	(790)	(1,002)	(466)	(779)	(1,018)
API gravity, degrees	34.8	22.1	8.7	35.4	25.4	9.4
Kjeldahl, nitrogen, wt. %(c)	-	-	-	-	-	-
Sodium, ppm	-	-	-	-	-	-
Titanium, ppm	-	-	-	-	-	-

- (a) Naphtha, middle distillate and distillate solvent product combined.
(b) Values in parenthesis are from Galbraith Lab.
(c) Galbraith Lab analysis.

(Table continued)

Table 16 (continued)
Distillate Product Analyses - Special Product Workup Periods

Date, 1983	51 May			13 June		
Run	243K			243L		
Product	Naphtha and middle distillate		Distillate solvent	Naphtha and middle distillate		Distillate solvent
	SRC	HTR(a)	SRC	SRC	HTR(a)	SRC
<u>Elemental analysis, wt %</u>						
Carbon	84.44	87.9	88.39	84.16	87.71	88.34
Hydrogen	12.39	11.93	10.07	12.26	12.17	9.91
Nitrogen	0.32	0.09	0.35	0.18	0.06	0.46
Sulfur(b)	0.56(.77)	0.03(.027)	0.20(.24)	0.40	0.06	0.17
Oxygen (by difference)	2.29	-	0.99	3.00	-	1.12
<u>G.C. analysis</u>						
<u>boiling fraction, wt. %</u>						
(IBP, °F)	(119)	(132)	(463)	(68)	(97)	(460)
IBP-200°F	16.3	3.7	0	17.3	3.3	0
200-350°F	29.1	12.8	0	28.5	10.7	0
350-450°F	50.3	9.0	0.2	51.3	8.3	0.2
450-550°F	4.3	27.5	9.5	2.32	24.5	11.8
550-650°F	0	25.2	16.9	0	23.4	19.9
650°F-EP	0	21.8	73.4	0	29.82	68.1
(EP, °F)	(466)	(833)	(1,017)	(466)	(900)	(937)
API gravity, degrees	34.2	24.3	8.7	34.2	24.7	9.0
Kjeldahl, nitrogen, wt % (c)	0.24	0.11	0.38	-	-	-
Sodium, ppm	-	-	<5	-	-	-
Titanium, ppm	-	-	<10	-	-	-

- (a) Naphtha, middle distillate and distillate solvent product combined.
(b) Values in parenthesis are from Galbraith Lab.
(c) Galbraith Lab analysis.

(Table continued)

Table 16 (continued)
Distillate Product Analyses - Special Product Workup Periods

Date, 1983	19 June		
Run	243M		
	Naphtha and middle distillate		Distillate solvent
	SRC	HTR(a)	SRC
<u>Elemental analysis, wt %</u>			
Carbon	84.57	87.69	88.44
Hydrogen	12.12	12.2	9.75
Nitrogen	0.15	0.1	0.35
Sulfur(h)	0.45	0.01	0.16
Oxygen (by difference)	2.71	-	1.30
<u>G.C. analysis</u>			
<u>boiling fraction, wt. %</u>			
(IBP, °F)	(68)	(97)	(461)
IBP-200 °F	16.4	3.6	0
200-350 °F	26.4	12.2	0
350-450 °F	53.9	9.3	0.1
450-550 °F	3.3	24.8	8.6
550-650 °F	0	24.2	15.7
650 °F-EP	0	25.9	75.6
(EP, °F)	(466)	(868)	(1,048)
API gravity, degrees	34.8	25.0	8.7
Kjeldahl, nitrogen, wt % (c)	-	-	-
Sodium, ppm	-	-	-
Titanium, ppm	-	-	-

- (a) Naphtha, middle distillate and distillate solvent product combined.
(b) Values in parenthesis are from Galbraith Lab.
(c) Galbraith Lab. analysis.

