THE TEXAS COMPANY

REFINING DEPARTMENT
TECHNICAL & RESEARCH DIVISION

REPORT ON
CARTHAGE HYDROCOL, INC.
BROWNSVILLE PLANT OPERATIONS

ANALYSIS OF SYNTHESIS REACTOR DATA

Engr'g Dev. Group (NY Office)
Report No. 25
Date March 29, 1952

TECHNICAL AND RESEARCH DIVISION

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ANALYSIS OF SYNTHESIS REACTOR DATA

Introduction

The conversions and yields on the Synthesis Reactors at Brownsville have been consistently very much lower than those predicted in design and also much lower than those obtained with the same catalyst on pilot and laboratory units.

For over a year this has been the subject of much concern to many individuals and almost every conceivable reason to account for this discrepancy has been expressed at some time or another.

The latest widely accepted opinion is that poor catalyst contacting efficiency in the large commercial reactors relative to that obtained in the small pilot units is responsible for much if not most of the trouble and steps are now being taken to compartmentalize one of the reactors at Brownsville to simulate operation with a number of smaller reactors in parallel.

In addition, on the assumption that this may not be the answer,engineering studies are being made to determine what changes would be required to operate the two reactors in two stages instead of in parallel. So far, the opinion seems to be divided on whether two stage operation will result in better conversion and yields than parallel operation.

On the off-chance that an additional independent review of the situation, and particularly a detailed study of the Brownsville data itself, might disclose some factors which had been overlooked, or help to establish which opinions are correct, arrangements were made for the writer to make such a survey at Brownsville. This study which was made during the period of February 12 to March 25, 1952 is the subject of the present report.

Scope

The first step in this survey was to trace all pertinent lines in the field to become familiar with the location of flow meters, sampling connections etc. and to look for by-passing and leakage possibilities. None of the latter were found. In the course of this step flow diagrams were made of the important lines and these diagrams are included in the appendix for future reference.

Next, a detailed review was made of the methods used by the plant to calculate and report run data. Checks were made on the reliability of the data, as discussed in the report where pertinent, and then after innunerable false starts the correlations presented here were developed.

Correlations - H_2 Conversion vs %CO in FF to C_3+

The following Figs. 1, 1A and 1B, which are a plot of H_2 converted vs % of CO in fresh feed which went to C_3+, are a graphical comparison of all the following data:

1. All available Brownsville data.
2. Stanolind Pilot unit data on Allan Wood and Brownsville Mill Scale catalysts.
3. Montebello Pilot unit data on Allan Wood, Brownsville Mill Scale and Spent CM&S catalysts.

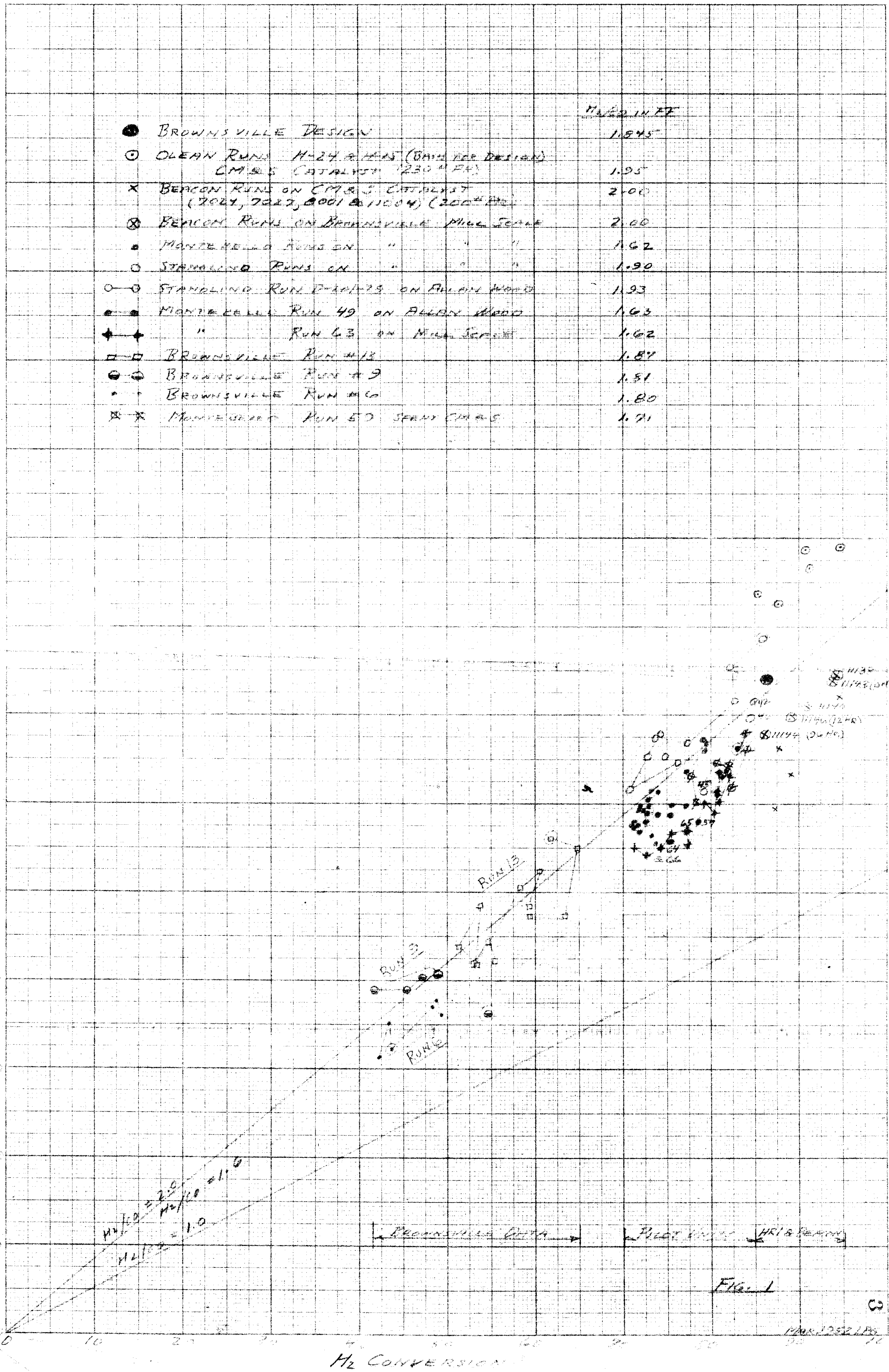


FIG. 1

Mar 1952 LBS

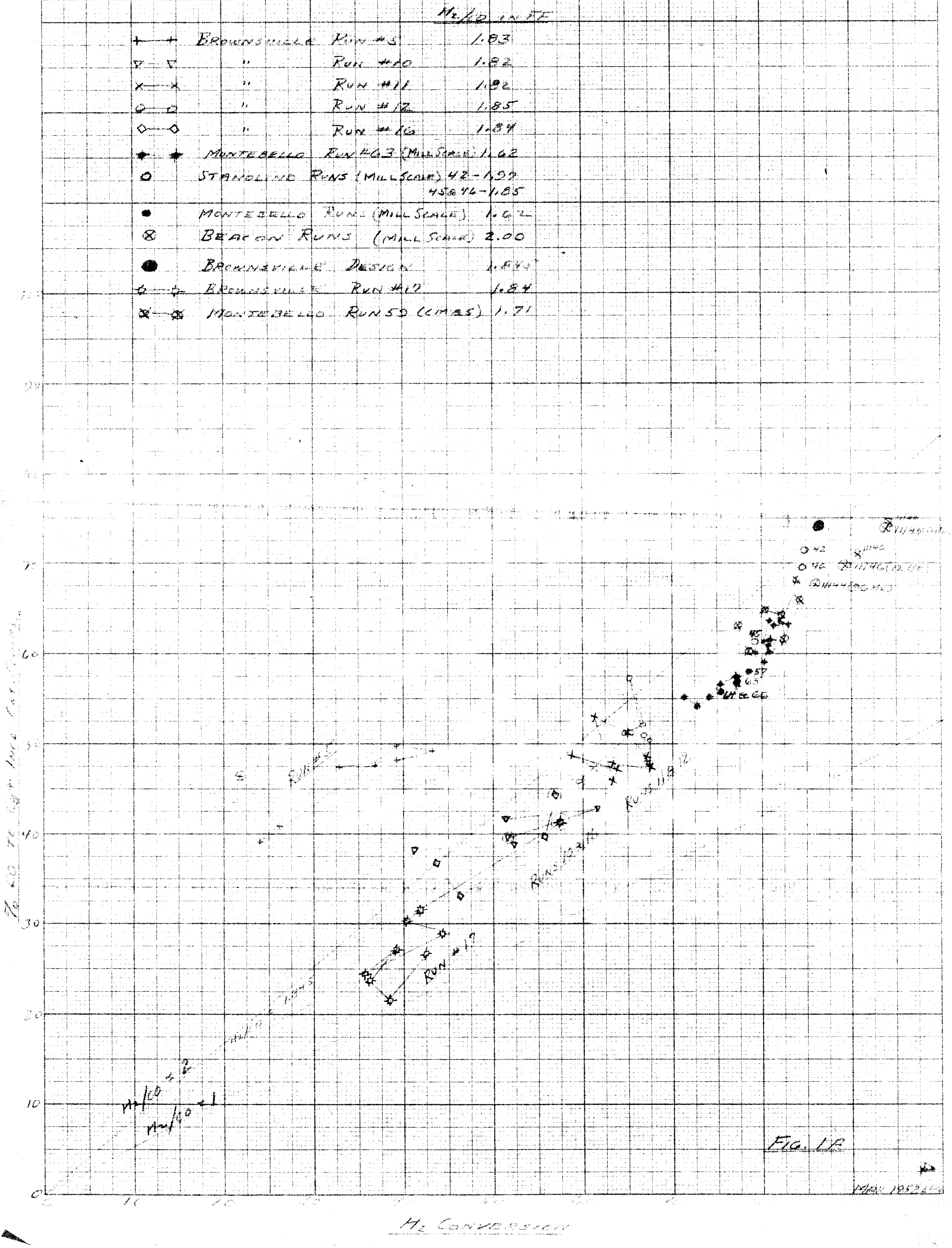

H_2/CO in FE
+—+ BROWNSVILLE RUN #5 1.83
▽—▽ " RUN #10 1.82
×—× " RUN #11 1.92
□—□ " RUN #12 1.85
◇—◇ " RUN #16 1.84
✦—✦ MONTEBELLO RUN #63 (MILL SCALE) 1.62
○ STANOLIND RUNS (MILL SCALE) 42-1.97
45 & 46-1.85
● MONTEBELLO RUNS (MILL SCALE) 1.62
⊗ BEACON RUNS (MILL SCALE) 2.00
● BROWNSVILLE DESIGN 1.84
☆—☆ BROWNSVILLE RUN #17 1.84
✲—✲ MONTEBELLO RUN 50 (CMBS) 1.71
0
10
20
30
40
50
60
70
80
90
% CO to Gas Line Cat. Converter
H_2 CONVERSION
RUN #5
RUNS 10 & 16
RUN #11 & 12
RUN #17
42
46
1140
11146 (12 HR)
11144 (80 HR)
11146
57
65
64 & 66
45
5
H_2/CO
H_2/CO
1
2
MAY 1953

FIG. 1F

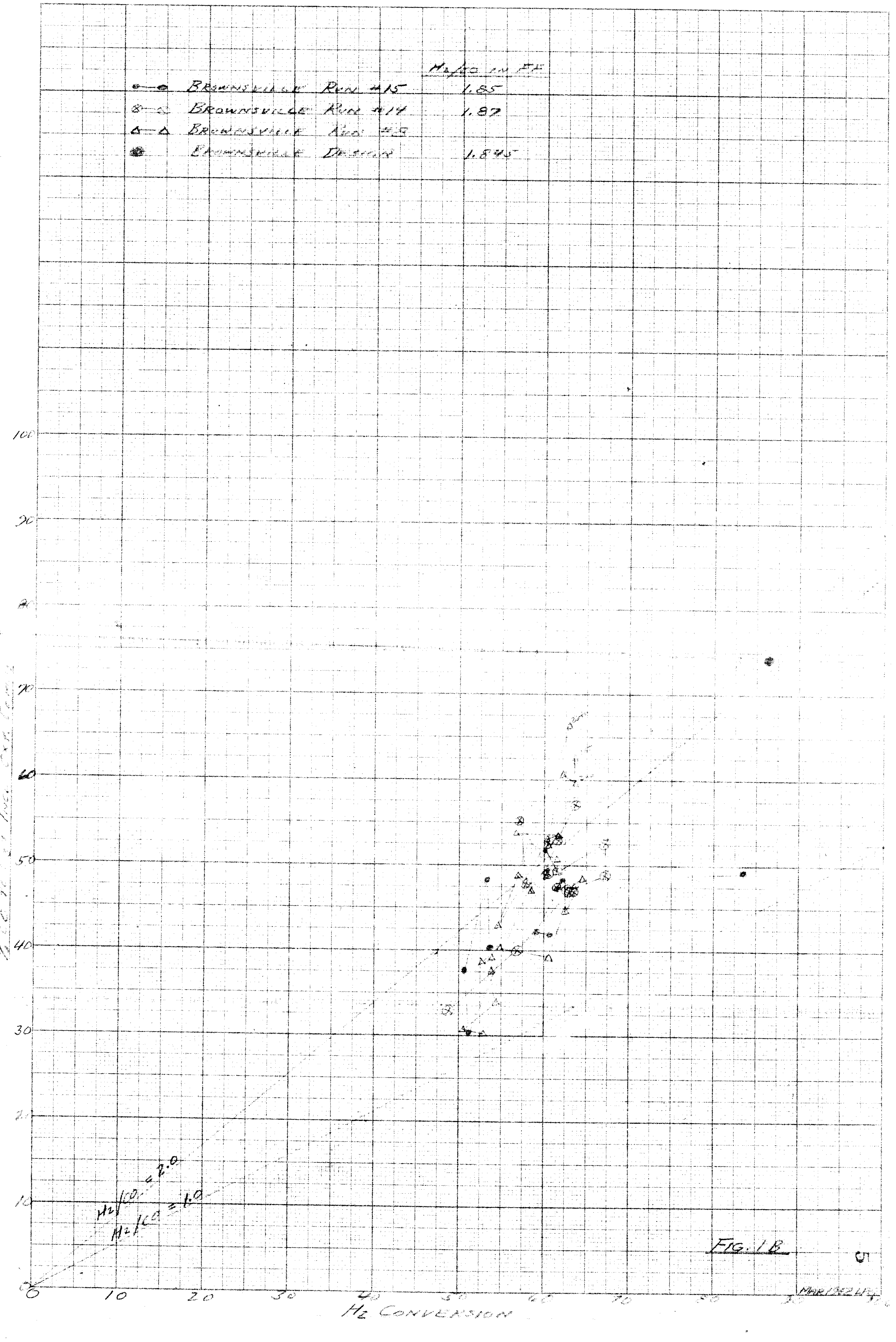


FIG. 1B

MAR 1952

4. Beacon data on Brownsville Mill Scale and Spent CM& S catalysts.
5. HRI Olean Runs H-24 & H-25 on Spent CM&S catalyst, which runs formed the basis for the Brownsville Plant Design.
6. The Brownsville Design.

On these graphs each point which is joined by lines, represents about 24 hrs. operation. The points are joined to-gether in chronological order. A ring has been placed around the first day of each run. The unjoined points which are all laboratory or pilot unit data, represent averages of several periods or of a whole run.

The Brownsville data were divided into three plots, Figs. 1, 1A & 1B simply to avoid cluttering. The Beacon, Montebello and Stanolind data obtained with Brownsville Mill Scale catalyst, the design point and the Montebello data on CM&S catalyst have been repeated on Fig. 1A.

The solid lines on all three of these plots, one for Fresh Feed having an H_2/CO ratio of 2.0 and the other for an H_2/CO ratio of 1.0 are those which were developed in EDG Report No. 1 dated May 20, 1947. These lines represent an extremely large number of runs made at various conditions in HRI, Beacon, Stanolind and Jersey laboratories.

The data for Figs. 1, 1A & 1B and for others which will be described later are included in Tables I & II of the appendix.

We shall discuss these figures after we have developed sufficient background to understand what they mean.

Sources of Data

The sources of these data to-gether with a brief description of the reactors on which they were obtained are as follows:

Montebello Data

The Montebello Data for Run 49 with Allan Wood catalyst were obtained from the detailed yield calculation sheets included in the appendix of partial report TDC 802 - 37 P.

The data for Run 63 on Brownsville's Mill Scale catalyst and for Run 59 on spent CM&S catalyst were obtained from the daily yield calculation sheets which were sent to us from Montebello by mail.

The data for the single points representing parts of Runs 57, 64, 65 & 66 with Mill Scale catalyst were obtained from the calculation sheets included in the undated report which Mr. duBois Eastman presented at the recent Tulsa Meeting with Stanolind.

All these data were obtained on the 11 3/4" I. D. Reactor which is described in detail in P.R. 37 P referred to above. This reactor is a straight pipe 30 ft. long with 3-2" sched. 80 pipes about 18 ft. long inside the reactor for cooling. Steaming water is used as the cooling medium. The 11 ft. above the cooling tubes is disengaging space. An external cyclone is used to separate the carried over fines from the reactor effluent but no fines are returned to the unit. Preheat of the total feed is varied automatically to control reactor bed temperature.

Stanolind Data

The Stanolind Data for Run D-201-29 on Allan Wood Catalyst were obtained from the calculation sheets included in the appendix of partial report TDC 802 - 37 P, and the data for the other runs on Mill Scale Catalyst from the Tulsa Meeting Report referred to above.

The Stanolind D-201 reactor is 8" I.D. about 20 ft. long and is cooled by an external jacket. About 6 to 8 ft. of the upper part of the reactor is expanded to provide catalyst disengaging space. An external cyclone is used and feed preheat is varied automatically as at Montebello.

Beacon Data

The Beacon data for old runs 7024, 7027 and 8001 on Spent CM&S Catalyst were taken from the 1947 Report (EDG #1). The first two were made on a 1 5/8" I.D. stirred reactor and the other on a 3/4" I.D. 9 ft. long baffled reactor similar to that still in use and on which the other data shown on the graphs were obtained. This reactor is topped with a catalyst disengaging space 4 to 6" in diam. and about 2 ft. long and filters are used to knock back the catalyst. These laboratory reactors are jacket cooled and the total feed is normally regularly preheated to about 600°F.

HRI Data

The HRI data on spent CM&S catalyst were reproduced from the 1947 correlation referred to above. They were obtained on an 11 1/2" I.D. reactor 18 1/2 ft. long with 19 - 1" ex. hvy. tubes provided for cooling with Dowtherm. An expanded section about 2 ft. long was provided for catalyst disengaging and filters were used for final catalyst separation. In the particular runs shown here the total feed was preheated to 600 - 650°F.

Brownsville Design Conditions

The following yields and operating conditions were predicted by HRI in Case VI Process Specs. Sect. 350 and are the goal we are shooting for:

	Per Reactor		Total
Syn. Gas Feed Rate (MMSCFH)	5.0		10.0
Recycle/F.F. ratio	1.0		1.0
Catalyst Holdup Tons	99		198
Steam Prod'n. M#/Hr.	215.5		431
Cat. Bed Density #/C.F.		100	
Reactor Press.		425	
Reactor Effluent Temp. °F.		650	
% CO Conv. (on F.F.)		98.2	
% H_2 Conv. (on F.F.)		86.3	
% H_2+CO Conv. (on F.F.)		90.4	
Fresh Feed Comp: Mol %			
CO		33.14	
H_2		61.12	
CO_2		1.30	
N_2+ A		2.95	
CH_4		1.07	
H_2O		0.43	

In the design, the water-gas shift reaction was assumed to be in equilibrium $\frac{(H_2)(CO_2)}{(CO)(H_2O)} = 22$ at 650°F) at the reactor outlet.

The predicted yields were as follows:

	BPOD	BPOD Ex Casinghead 10# RVP Gaso.*
Casinghead C_4's	150	
Casinghead Gaso.	179	
Synthetic C_4's	164	
Synthetic Gaso. (DB)	4781	
Poly Gaso.	915	
Total Gaso.	6189	6079
Gas Oil	946	947
Waxy Btms.	103	103
Poly Tar	99	95
Total Oil	7337	7224
Water Sol. Chemicals 213,168#/day @ 8#/gal =	631	631
Water	9144	
Total Synthetic Oil plus WSC Bbls/MMSCF of Syn. Gas	31.8	32.6

* From PR TDC 802 - 37P page 88

The total C_3+ yield, including water soluble chemicals can be calculated from the breakdown of the reactor effluent streams reported in the HRI Process Specs. for Sect. 350 (Case 6 design) as follows:

TABLE A

Total C_3+ Design Yields For Two Reactors And 10,000,000 SCFH of Fresh Feed

	#/Hr. Flash Vapor	#/Hr. Stripper Feed	Net Reactor Effluent #/Hr.	#/Gal.	#/Bbl.	BPH
N_2	21,865	73	21,938	8.33	349.9	
CO	4,412	20	4,432	8.33	349.9	
CO_2	69,529	2,666	72,195	8.33	349.9	
H_2	7,447	10	4,457	8.33	349.9	
C_1	11,554	179	11,733	2.40	100.8	
$C_2=$	6,062	232	6,294	3.25	136.5	
C_2+	5,649	306	5,955	2.63	110.5	
$C_3=$	5,871	710	6,581	4.33	181.9	36.18
C_3+	537	70	607	4.25	178.5	3.40
C_4-	4,435	1,249	5,684	5.04	211.7	26.85
C_4+	388	128	516	4.80	201.6	2.56
C_5-	6,251	5,565	11,816	5.25	220.5	53.59
C_6	2,466	6,182	8,648	5.66	237.7	36.38
C_7	966	6,834	7,800	5.91	248.2	31.43
C_8	408	7,032	7,440	6.10	256.2	29.04
C_9	121	5,719	5,840	6.41	269.2	21.69
C_{10}	60	7,090	7,150	6.61	277.6	25.76
C_{11}	17	7,924	7,941	6.83	286.9	27.68
C_{13}		2,580	2,580	6.95	291.9	8.84
C_{15}		2,970	2,970	7.05	296.1	10.03
C_{17}		2,230	2,230	7.10	298.2	7.48
C_{20}		4,540	4,540	7.20	302.4	15.01
	145,038	64,309	209,347			335.92
Water Sol. Chems.			8,882		336.0	26.30
Water			104,045			
Total Out			322,274			362.22
Total In (F.F.)			322,571			8700 BPD

The total C_3+ and WSC in the reactor effluent amounts to 362.2 BPH or 8700 BPD. The difference between this figure and the lower corresponding figure reported above in the predicted yield table is, of course, due to the poly contractions and the C_3, C_4 and other losses.

The total C_3+ Incl. WSC leaving the reactors amounts to 91,225#/Hr. which divided by 14 = 6,516 CH_2 radicals per hr. which is 74.05% of the 8,800 Mols of CO fed to the reactors in the fresh feed.

The other design factors used in these correlations were similarly calculated as follows:

% CO in F.F. to WSC = 7.2
% CO in F.F. to CO_2 Made = 14.73
% CO in F.F. to CH_4 Made = 5.1
% H_2 in F.F. to H_2O Made = 34.9

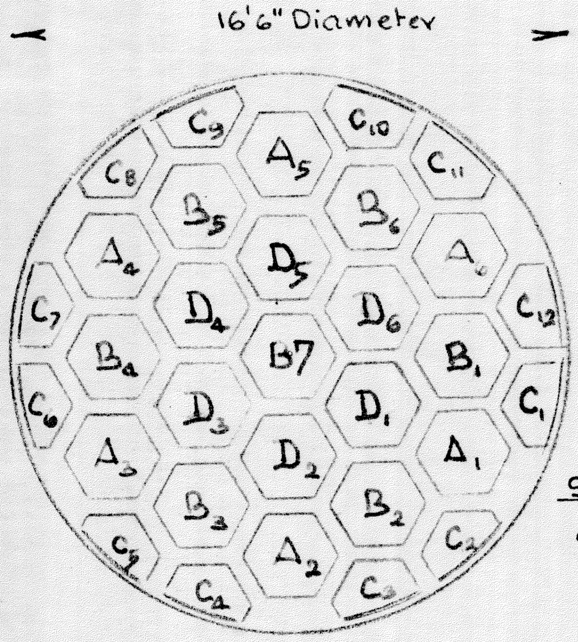
Brownsville Reactors

An assembly drawing of the Brownsville Reactors (Combustion Engineering Drg. No. E-152-572-7) is included in the appendix for ready reference. These reactors, of which there are two alike, are 16'-6" I.D. and 21'-9" high from bend line to bend line with hemispherical heads. Each reactor is filled with steam tubes which are arranged in bundles as shown in plan on the following Sketch A.