Table 17
Residual Stream Analyses - Special Product Workup Periods

Date, 1983 Run	21 February 243A			1 March 243B			10 March 243C		
	CSD SRC	HTR SRC	HTR flashed bottoms	CSD SRC	HTR SRC	HTF flashed bottoms	CSD SRC	HTR SRC	HTR flashed bottoms
<u>Ultimate analyses, wt. %</u>									
Carbon	86.89	87.06	87.99	86.90	87.50	88.78	87.56	87.55	88.06
Hydrogen	6.32	6.85	8.17	6.36	6.94	8.12	6.36	6.96	8.37
Nitrogen(h)	1.43(1.62)	1.33(1.54)	0.92(1.03)	1.17(1.52)	1.02(1.50)	1.02	1.22(1.57)	1.16(1.33)	0.73(0.90)
Sulfur(h)	0.50(0.57)	0.24	0.16	0.38(0.39)	0.27	0.10	0.52(0.47)	0.21(0.25)	0.21
Ash	0.23	0.46	0.25	0.10	0.47	0.06	0.08	0.76	0.39
Oxygen (by difference)	4.58	4.01	2.51	5.09	3.80	1.92	4.26	3.36	2.24
<u>Mineral analyses, ppm</u>									
Arsenic	<1	-	-	<1	-	-	<1	<1	-
Vanadium	<13	-	-	<15	-	-	<5	<5	-
Iron	530	-	-	113	-	-	138	610	-
Sodium	-	-	-	11	-	-	<5	<5	-
Titanium	90	-	-	<8	-	-	27	44	-
Chlorine	<100	-	-	400	-	-	<100	200	-
<u>Solvent fractionation analyses, wt %</u>									
		Calc.			Calc.			Calc.	
Oil(a)	33.9	35.61	16.6	39.88	37.52	20.5	30.57	37.16	17.8
Asphaltenes(b)	48.5	61.87	34.4	44.22	59.93	32.9	56.49	60.31	31.0
Benzene insoluble(c)	7.16	1.62	0.9	8.3	2.28	1.25	2.17	1.05	0.54
Cresol insoluble	0.84	0.9	0.5	0.2	0.27	0.15	0.56	1.48	0.76
Ash	0.45	0.45	0.25	0.1	0.11	0.06	0.08	0.76	0.39
Distillate solvent(d)	9.6	-	47.6	7.4	-	45.2	10.2	-	49.9
Fusion point, F(e)	265(G)	297(G)	-	279(G)	298(G)	-	273(G)	289(G)	-
<u>Viscosity, centipoise</u>									
Temp., °F	Shear rate, sec ⁻¹								
400(f)	3.4	20	-	25	-	-	15	-	-
	8.4	22	-	24	-	-	12	-	-
	16.8	23	-	25	-	-	11	-	-
500(g)	3.4	55	75	50	68	-	80	110	-
	8.4	48	72	46	66	-	70	108	-
	16.8	48	68	44	65	-	70	100	-
550(g)	3.4	55	30	20	30	-	25	30	-
	8.4	28	28	20	28	-	24	30	-
	16.8	25	28	20	26	-	24	30	-

(Table continued)

Table 17 (continued)
Residual Stream Analyses - Special Product Workup Periods

Date, 1983	14 March			22 March			2 April		
Run	243D			243E			243F		
	CSD SRC	HTR SRC	HTR flashed bottoms	CSD SRC	HTR SRC	HTR flashed bottoms	CSD SRC	HTR SRC	HTR flashed bottoms
<u>Ultimate analyses, wt. %</u>									
Carbon	87.74	88.86	89.36	88.14	88.42	88.76	87.66	87.58	88.32
Hydrogen	6.30	7.09	8.40	6.46	7.03	8.41	6.80	7.12	8.63
Nitrogen(h)	1.18	0.79	0.61	1.12	0.80	0.50	1.08	1.19	0.39
Sulfur(h)	0.41	0.11	0.11	0.42	0.23	0.27	0.59	0	0.23
Ash	0.27	0.24	0.07	0.02	0.35	0.52	0.08	0.60	0.17
Oxygen (by difference)	4.10	2.91	1.45	3.84	3.17	1.54	3.79	3.51	3.26
<u>Mineral analyses, ppm</u>									
Arsenic									
Vanadium									
Iron									
Sodium									
Titanium									
Chlorine									
<u>Solvent fractionation analyses, wt %</u>									
		Calc.			Calc.			Calc.	
Oil(a)	51.8	52.4	24.8	39.6	49.40	23.7	44.3	44.33	22.5
Asphaltenes(b)	37.2	46.8	23.4	48.4	43.90	22.4	47.5	50.81	25.1
Benzene insoluble(c)	9.92	0.6	0.29	1.8	4.90	2.5	7.85	4.41	2.18
Cresol insoluble	1.08	0.22	0.11	0.50	1.75	0.37	0.35	0.45	0.22
Ash	0.27	0.14	0.07	0.01	1.02	0.52	0.08	0.34	0.17
Distillate solvent(d)	9.0	-	51.4	9.7	-	50.5	10.4	-	50.0
Fusion point, °F(e)	271(G)	281(G)	-	259(G)	279(G)	-	267(G)	299(G)	-
<u>Viscosity, centipoise</u>									
Temp., °F	Shear rate, sec ⁻¹			Shear rate, sec ⁻¹			Shear rate, sec ⁻¹		
400(f)	3.4	10	-	10	-	-	10	-	-
	8.4	10	-	10	-	-	10	-	-
	16.8	10	-	10	-	-	10	-	-
500(g)	3.4	25	55	35	45	-	35	90	-
	8.4	26	50	32	44	-	32	86	-
	16.8	26	49	32	43	-	31	84	-
550(g)	3.4	15	25	15	20	-	15	45	-
	8.4	12	22	16	20	-	14	36	-
	16.8	12	22	15	19	-	14	34	-

(Table continued)