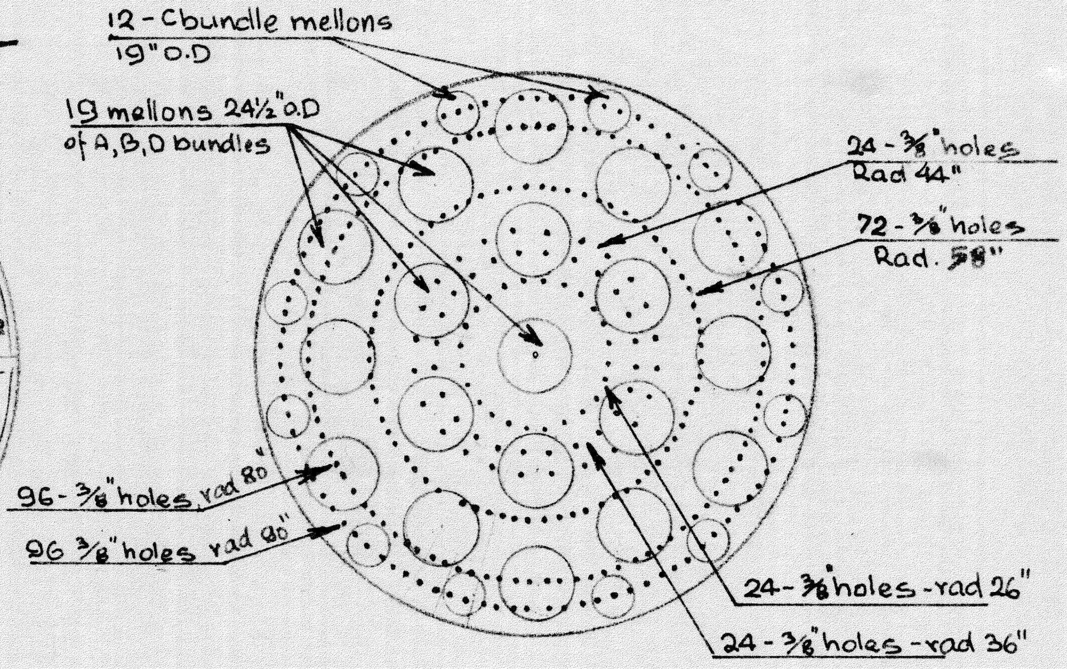
There are 1420 - 1 7/8" O.D. tubes in all, arranged in 31 bundles. All but 12 of the bundles have 61 tubes each with 24" melons at top and bottom. The other 12 bundles have 21 or 22 tubes with 19" melons. The height of the bundles from ctr. line of bottom melons to ctr. line of top melons is 16'-6" for most bundles and 18'-6" for a few to stagger the top melons. The bottom melons are all on the same plane with their center line 21 1/4" above the grid.

SKETCH A

Arrangement of water tube bundles in reactor K 351B



Arrangement of reactor grid holes and location of mellons.



Total of 1⅞" O.D water tubes - 1420
in 19 bundles A_1-A_6, B_1 to B_7, D_1 to D_6, each 61 tubes
and 12 bundles C_1 to C_{12} each 21/22 tubes.
Mellons installed 24" above grid (to center)
Distance between mellon centers vertically:
Bundles A, B, - 16½ ft, Bundles C & D - 18½ ft

Total number of 3/8" I.D holes - 336
Grid consist of 24 pie sections, center plate
and 48 sectors at periphery, each with 4 holes

MPH - 3-26-52

The free area between tubes is 187 sq. ft. and the distance from the grid to the center line of the lower row of top melons is 18'-6". This is probably the maximum height of catalyst bed that can be used and still have enough submerged cooling surface to take away the exothermic heat of reaction.

The grid is made up of pie shaped castings and contains 336 openings as shown in the plan on the above Sketch A. These openings were originally 3/4" diameter but in May 1951, after Run #8, these were reduced to 3/8" diameter by means of sleeve inserts. This was done on both reactors.

In the original reactors there were three horizontal rows of louvre type baffles installed between the cooling tubes near the tops of the bundles. These caused localized erosion of some of the tubes and were removed from both reactors in Feb. 1951 after Run #5.

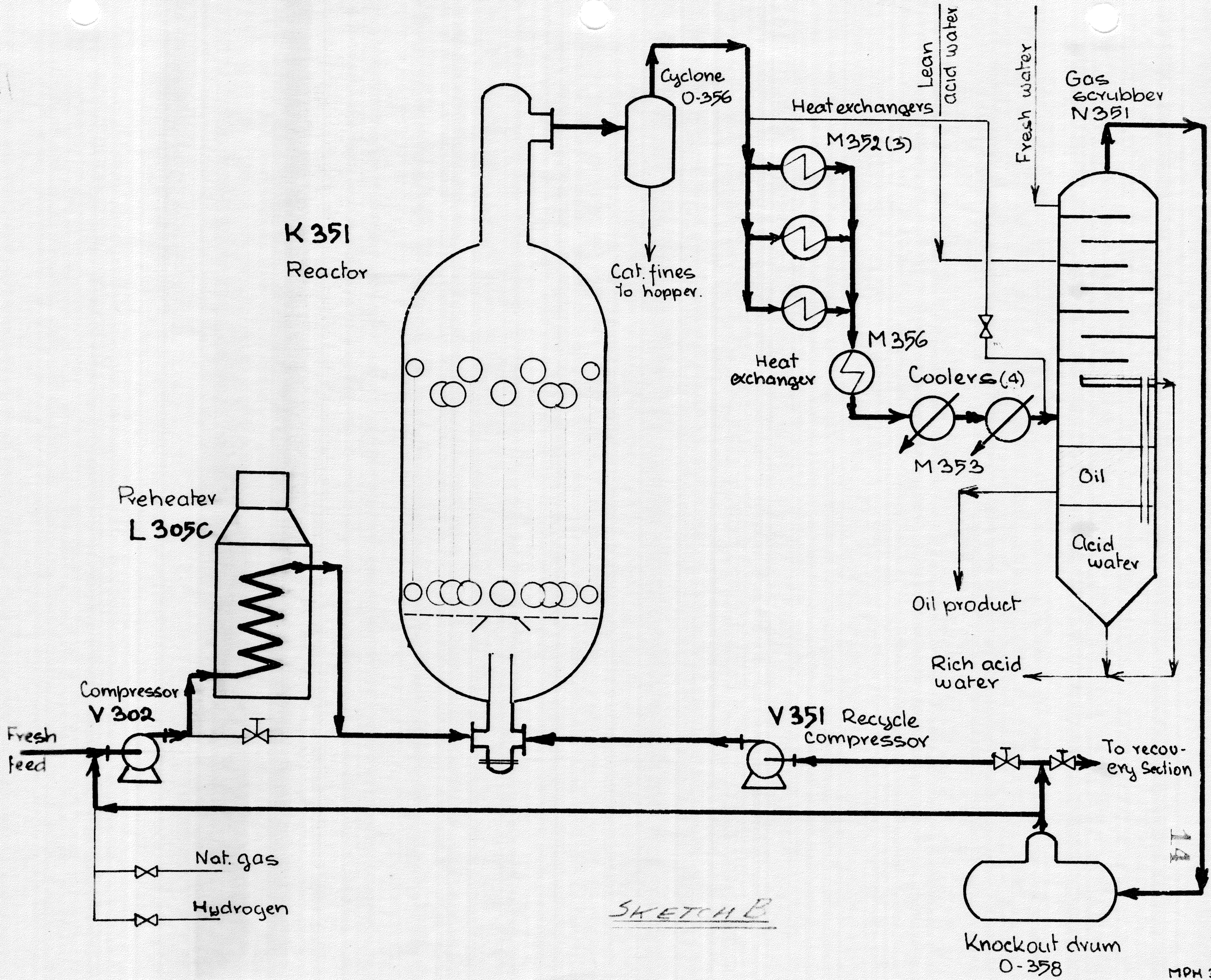
Reactor Operations

Before attempting to analyze the Brownsville data it is well to briefly review the operating procedures used on the reactor system.

The following Sketch B is a simplified flow diagram of the Reactor System. Su pose we start with the reactor in operation and about to come down.

A. Catalyst Stripping After Shutdown - Circulation

First the synthesis gas feed is shut off at the fresh feed compressor (V-302) section. The compressor V-302 will then be on recycle gas alone, supplemented by the Nat. Gas used for Aeration, about 55,000 SCFH and an additional 45,000 SCFH or so of Nat. Gas admitted to the V-302 suction when the Syn. Gas is cut off. The recycling rate is maintained to hold a lineal velocity thru the bed of 0.6 ft/sec with a minimum of 0.4 ft/sec to insure maintaining



SKETCH B

MPH 3-28

fluidization. The flow will be from the V-302 compressor thru the steam superheater L-305C (now used all the time as gas htr.) thru the reactor, the M-352 & M-356 exchangers, the M-353 cooler and then thru the Gas Scrubber N-351 and thus back to the V-302 suction. The V-351 recycle compressors will be shut down.

During stripping, the system pressure is reduced to about 100# and the reactor effluent temperature is held at 650-700°F. without exceeding 800° on the L-305C outlet. To maintain the bed temperature at this level the steam bundles have to be cut out of service. When the mass spec. analysis shows 90 to 94% CH_4 in the tail gas the stripping is considered complete.

The reactor temperature is then reduced to 270 to 300°F. by lowering the L-305C heater outlet. <u>The acid water is then cut out of the gas scrubber (N-351) and city water only is used</u>. After displacing the water in the acid water line to Stanolind for one hour the water from the gas scrubber is discharged to the pond.

If the catalyst is to be continuously circulated between runs, the conditions described in the previous paragraph are the ones used except that the reactor pressure may be lowered to about 80#. The rate required to maintain a lineal velocity of 0.6 ft/sec at 80# press. and 300°F. is about 1,800,000 SCFH.

Starting From Scratch

When coming up from a dead stop the same method of circulation is used except that the bed temperature is held at 500 to 700°F. while adding the catalyst to the reactor.

Unloading Reactor

The same circulation procedure (at 300°F.) is also used when catalyst is unloaded from the reactor. After all possible catalyst has been removed in this manner (thru bottom center outlet) the circulation is stopped and the reactor washed with hot water before unheading. When the reactors are opened several tons of catalyst are always found packed between the tubes. This has to be removed by hand prodding.

Reduction Before Startup

With the reactor circulating Natural Gas as described above, the reactor temperature is raised to 700-725°F. and the pressure increased to 200# press. while raising the recycle rate and Nat. Gas input as necessary to maintain a lineal velocity of 0.6 ft/sec. This requires a rate of about 2,800,000 SCFH.

Hydrogen is then cut into the V-302 suction at the maximum rate of production, about 20,000 SCFH and the Nat. Gas is cut out. Aeration is maintained by recirculation in the separate (reciprocating) compressors (V-352). After about 48 hours the hydrogen concentration in the system will have reached about 40% and reduction is considered completed. In some runs where in a hurry to get started this time has been cut to 12 hrs. with only 30% H_2 concentration attained.

Nothing but city water is used in the gas scrubber N-351 during reduction.

Carbiding

Prior to the last three runs #15, #16 and #17 a carbiding step has been added after reduction. This is accomplished by simply shutting off the hydrogen and substituting synthesis gas from the generator with reactor at 650 to 700°F. and 250# pressure, synthesis gas is added to the V-302 compressor section at a rate of about 50,000 SCFH and is increased by that amount every 15 minutes until a total of about 700,000 SCFH is being added. This condition is maintained for about 20 hrs.

Shortly after the start of syn. gas admission acid water washing is started in the gas scrubber N-351.

Start Up

The normal starting up procedure is essentially the same as that described above for carbiding except that the increase in syn. gas admission rate is not interrupted until the full desired rate, usually 3,000,000 SCFH has been attained. Also as the syn. gas rate is increased the reactor pressure is raised to 350# and steam bundles are placed in service as necessary to maintain and equalize reactor bed temperatures.

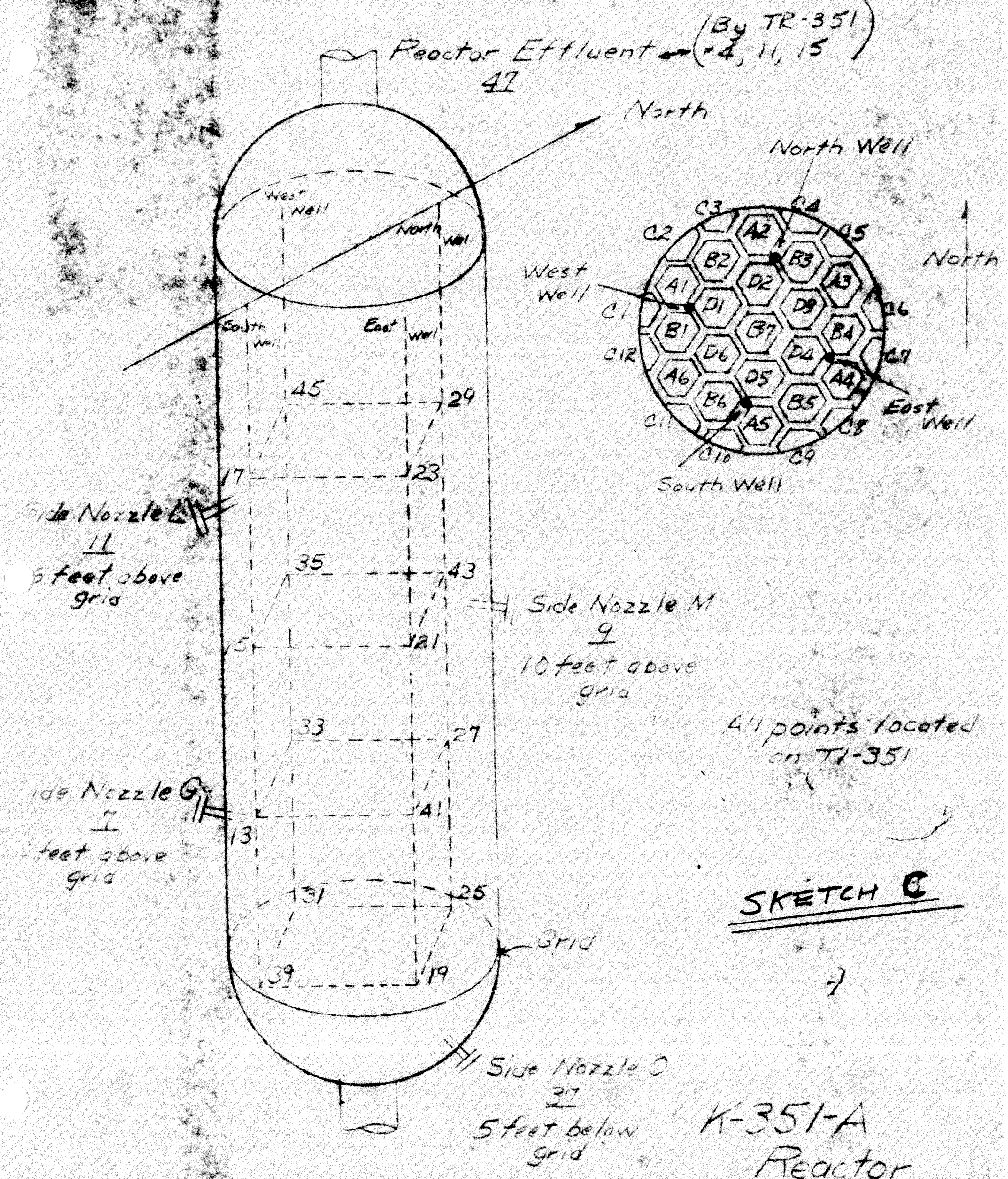
In the earlier runs some of the bundles were left out of service entirely but in recent runs it has been the practice to place them all in service pinching off each bundle circuit as necessary to equalize bed temperatures. No record is kept of the amount of pinching off of the individual steam circuits.

The following Sketch C shows the location of the thermowells in Reactor A with respect to the tube bundles. Those in Reactor B are opposite hand.

Whether carbiding or just starting up directly, acid water is admitted to the gas scrubber as soon as or shortly after synthesis gas is added to the reactor.

The recycle compressor V-351 is started as soon as pressure has been built up on the system.

The plant is always run to load the fresh feed compressor V-302, with fresh feed plus part of the recycle and this entire stream, usually about 4,500,000 SCFH is routed thru the L-305C heater and there preheated to 650°F. The remainder of the recycle is handled by the V-351 compressor and is not preheated. Thus when running with a fresh feed rate of about 3,000,000 SCFH, the



All points located on TI-351

SKETCH C

K-351-A
Reactor

9/21/51

output when only one O_2 plant is running, and with a recycle to fresh feed ratio (R/FF) of one, approximately 1,500,000 SCFH of the recycle is preheated along with the fresh feed and an equal amount of the recycle is not. Therefore when the fresh feed rate is increased with the R/FF remaining the same, less of the recycle goes thru the V-302 compressor heater and therefore the combined steam reactor inlet temperature drops. In other words when running with a F.F. rate of 3,000,000 SCFH and R/FF of 1.0, 75% of the total feed to the reactor is preheated to 650°F. resulting in a total feed temperature of about 530°F. whereas when the F.F. rate is increased to 4,500,000 SCFH and the R/FF rate is still maintained at one, then only 50% of the total feed is preheated and the combined feed temperature drops to about 415°F.

Brownsville Data

Seventeen runs have been made at Brownsville. The first of any consequence so far as the reactor is concerned was Run #5. No data were worked up for Run #7. A general description of each run with causes of shutdown etc., is periodically made up by Carthage in N.Y. and is called "Summary of Operations". Our copy of this summary with supplementary notes is included in the appendix.

The following Table B is a list of Runs 5 to 17 inclusive showing the dates of the runs, their duration and the catalysts used. It will be noted that all runs except #8 were less than 2 weeks long and all but four were of 10 days or less. Run #10 was the first run made with well reduced catalysts and Run #11 was the first made with the fine grind catalyst now being used.

TABLE B

BROWNSVILLE REACTOR RUNS

Run No.	Start	End	Days	Reactor Used	Catalyst			
					Tons	Type	% Fe	Red'n. Temp.
5	1/16/51	1/25/51	9		140	Used AW & MS*	72.3	
					80	Fresh MS Added	90	770
6	3/11/51	3/20/51	9		170	Fresh MS	88	750
					100	Fresh MS Added	90	
7	4/8/51	4/13/51	6		Run Not Used. Data unavailable			
8	4/21/51	5/15/51	24		160	Used in Run 7	73.7	
					194	Fresh MS Added	90	
9	6/5/51 8 PM	6/9/51 3:15 PM	4	B	126	Used in Run #8	74	
					57	Fresh Added	88	
10	7/20/51 11 AM	8/1/51 12:35 AM	11	B	240	Fresh	95+	
					43	Fresh Added	97	
11	11/11/51 6 AM	11/20/51 10:15 AM	10	A	248	Fresh	96	725
					61	Fresh Added	97	
12	11/28/51 11 PM	12/7/51 12 N	9	A	214	Used in Run 11	79.3	
					82	Fresh Added	96.6	725
13	12/21/51 5 PM	1/2/51 9:13 AM	13	B	130	Used	80.9	
					127	Fresh	97.3	
					60	Fresh Added	97	725
					49	Fresh Added**	96.2	
14	1/9/52 5 PM	1/22/52 11 AM	14	B	207	Used	80.7	
					55	Fresh Added	95.3	775
15	2/2/52 9:30 AM	2/11/52 4:30 PM	10	A	79	Used	77.7	
					121	Fresh	94.8	
					13	Used Added	77.7	
					42	Fresh Added**	95.5	810
16	2/19/52 12:30 PM	2/22/52 9:30 AM	4	A	104	Used	78.2	
					24	Fresh**	96	825
					71	Fresh	95	810
17	3/4/52 9:13 AM	3/13/52 2 PM	10	A	130	Used	80.3	
					6	Fresh	95	
					55	Fresh Added	80.3	
					31	Fresh Added	87	

* AW = Allan Wood used only in Run #5 and before all other runs used Mill Scale MS. Where so noted the catalyst was <u>added</u> during the run.

** These batches were reduced and precarbided before adding to reactor. In addition in situ carbiding was practiced in the reactor before the beginning of Runs 15, 16 & 17.

The stock room at Brownsville works up a daily (6 AM to 6 AM) statement of reactor operations using 24 hr. averages of meter readings, temperature and pressure measurements with averages of three mass spectrometer analyses on the fresh feed and two on the recycle.

In this calculation, because there is no direct measure of the fresh feed to the reactor, the fresh feed is found by balance in which the output is made up of:

1. Absorber tail gas - metered and analyzed.
2. Raw Primary Oil - gaged when treating unit not running, otherwise metered.
3. Water Soluble Chemicals - obtained from Stanolind.
4. Water make - obtained from Stanolind.

The absorber tail gas is adjusted to remove metered aeration gas (Nat. Gas) and the total output weight is then used together with fresh feed analysis to calculate the fresh feed rate and input of each fresh feed component.

A check against this calculated rate can be obtained by subtracting from the metered rate of the combined fresh feed and part of the recycle on the fresh feed compressor discharge (preheater outlet), the rate of recycle to the fresh feed compressor which is measured by a pitot venturi not considered reliable enough to use for the daily calculations. The remainder of the recycle, that going thru the recycle compressor, is metered separately.

An additional check on the calculated reactor fresh feed rate is obtained by comparing with the syn. gas generator output which in turn is calculated by carbon balance around the generator.

The accuracy of the reactor calculation is also noted daily by comparing the calculated argon input with that leaving the system which is calculated by difference as outlined above. We have made spot checks on all these calculated rates and found them reasonably reliable.

The above method of calculation applies to all runs which were made since March 1951 after Run #5. Run #5 was calculated separately but in a similar manner.

These stock room data do not agree exactly with those reported in the teletypes because the teletypes are based on spot 6 AM readings using midnight sample analyses and short-cut calculations.

At the end of each run the daily stock room data are tabulated to form what is called the run "Operating and Yield Summary" which is sent to New York and copies of which are included in the appendix.*

The data from the run summaries, supplemented by a few additional data, were tabulated and recalculated for correlation purposes and are included in Tables I & II in the appendix as referred to above.

Reliability of Brownsville Data

It will be evident from the above description of the method of daily data calculations and from consideration of the many factors involved, that the possibility of inconsistencies in the Brownsville data from day to day and run to run is great. Therefore,

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* The weight percentages in the Run Summaries do not add up to 100% because the CO_2 and CH_4 in the fresh feed have been subtracted from the CO_2 and CH_4 respectively in the reactor effluent. The total products shown are the 'make' products they are all expressed as wgt.% of the fresh feed synthesis gas and not of the pure H_2 plus CO input.

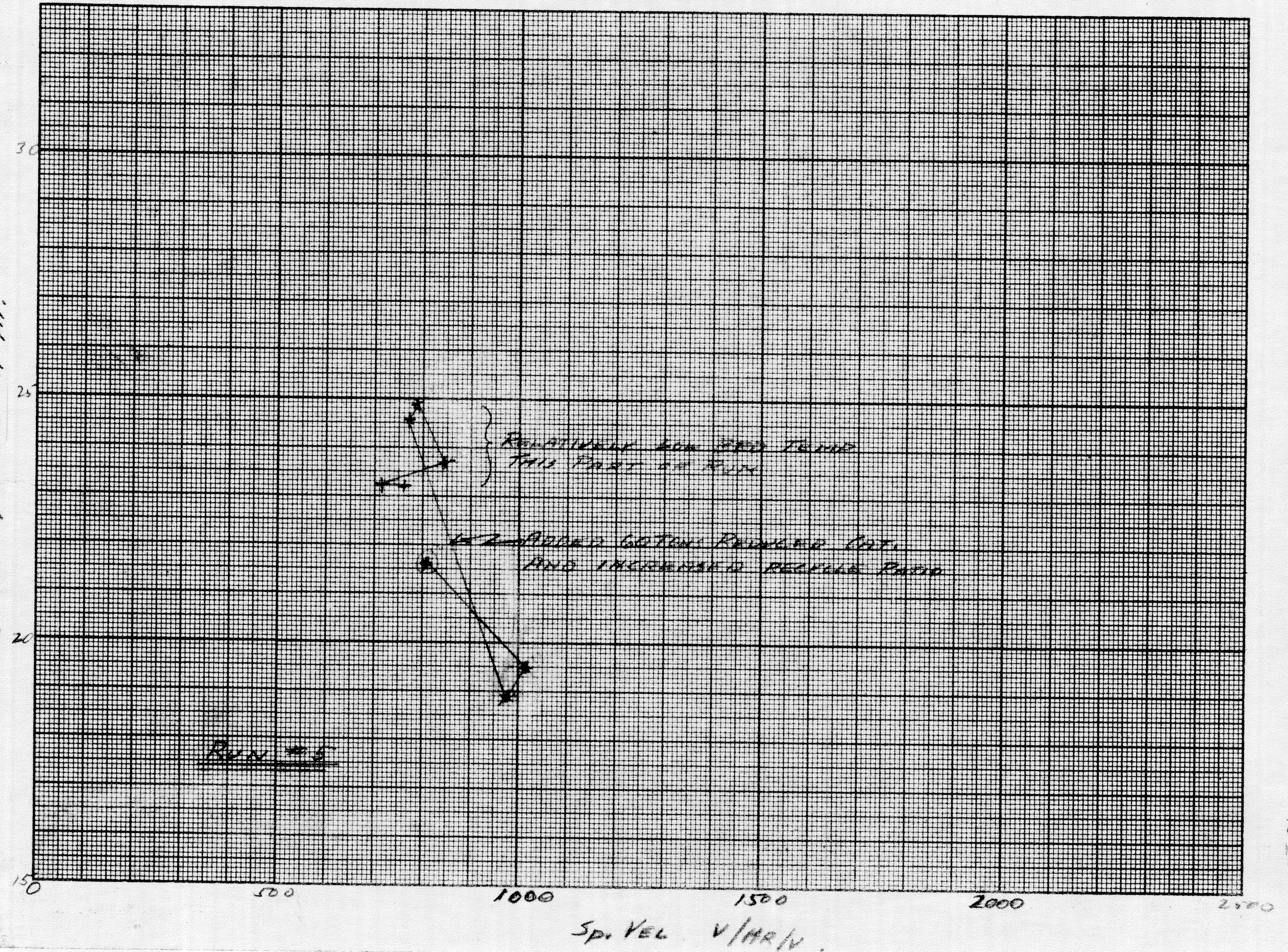
in order to explore the relative reliability of the point to point data and to examine the effect, if any, of changes in operations made during the runs a plot was made of all the Brownsville data run by run in the following separate graphs. These graphs are plots of space velocity (SCF of F.F./Hr/Cu.Ft. of fluidized catalyst) against yield of C_3+ expressed in Bbls/MMSCF of fresh feed. They are numbered Run 5, Run 6, Run 8 etc. On each plot the points have been joined in chronological order with a ring around the first day's operation. Examination of these individual graphs and Table II in the appendix, which lists the plotted data as well as the operating conditions used, discloses the following:

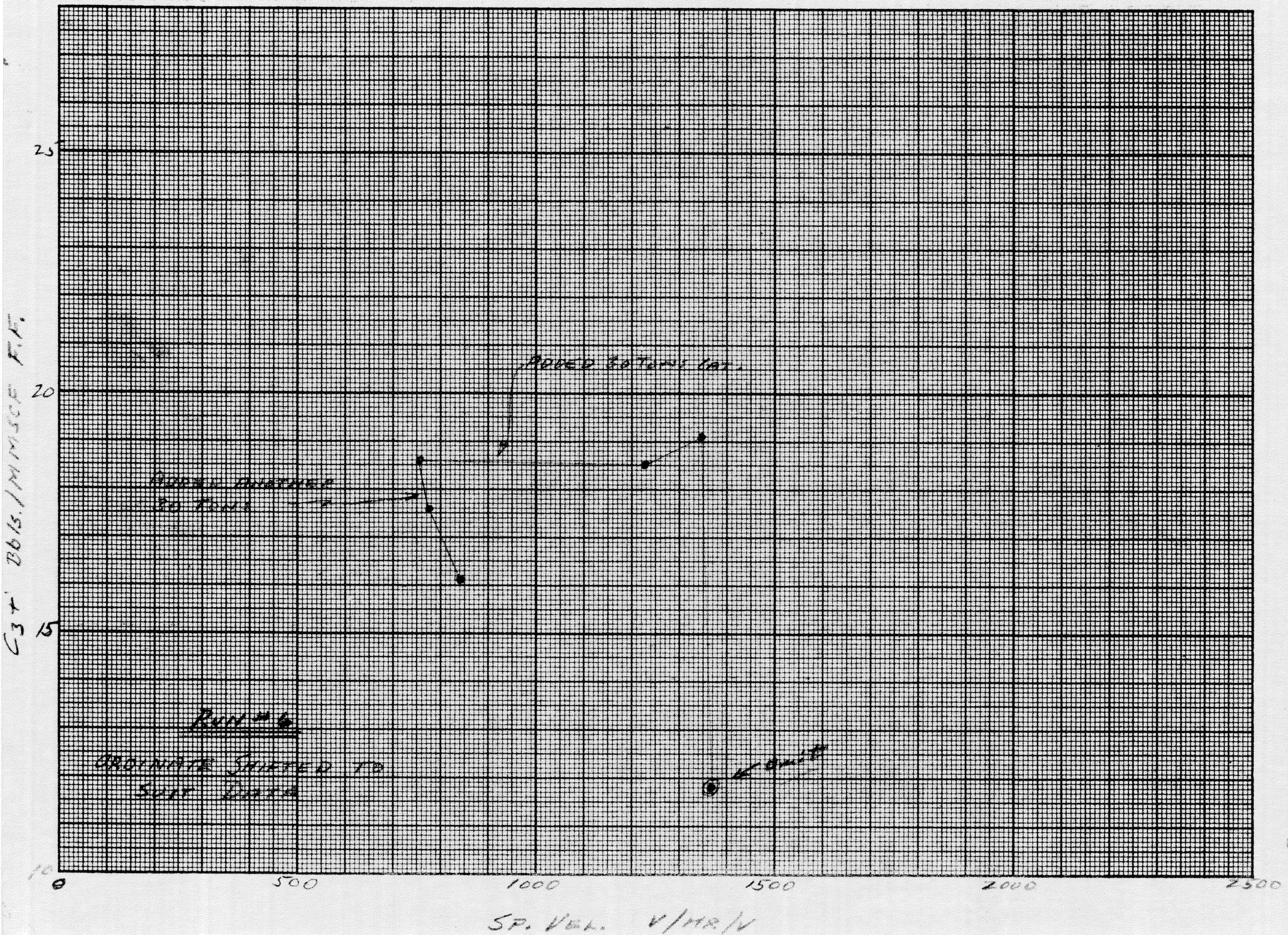
1. Some points, but not too many, are obviously way out of line and can legitimately be discarded if necessary to avoid confusion. (Note: A great many points which were out of line in the original rough graphs were corrected when on checking back to the original stock room calculations, it was found that errors in arithmetic or errors in transcription or errors of ommission were responsible).

2. In the first part of Runs 8, 13 & 14 all of Runs 11, 12 and the last part of Run 17 there is obviously a wide random distribution of the data during periods when operating conditions were deliberately being maintained as constant as possible in the plant. This random distribution shows that the plant data cannot be depended upon too much, from point to point at least, to show anything but large effects of changes in operating variables. We must look instead to the mass of the data to show trends

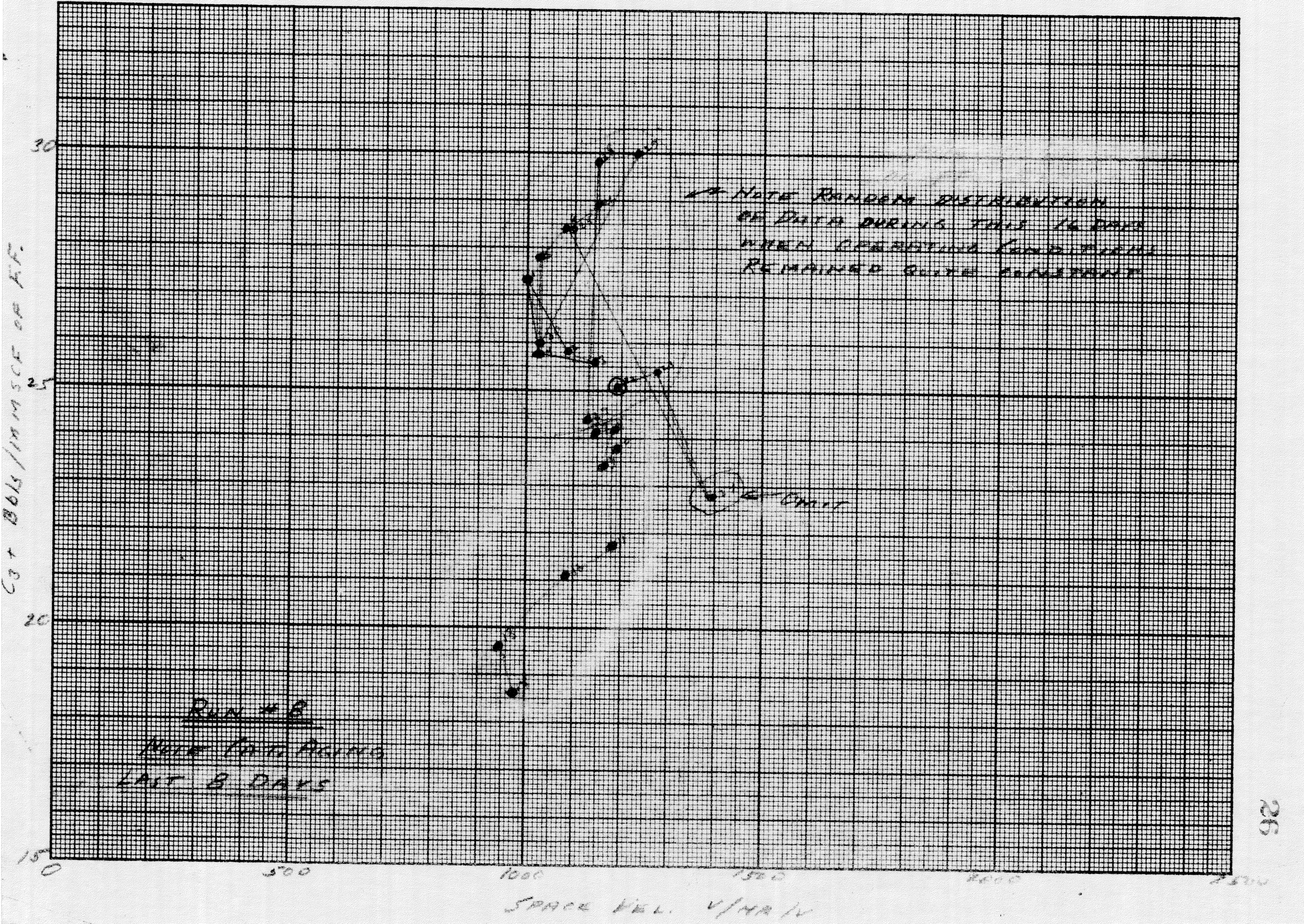
3. The effect of catalyst deactivation is quite pronounced in many runs. Note especially the sharp drop after the first or second day in Runs 5, 11, 12, 14 & 15. Note also the

①


C3+ BBLS/MMSCF OF F.F.
30
25
20
15
0
500
1000
1500
2000
2500
Sp. VEL V/HR/V
RELATIVELY LOW BED TEMP
THIS PART OF RUN
← ADDED 60 TONS REWORKED CAT.
AND INCREASED RECYCLE RATIO
RUN #5


ADDED 30 TONS CAT.
ADDED ANOTHER
30 TONS
RUN #6
ORDINATE SHIFTED TO
SUIT DATA
OMIT
C3+ Bbls./MMSCF F.F.
25
20
15
10
0
500
1000
1500
2000
2500
SP. VEL. V/HR/V

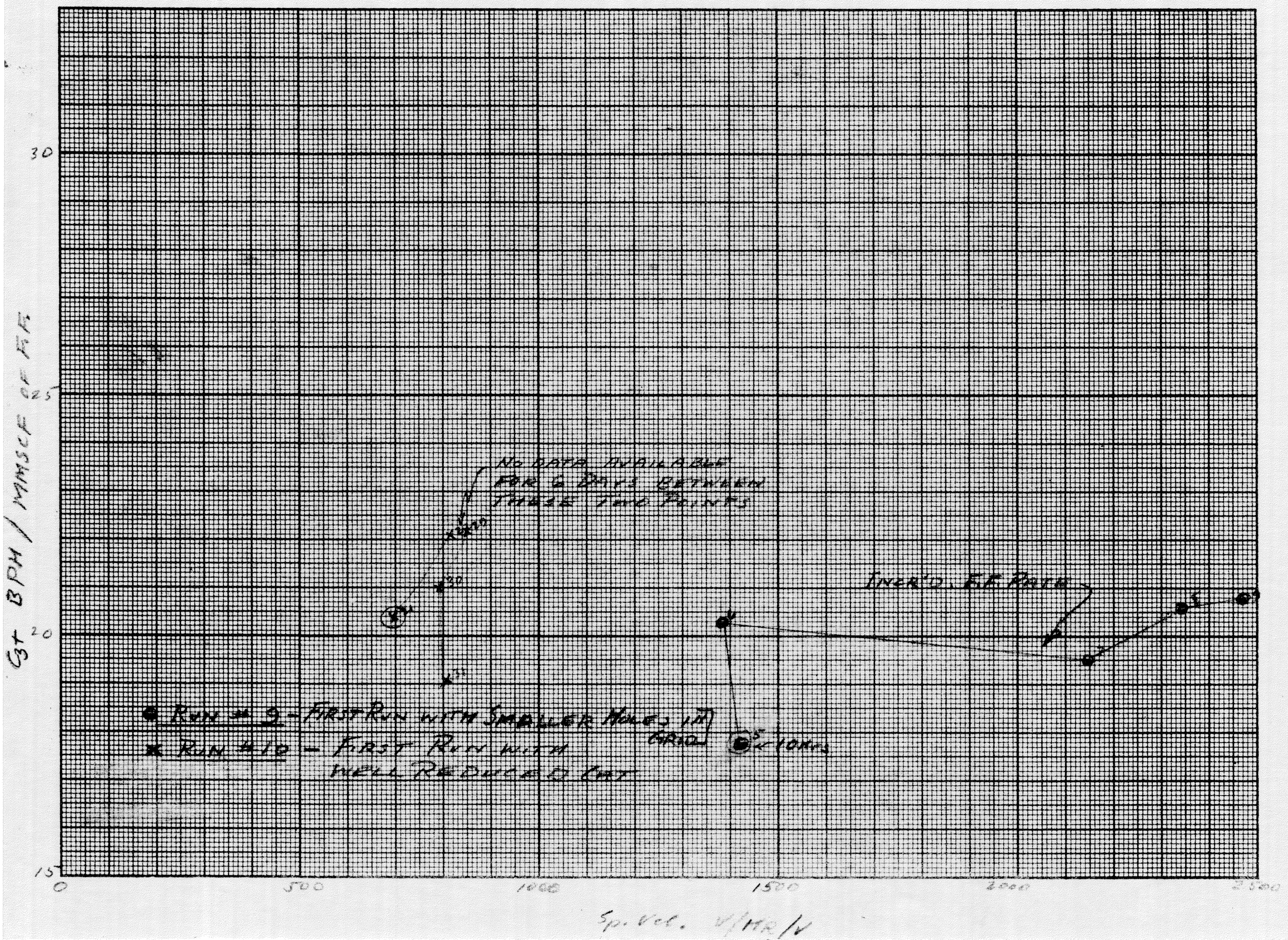
(3)