Table 17 (continued)
Residual Stream Analyses - Special Product Workup Periods

Date, 1983	1 May			8 May			23 May		
Run	243G			243H			243I		
	CSE SRC	HTR SRC	HTR flashed bottoms	CSD SRC	HTR SRC	HTR flashed bottoms	CSD SRC	HTR SRC	HTR flashed bottoms
<u>Ultimate analyses, wt. %</u>									
Carbon	88.32	88.00	88.54	87.55	88.10	88.74	87.30	88.28	88.56
Hydrogen	6.20	7.02	8.52	6.32	7.31	8.72	6.70	7.55	9.18
Nitrogen(h)	1.32	1.09	0.54	1.23	0.98	0.52	1.34	1.00	0.49
Sulfur(h)	0.44	0.26	0.10	0.39	0.20	0.10	0.50	0.20	0.12
Ash	0.01	0.08	0.06	0.11	0.11	0.08	0.06	0	0
Oxygen (by difference)	3.71	3.55	2.14	4.40	3.30	1.84	4.10	2.97	1.65
<u>Mineral analyses, ppm</u>									
Arsenic									
Vanadium									
Iron									
Sodium									
Titanium									
Chlorine									
<u>Solvent fractionation analyses, wt %</u>									
		CALC			CALC			CALC	
Oil(a)	35.1	44.4	20.5	49.2	58.45	26.8	46.5	57.7	27.9
Asphaltenes(b)	47.1	50.9	25.0	36.5	41.35	20.8	46.4	40.1	19.6
Benzene insoluble(c)	7.1	5.5	2.7	0.74	0	0	2.5	2.1	1.05
Cresol insoluble	0.3	0.2	0.1	0.16	0.20	0.1	0.12	0.1	0.05
Ash	0.02	0.12	51.7	0.11	0.14	0.07	0.06	0	0
Distillate solvent(d)	10.4	-	-	13.4	0	52.3	4.5	0	51.4
Fusion point, °F(e)	269(G)	289(G)	-	259(G)	279(G)	-	257(G)	265(G)	-
<u>Viscosity, centipoise</u>									
Temp., °F	Shear rate, sec ⁻¹								
400(f)	3.4	5	-	5	-	-	10	-	-
	8.4	6	-	4	-	-	8	-	-
	16.8	6	-	6	-	-	8	-	-
500(g)	3.4	30	85	45	35	-	30	20	-
	8.4	34	82	40	32	-	28	24	-
	16.8	36	81	34	32	-	28	26	-
550(g)	3.4	10	30	15	25	-	15	5	-
	8.4	12	32	16	20	-	14	8	-
	16.8	14	32	15	17	-	14	12	-

(Table continued)

Table 17 (continued)
Residual Stream Analyses - Special Product Workup Periods

Date, 1933 Run	29 May 243J			31 May 243K			13 June 243L		
	CSD SRC	HTR SRC	HTR flashed bottoms	CSD SRC	HTR SRC	HTR flashed bottoms	CSD SRC	HTR SRC	HTR flashed bottoms
<u>Ultimate analyses, wt. %</u>									
Carbon	88.05	88.33	89.39	88.14	88.63	89.44	88.23	88.94	89.68
Hydrogen	6.76	7.62	9.04	6.76	7.69	9.12	6.45	7.40	8.92
Nitrogen(h)	1.06	0.79	0.48	1.16	1.10(.43)	0.70	1.06	0.55	0.88
Sulfur(h)	0.51	0.16	0.18	0.50	0.37(.25)	0.19(.56)	0.39	0.16	0.07
Ash	0.04	0.05	0.03	-	0.19	0.09	0.04	0.06	0.03
Oxygen (by difference)	3.58	3.05	0.88	3.44	2.02	0.46	3.83	2.89	0.42
<u>Mineral analyses, ppm</u>									
Arsenic	-	-	-	-	-	-	-	-	-
Vanadium	-	-	-	<11	<11	-	-	-	-
Iron	-	-	-	37	564	-	-	-	-
Sodium	-	-	-	<10	<10	-	-	-	-
Titanium	-	-	-	23	7	-	-	-	-
Chlorine	-	-	-	240	<80	-	-	-	-
Calcium	-	-	-	11	-	-	-	-	-
<u>Solvent fractionation analyses, wt %</u>									
		CALC.			CALC.			CALC.	
Oil(a)	36.5	59.64	28.4	37.0	59.1	28.7	38.5	52.7	26.4
Asphaltenes(b)	51.2	39.35	19.4	52.7	38.5	18.7	44.1	44.0	20.8
Benzene insoluble(c)	3.45	0.87	0.43	1.3	2.1	1.03	7.3	3.2	1.5
Cresol insoluble	0.05	0.14	0.07	0.2	0.29	0.14	0.10	0.21	0.10
Ash	0.04	0.06	0.03	-	0.19	0.09	0.04	0.06	0.03
Distillate solvent(d)	8.8	-	51.7	8.8	-	51.4	10	-	51.2
Fusion point, °F(e)	259(G)	264(G)	-	258(G)	266(G)	-	260(G)	280(G)	-
<u>Viscosity, centipoise</u>									
Temp., °F	Shear rate, sec ⁻¹								
400(f)	3.4	10	-	15	-	-	5	-	-
	8	8	-	10	-	-	8	-	-
	16.8	8	-	10	-	-	10	-	-
500(g)	3.4	30	40	25	20	-	30	45	-
	8.4	28	44	26	18	-	30	46	-
	16.8	28	45	26	19	-	30	47	-
550(g)	3.4	15	20	15	15	-	15	16	-
	8.4	12	20	14	8	-	14	18	-
	16.8	13	22	15	9	-	14	22	-

(Table continued)