← NOTE RANDOM DISTRIBUTION OF DATA DURING THIS 16 DAYS WHEN OPERATING CONDITIONS REMAINED QUITE CONSTANT

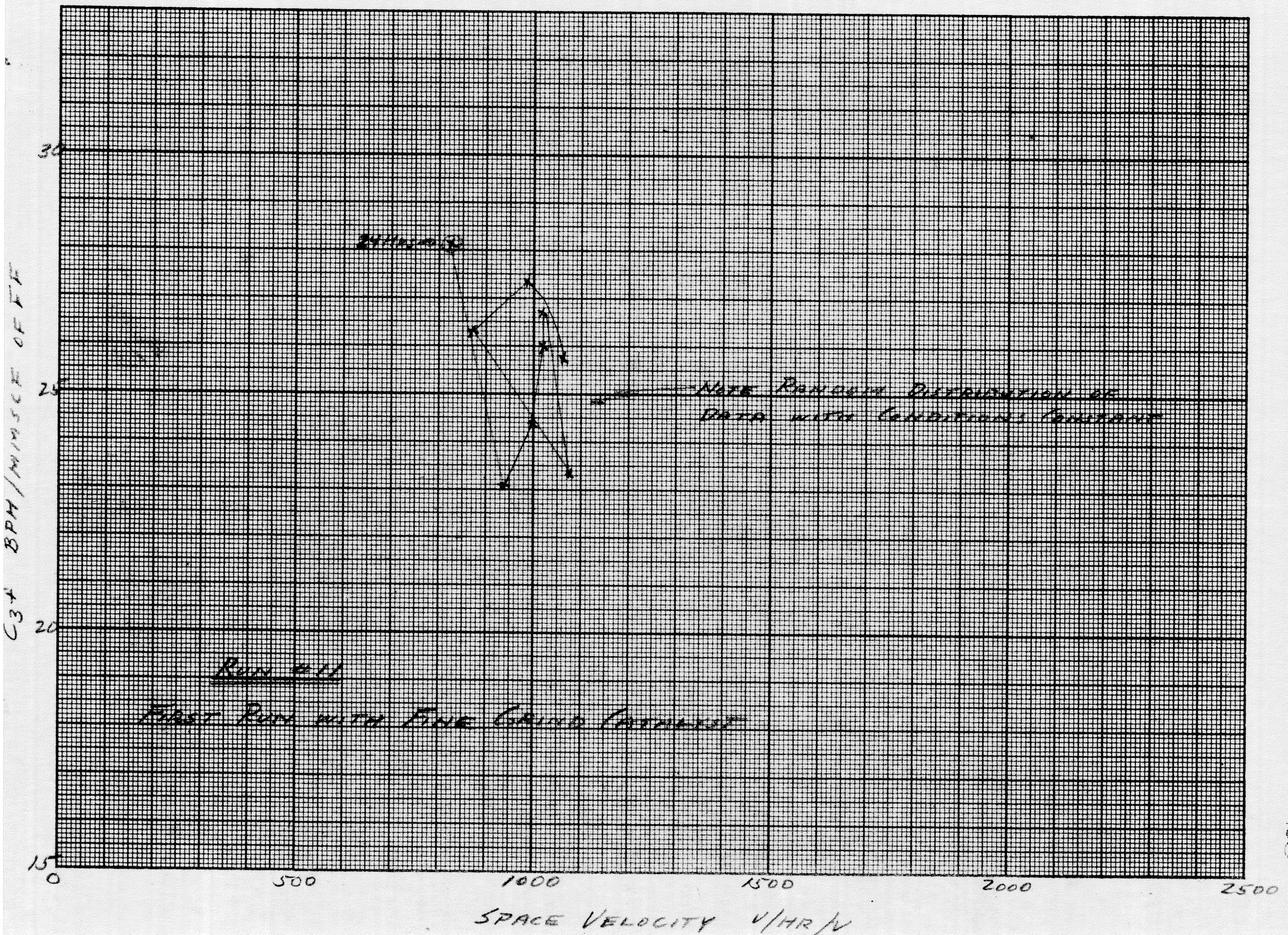
RUN #8

NOTE CAT. AGING LAST 8 DAYS



NO DATA AVAILABLE FOR 6 DAYS BETWEEN THESE TWO POINTS

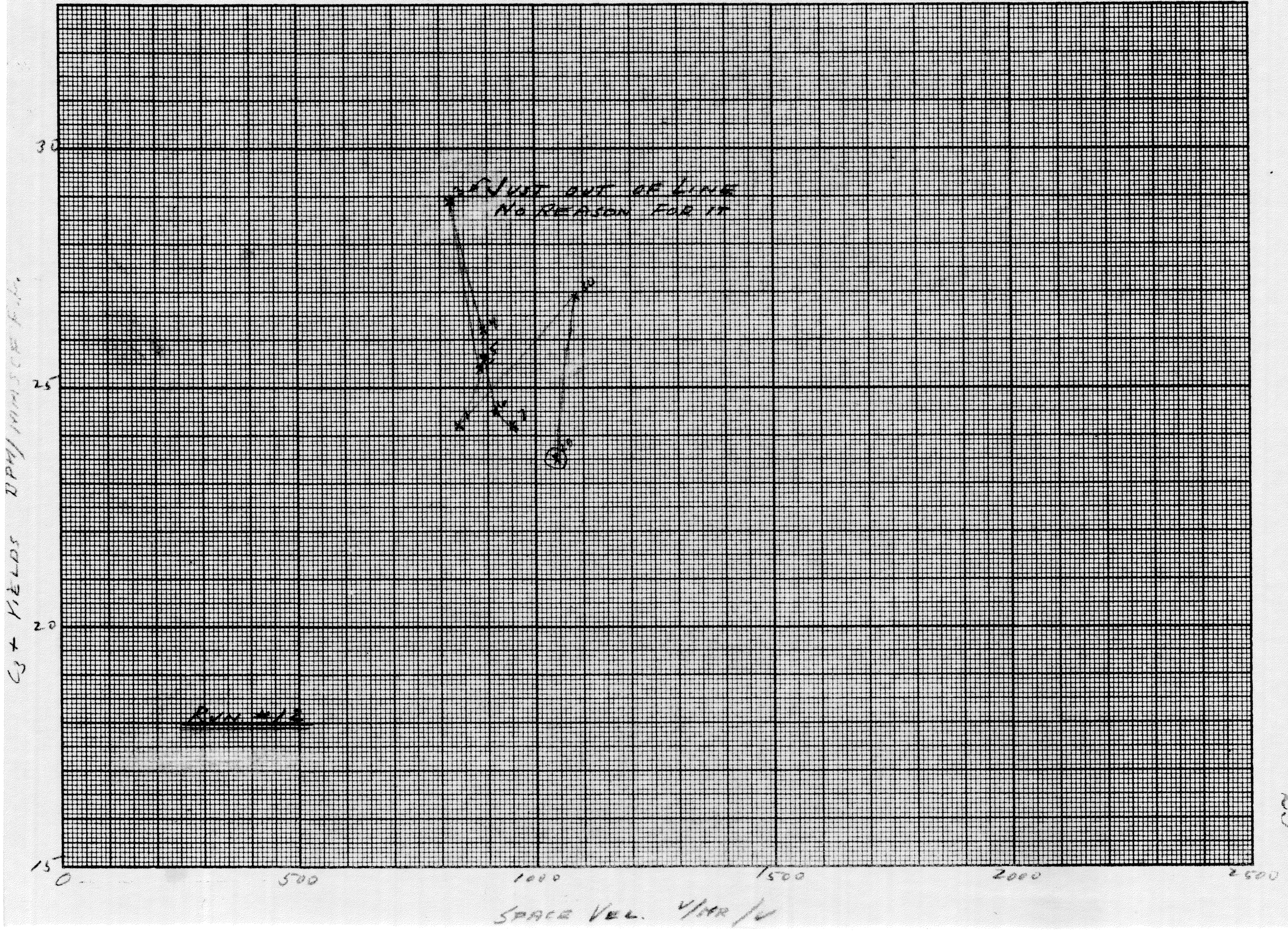
INCR'D. F.F. RATE

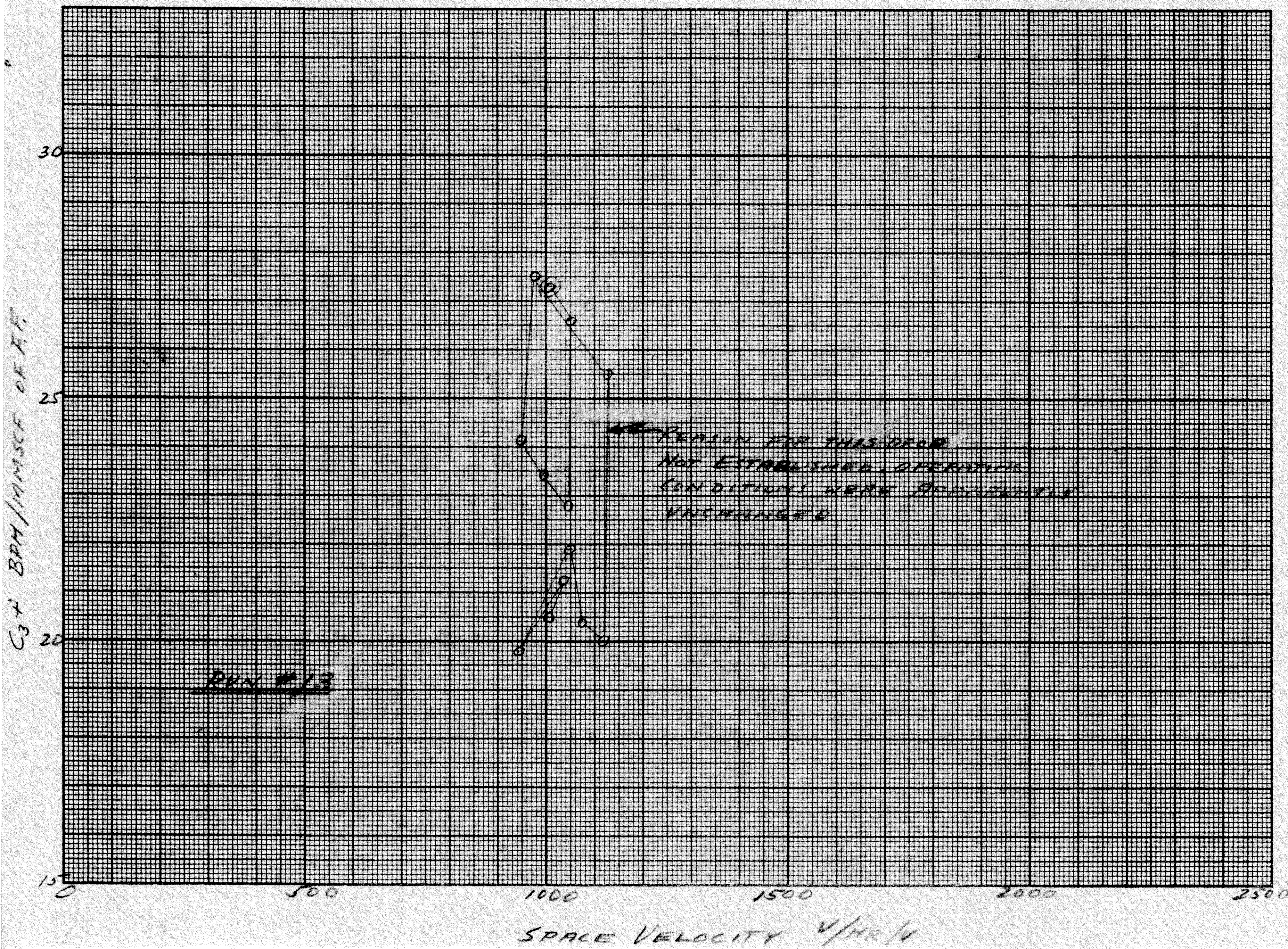


RUN #11

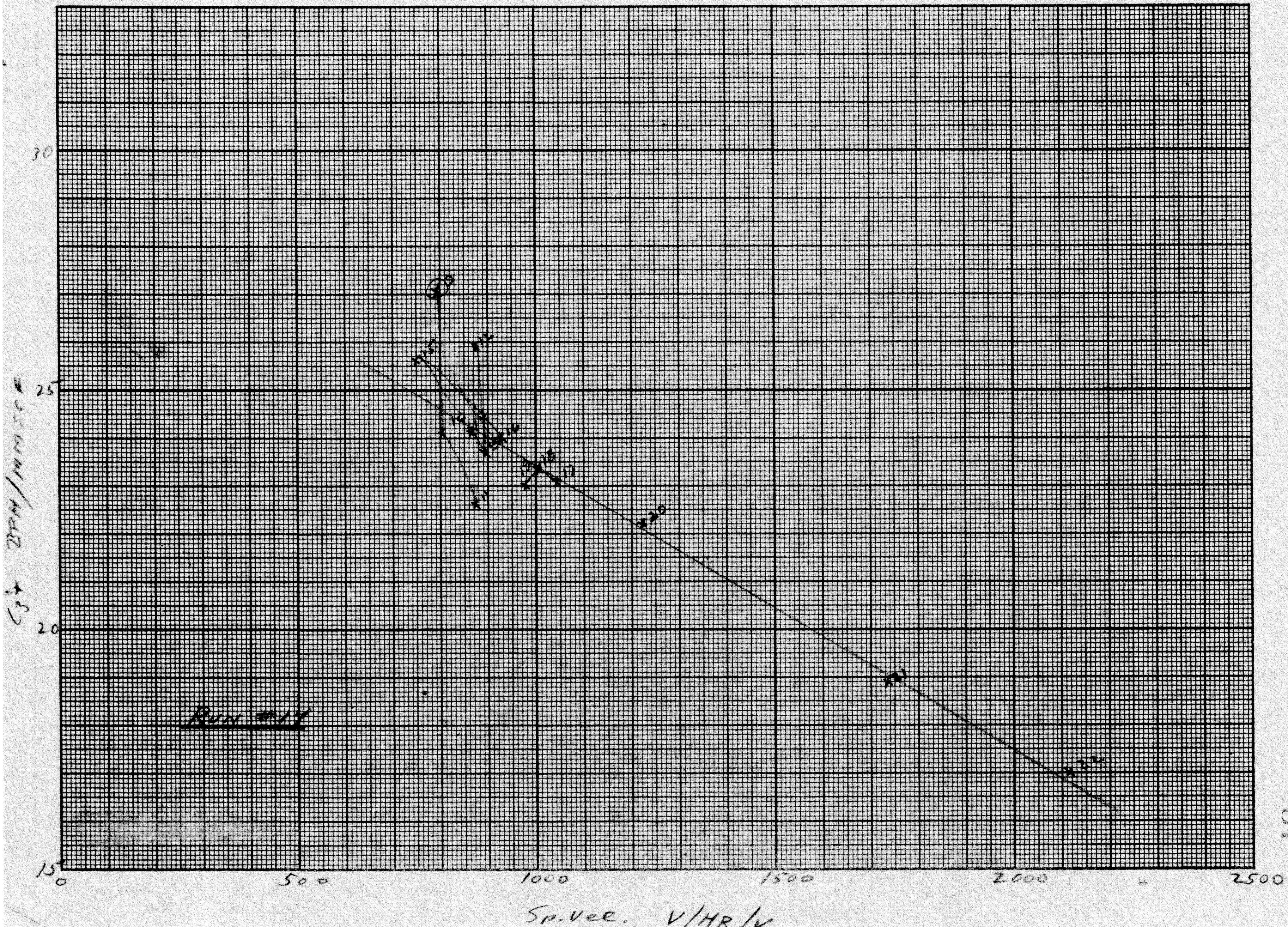
FIRST RUN WITH FINE GRIND CATALYST

(4) 2


3.0
2.5
2.0
1.5
0
500
1000
1500
2000
2500
C3+ YIELDS DPM/MMSCF F.F.
SPACE VEL. V/HR/V
JUST OUT OF LINE
NO REASON FOR IT
RUN #12
1
4
5
7
8
10


C₃+ BPH/MMSCF OF R.F.
30
25
20
15
REASON FOR THIS DROP
NOT ESTABLISHED. OPERATING
CONDITIONS WERE APPARENTLY
UNCHANGED
RUN #13
0
500
1000
1500
2000
2500
SPACE VELOCITY V/HR/V

6


30
25
20
15
0
500
1000
1500
2000
2500
C_3^+ BPH/MMSCF
Sp.Vel. V/HR/V
9
15
12
14
16
18
17
13
20
21
22
Run #14

31

NO. 340-AM DIETZGEN GRAPH PAPER
MILLIMETER

EUGENE DIETZGEN CO.
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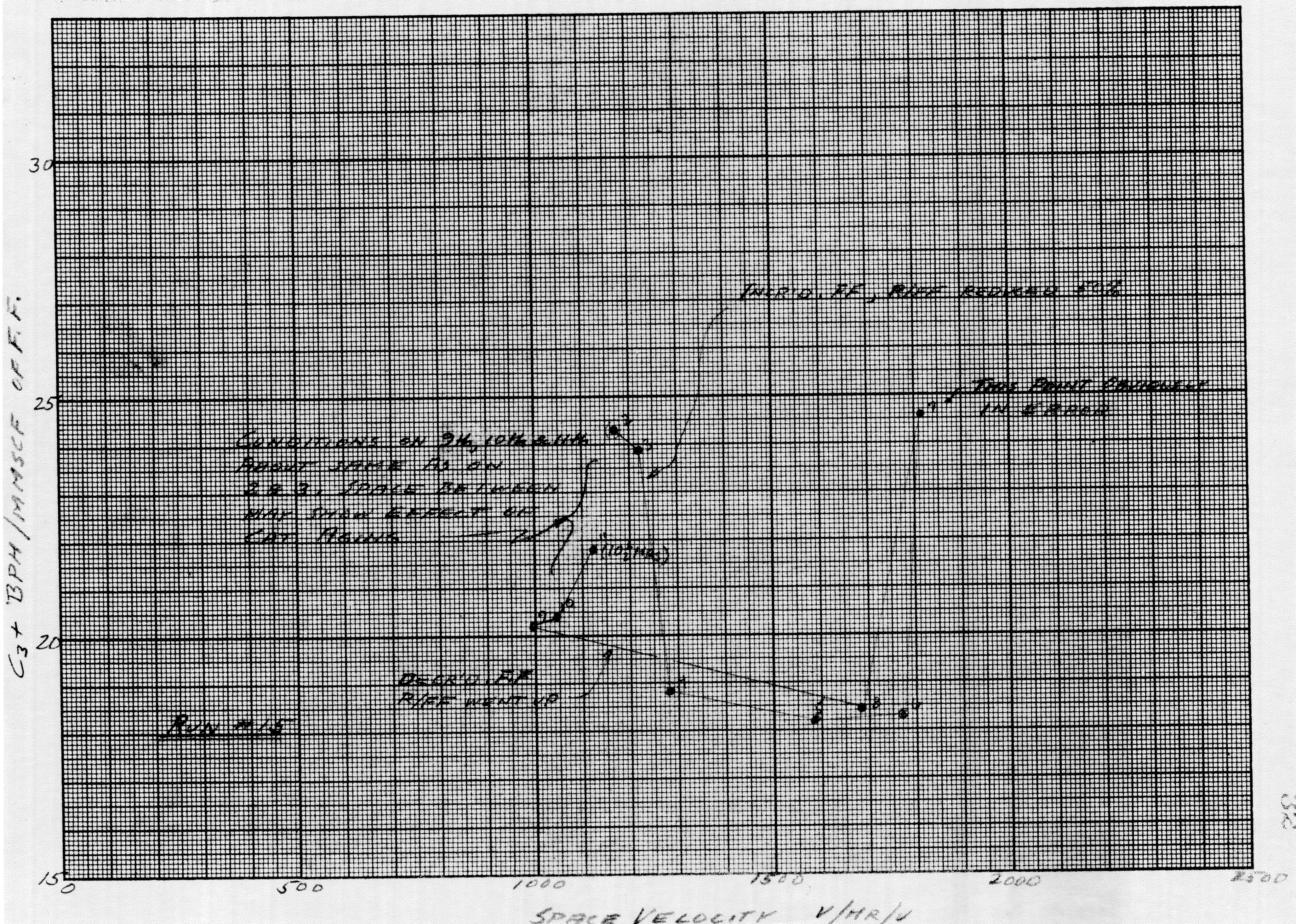
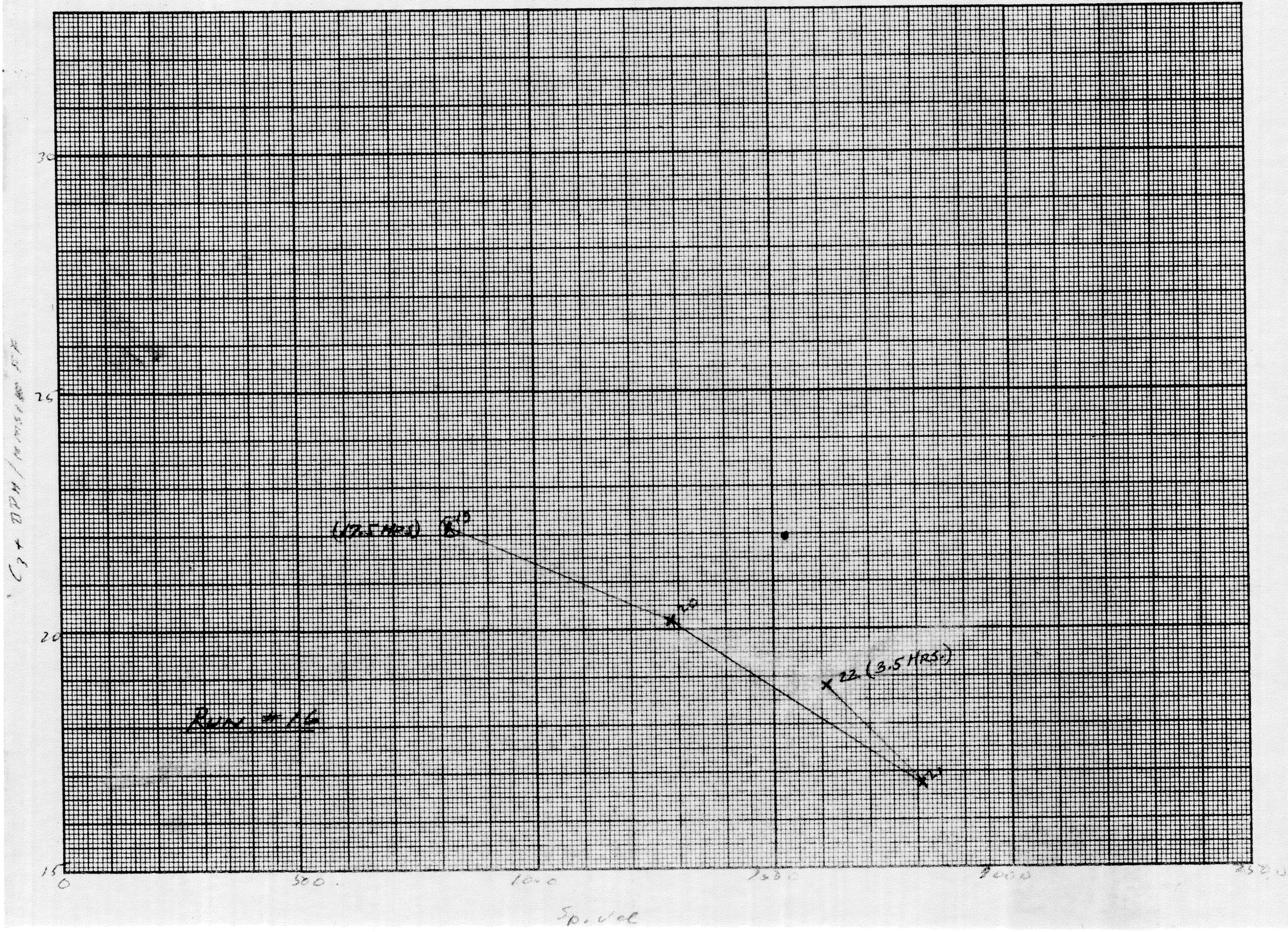
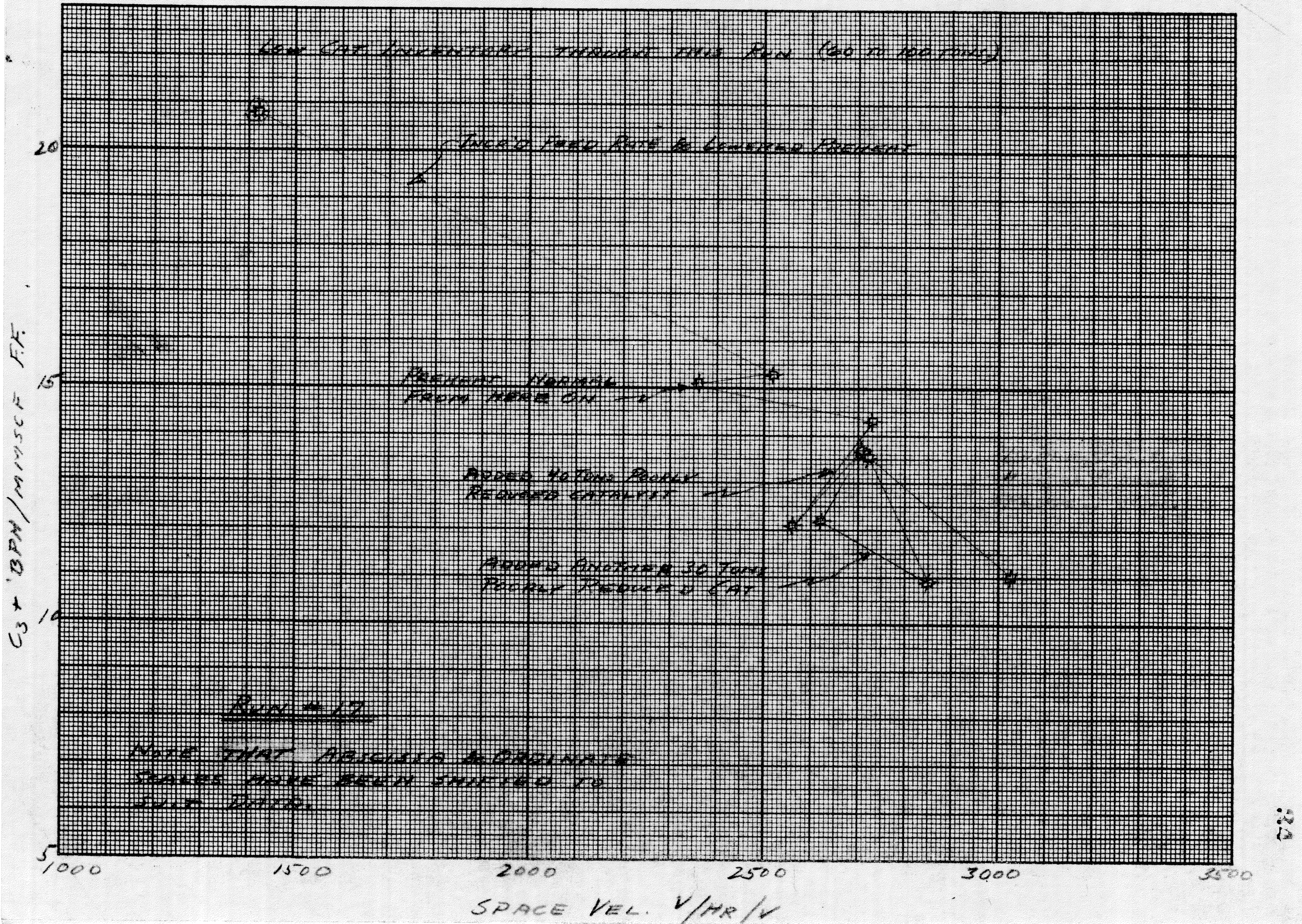


NO. 340-AM DIETZGEN GRAPH PAPER
MILLIMETER

EUGENE DIETZGEN CO.
PRINTED IN U. S. A.




LOW CAT. INVENTORY THROUGHOUT THIS RUN (60 TO 100 TONS)
INCR'D FEED RATE & LOWERED PREHEAT
PREHEAT NORMAL FROM HERE ON
ADDED 40 TONS POORLY REDUCED CATALYST
ADDED ANOTHER 30 TONS POORLY REDUCED CAT
RUN # 17
NOTE THAT ABSCISSA & ORDINATE SCALES HAVE BEEN SHIFTED TO SUIT DATA.
C3+ BPH/MMSCF F.F.
20
15
10
5
1000
1500
2000
2500
3000
3500
SPACE VEL. V/HR/V

sharp drop which occurred during the later part of Runs 13 & 8. The drop in Run 13 may have been caused by a sharp change in mass spectrometer operations (could not be pinned down as such however) but that in Run #8 it is too consistent, in spite of maintaining constant operating conditions to be anything but catalyst deactivation.

4. In runs 14, 16 and 17 there is an apparent pronounced effect of space velocity. This is not solely the effect of space velocity however because space velocity was always increased as the run progressed and therefore the effect of catalyst aging is superimposed.

In summary, these individual run graphs indicate that some rapid deactivation takes place the first day. The graphs also indicate that if the runs were longer, some further deactivation would occur as it did in run 8 where the catalyst apparently went to pot completely. Space velocity has an apparent effect but the magnitude of its effect is clouded by the superimposed catalyst aging and possibly the effect of automatically reducing the combined feed inlet temperature when total feed rate is increased as discussed above.

The point to point data of each individual run are not accurate enough by themselves to show the effect, if any, of other operating variables.

Fig. A H_2+CO Conv. vs % Contraction

In order to get some idea of the consistency of the runs with each other, we have plotted all of the data on the following Fig. A where H_2 + CO conversion is plotted against % contraction. This relationship is almost mathematical and if the methods of measurement and calculations were correct, the points should all

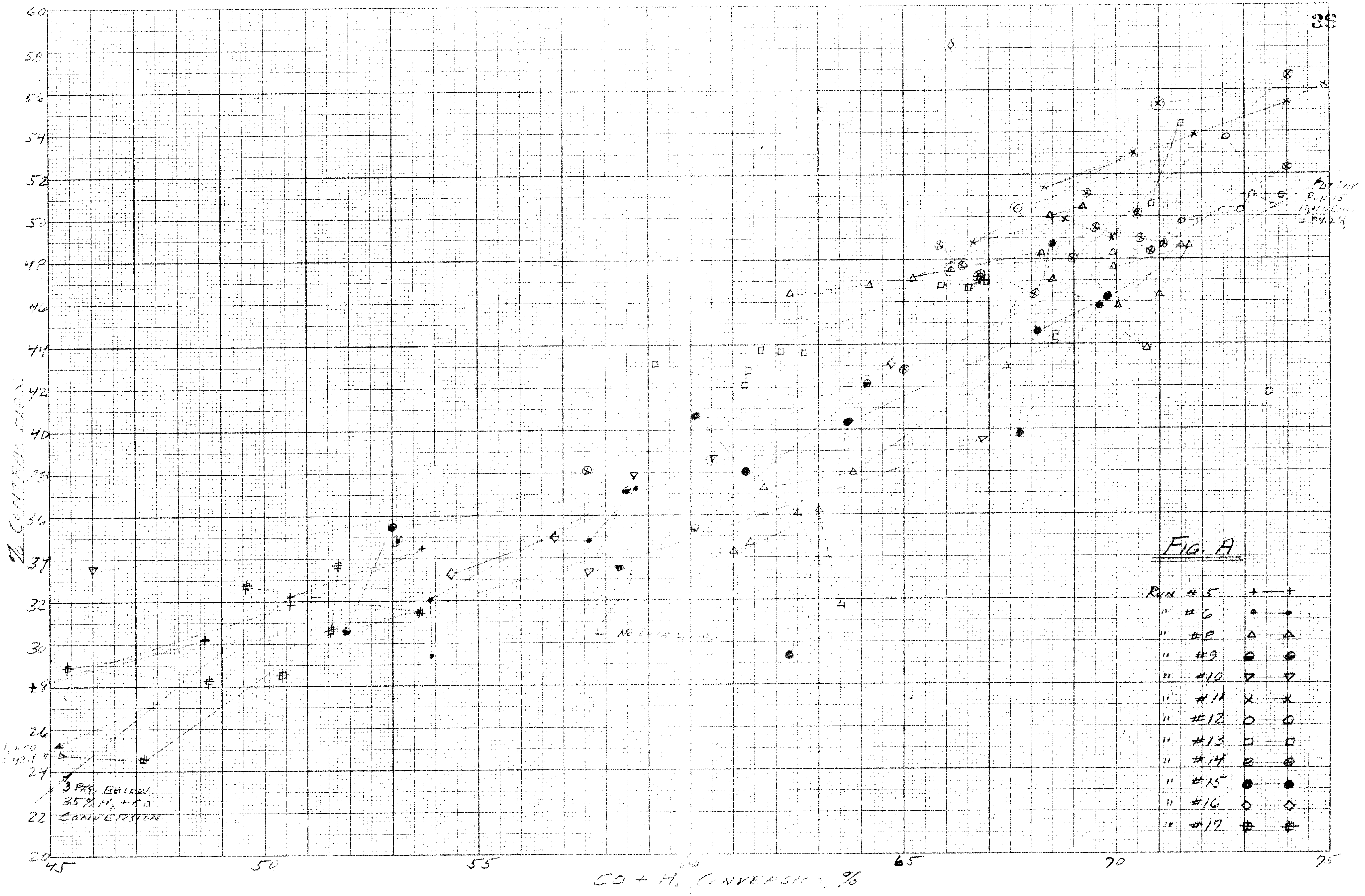

60
58
56
54
52
50
48
46
44
42
40
38
36
34
32
30
28
26
24
22
20
% CENTRAC MAX
45
50
55
60
65
70
75
CO + H_2 CONVERSION %
RUN #5
" #6
" #8
" #9
" #10
" #11
" #12
" #13
" #14
" #15
" #16
" #17
1st Day Run 15 H_2+CO Conv = 84.4%
H_2+CO = 43.1%
3 Pts. BELOW 35% H_2+CO CONVERSION
No [illegible]

FIG. A

fall on a single line.