Table 17 (continued)
Residual Stream Analyses - Special Product Workup Periods

Date, 1983 Run	19 June 243M		
	CSP SRC	HTF SRC	HTR flashed bottoms
<u>Ultimate analyses, wt. %</u>			
Carbon	88.94	88.89	89.18
Hydrogen	6.52	7.38	8.87
Nitrogen(h)	0.98	0.74	0.64
Sulfur(h)	0.43	0.25	0.10
Ash	0.02	0.15	0.07
Oxygen (by difference)	5.11	2.59	1.14
<u>Mineral analyses, ppm</u>			
Arsenic			
Vanadium			
Iron			
Sodium			
Titanium			
Chlorine			
<u>Solvent fractionation analyses, wt %</u>			
		CALC.	
Oil(a)	39.8	48.7	20.9
Asphaltenes(b)	42.5	47.0	22.1
Benzene insoluble(c)	7.38	4.1	1.92
Cresol insoluble	0.02	0.17	0.08
Ash	0.02	0.15	0.07
Distillate solvent(d)	10.3	-	55.0
Fusion point, °F(e)	258(G)	276(G)	-
<u>Viscosity, centipoise</u>			
Temp., °F	Shear rate, sec ⁻¹		
400(f)	3.4	10	-
	8.4	12	-
	16.8	12	-
500(g)	3.4	10	40
	8.4	12	42
	16.8	14	43
550(g)	3.4	35	15
	8.4	32	18
	16.8	32	18

{Table continued}

Table 17 (continued)
Residual Stream Analyses - Special Product Workup Periods

- (a) Pentane soluble less distillable solvent.
- (b) Benzene soluble, pentane insoluble.
- (c) Cresol soluble.
- (d) Solvent at 0.1 mm Hg and 600°F pot temperature.
- (e) By Ring and Ball method (G is for glycerine, S is for silicone oil).
- (f) Feed blend to HTR reactor.
- (g) Viscosity of CSD SRC and HTR SRC "as is".
- (h) Values in parentheses are from Galbraith Lab.

Table 18
Feed Coal Analyses - Special Product Workup Periods

Coal Mine Date, 1983 Run	-----Illinois 6----- -----Burning Star-----					
	21 Feb 243A	1 Mar 243B	10 Mar 243C	14 Mar 243D	22 Mar 243E	2 Apr 243F
<u>Proximate analysis, wt %</u>						
Volatile matter	35.61	35.34	35.69	-	-	-
Fixed carbon	51.12	50.91	49.58	-	-	-
Ash	10.61	10.97	11.39	-	-	-
Moisture	2.66	2.78	3.34	-	-	-
<u>Ultimate analysis, wt %</u>						
Carbon	67.88	67.50	67.75	67.73	68.08	67.94
Hydrogen	4.38	4.34	4.44	4.38	4.32	4.52
Nitrogen	1.26(1.41)(a)	1.30(1.22)(a)	1.22(1.43)(a)	1.44	1.20	1.18
Sulfur	3.68	3.05	3.16	3.37	3.13	3.10
Chlorine(a)	0.08	0.08	0.08	0.09	0.07	0.05
Ash	10.89	11.28	11.77	11.38	11.28	12.05
Oxygen (by difference)	11.83	12.45	11.58	11.61	11.92	11.16
H/C atomic ratio	0.77	0.77	0.79	0.78	0.76	0.80
Dry heating value, Btu/lb(a)	12,553	12,637	12,584	-	-	-
<u>Sulfur forms, wt % (a)</u>						
Pyritic	0.93	0.90	1.30	1.23	1.17	1.35
Sulfate	0.20	0.18	0.03	0.02	0.04	0.04
Sulfide	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Organic	2.08	2.10	1.96	2.15	2.27	1.87
<u>Mineral analysis, wt % (ignited basis)(a)</u>						
Phos. pentoxide, P ₂ O ₅	0.09	0.08	0.12	0.11	0.32	0.12
Silica, SiO ₂	49.46	49.10	50.46	51.29	48.33	48.93
Ferric oxide, Fe ₂ O ₃	17.58	16.93	16.17	17.20	18.62	17.55
Alumina, Al ₂ O ₃	17.88	17.42	17.20	17.48	18.15	17.65
Titania, TiO ₂	0.94	0.88	0.80	0.82	0.94	0.89
Lime, CaO	6.13	5.94	6.29	6.59	6.97	6.47
Magnesia, MgO	0.87	0.86	0.96	0.94	0.99	1.01
Sulfur trioxide, SO ₃	5.32	6.94	4.12	2.70	2.07	5.04
Potassium oxide, K ₂ O	1.74	1.28	2.31	2.36	1.83	2.08
Sodium oxide Na ₂ O	-	0.40	0.52	0.63	0.47	0.46
Vanadium oxide, V ₂ O ₅	0.05	0.05	0.07	0.07	0.06	0.06
Undetermined	-	0.12	0.98	-	0.25	-
<u>Trace metal analysis, ppm(a)</u>						
Arsenic	2	2	2	2	2	2
<u>Reactivity, % THF conversion (by the equilibrium test)(b)</u>						
	74.6	74.2	79.7	80.0	77.4	77.4

(a) Data from Galbraith analyses.

(b) Thirty minutes at 750°F; 2:1 solvent-to-coal ratio. The solvent is 25% tetralin and 75% 1-methylnaphthalene.

(Table continued)

Table 18 (continued)
Feed Coal Analyses - Special Product Workup Periods

Coal Mine Date, 1983 Run	-----Illinois 6----- -----Burning Star-----						
	1 May 243G	8 May 243H	23 May 243I	29 May 243J	31 May 243K	13 Jun 243L	19 Jun 243M
<u>Proximate analysis, wt %</u>							
Volatile matter	-	35.74	-	-	35.20	-	-
Fixed carbon	-	50.30	-	-	50.29	-	-
Ash	-	10.71	-	-	10.78	-	-
Moisture	-	3.25	-	-	3.73	-	-
<u>Ultimate analysis, wt %</u>							
Carbon	67.12	68.10(68.95) (a)	68.00	68.13	68.16	68.78	68.51
Hydrogen	4.24	4.47(4.73) (a)	4.30	4.63	4.35	4.54	4.50
Nitrogen	1.19	1.42	1.40	1.30	1.32	1.39	0.99
Sulfur	3.51	3.20	3.31	3.29	3.15	3.06	3.28
Chlorine(a)	0.05	0.02	0.05	-	0.02	-	-
Ash	11.01	11.06	10.85	11.18	11.18	10.59	10.84
Oxygen (by difference)	12.88	11.73	12.09	11.47	11.82	11.64	11.88
H/C atomic ratio	0.76	0.79	0.76	0.82	0.77	0.79	0.79
Dry heating value, Btu/lb	-	12,689	-	-	12,384	-	-
<u>Sulfur forms, wt % (a)</u>							
Pyritic	1.30	1.20	1.21	-	1.26	-	1.18
Sulfate	0.05	0.02	0.07	-	0.07	-	0.07
Sulfide	<0.01	<0.01	<0.01	-	<0.01	-	0.02
Organic	1.89	2.15	1.94	-	1.98	-	2.22
<u>Mineral analysis, wt % (ignited basis) (a)</u>							
Phos. pentoxide, P ₂ O ₅	0.07	0.06	0.06	-	0.07	-	0.10
Silica, SiO ₂	48.59	49.28	50.08	-	49.92	-	49.02
Ferric oxide, Fe ₂ O ₃	18.08	16.80	17.47	-	17.39	-	17.26
Alumina, Al ₂ O ₃	18.20	18.92	17.66	-	18.44	-	17.35
Titania, TiO ₂	0.95	0.93	0.91	-	0.94	-	0.82
Lime, CaO	6.40	6.23	6.30	-	6.82	-	6.08
Magnesia, MgO	0.95	0.97	0.90	-	0.89	-	0.88
Sulfur trioxide, SO ₃	4.67	4.37	4.47	-	2.82	-	6.19
Potassium oxide K ₂ O	1.90	1.87	2.02	-	1.76	-	1.66
Sodium oxide Na ₂ O	0.37	0.38	0.34	-	0.39	-	0.40
Vanadium oxide, V ₂ O ₅	0.05	0.05	0.04	-	0.05	-	0.04
Undetermined	-	0.14	-	-	0.51	-	0.20
<u>Trace metal analysis, ppm(a)</u>							
Arsenic	2	2	2	-	5	-	2
<u>Reactivity, % THF conversion (by the equilibrium test)(b)</u>							
	79.1	78.6	77.2	79.0	77.6	76.4	77.9

(a) Data from Galbraith analyses.

(b) Thirty minutes at 750°F; 2:1 solvent-to-coal ratio. The solvent is 25% tetralin and 75% 1-methylnaphthalene.

Table 19
Sour Water Analyses - Special Product Workup Periods

Date, 1983	21 February		1 March		10 March		14 March		22 March		4 April	
MB Run	243A		243B		243C		243D		243E		243F	
Unit	SRC	HTR	SRC	HTR	SRC	HTR	SRC	HTR	SRC	HTR	SRC	HTR
Sour water analyses, mg/l												
Total organic carbon	17,880	2,540	-	-	25,700	4,400	28,650	4,140	9,080	234	18,300	2,180
Ammonia (as nitrogen)	15,330	5,460	-	-	12,250	9,240	12,460	10,920	12,740	8,120	10,080	6,440
Sulfide (as sulfur)	5,835	4,136	-	-	10,596	5,130	6,909	5,530	5,474	5,739	10,131	5,947
Chlorides	-	79	-	-	-	43	-	22	-	67	-	27
Oil and grease	1,277	393	-	-	491	115	459	146	229	104	453	105
Phenols	7,500	3,300	-	-	8,050	1,175	7,350	1,865	7,375	1,425	7,450	1,340
Inorganic carbon	-	77	-	-	-	67	-	69	-	61	-	71
Kjeldahl nitrogen	-	5,740	-	-	-	10,780	-	13,650	-	10,920	-	8,820

Date, 1983	1 May		8 May		23 May		29 May		31 May		13 June	
MB Run	243G		243H		243I		243J		243K		243L	
Unit	SRC	HTR	SRC	HTR	SRC	HTR	SRC	HTR	SRC	HTR	SRC	HTR
Sour water analyses, mg/l												
Total organic carbon	20,800	2,650	20,250	1,500	20,550	1,740	22,150	4,540	-	2,080	24,417	2,110
Ammonia (as nitrogen)	11,900	10,850	-	-	-	-	-	-	-	-	-	-
Sulfide (as sulfur)	8,279	9,714	9,714	11,285	8,624	-	6,733	-	-	8,015	4,456	8,592
Chlorides	-	13	705	29	318	23	486	54	-	10	600	17
Oil and grease	1,231	160	173	195	605	123	10,500	-	-	27	174	46
Phenols	8,625	2,225	4,560	1,180	6,750	1,050	8,300	1,140	-	840	9,300	1,572
Inorganic carbon	-	79	8,425	65	2,675	32	1,437	71	-	59	2,060	68
Kjeldahl nitrogen	-	13,020	13,860	11,480	11,340	13,300	11,480	10,150	-	11,900	10,710	10,500