It will be noted that altho the deviation is fairly great, all but a few points fall within a band which should be good enough for our purpose. The points that are outside that band are all unreliable and not real effects of operating conditions. These points cannot be discarded yet however because altho they may be in error so far as % contr. or H_2+CO conv. is concerned they may be correct when other factors are correlated.

Fig. B H_2+CO Conversion vs C_3+ Yields/MMSCF of Feed

Another plot used for the purpose of establishing the consistency of the data with each other is Fig. B where we have shown H_2+CO conversion vs the yield of C_3+ in Bbls/MMSCF of F.F. for all points. Here the scattering is even greater than in Fig. A because the C_3+ yield is numerically dependent on the accuracy of many more values than the % contraction.

All of this merely reiterates that we must draw conclusions from the mass of the data and not try to deduce too much from a point to point comparison.

It will be noted from this Fig. B and also from Fig.1A that the C_3+ yields reported for Run #5 are way out of line. As a matter of fact these yields are stoichoimetrically impossible for the H_2 and CO conversions reported. This particular run was not worked up by the usual stock department procedure and the complete recalculation of the original data might have disclosed the cause of the discrepancy. However, this expenditure of time was not warranted and we have elected to ignore Run #5 instead.

All the data in Run #8 are suspect. This is unfortunate since this is the longest run. An examination of the data discloses that the mass spectrometer analyses on the reactor fresh feed

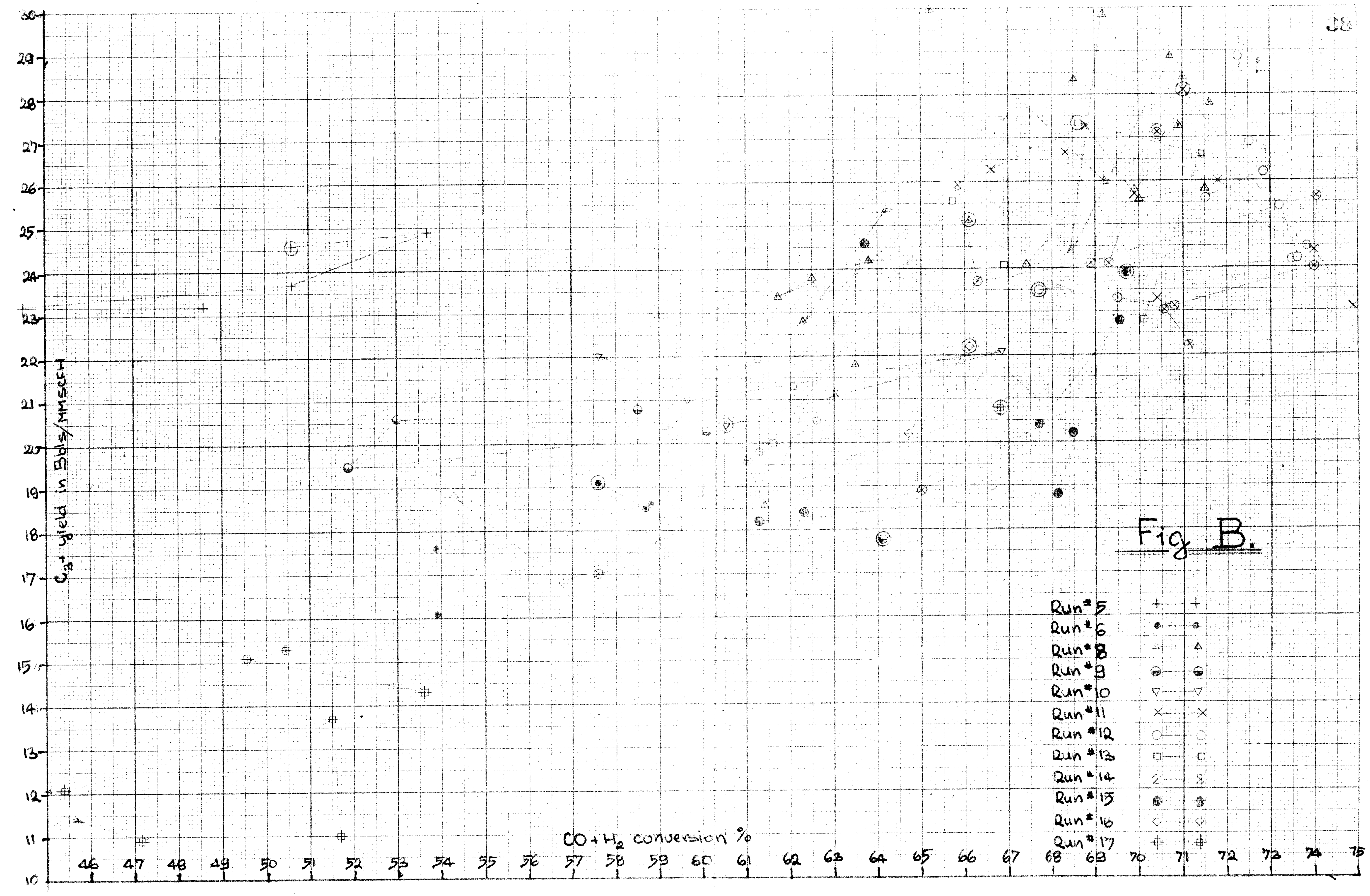

C_3^+ yield in Bbls/MMSCFH
30
29
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
CO + H_2 conversion %
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
Run # 5 + — +
Run # 6 ● — ●
Run # 8 △ — △
Run # 9 ⊖ — ⊖
Run # 10 ▽ — ▽
Run # 11 × — ×
Run # 12 ○ — ○
Run # 13 □ — □
Run # 14 ⊗ — ⊗
Run # 15 ● — ●
Run # 16 ◇ — ◇
Run # 17 ⊕ — ⊕

Fig. B.

(V-301 effluent) was in error. The H_2/CO ratio averaged about 1.7 instead of the 1.8 in other runs before and after Run #8. This has such a great effect on the correlations which use H_2 conversion or H_2+CO conversion as a base that Run #8 must be ignored for this purpose. The error however was consistent throughout the run and therefore the run may be used to evaluate the effect of operating variables & catalyst age.

We also note from Fig. B that the following points should be treated with suspicion.

1. The last three points in Run #9
2. The last two points in Run #10.

Fig. C Space Velocity vs C_3+ Yields

The following Fig. C is a plot of space velocity vs C_3+ yields in Bbls. per million SCF of synthesis gas feed for all Brownsville Runs from Run #10 on. This plot was made up to see what these recent and more reliable runs, shown on the individual plots above, would look like if superimposed on each other. In general it will be noted that they check each other reasonably well. From examination of this plot and Table II of the appendix there is no clear cut evidence that difference in operating conditions from run to run made any consistent change in results. We were particularly surprised to find no large consistent effect of differences in degree of catalyst reduction. In general it can be concluded that catalyst aging and space velocity, as modified by catalyst aging and perhaps preheat, are the only two factors that make large differences in results.

One might argue that the fine grind catalyst, used in Run #11, was better than coarse catalyst because the results in Run #10 and also in Runs #6 & 9 (see Fig. 1) were not as good as those ob-

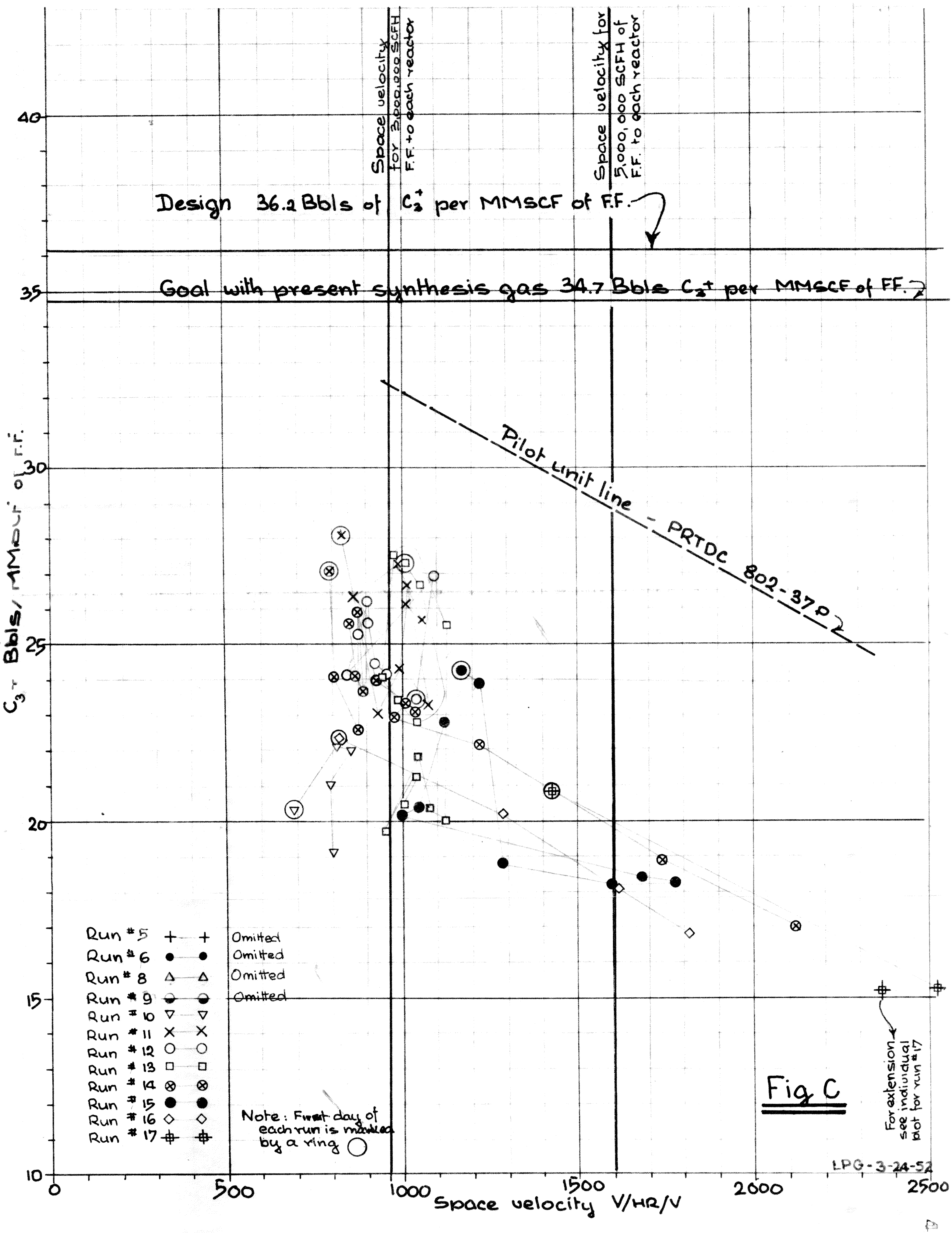

Space velocity for 3,000,000 SCFH F.F. to each reactor
Space velocity for 5,000,000 SCFH of F.F. to each reactor
Design 36.2 Bbls of C_3^+ per MMSCF of F.F.
Goal with present synthesis gas 34.7 Bbls C_3^+ per MMSCF of FF.
Pilot unit line - PRTDC 802-37P
C_3^+ Bbls/MMSCF of F.F.
40
35
30
25
20
15
10
0
500
1000
1500
2000
2500
Space velocity V/HR/V
Run #5 + — + Omitted
Run #6 ● — ● Omitted
Run #8 △ — △ Omitted
Run #9 ◒ — ◒ Omitted
Run #10 ▽ — ▽
Run #11 × — ×
Run #12 ○ — ○
Run #13 □ — □
Run #14 ⊗ — ⊗
Run #15 ● — ●
Run #16 ◇ — ◇
Run #17 ⌗ — ⌗
Note: First day of each run is marked by a ring ○
For extension see individual plot for run #17
LPG-3-24-52

Fig C

tained in the succeeding runs. (The Run #8 data are unreliable as discussed above)

On this same Fig. C we have shown for comparison the effect of space velocity in pilot unit operations as reported in Table #5, p. 21 of P.R. TDC 802 - 37 P. We have also shown for comparison horizontal lines representing the design goal of C_3+ yields both as originally proposed and as adjusted for the quality of the present synthesis gas as follows:

<u>Effect of Synthesis Gas Quality on Yields</u>

From the Case 6 design breakdown of the reactor effluent previously submitted, it was found that the total C_3+ yield (incluing WSC) per MM SCFH of syn. gas feed predicted was 36.22 Bbls. This was for a synthesis gas that was quite different from that now being produced at Brownsville.

Shown in the following Table C are randomly selected analyses of the synthesis gas in various runs compared with that predicted in design.

On Nov. 29, 1951, the end of Run 13, the practice of adding about 15% steam to the natural gas feed to the generator in order to reduce soot formation was started. It will be noted that this made a perceptible difference in the syn. gas composition, H_2/CO ratio and H_2+CO purity as shown below.

	Design	Average Runs #13 & #16 Incl. with Steam	Average Runs #6 & #12 Incl.* No Steam
Syn. Gas Rate MMSCFH	5.0	3.18	3.10
Mol % Dry: CO	33.23	31.73	33.27
H_2	61.35	59.78	60.15
CO_2	1.31	3.90	2.97
N_2+A	3.01	2.12	1.94
CH_4	1.10	2.47	1.80
H_2/CO	1.845	1.88	1.81
(H_2+CO)%	94.2	91.5	93.42

* Run #8 Excluded

TABLE C

COMPARISON OF FRESH FEED COMPOSITIONS

Run #			#16		#15		#14			#13	
Date	Design		2/22/52	2/29/52	2/3/52	2/10/52	1/11/52	1/21/52	1/22/52	12/23/51	12/30/51
Syn. Gas Rate MMSCF	Wet	Dry	4.06	3.30	2.856	2.663	2.646	3.354	3.771	2.999	2.990
A			.65	.63	.69	.69	.73	.68	.65	.73	.70
CO	33.1	33.23	30.92	32.34	32.20	31.43	31.74	31.62	31.69	32.08	31.56
H_2	61.1	61.35	59.70	58.98	59.65	60.14	59.58	60.23	60.08	59.82	59.87
CO_2	1.3	1.31	4.63	3.87	3.71	4.01	3.90	3.63	3.77	3.71	3.84
N_2	3.0	3.01	1.34	1.60	1.31	1.11	1.45	1.68	1.38	1.43	1.61
CH_4	1.1	1.10	2.76	2.58	2.44	2.62	2.60	2.16	2.43	2.23	2.42
H_2O	0.4	-									
	100.0	100.00									
H_2/CO	1.845		1.93	1.81	1.85	1.91	1.88	1.90	1.90	1.86	1.90
$(H_2+CO)\%$	94.2		90.62	91.32	91.85	91.57	91.32	91.85	91.77	91.90	91.43

Run #	#12		#11		#10		#9		#8		#6	
Date	11/30	12/5	11/12	11/17	7/21	7/29	6/6	6/8	4/25	5/8	3/15	3/18
Syn. Gas Rate	3.03	2.81	3.00	3.05	2.51	2.67	2.81	4.77	3.07	3.46	3.24	3.06
A	.69	.68	.65	.71	.66	.61	.67	.71	.74	.79	.74	.73
CO	33.48	32.14	32.88	34.03	32.66	34.42	33.31	33.93	34.70	34.95	33.30	32.51
H_2	59.77	59.86	60.89	59.97	60.93	60.56	60.93	60.42	58.40	58.05	58.63	59.52
CO_2	3.06	3.88	2.87	2.69	2.65	2.49	2.74	3.07	2.94	2.58	3.12	3.09
N_2	.93	1.41	1.04	1.08	1.08	.88	1.07	1.18	1.00	1.45	1.88	1.95
CH_4	2.07	2.03	1.67	1.52	2.02	1.04	1.28	0.69	2.22	2.19	2.33	2.23
H_2/CO	1.79	1.86	1.85	1.76	1.87	1.76	1.83	1.78	1.68	1.66	1.76	1.83
$H_2+CO)\%$	93.25	92.00	93.77	94.00	93.59	49.80	94.24	94.35	93.10	93.00	91.93	92.03

If it is assumed that steam will continue to be added to the generator to control soot formation the syn. gas will contain only 90.32 of H_2+CO having an H_2/CO ratio of 1.845, assuming the extra hydrogen is not beneficial, thus

$$\% \text{ CO} = 31.73 \times 1.845 = 58.6 = \% \text{ Effective } H_2$$

$$31.73 + 58.6 = 90.3\% \ H_2+CO$$

It follows therefore that the anticipated yield of C_3+/MMSCF of synthesis gas must be reduced to 90.3/94.2 = 95.9% of that originally anticipated due to inferior synthesis gas composition. This amounts to 34.73 Bbls/MMSCF of syn. gas.

Similarly if steam is not added the syn. gas will contain 92.1% of H_2+CO of 1.845 H_2/CO ratio and the anticipated yield must be reduced to $\frac{92.1}{94.2}$ = 97.82 of that predicted (35.42 Bbls/MMSCF FF). Roughly therefore some 3 or 4 percentage points of the discrepancy between anticipated and actual yields of C_3+/MMSCF of syn. gas at Brownsville can be accounted for by differences in the synthesis gas compositions.

Incidentally, it is noted that the Nitrogen plus Argon in the Brownsville gas is consistently less than that predicted. This is because it was assumed in design that the nat. gas would contain 5% N_2 whereas this has been running consistently at 0.3 to 0.5%.

On the above Fig. C we have also shown vertical lines representing the space velocity required per reactor for the present production of syn. gas (abt. 3,000,000 SCFH/Reactor) and that required ultimately for the design rate of 5,000,000 SCFH for each reactor. These values were developed as follows:

Space Velocity:

The design space velocity calculated from the data submitted in the Case 6 design specifications is 2520 V/HR/V. These specs. show a horizontal reactor however and later, if my memory is correct, as changes were made in the design 2200 was consistently referred to as the design space velocity.

In actual practice the bed density has been found to run much higher than the 100#/c.f. predicted in design. It actually is nearer 150 at Brownsville and about 140 at Montebello.

The present reactors can probably accomodate a bed beight of about 17 ft. which, with an average free area between the tubes of 187 sq. ft. amounts to a total catalyst volume of 3180 C.F. or a space velocity with the design rate of 5,000,000 SCFH of Syn. gas of 1570 V/HR/V. At 150#/c.f. catalyst density, this bed height requires about 240 tons of catalyst which is the amount now normally used for a full load.

Although the ultimate goal is to operate at 1600 space velocity the present synthesis gas output with one oxygen plant in service is only 3 million SCF of syn. gas instead of the design value of 5 million. At this actual rate therefore the space velocity required per reactor is about 960 SCF of Gas/Hr/CF of catalyst bed.

Discussion of Fig.C.

It will be noted from Fig. C that there is a long way to go before Brownsville results will equal those of the pilot units and, what is more important, the pilot units have almost as far again to go to reach the desired goal at the ultimately desired space velocity of 1600.

It will be noted also from Fig. C that if a line is drawn thru the best of the Brownsville high space velocity data and extended to zero space velocity the yields would still not be as good as those obtained on the pilot units at 960 space velocity.

Fig. D Space Velocity vs C_3 + Yield for Averaged Data

In plotting the points on Fig. C it was observed that in many runs the yields in the first day's operation were substantially higher than those for succeeding days at the same operating conditions. This effect was obscured in Fig. C because of the random distribution of the points representing succeeding days. Furthermore in nearly all runs the space velocity was increased only after several day's operation (time required to get the second oxygen plant in service). We therefore averaged the data for periods where operating conditions were kept constant leaving the first day's operation separate and obtained the following plot Fig. D. On this plot we have shown besides each point the number of days represented by the point and we have put a ring around each pt. representing the first day.

On this graph the abscissa should have been made longer to permit showing all the points at very high space velocities in Run 17. These however are simply an extension of the graph as can be seen thru reference to the individual plot for Run 17.

This is one of the most important graphs in this report. It correlates well all the recent run data, Runs 11 thru 17, excepting only the first day of Run 16 which covered a 17 1/2 Hr. period but was obviously out of line.

The line thru the Brownsville data shows the combined effect of space velocity and catalyst deactivation. *

*To a certain extent the lower end of the curve, beyond 1000 to 1200 Sp.vel. also may be influenced by total feed inlet temperature but as shown before this temperature actually doesn't change very much (530°F to 415°F) and therefore its effect on this graph should not be pronounced.

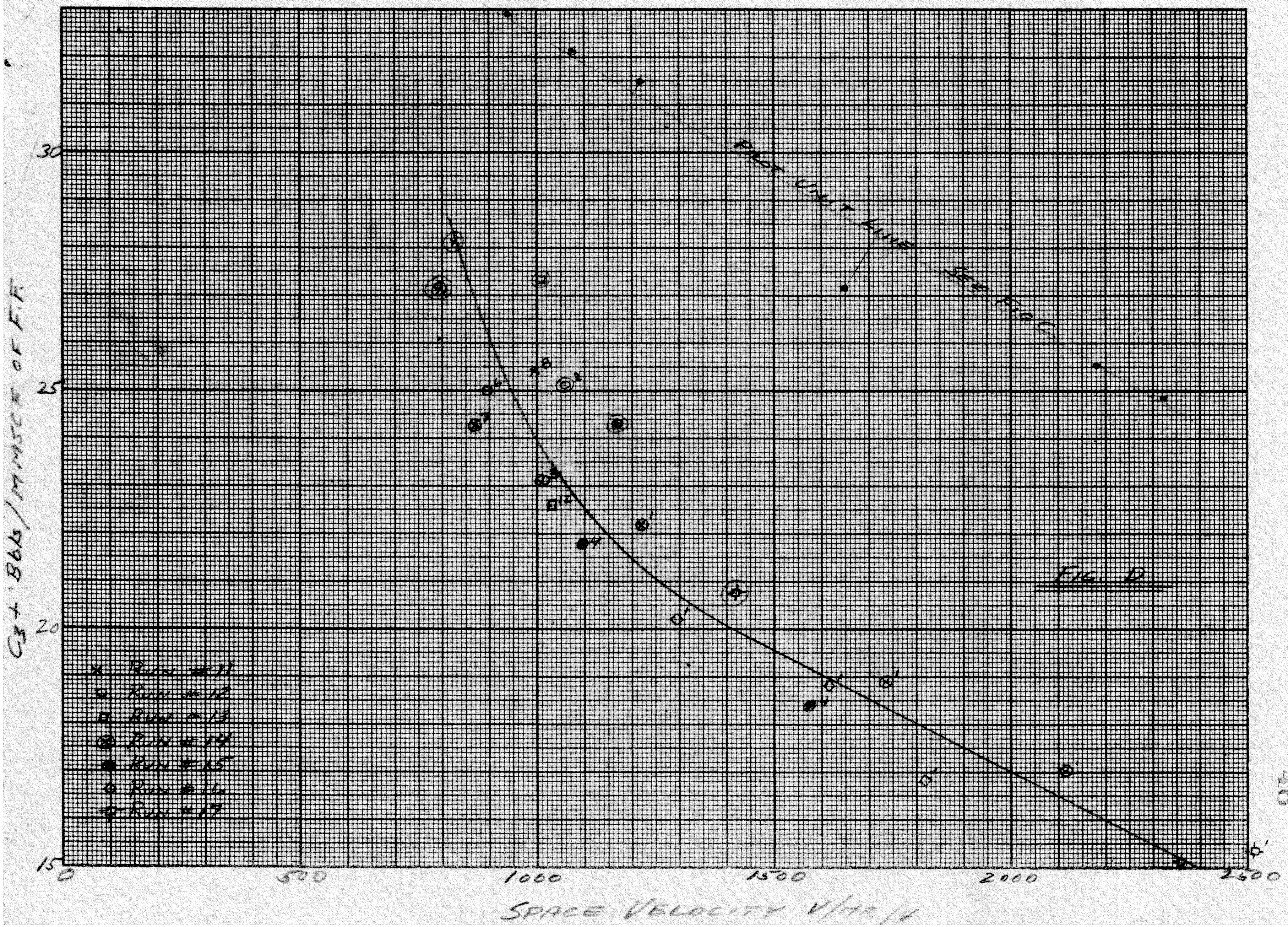

30
25
20
15
0
500
1000
1500
2000
2500
C_3 + Bbls/MMSCF of F.F.
SPACE VELOCITY V/HR/V
PILOT UNIT CURVE SEE FIG. C
× Run #11
⊗ Run #12
□ Run #13
⊛ Run #14
● Run #15
◇ Run #16
✧ Run #17

FIG. D

The pilot unit line on the other hand since it was based on the first few days operation of several different runs (see Table V p. 21 PR 37P) shows the effect predominantly of space velocity alone.