Date, 1983	19 June	
MB Run	243M	
Unit	SRC	HTR
Sour water analyses, mg/l		
Total organic carbon	24,500	2,740
Ammonia (as nitrogen)	-	-
Sulfide (as sulfur)	6,127	7,887
Chlorides	317	36
Oil and grease	295	84
Phenols	9,180	1,572
Inorganic carbon	1,353	55
Kjeldahl nitrogen	9,370	11,200

FIGURE I. TWO STAGE LIQUEFACTION
(INTEGRATED MODE)

FIGURE 2. SRC UNIT FLOWSHEET

FIGURE 4. HTR UNIT FLOWSHEET

Run No. 243 Phase 1
 From: 3 Feb. 1983
 To: 6 April 1983

FIGURE 5. DAILY TWO STAGE PROCESS STABILITY TREND CHART

(Figure continued)

RUN NO. 243 PHASE 2
FROM: 22 APRIL, 1983
TO: 28 JUNE, 1983

FIGURE 5. (continued) DAILY TWO STAGE PROCESS STABILITY TREND CHART

Run No. 243 Phase 1
 From: 3 Feb. 1983
 To: 6 April 1983

NOTES

DESCRIPTION

- A. Feed gas rate increased from 28 to 40 MSCF/ton MF coal.
 B. Dissolver temperature decreased from 800°F to 785°F.

FIGURE 6. SRC UNIT TREND CHART (PART 1)
 (Figure continued)

NOTES

- A. Feed gas rate increased from 28 to 40 MSCF/ton MF coal.
 B. Dissolver temperature decreased from 800°F to 785°F.

DESCRIPTION

FIGURE 6. SRC UNIT TREND CHART (PART 1)

(Figure continued)

NOTES

DESCRIPTION

- A. Dissolver temp. decreased from 825 to 810°F.
- B. Coal feed rate decreased from 250 to 200 lb/hr.
- C. Dissolver pressure decreased from 2,400 to 1,700 psig.
- D. Dissolver pressure decreased from 1,700 to 1,500 psig.

720

FIGURE 6. (continued) SRC UNIT TREND CHART (PART 1)

Run No. 243 Phase 1
From: 3 Feb. 1983
To: 6 April 1983

NOTES

- A. Feed gas rate increased from 28 to 40 MSCF/ton MF coal.
B. Dissolver temperature decreased from 800°F to 785°F.

DESCRIPTION

FIGURE 7. SRC UNIT TREND CHART (PART 2)

RUN NO. 243 PHASE 2
FROM: 22 APRIL, 1983
TO: 28 JUNE, 1983

NOTES

- A. Dissolver temp. decreased from 825 to 810°F.
- B. Coal feed rate decreased from 250 to 200 MF lb/hr.
- C. Dissolver pressure decreased from 2,400 to 1,700 psig.
- D. Dissolver pressure reduced from 1,700 to 1,500 psig.

DESCRIPTION

FIGURE 7. (continued) SRC UNIT TREND CHART (PART 2)

Drummed Material

A - 1,744 lb of CSD feed	J - 867 lb of CSD SRC	T - 280 lb CSD feed	1A - 1,430 lb CSD SRC	1J - 889 lb CSD SRC	1R - 482 lb CSD SRC
B - 207 lb of CSD feed	K - 892 lb of CSD SRC	U - 1,739 lb CSD SRC	1B - 465 lb CSD SRC	1K - 515 lb CSD SRC	1S - 938 lb CSD SRC
C - 519 lb of CSD feed	L - 922 lb of CSD SRC	V - 820 lb V-131B	1C - 481 lb CSD SRC	1L - 953 lb CSD SRC	723 lb CSD feed
D - 1,198 lb of CSD feed	M - 857 lb of CSD SRC	W - 1,883 lb CSD SRC	1D - 886 lb CSD SRC	1M - 915 lb CSD SRC	1T - 474 lb CSD SRC
E - 211 lb of CSD feed	N - 1,412 lb of CSD SRC	X - 1,445 lb CSD SRC	1E - 974 lb CSD SRC	1N - 1,325 lb CSD SRC	1U - 1,239 lb CSD SRC
F - 791 lb of CSD feed	O - 493 lb of CSD SRC	Y - 620 lb CSD SRC	1F - 888 lb CSD SRC	1O - 1,397 lb CSD SRC	1V - 419 lb CSD SRC
G - 1,043 lb of CSD feed	P - 1,377 lb of CSD SRC	Z - 1,215 lb CSD SRC	1G - 1,039 lb CSD SRC	1P - 1,413 lb CSD SRC	1W - 1,532 lb CSD SRC
H - 1,909 lb of CSD SRC	Q - 969 lb of CSD SRC	1I - 1,105 lb CSD feed	1H - 268 lb CSD SRC	1Q - 465 lb CSD SRC	1X - 6,056 lb CSD SRC
I - 409 lb of CSD SRC	R - 958 lb of CSD SRC	S - 1,576 lb of CSD feed	1I - 1,105 lb CSD feed	1Q - 465 lb CSD SRC

FIGURE 8. SRC INVENTORY TRENDS

(Figure continued)

RUN NO. 243 PHASE 2
FROM: 22 APRIL, 1983
TO: 28 JUNE, 1983

Drummed Material

A. 196 lb CSD SRC	F. 898 lb CSD SRC	M. 962 lb CSD SRC	R. 260 lb CSD SRC	Y. 870 lb CSD SRC
B. 425 lb CSD SRC	G. 1,370 lb CSD SRC	N. 1,457 lb CSD SRC	S. 261 lb CSD SRC	Z. 403 lb CSD SRC
362 lb V-1067	H. 992 lb CSD SRC	O. 390 lb CSD SRC	T. 434 lb CSD SRC	
C. 361 lb V-1067	I. 132 lb CSD feed	188 lb CSD feed	U. 1,348 lb CSD SRC	
118 lb CSD feed	J. 271 lb CSD SRC	P. 535 lb CSD SRC	V. 130 lb CSD SRC	
D. 890 lb CSD SRC	K. 1,580 lb CSD SRC	Q. 1,826 lb CSD feed	W. 127 lb CSD feed	
E. 935 lb CSD SRC	L. 438 lb CSD SRC	466 lb CSD SRC	X. 200 lb CSD SRC

FIGURE 8. (continued) SRC INVENTORY TRENDS

NOTES

DESCRIPTION

- A. Off feed due to HTR outage.
- B. DAS A changed to DAS E.
- C. DAS E changed to DAS F.
- D. DAS F changed to DAS G.
- E. First Stage temp. lowered.
- F. First Stage level lowered.
- G. DAS G changed to DAS H.

NOTES

DESCRIPTION

- H. First Stage temp. lowered.
- I. Began DAS adjustment test.
- J. Raised First Stage level.
- K. DAS H changed to DAS I.
- L. Stopped DAS adjustment test.
- M. First Stage temp. lowered.
- N. First Stage emptied and flushed.

FIGURE 9. CSD UNIT TREND CHART (PART 1)

(Figure continued)

RUN NO. 243 PHASE 2
FROM: 22 APRIL, 1983
TO: 28 JUNE, 1983

NOTES

DESCRIPTION

- A. DAS/Feed Ratio Increased.
- B. Unit Off-line for HTR Catalyst Replacement.
- C. First Stage Temp. Increased.
- D. First Stage Pressure Decreased.
- E. Changed to DAS H.
- F. Off-line Due to HTR Outage.
- G. Change to DAS G.
- H. Off-line due to SRC Outage, Flushed First Stage.
- I. Unit Off-line due to First Stage Plugging.

FIGURE 9. (continued) CSD UNIT TREND CHART (PART 1)

NOTES

DESCRIPTION

- A. Cff feed due to HTR outage.
- B. DAS A changed to DAS E.
- C. DAS E changed to DAS F.
- D. DAS F changed to DAS G.
- E. First Stage temp. lowered.
- F. First Stage level lowered.
- G. DAS G changed to DAS H.
- H. First Stage temp. lowered.
- I. Began DAS adjustment test.
- J. Raised First Stage level.
- K. DAS H changed to DAS I.
- L. Stopped DAS adjustment test.
- M. First Stage temp. lowered.
- N. First Stage emptied and flushed.

FIGURE 10. CSD UNIT TREND CHART (PART 2)

(Figure continued)

RUN NO. 243 PHASE 2
FROM: 22 APRIL, 1983
TO: 28 JUNE, 1983

NOTES	DESCRIPTION
A.	DAS/Feed ratio increased.
B.	Unit off-line for HTR catalyst replacement.
C.	First Stage Temp. Increased
D.	First Stage Pressure Decreased.
E.	Changed to DAS H.
F.	Off-line due to HTR outage.
G.	Change to DAS G.
H.	Off-line due to SRC outage, flushed First Stage.
I.	Unit off-line due to First Stage plugging.

FIGURE 10. (continued) CSD UNIT TREND CHART (Part 2)

NOTES

DESCRIPTION

- A. HTR Reactor temp. increased from 630 to 660°F.
 B. HTR Reactor temp. raised to 690°F.
 C. HTR Reactor temp. increased to 720°F.
 D. SRC unit feed gas rate increased from 28 to 40 MSCF/ton MF coal.
 E. SRC unit dissolver temperature decreased from 800 to 785°F.