From the relative position of the first day points the Brownsville catalyst deactivates very rapidly at the very beginning of each run. It will be noted also that if the steep portion of the curve were to be extrapolated to, say, the first hour's operation, the yields would very likely be right up there with those obtained at the same space velocity on the pilot units.

Moving down The Brownsville line to the points representing the largest number of days (at about 1000 space velocity) it will be noted that the slope is still very steep until we get to space velocity of about 1200 beyond which the line parallels the true effect of space velocity on the pilot units. This steep intermediate portion of the curve, where most of the data fall, indicates that poisons are entering the system with the gases. A small increase in space velocity increases the rate of poison entering the system so that catalyst activity and yields drop off rapidly. Beyond that, the catalyst is virtually dead anyway and the effect is almost purely one of space velocity alone.

This graph and the previous Fig. C also show that if the initial degree of reduction of the catalyst and catalyst carbiding have any effect at all, the effects are well within the accuracy of the data.

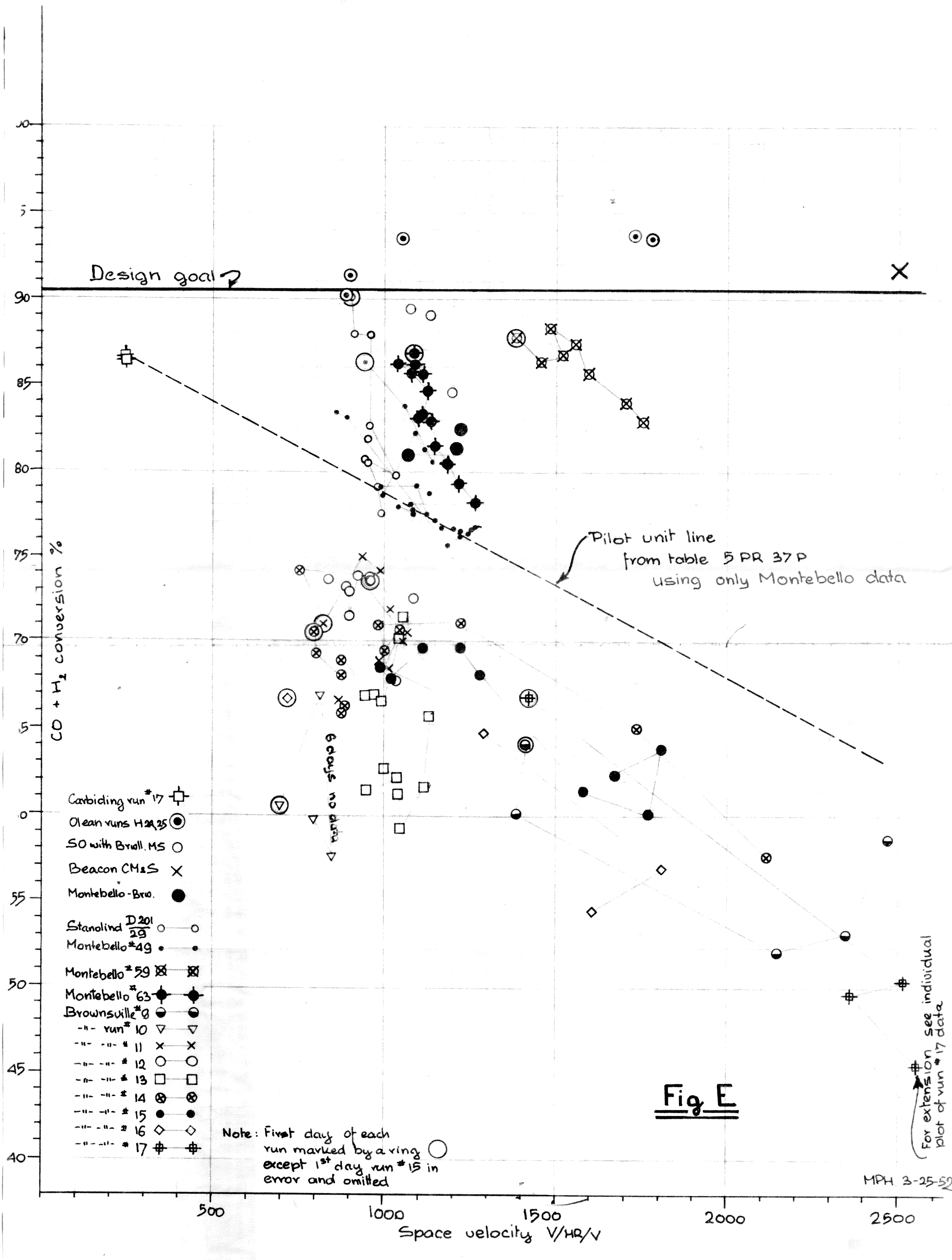
Also since Run 17 made predominantly at very high space velocity because of very low catalyst bed, falls on the curve with other runs of deeper bed where the space velocity was high only because of high thruput instead, Fig. D indicates that at this low level of activity, at least, bed height and therefore probably catalyst contacting efficiency have little to do with the poor conversions, at least not at these low levels of activity.

Fig. E. Space Velocity vs H_2 + CO Conversion:

Fig. E is a plot similar to Fig. C except that H_2+CO conversion is the ordinate instead of the C_3+ yields. This graph like Fig. 1, permits a direct comparison of Brownsville and Pilot Unit data and also shows the H_2+CO conversions obtained at Brownsville at very low space velocity during carbiding operations.

The solid line at 90.4% H_2+CO conversion represents the design goal. It will be noted that the HRI H series runs H-24 & H-25 (⊙) which it will be remembered were made on an 11.5" i.d. reactor with spent CM&S catalyst all fall on or above the goal. The Beacon data (x) with the same catalyst and with Brownsville Mill Scale catalyst also all fall along this line but only one run (7027) was available at low enough space velocity to be shown on this plot. The others were all made at space velocities of 5,000 to 15,000 V/HR/V.

Referring to the Stanolind and Pilot unit data it will be noted that the deactivation with time when using either mill scale ~~on~~ or Allan Wood Catalyst at a given space velocity is quite pronounced though much slower than which takes place at Brownsville as shown in Fig. D above. The deactivation in the Stanolind Run #2D with Allan Wood catalyst (O-O) was somewhat more rapid and more consistent than that obtained with the same catalyst at Montebello.



The Montebello Run #59 (⊠) with spent CM&S catalyst, on the other hand shows a much slower rate of deactivation, if any. A line thru the points for this run is almost parallel to the dotted line showing the effect of space velocity in the Pilot units. This line is the same as that shown on Fig. D above.

It is quite interesting to note that the Brownsville carbiding runs fall exactly on an extrapolation of this space velocity line. This indicates that during carbiding operations when operating with a fresh catalyst and relatively high hydrogen partial pressure The Brownsville Reactor acts just about the same as the Pilot unit reactor. On the other hand it is evident, of course, that this space velocity line does not go thru the best pilot unit results but perhaps represents instead average results with a catalyst that has become somewhat stabilized.

Except for Run #10 and the latter part of Run #13, the plant scale data, at a lower conversion level show about the same effect of space velocity on H_2+CO conversion as does the pilot unit line. As we have seen from Fig. D however this is not the whole story.

Discussion of Figs. 1, 1A & 1B

Figs. 1, 1A & 1B were included at the beginning of the report because they show quite strikingly the differences between Brownsville, pilot unit and laboratory results. They were among the first plots made and all the Brownsville data were included even though we now know that some of these data, notably Runs 5 & 8, are in error. These form the first of a series of graphs where

Brownsville and Pilot unit results are compared with base lines established in the 1947 correlations (EDG Report No.1) from an extremely large number of data obtained at several laboratories.

Since the points are joined in chronological order with rings around the first day of each run, the drift downward to lower H_2 conversion with time is quite evident. It is also clear that the drift on Pilot units is of the same order though slower than that experienced at Brownsville.

With reference to the Pilot unit results it will be noted that the Montebello data fall about where they should with respect to the base lines because the Montebello gas has an H_2/CO ratio of only 1.6 compared to 1.8 for Brownsville and 2.0 for the lab. and the Stanolind Pilot unit runs. This, incidentally, may explain the relatively high selectives for a given H_2+CO conversion consistently reported by Montebello because conversion is always expressed as % of H_2+CO and Montebello has less H_2 to start with.

On the other hand, The Allan Wood catalyst at Montebello apparently results in better selectivity than that obtained with Mill Scale.

It would appear from Figs. 1, 1A & 1B that the problem of raising Brownsville conversions is the same <u>kind</u> of problem as that of raising Pilot unit results to those of the smaller units.

Although a little difficult to see on Fig. 1 & 1A, it will be noted that the drift in activity with time of the spent CM&S catalyst on the Montebello unit was not as great as with Mill Scale.

It was still there however and even with this apparently more stable catalyst periodic reactivations would be required to maintain activity. Such periodic reductions were used on the "1000 Hr. demonstration Run 19-6 with <u>fresh</u> CM&S catalyst at Trenton.

In general it will be observed from Figs. 1, 1A & 1B that all the data, comm'l., pilot unit and lab. fall pretty close to the base lines established in 1947. This is pertinent to succeeding discussions.

<u>H_2 vs CO Conversion - Fig. 2</u>

The following Fig. 2 is a plot of H_2 vs CO Conversion for all the data used in Figs. 1, 1A & 1B except for a few points and Runs 5 & 8 which were discarded above. On this plot the CO Conversions for Run 10 are obviously in error and should be ignored. The nomenclature on this and succeeding plots is the same as in Fig. 1.

The solid lines on this graph are those that were established in the 1947 correlation (EDG Report #1) and the dotted line is an interpolation for Brownsville feed showing where Brownsville data ought to fall.

I strongly believe that this graph is the key to the entire problem. If we can explain why the Brownsville and pilot unit data on Allan Wood and Mill Scale fall below the lines where they should, that is, why the CO disappearance for a given H_2 disappearance is less than it should be, we shall probably have a clear understanding not only of the poor Brownsville yields but also of the reason why the pilot units at Stanolind and Montebello

Do over

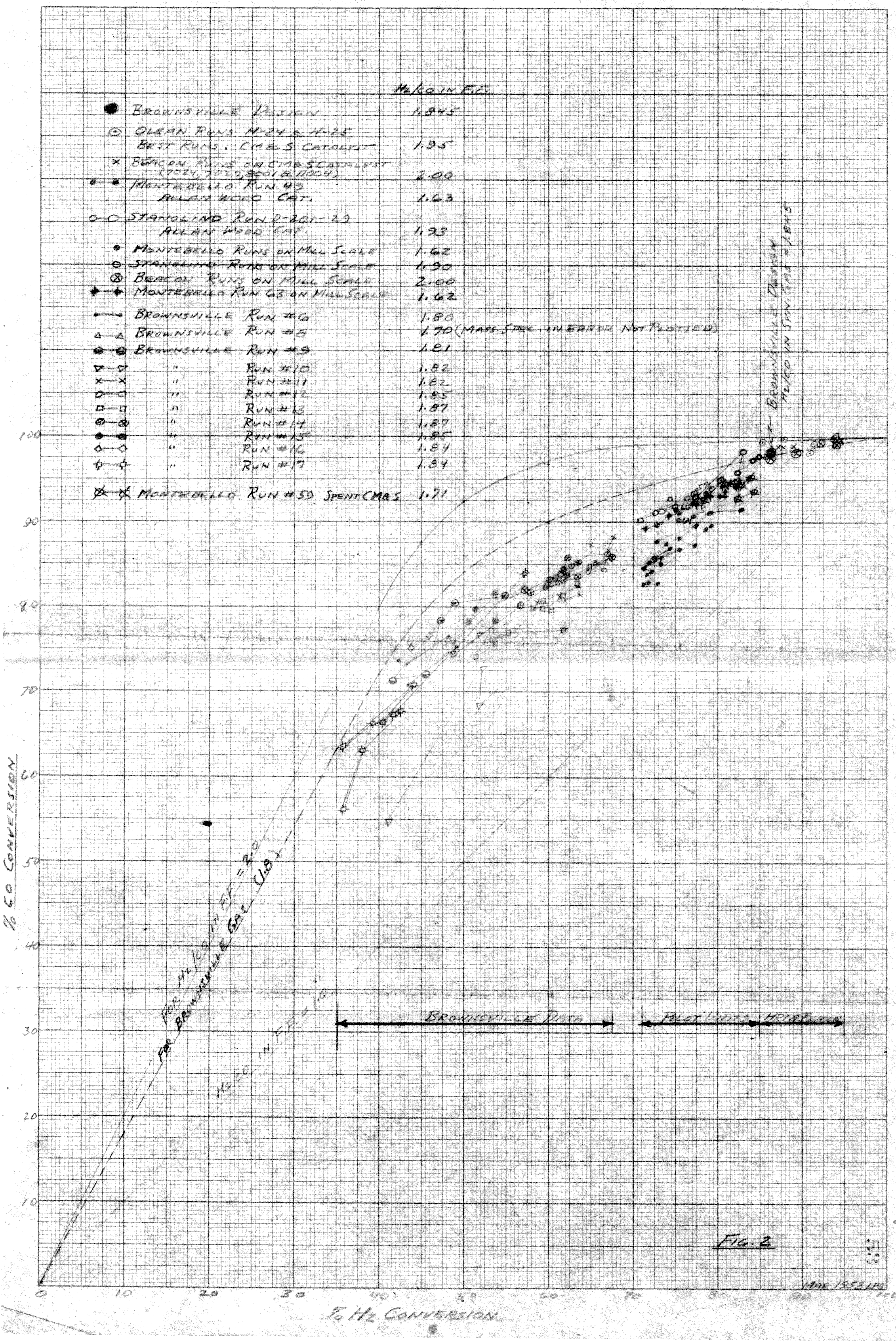

H₂/CO IN F.F.
● BROWNSVILLE DESIGN 1.845
⊙ OLEAN RUNS H-24 & H-25 BEST RUNS. CM&S CATALYST 1.95
× BEACON RUNS ON CM&S CATALYST (7024, 7022, 8001 & 11004) 2.00
•—• MONTEBELLO RUN 49 ALLAN WOOD CAT. 1.63
○—○ STANOLIND RUN D-201-29 ALLAN WOOD CAT. 1.93
• MONTEBELLO RUNS ON MILL SCALE 1.62
⊖ STANOLIND RUNS ON MILL SCALE 1.90
⊗ BEACON RUNS ON MILL SCALE 2.00
◆—◆ MONTEBELLO RUN 63 ON MILL SCALE 1.62
•— BROWNSVILLE RUN #6 1.80
△—△ BROWNSVILLE RUN #8 1.70 (MASS SPEC. IN ERROR NOT PLOTTED)
●—● BROWNSVILLE RUN #9 1.81
▽—▽ " RUN #10 1.82
×—× " RUN #11 1.82
○—○ " RUN #12 1.85
□—□ " RUN #13 1.87
⊗—⊗ " RUN #14 1.87
●—● " RUN #15 1.85
◇—◇ " RUN #16 1.84
" RUN #17 1.84
MONTEBELLO RUN #59 SPENT CM&S 1.71
BROWNSVILLE DESIGN
H₂/CO IN SYN. GAS = 1.845
FOR H₂/CO IN F.F. = 2.0
FOR BROWNSVILLE GAS (1.8)
H₂/CO IN F.F. = 1.0
BROWNSVILLE DATA
PILOT UNITS
HRI BASIS
% CO CONVERSION
% H₂ CONVERSION
0
10
20
30
40
50
60
70
80
90
100
MAR 1952 LPG

FIG. 2

do not check the results obtained on the smaller Beacon units or in the H series runs on CM&S catalyst in the 11 1/2" reactor at Olean. Incidentally, we shall also probably explain the as yet unexplained reason why the HRI 14 and 15 series runs in the 4 1/2" reactor at Olean and the Trenton 19-6 Run also fall below the base lines which were established predominantly by Beacon and HRI H series data in 1947 (see EDG Report #1).

It will be noted that the design point falls on the line. This, plus the fact that Beacon has exceeded the desired H_2 and CO conversions at very high space velocities (up to 15,000) indicates that the goal can be attained.

Before attempting to explain the difficulty, we shall introduce the next plot.

H_2 Conv. vs CO to CO_2 and H_2 to H_2O - Fig. 3

The following Fig. 3 is a plot of all the data, except that previously discarded, showing the relationships between H_2 Conversion and the amount of CO in the fresh feed that went to CO_2 and also the amount of H_2 in the fresh feed that went to H_2O.

The solid lines in the CO_2 plot are, as before, those which were established in our correlation of 1947. The corresponding lines in the H_2O plot are shown dotted because they not only correlated the data well in 1947 but they are actually calculated by oxygen balance assuming that the solid lines in the CO_2 plot on Fig. 3 and the solid lines in H_2 vs CO plot on Fig. 2 are correct. The fact that the 1947 data fell on these calculated lines is therefore a check on the validity of the lines of CO Conv. and CO to CO_2 which were established by the data

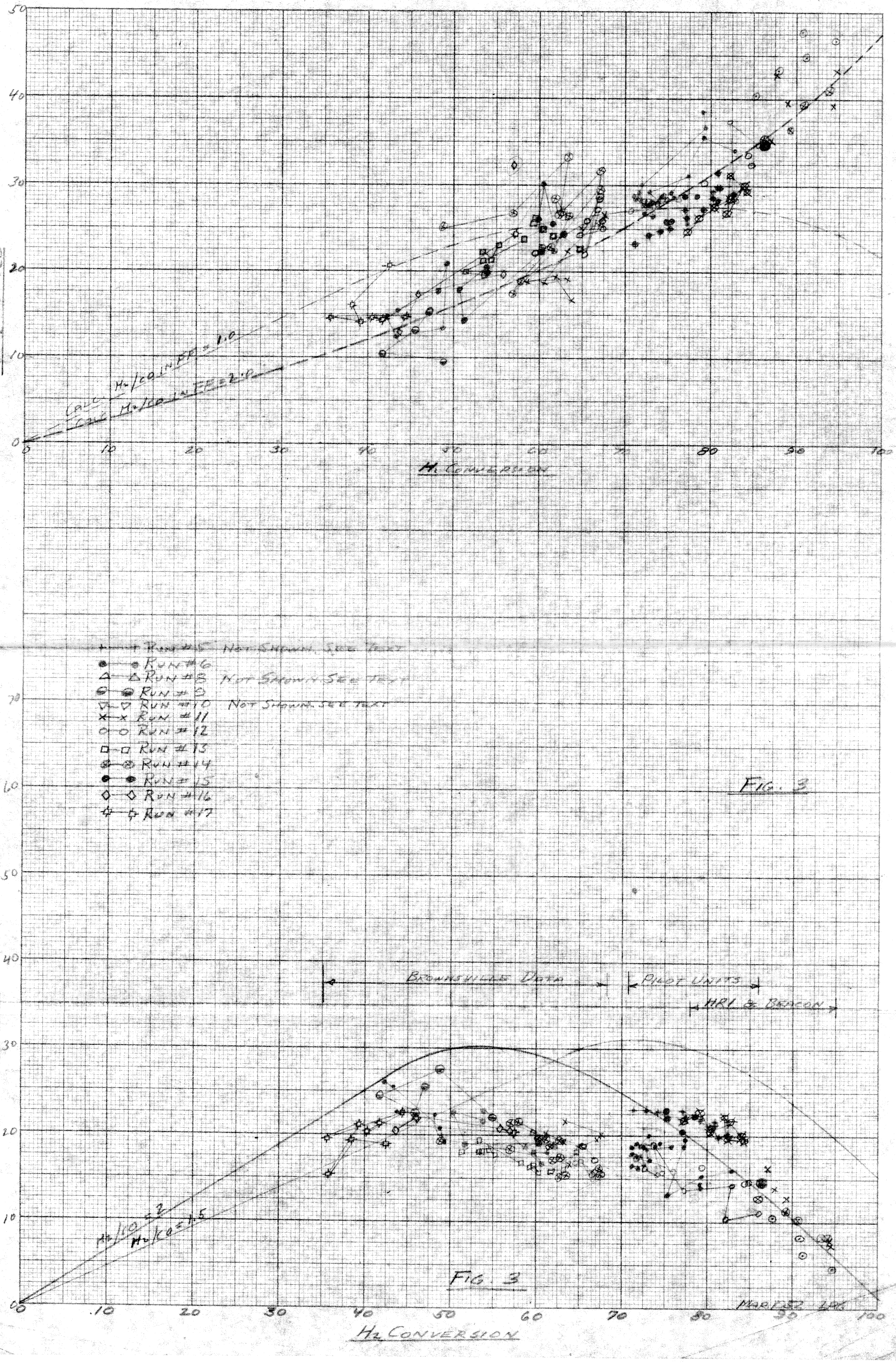

% H_2 TO H_2O
H_2 CONVERSION
CALC. H_2/CO in FF = 1.0
CALC. H_2/CO in FF = 2.0
0
10
20
30
40
50
60
70
80
90
100
Run #5 Not Shown, See Text
Run #6
Run #8 Not Shown See Text
Run #9
Run #10 Not Shown, See Text
Run #11
Run #12
Run #13
Run #14
Run #15
Run #16
Run #17
% CO TO CO_2
BROWNSVILLE DATA
PILOT UNITS
HRI & BEACON
H_2/CO = 2
H_2/CO = 1.5
MAR/52 LHK

FIG. 3

FIG. 3

themselves.

The fact that the present data falls on this same H_2O line while it falls below the CO_2 line in Fig. 3 and the CO line in Fig. 2 shows that the speed of the water gas shift reaction with respect to that of the Fischer-Tropsch reaction is less at Brownsville, Montebello and Stanolind on Mill Scale than it was in the HRI H-Series reactor and in Beacon's runs on CM&S catalyst which runs formed the basis predominantly for the 1947 correlation.

Mill Scale may have exactly the same effect on the Beacon reactors but there, where conversions are so high, the effect is too small to detect.

Discussion

As discussed extensively in the correlation report of 1947, the water gas shift and the Fischer-Tropsch reaction go on simultaneously both using up CO as the reactants proceed up the reactor thus:

1) $2H_2 + CO \longrightarrow (=CH_2) + H_2O$ Fischer-Tropsch

2) $CO + H_2O \longrightarrow H_2 + CO_2$ Water-Gas Shift

Since the feed to the reactor, total feed in this case, is relatively dry it is far removed from equilibrium and should proceed quite rapidly as soon as water is made by the Fischer-Tropsch reaction. Normally as these two reactions proceed simultaneously the CO disappears rapidly, part of it going quickly to CO_2 until the concentration of CO_2 has been built up and the CO concentration reduced to the point where the water gas shift reverses thereby converting the CO_2 back to CO by reaction with the remaining H_2 thus:

$$CO + H_2O \longleftarrow H_2 + CO_2$$

This reversal of the water gas shift is of course what accounts for the humped shape of the CO_2 base line in Fig. 3. When the shift reaction is occurring at normal speed this reversal <u>must</u> take place if one wishes to exceed an H_2 conversion of 50 to 60% (for H_2/CO ratio feed of 2) otherwise the reactions would stop simply because practically all the CO has been used up. If the water gas shift is slow however and doesn't use up the CO so rapidly, the H_2 conversion can exceed this figure of 50 to 60% materially but never can it get up to the level of conversion we want, of the water gas shift is occurring at all, because the water gas shift inevitabl~~e~~y uses up part of the CO and if it is too slow to reach a point of reversal it never gives the CO back.

The 1947 Correlation shows that about 30% of the CO is initially consumed by the water gas shift before it~~'~~s reversal occurs. At that time most of the rest of the CO has been consumed simultaneously by the F-T reaction.

Consider for example the case for 50% H_2 conversion. From the base lines for 2/1 gas we get the following:

H_2 Conv.	50%
CO Conv.	92.5%
CO to CH_2	42%
CO to CO_2	30%
H_2 to H_2O	16%

The equations can be written as follows:

W-G Shift $30\ CO + 30\ H_2O$ —— $30\ H_2 + 30\ CO_2$

F-T $70\ CO + 200\ H_2$ —— $42\ CH_2 + 8.5\ CO + 70\ H_2$

$+ 62\ H_2O + 19.5\ CH_{2.66}$ *

Overall $100\ CO + 200\ H_2$ —— $42\ CH_2 + 70\ CO_2 + 32\ H_2O + 100 H_2$

$+ 8.5\ CO + 19.5\ CH_{2.66}$

The water gas shift ratio at this point is $\frac{(H_2)\ (CO_2)}{(H_2O)\ (CO)} = 11$ and shortly thereafter the water gas shift starts reversing to convert CO_2 back to CO.

If on the other hand an average line is drawn thru the Brownsville data on Figs. 1, 2 & 3 however the same approach shows that at 50% H_2 conversion the amount of CO used up by the water gas shift is only 22.5% of the total, some 25% less than normal, thus:

For Brownsville data H_2/CO in FF = 1.84

H_2 Conv. = 50%

CO Conv. = 77.5%

CO to CO_2 = 22.5

CO to CH_2 = 42

H_2 to H_2O = 17.5

$184\ H_2 + 100\ CO = 92\ H_2 + 42\ CH_2 + 22.5\ CO + 22.5\ CO_2$

$+ 32.2\ H_2O + 13\ CH_{3.5}^{*}$

Water Gas Shift ratio = $\frac{(92)\ (22.5)}{(22.5)\ (72.2} = 2.9$

*Found by C & H Balance

Precisely the same effect is evident at 80% H_2 conversion level from a similar comparison of the 1947 correlation base lines and an average line thru the pilot unit data on Mill Scale. It is suspected that the same <u>kind</u> of thing is true also in the Beacon Runs with Mill Scale but in this case, at the high levels of conversion attained, the differences are too small to notice.

This characteristic of Mill Scale catalyst (slow water-gas shift) and it's relationship to the fact that lower conversions are obtained at Brownsville than on Pilot units could stand some further thought and development. It is felt however that the facts are already sufficiently developed to permit drawing conclusions and therefore, in the interest of getting this report out, indulgence in further discussion will be left until later.

Conclusions

It is concluded that Mill Scale is not a good Fischer-Tropsch catalyst. It changes activity up or down very rapidly depending upon the composition of the gases surrounding it and in addition it does not promote the water-gas shift as much as it should. A freshly reduced Mill Scale catalyst gives excellent results in the Beacon reactors where pure H_2 and CO and stable conditions are used, and altho there is even there a slight deactivation with time aggravated by the fact that the composition of the recycle gas is gradually changing, the catalyst appears quite stable.

On the pilot units, on the other hand, the synthesis gas is not so pure (it contains CO_2, CH_4 and some H_2O) the bed conditions are not as stable and as time goes on the catalyst continuously readjusts itself to the surrounding gases chemically and in effectiveness and deactivates much more rapidly than on the purer laboratory units. This again is aggravated by recycling and constantly changing recycle composition. This change occurs even though in the very beginning, say in the first hour, of the pilot unit runs the catalyst activity and results obtained are fully as good as those obtained under more ideal conditions on the laboratory units.

The same thing happens in the plant but to a greater extent. There operating conditions are still more unstable and the situation is apparently further aggravated by the fact that the gases contain poisons as well as the CO_2, CH_4 and H_2O also found in the pilot unit.*

The stability of the operating conditions is quite important. In the F-T reaction there tries to be a dynamic

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* Poisons may come from the salt water used to wash the fresh feed, acid water used to wash the recycle or highly chlorinated city water used as trim on both.

equilibrium between the solid and gaseous phases. In recycling operations any momentary change in operating conditions and therefore conversions causes a change in recycle composition which in turn affects the solid phase and its activity thereby upsetting the equilibrium to create a vicious circle.

It appears therefore that the low conversions at Brownsville are caused by exactly the same factors that prevent the pilot units from maintaining continuously the same results as obtained on the laboratory units which are operating under more nearly perfect conditions.

Since Mill Scale catalyst deactivates rapidly when certain changes occur in its surrounding atmosphere it, conversely, reactivates rapidly when the atmosphereis favorable. That explains why a catalyst sample drawn from the Brownsville reactor at say 12 or 96 hrs. operation and which was giving poor results at Brownsville gave almost immediately good results under Beacon's condition.

The difference in results obtained at Beacon on the samples drawn from the Brownsville reactor at the 0, 12 & 96th hr. of Run #11 are quite significant in this respect. In spite of widely different chemical compositions the results obtained at Beacon on the three samples were all very high. The small differences obtained at Beacon were probably due to permanent poisoning which had occurred in even that very short period.

The X-Ray analyses of these three samples together with the relative yields were as follows. They are compared with the Brownsville, Pilot unit and other laboratory data on Fig. 1.

Age of Catalyst Hrs.	0	12	96
Beacon Run #	11143	11146	11144
Analysis			
% Fe	100	25	-
% Carbide	-	60	75
% Oxide	-	15	25
C_3+ Yields gms/cm	152.4	142.0	141.0

The solution to the problem is to use a catalyst which resist changes effected by the surrounding atmosphere. The fused catalysts such as spent CM&S catalyst are apparently much more stable in this respect. Even these however will show a drift in activity with time especially at Brownsville and a method must be developed to periodically reactivate the catalyst in place. Permanent poisons, whatever they may be, will have to be identified and removed from the fresh feed and recycle gases.

It might be argued that the Mill Scale activity could be maintained by periodic reactivation. This is probably true but with this catalyst reactivations would probably be required every 4 hrs. or so.

Another hypothetical solution to the problem is to build 600 - 11.5" I.D. units like Montebello but even then Mill Scale catalyst would probably have to be reactivated every 2 days or so.

Effect of Operating Variables

The effect of changes in operating conditions and physical features of the reactor will be insignificant compared to the effect of the catalyst discussed above. This is true at present low conversion levels but when higher levels are being attained the choice of operating conditions may become quite important. It seems quite reasonable to expect that best results will be obtained with a full bed of well reduced catalyst. There is also a little evidence that fine catalyst is better than coarse. There is also some evidence that both the fresh feed and recycle streams should be preheated to full reaction temperature. Whether this and an additional reactor, to permit operating at lower space velocity, will be required when a good intermittently reactivated catalyst is used remains to be seen.

Recommendations

The following recommendations are made:

1. After Beacon, Montebello and others involved have reviewed this report we should get together and agree upon a single concerted position and be ready to work toward a common goal.

2. Perhaps we should consult with experts on Fischer-Tropsch mechanism and catalysts such as Craxford and Herrington.

3. Once having agreed upon a goal a series of experiments should be layed out for Beacon, Montebello and Brownsville to:

A. Confirm these conclusions.

B. Learn how to manufacture a good catalyst.

C. Learn how to keep it active by in situ reactivation.

The program of experimentation should be layed out in conference but the following are a few suggestions for consideration.

1. Beacon should learn to operate its reactor with diluted catalyst or at higher space velocities so that it can deliberately produce a lower level of conversion where differences in catalysts should show up.

2. Montebello should continue working, first with Mill Scale and then with spent CM&S catalyst and should try to develop a procedure to periodically reactivate the catalyst. Montebello should also set up fused catalyst manufacturing conditions and with Beacon's small unit assistance learn how to manufacture a good stable catalyst commercially.

3. Montebello should try poisoning its gas with salt water, acid water and highly chlorinated drinking water washes as at Brownsville to see if these, and which of them are really responsible for permanent poisons if any.

In the meantime Brownsville should also be conducting a series of experiments, to confirm the conclusions reached here, as follows:

1. A small reactor should be set up at once to operate in parallel with the commercial unit. Runs should be made first with their catalyst, fresh feed and recycle gas. The results of this run should be compared with another made with the same catalyst but with synthesis gas from the small hydrogen generator (K-303) which has been washed with only fresh water. Runs should also be made with fresh & spent Brownsville catalysts, methods of in situ reactivation should be tried etc.

2. It is also suggested that Brownsville try running once thru (no recycling) with a fresh catalyst to see by difference if the acid water used in the effluent gas scrubber (recycle) is responsible for poisons.

3. They should also make a similar test run (test run meaning changing only one thing at a time) using once the operation with a closed water cooling system on the synthesis gas wash tower.

Acknowledgement

I wish to thank the plant for the excellent cooperation I received in this study and particularly do I gratefully acknowledge the help of Mr. M. P. Hnilicka who was assigned to work with me thruout my stay in Brownsville.

Report by: L. P. Gaucher
L. P. GAUCHER

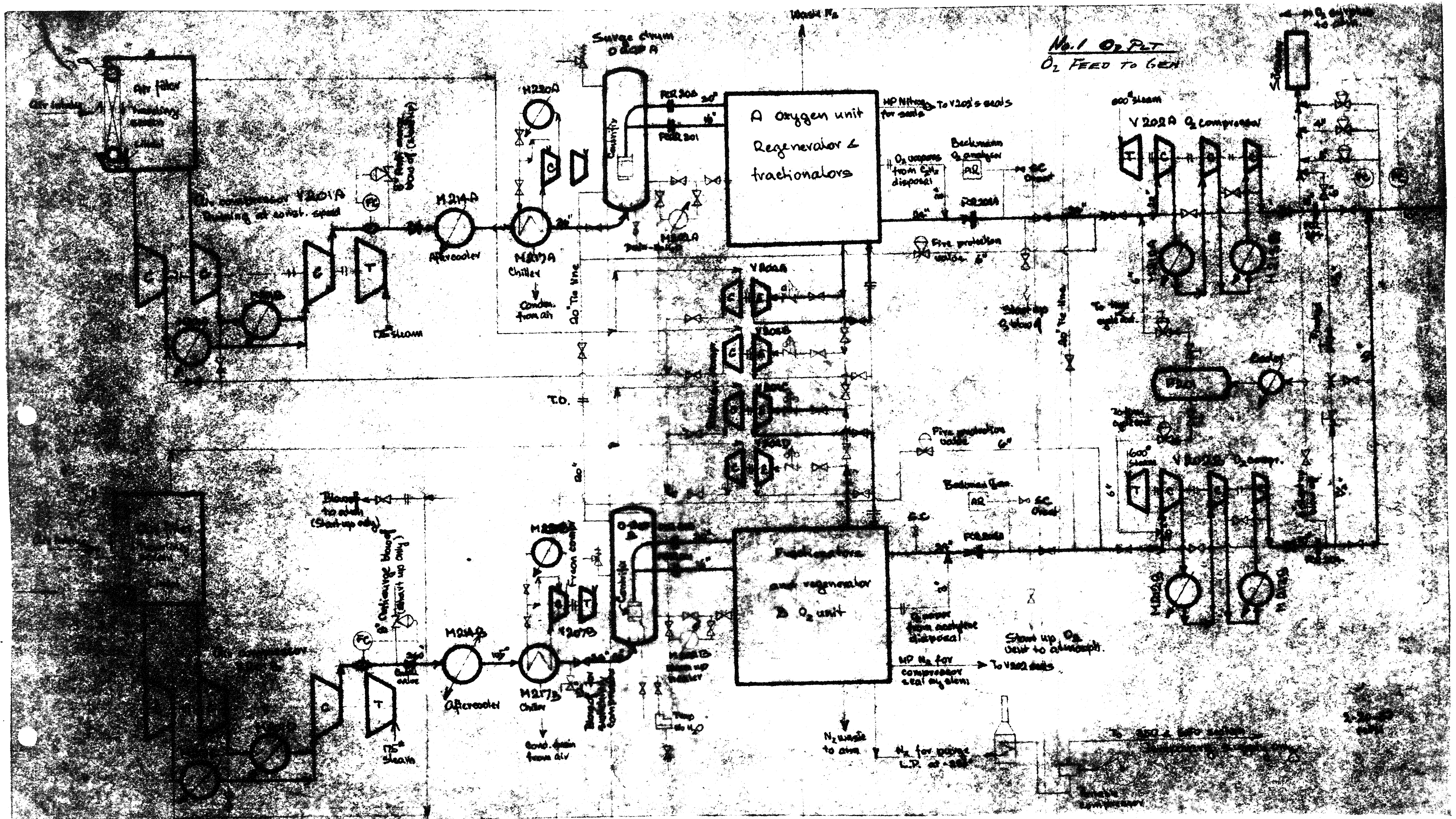
LPG-(MF-MI-ML-JR)

MH-FHH-RP-(DWC-REN)-TAM-
CEL-CEM-dBE

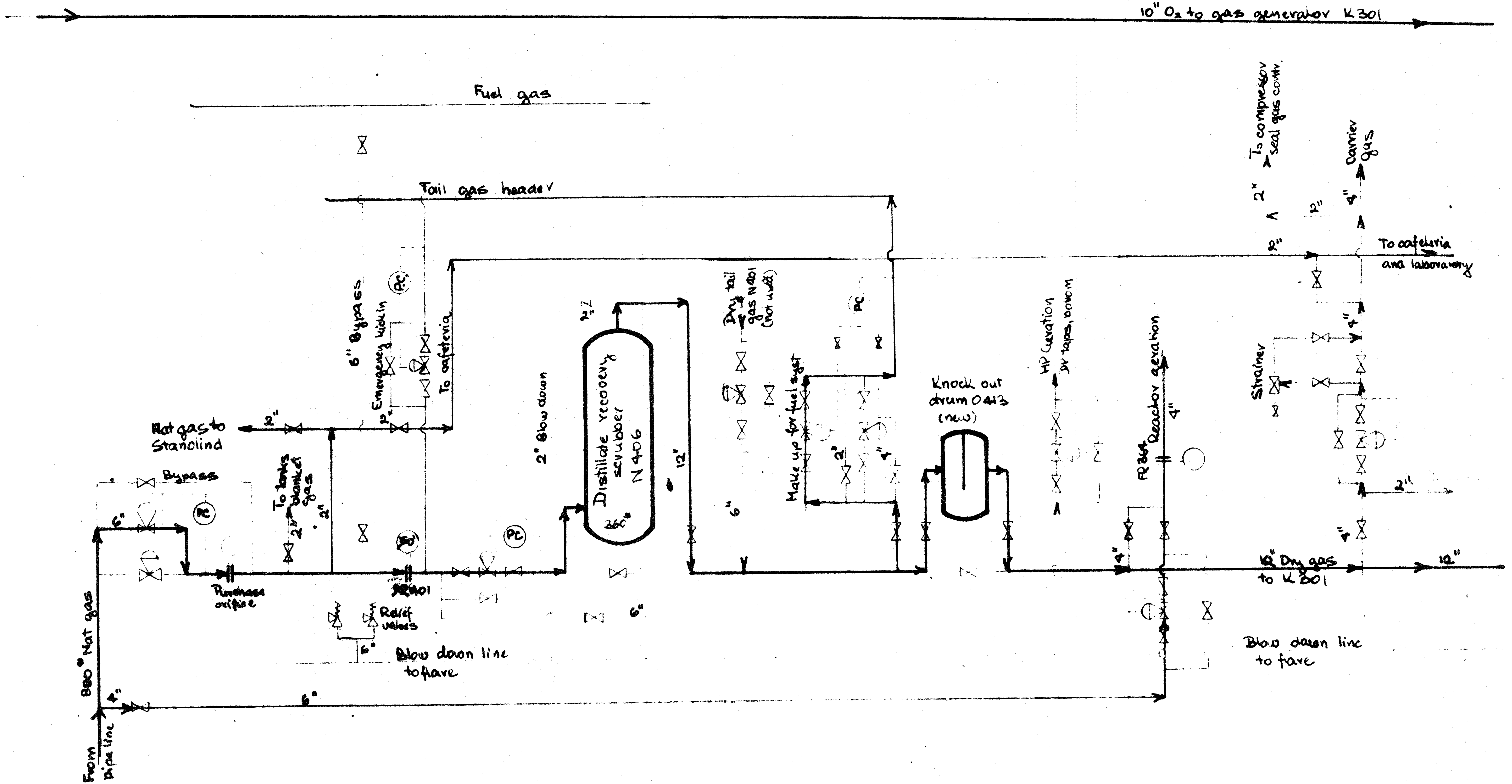
WMS-KGM

FMDawson(2), RHAitken(2) from LCKjr

APPENDIX

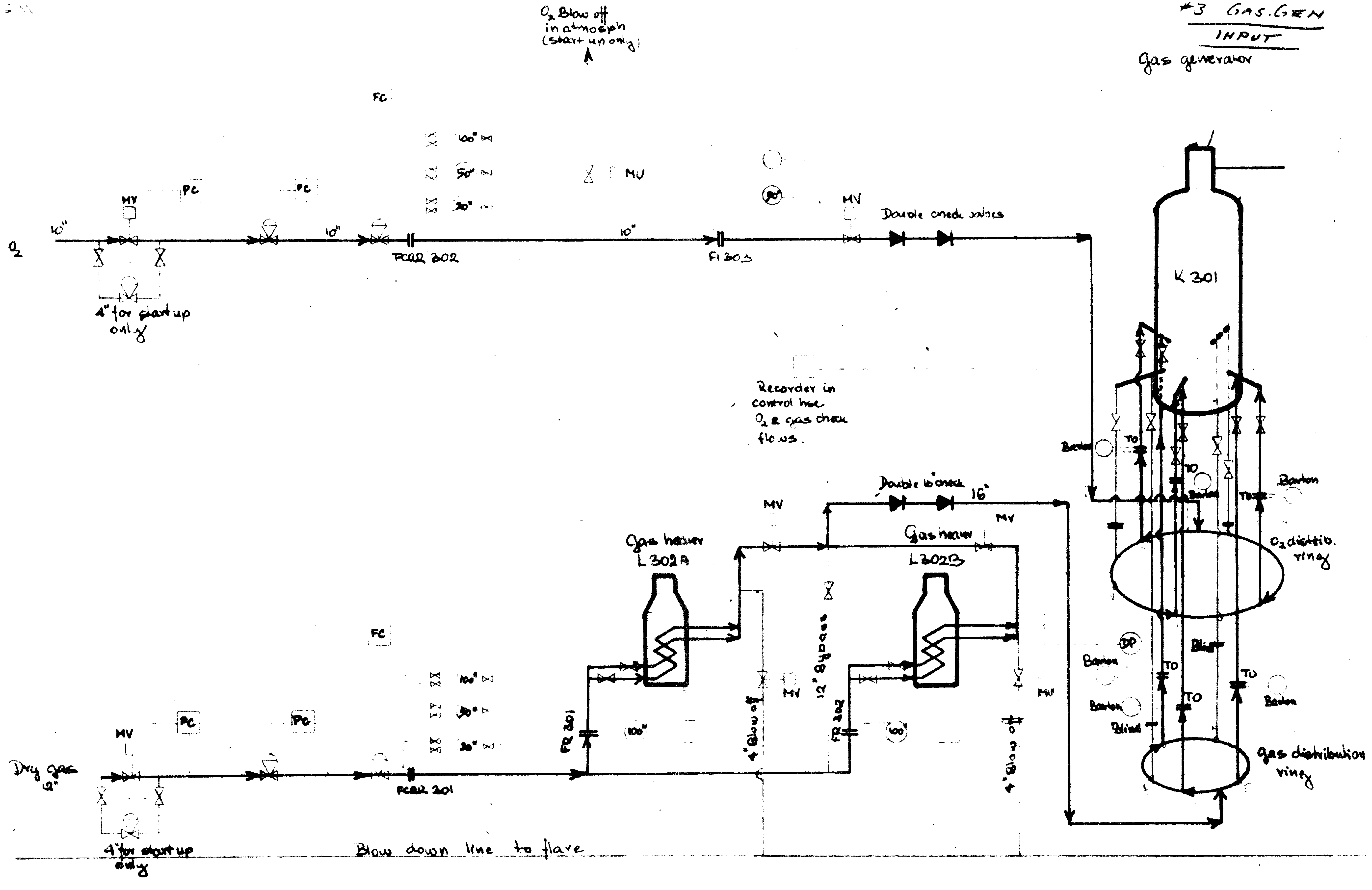

No.1 O2 PLT
O_2 FEED TO GEN

#2 Nat. Gas
Feed to Gen.