Run No. 243 Phase 1

From: 3 Feb. 1983

To: 6 April 1983

FIGURE 11. LABORATORY ANALYSES DAILY TREND CHART

(Figure continued)

NOTES

DESCRIPTION

- A. HTR Reactor temp 720°F.
 B. HTR reactor catalyst replaced 3-4 May. Temperature was 680°F for initial operation.
 C. HTR reactor temperature varied between 700 and 720°F for 11 to 17 May.
 D. HTR reactor temperature increased to 720°F.
 E. SRC unit dissolver temperature reduced from 825 to 810°F.
 F. SRC unit coal feed rate decreased from 250 to 200 MF lb/hr.
 G. SRC unit dissolver pressure reduced from 2,400 to 1,700 psig. Feed gas hydrogen purity reduced from 85 to 70 mole %.
 H. Dissolver pressure reduced to 1,500 psig.
 I. HTR reactor temperature increased from 720 to 730°F.
 J. HTR reactor temperature decreased to 720°F.

RUN NO. 243 PHASE 2
 FROM: 22 APRIL, 1983
 TO: 28 JUNE, 1983

FIGURE 11. (continued) LABORATORY ANALYSES DAILY TREND CHART

Run No. 243 Phase 1
From: 3 Feb. 1983
To: 6 April 1983

NOTES

- A. Pump line to withdrawal tube plugged.
- B. On solvent due to CSD outage.
- C. Reactor temperature increased to 660°F.

NOTES

- D. Reactor temperature increased to 690°F.
- E. Reactor temperature increased to 720°F.
- F. Unit off-line 8.9 hr due to E-1212 plugging.
- * Catalyst samples removed.

FIGURE 12. HTE UNIT TREND CHART (PART 1)

(Figure continued)

RUN NO. 243 PHASE 2
FROM: 22 APRIL, 1983
TO: 28 JUNE, 1983

NOTES

- A. Increased Reactor temp. to 720°F.
- B. Catalyst changed out.
- C. Unit off-line to repair gas leaks and clear B1201
- D. Increased Reactor temp. to 700°F.
- E. Increased Reactor temp. to 720°F.

NOTES

- F. Unit off-line due to SRC outage.
- G. Coal rate reduced at SRC unit.
- H. Unit off-line due to CSD outage.
- I. Increased Reactor temp. to 730°F.
- J. Reactor temp. adjusted.
- K. Decreased Reactor temp. to 717°F.
- * Catalyst samples removed.

DESCRIPTION

DESCRIPTION

FIGURE 12. (continued) HTR UNIT TREND CHART (PART 1)

NOTES

- A. Pump line to withdrawal tube plugged.
- B. On solvent due to CSD outage.
- C. Reactor temperature increased to 660°F.

NOTES

- D. Reactor temperature increased to 690°F.
- E. Reactor temperature increased to 720°F.
- F. Unit off-line 8.9 hr due to E-1212 plugging.
- * Catalyst samples removed.

FIGURE 13. HTR UNIT TREND CHART (PART 2)

(Figure continued)

RUN NO. 243 PHASE 2
FROM: 22 APRIL, 1983
TO: 28 JUNE, 1983

NOTES

- A. Increased Reactor temp. to 720°F.
- B. Catalyst changed out.
- C. Unit off-line to repair gas leaks and clear B1201.
- D. Increased Reactor temp. to 700°F.
- E. Increased Reactor temp. to 720°F.

NOTES

- F. Unit off-line due to SRC outage.
- G. Coal reate reduced to SRC unit.
- H. Unit off-line due to CSD outage.
- I. Increased Reactor temp. to 730°F.
- J. Reactor temp. adjusted.
- K. Decreased Reactor temp. to 717°F.
- * Catalyst samples removed.

FIGURE 13. (continued) HTR UNIT TREND CHART (PART 2)

FIGURE 14. MATERIAL BALANCE FLOW DIAGRAM FOR 243A

FIGURE 15. MATERIAL BALANCE FLOW DIAGRAM FOR 243B

FIGURE 16. MATERIAL BALANCE FLOW DIAGRAM FOR 243C

FIGURE 17. MATERIAL BALANCE FLOW DIAGRAM FOR 243D

FIGURE 13. MATERIAL BALANCE FLOW DIAGRAM FOR 243E

FIGURE 19. MATERIAL BALANCE FLOW DIAGRAM FOR 243F

FIGURE 20. MATERIAL BALANCE FLOW DIAGRAM FOR 243G

FIGURE 21. MATERIAL BALANCE FLOW DIAGRAM FOR 243H

FIGURE 22. MATERIAL BALANCE FLOW DIAGRAM FOR 243I

FIGURE 23. MATERIAL BALANCE FLOW DIAGRAM FOR 243J

FIGURE 24. MATERIAL BALANCE FLOW DIAGRAM FOR 243K

FIGURE 25. MATERIAL BALANCE FLOW DIAGRAM FOR 243L

FIGURE 26. MATERIAL BALANCE FLOW DIAGRAM FOR 243M

FIGURE 27. SRC UNIT DISTILLATE SOLVENT YIELD

FIGURE 28. NITROGEN, SULFUR, HYDROGEN AND H/C ATOMIC RATIO IN SELECTED STREAMS

(Figure continued)

STREAMS

- V178 SRC DISTILLATE
- V1067 HTR DISTILLATE
- △ HTR FEED SRC
- ⊙ V1067 HTR RESIDUE
- V1067 RECYCLE PROCESS SOLVENT

FIGURE 28. (continued) NITROGEN, SULFUR, HYDROGEN AND H/C ATOMIC RATIO IN SELECTED STREAMS

FIGURE 29. EFFECT OF CATALYST AGE ON RELATIVE ACTIVITY