#3 GAS.GEN
INPUT

Gas generator



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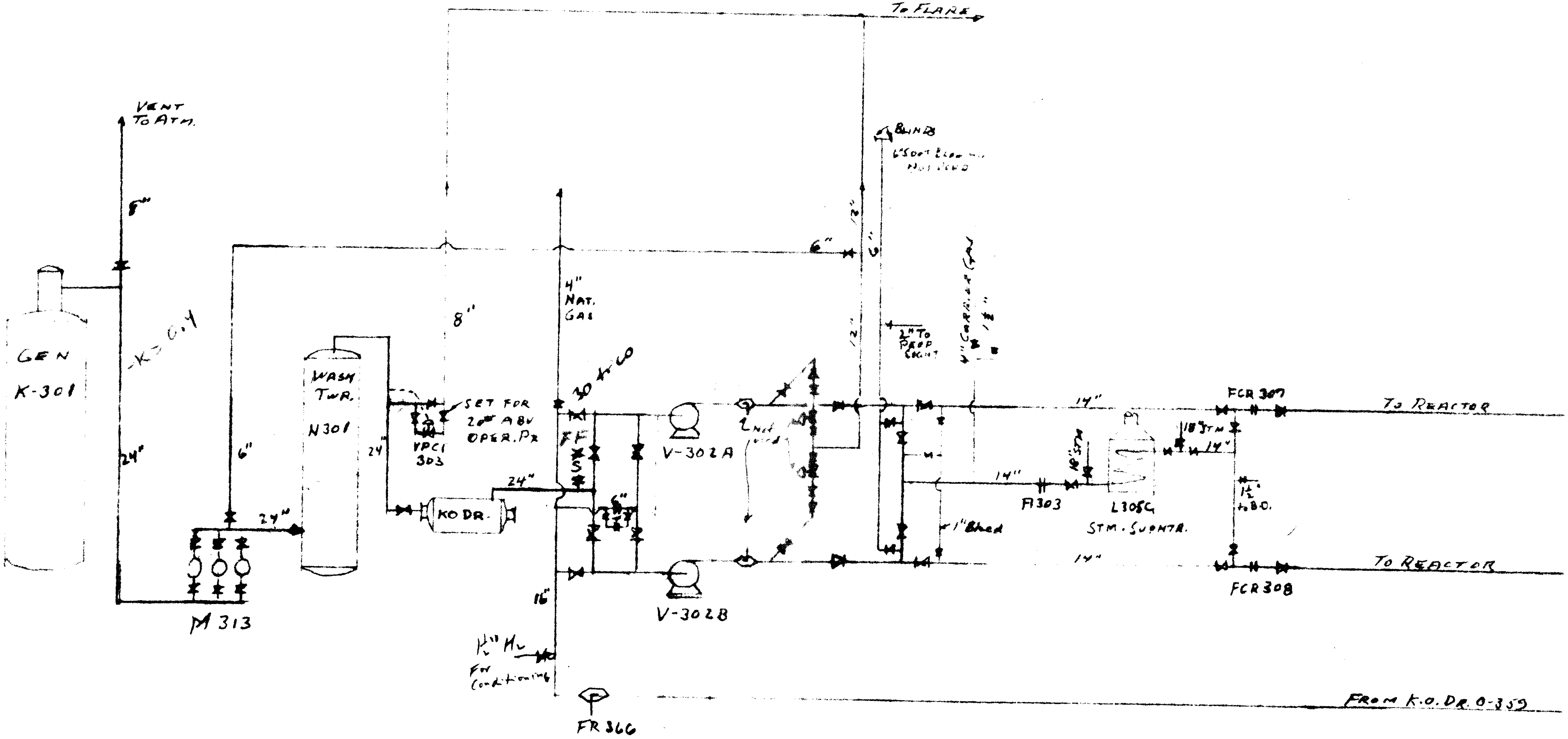
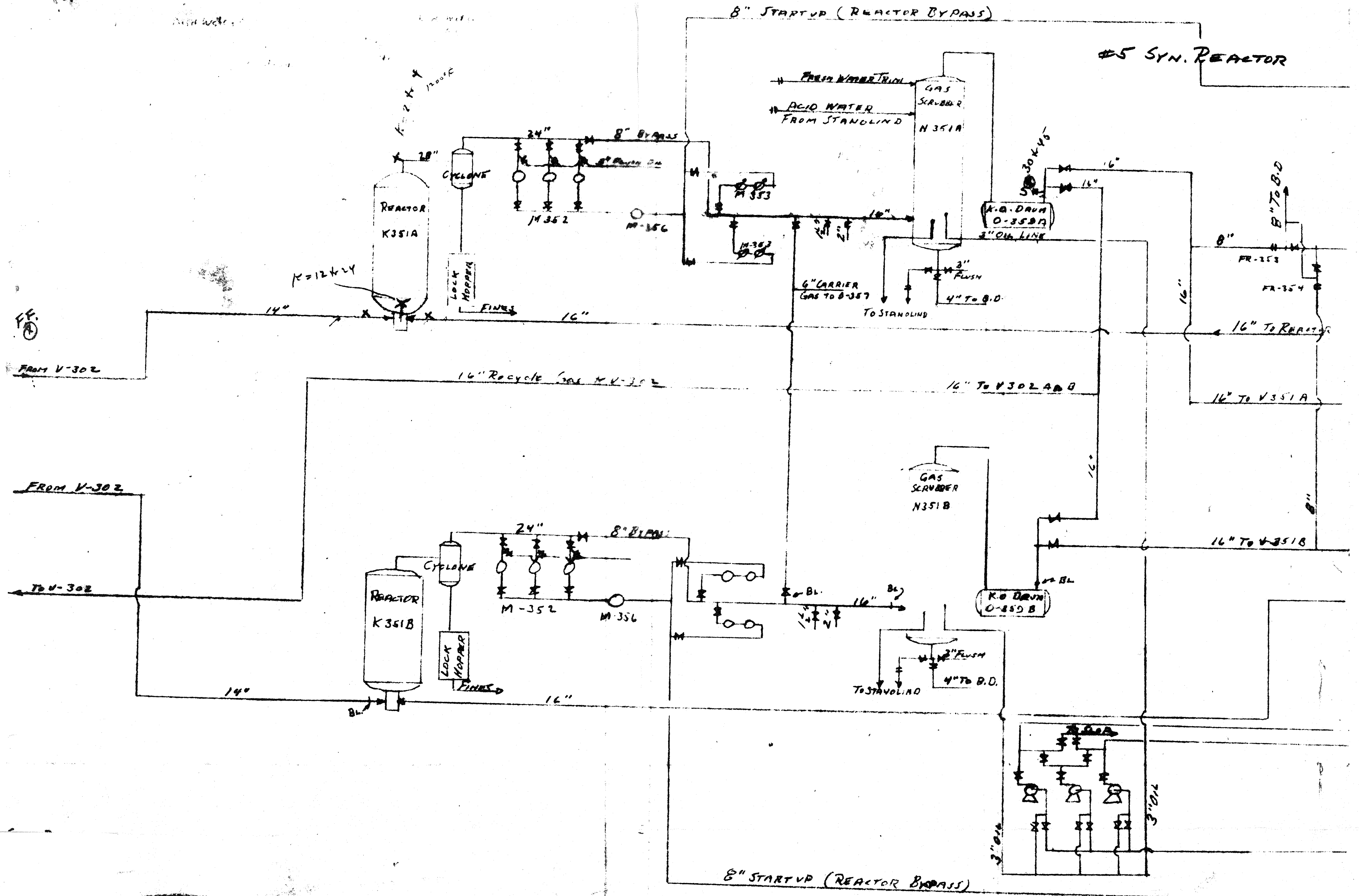



#5 SYN. REACTOR
8" STARTUP (REACTOR BYPASS)
FRESH WATER TRIM
ACID WATER FROM STANOLIND
GAS SCRUBBER N 351A
30 x 45'
16"
16"
K.O. DRUM O-359A
3" OIL LINE
8" TO B.D
8"
FR-353
FR-354
16" TO REACTOR
16" TO V302 A&B
16" TO V351 A
K=2 x 4
1200°F
20"
CYCLONE
REACTOR K351A
24"
8" BYPASS
M 352
M-356
M 353
M-363
16"
2"
10"
6" CARRIER GAS TO D-357
3" FLUSH
4" TO B.D.
TO STANOLIND
K=12 x 24
LOCK HOPPER
FINES
14"
16"
FROM V-302
16" Recycle Gas to V-302
FROM V-302
TO V-302
GAS SCRUBBER N351B
16"
8"
16" TO V-351B
24"
8" BYPASS
CYCLONE
REACTOR K351B
M-352
M-356
BL.
16"
BL
1 1/2"
2"
K.O. DRUM O-359 B
BL.
3" FLUSH
4" TO B.D.
TO STANOLIND
LOCK HOPPER
FINES
14"
16"
BL.
3" OIL
3" OIL
8" STARTUP (REACTOR BYPASS)

#6 SYN. REACTOR RECYCLE

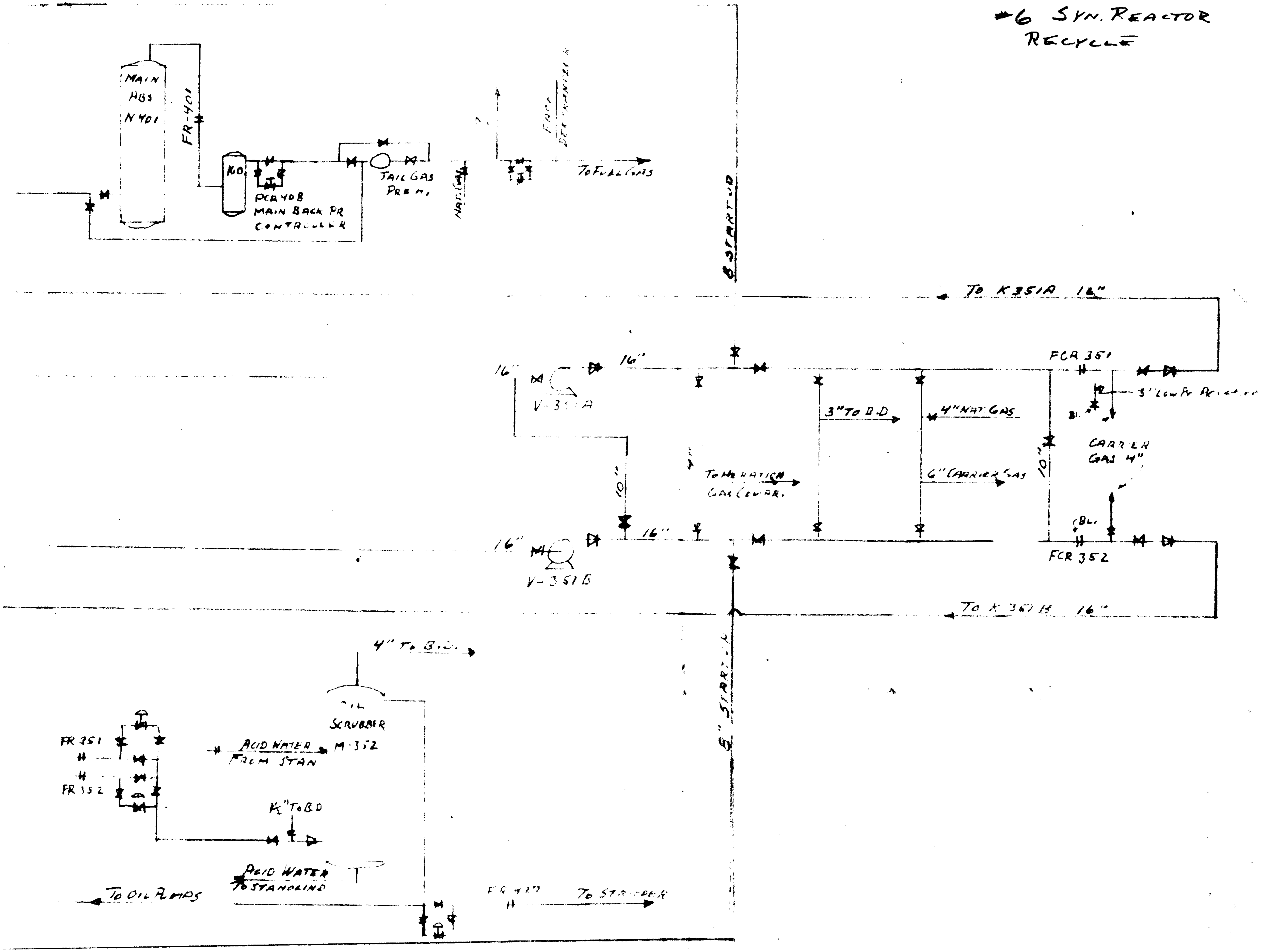


TABLE I

TABULATION OF DATA USED IN H_2 CONVERSION CORRELATIONS

Montebello Run #63 Brownsville Mill Scale Cat.	FF H_2/CO	CO Conv. %	H_2 Conv. %	Mols CO_2 Made	CO to CO2	$\frac{(H_2)(CO_2)}{(CO)(H_2O)}$	Tot. C_{3+} lbs./hr.	CH_2 Mols/Hr.	Mols CO Fed	CO to C_{3+}	R/FF	CO + H_2 Conv.	Mols CH_4 Make	CO to CH_4	Net H_2O Make MPH	H_2 MPH in Feed	H_2 to H_2O	Space Velocity	Reactor inlet °F.
A	1.56	34.36	80.95	3.220	21.2	12.84	130.89	9.35	15.213	61.5	0.99	86.19	1.114	7.32	7.471	23.751	31.45	1039	415
B	1.63	94.15	80.30	3.250	21.2	12.65	131.92	9.42	15.343	61.4	0.98	85.55	1.275	8.30	7.325	25.065	29.22	1079	414
C	1.60	94.56	80.85	3.238	21.1	13.11	136.50	9.75	15.338	63.6	0.96	86.13	0.944	6.15	7.316	24.512	29.84	1085	412
D	1.63	94.47	81.11	3.074	19.8	12.25	137.02	9.79	15.511	63.1	0.97	86.20	1.437	9.25	7.506	25.224	29.75	1096	415
E	1.66	94.13	82.28	3.075	20.1	11.38	135.37	9.67	15.284	63.3	0.96	86.73	1.177	7.70	7.410	25.397	29.17	1084	414
F	1.62	93.71	80.87	3.369	21.5	11.58	131.58	9.40	15.639	60.1	0.96	85.76	1.249	7.98	7.248	25.413	28.52	1095	413
G	1.62	93.33	80.76	3.324	21.1	10.88	134.65	9.62	15.777	61.0	0.95	85.55	1.265	8.01	7.255	25.621	28.31	1114	416
H	1.62	93.53	80.27	3.375	21.5	11.58	129.66	9.26	15.684	59.0	0.96	85.33	1.310	8.35	7.283	25.438	28.63	1102	415
I	1.62	93.27	79.14	3.485	21.9	11.98	133.96	9.57	15.891	60.2	0.95	84.51	1.259	7.92	6.984	25.674	27.20	1126	412
J	1.58	92.42	77.16	3.623	22.8	11.78	122.98	8.78	15.878	55.3	0.98	83.07	1.328	8.36	6.883	25.096	27.42	1112	409
K	1.68	92.16	77.33	3.413	22.1	11.60	123.85	8.84	15.432	57.3	0.99	82.86	1.315	8.52	6.807	25.943	26.23	1133	409
L	1.63	91.07	75.28	3.519	22.3	11.05	124.92	8.92	15.763	56.6	0.99	81.28	1.326	8.41	6.491	25.701	25.25	1149	408
M	1.64	90.81	74.03	3.618	22.9	11.93	122.06	8.72	15.813	55.1	1.00	80.39	1.259	7.96	6.448	25.915	24.88	1187	406
N	1.61	89.58	72.63	3.620	22.8	10.76	120.64	8.62	15.892	54.2	0.99	79.11	1.301	8.18	6.229	25.656	24.27	1218	404
O	1.64	89.46	71.22	3.637	22.9	11.41	122.20	8.73	15.856	55.1	0.99	78.13	1.279	8.06	6.080	26.018	23.36	1265	402
MISC. LAB. & PILOT UNIT DATA FROM EASTMAN'S TULSA REPORT																			
Beacon 11140	2.0	98.60	90.66	0.897	10.22	23.31	87.29	6.23	8.775	71.0	2.0	93.31	0.838	9.54	6.895	17.575	39.23	9120	-
Stanolind																			
D-201-42 3/5	1.97	97.94	84.97	0.652	14.61	20.33	44.68	3.19	4.462	71.5	1.0	89.34	0.446	10.0	2.850	8.791	32.41	1072	-
D-201-45 3/5	1.85	93.85	79.21	0.753	16.41	9.07	39.37	2.81	4.586	61.3	1.0	84.35	0.496	10.8	2.564	8.471	30.26	1195	-
D-201-46 3/5	1.84	97.23	84.45	0.655	14.49	15.55	43.98	3.14	4.520	69.5	1.0	88.94	0.440	9.73	2.796	8.332	33.55	1137	-
Montebello																			
57 F/O	1.57	93.75	78.57	2.850	22.47	13.37	102.87	7.35	12.678	58.0	0.98	84.47	1.023	8.06	5.712	19.925	28.66	1119	-
64 F/P	1.62	90.26	75.44	3.403	22.32	10.85	119.32	8.52	15.240	55.9	1.06	81.10	1.166	7.65	6.402	24.645	25.97	1138	-
65 F/N	1.62	90.87	77.00	3.114	20.49	9.18	120.97	8.64	15.194	56.9	1.05	82.31	1.216	8.00	7.108	24.537	28.96	1218	-
66 F/O	1.63	91.15	75.03	3.430	22.88	11.82	117.28	8.38	14.985	55.9	1.00	81.17	1.262	8.42	6.294	24.358	25.83	1210	-
MONTEBELLO RUN #59 (SPENT CM&S)																			
A	1.65	93.71	84.10	3.175	19.51	-	150.6	10.76	16.267	66.14	0.87	87.73	1.444	8.87	7.893	26.810	29.44	1383	140
B	1.65	92.74	82.32	3.271	19.95	7.72	142.21	10.16	16.394	61.97	0.88	86.25	1.137	6.93	8.470	27.128	31.22	1463	146
C	1.66	94.53	81.90	3.587	22.01	12.80	143.97	10.28	16.293	63.09	0.85	86.65	1.258	7.72	7.558	27.070	27.92	1517	153
D	1.65	95.29	83.81	3.264	19.99	12.19	155.63	11.12	16.327	68.11	0.84	88.14	1.168	7.15	8.079	26.975	29.94	1488	155
E	1.72	95.58	82.38	3.504	21.73	15.46	145.05	10.36	16.125	64.25	0.85	87.23	1.229	7.62	7.940	27.748	28.61	1565	155
F	1.77	94.57	80.48	3.343	20.89	13.63	145.10	10.36	15.996	64.76	0.87	85.56	1.210	7.56	7.841	28.385	27.62	1596	152
G	1.77	93.19	78.60	3.562	22.26	12.77	134.67	9.62	15.999	60.12	0.87	83.86	1.201	7.50	7.491	28.384	26.39	1705	152
H	1.82	92.59	77.31	3.423	21.83	13.16	138.35	9.88	15.677	63.02	0.87	82.74	1.238	7.89	7.005	28.459	24.61	1761	156

--Note Trend --

MONTEBELLO RUN 49 ALLAN WOOD CAT.	FF H_2/CO	CO Conv. %	Space Vel.	H_2 Conv. %	CO to CO_2	$\frac{(H_2)(CO_2)}{(CO)(H_2O)}$	Tot. C_3+ lbs./Hr.	(CH_2) Mols/Hr.	Mols CO Fed	CO to C_3+	R/FF	Mols CH_4 Make	CO to CH_4	Net MPH H_2O Make	H_2 MPH in Feed	H_2 to H_2O	CO $+H_2$ Conv.
A	1.59	91.63	945	82.74	16.0	6.2	134.67	9.62	14.506	66.3	0.96	1.135	7.8	7.845	23.065	34.0	86.17
B	1.60	91.09	1057	79.12	15.4	6.5	138.62	9.91	14.705	67.4	1.03	0.889	6.0	8.377	23.499	35.6	83.73
C	1.60	88.25	1140	75.48	13.1	7.5	123.01	8.78	14.937	58.8	1.02	0.845	5.7	6.959	23.870	29.2	80.40
D	1.65	87.41	1120	77.26	18.9	7.2	132.94	9.49	14.890	63.7	.99	0.859	5.8	6.296	24.623	25.6	81.08
E	1.65	89.67	1088	77.46	19.6	7.8	121.91	8.70	14.565	59.7	1.00	0.907	6.2	7.473	24.024	31.1	82.06
F	1.615	87.98	997	72.57	19.2	7.7	127.14	9.08	15.053	60.3	.99	0.816	5.4	7.092	24.310	29.2	78.46
G	1.664	87.52	994	73.80	18.9	7.2	127.87	9.13	14.858	61.4	.99	0.785	5.3	6.985	24.724	28.3	78.95
H	1.645	86.34	1094	74.41	18.9	6.7	124.88	8.92	15.149	58.9	.98	0.804	5.3	7.129	24.924	28.6	79.15
I	1.63	85.75	1122	72.32	18.9	7.1	126.24	9.02	15.212	59.3	.99	0.973	6.4	6.610	24.760	26.7	77.43
J		No		data		-	-	-	-	-	1.06	-	-	-	24.188	-	-
K	1.59	85.20	1037	73.14	20.0	6.7	117.23	8.37	14.828	56.4	.98	0.938	6.3	6.218	23.561	26.4	77.80
L	1.63	85.90	1033	73.03	17.3	6.1	127.17	9.09	14.775	61.5	1.03	0.939	6.4	6.792	24.083	28.2	77.92
M	1.60	85.58	1085	72.81	18.5	6.7	123.30	8.81	14.731	59.8	1.03	0.886	6.0	6.534	23.548	27.7	77.72
N	1.62	86.82	1127	75.53	18.8	7.0	126.43	9.03	15.064	59.9	1.01	0.863	5.7	6.948	24.329	28.6	78.61
O	1.62	85.65	1083	72.51	18.8	6.7	120.95	8.64	14.904	58.0	1.02	0.856	5.7	6.747	24.169	27.9	77.52
P	1.59	84.86	1163	71.30	18.6	6.4	119.94	8.57	14.927	57.4	1.04	0.807	5.4	6.772	23.756	28.5	76.53
Q	1.61	85.37	1142	71.99	18.5	8.8	125.97	9.00	15.077	59.7	1.49	0.876	5.8	6.909	24.313	28.4	77.11
R	1.59	84.50	1244	71.13	18.0	7.9	125.59	8.97	15.503	57.9	1.55	0.732	4.7	7.110	24.588	28.9	76.30
S	1.64	84.13	1256	72.18	17.7	7.9	126.66	9.05	15.221	59.5	1.47	0.773	5.1	6.913	24.922	27.7	76.71
T	1.52	83.94	1203	71.64	17.7	7.4	125.15	8.94	15.556	57.5	1.49	0.833	5.4	6.949	23.603	29.4	76.53
U	1.70	82.85	1252	72.80	16.6	6.8	123.68	8.83	15.034	58.7	1.46	0.837	5.6	7.198	25.956	27.7	76.48
V	1.63	82.70	1185	71.20	16.6	6.6	125.46	8.96	15.536	57.7	1.46	0.748	4.8	7.337	25.360	28.9	75.57
W	1.62	82.80	1219	71.99	16.4	6.2	123.56	8.83	15.509	56.9	1.46	0.805	5.2	7.584	25.157	30.1	76.11
X	1.54	88.86	894	79.19	14.4	5.0	99.53	7.11	10.558	67.3	1.06	0.539	5.1	5.962	16.220	36.8	83.0
Y	1.55	89.49	856	79.16	14.3	4.6	98.18	7.01	10.626	66.0	0.99	0.541	5.1	6.362	16.441	38.7	83.11
MONTEBELLO RUN 46 & STANOLIND RUN 29 (FROM TDC802-37P)																	
46 F/1	1.68	68.60	856	54.31	18.1	5.8	91.75	6.55	15.680	41.8	1.12	0.664	4.2	5.268	26.353	20.0	
46 J/P	1.66	75.29	856	58.20	18.9	5.9	104.03	7.43	15.964	46.5	1.04	0.721	4.5	6.000	26.531	22.6	
46 Q/W	1.69	77.44	856	61.60	18.5	5.7	104.85	7.49	15.510	48.3	1.05	0.754	4.9	6.353	26.155	24.3	
Stand. 29-1	1.92	97.89	902	85.94	11.0	16.98	33.92	2.42	3.078	78.6	1.03	0.334	10.8	2.062	5.909	34.9	90.0
Stan. -2	1.90	95.08	912	82.19	10.4	7.60	32.93	2.35	3.112	75.5	1.01	0.104	3.3	2.210	5.902	37.4	87.8
-3	2.04	98.28	956	82.80	14.2	31.2	30.45	2.17	3.025	71.7	1.00	0.439	14.5	1.738	6.185	28.1	87.9
-4	1.89	92.29	957	77.24	16.4	8.73	29.96	2.14	3.204	66.8	.99	0.273	8.5	1.774	6.045	29.3	82.5
-5	1.92	91.29	1033	73.69	18.8	8.81	30.04	2.15	3.192	67.4	1.00	0.286	8.9	1.715	6.135	28.0	79.7
-6	1.96	91.75	945	74.90	15.9	9.27	28.06	2.00	3.054	65.5	1.00	0.263	8.6	1.689	5.977	28.3	80.6
-7	1.94	92.58	952	74.14	15.7	10.1	29.11	2.08	3.075	67.6	1.01	0.282	9.2	1.714	5.970	28.7	80.4
-8	1.90	91.18	982	72.53	16.4	9.1	29.03	2.07	3.176	65.2	1.01	0.272	8.6	1.677	6.029	27.8	79.0
-9	1.87	90.15	991	70.79	17.5	8.9	27.75	1.98	3.219	61.5	.99	0.261	8.1	1.636	6.022	27.2	77.5
-10	1.97	92.61	951	76.26	16.0	9.8	28.01	2.00	3.098	64.6	1.00	0.292	9.4	1.731	6.111	28.3	81.8
Stan. Ave.	1.93		954														

BEACON LABORATORY DATA (Received from Beacon 3/10/52)

Run #	11,138	11,143	11,144	11,146	11,004	11,096
Catalyst	Brownsville Mill Scale reduced at Beacon Best run with Mill Scale Cat. Rec'd. 10/10/51	Brownsville 0 Hr. Sample Run #11 Run as Received	Brownsville 96 Hr. Sample Run #11 Run as Received	Brownsville 12 Hr. Sample Run #11 Run as Received	Spent CM&S Run At 200 #	Bethlehem Mill Scale
Lgt. of Run (Hrs.)		84	84	72	84	84
R/FF	2.0	2.0	2.0	2.0	2.0	2.0
Pressure, psig	400	400	400	400	200	200
Temp.	675	675	675	675	650	650
Total C_3+ Yields (gms/CM)	155	152.4	141.0	142.0	149.6	157.4
V/Hr/V	80	80.7	81.7	79.1	39.6	39.6
V/Hr/V (x125)	10,000				5,000	
H_2/CO FF	2.02	2.0	1.89	2.05	1.99	1.96
% Contr.	87.1	86.7	78.3	82.2	87.0	85.3
H_2 Conv.	94.4	93.8	86.0	89.3	94.6	92.1
CO Conv.	99.2	99.0	97.5	98.1	99.4	99.3
CO to CO_2 %	8.0	8.1	12.9	11.4	7.3	8.0
CO to CH_4	9.8	10.0	10.9	10.0	10.9	9.4
CO to C_2s	7.7	8.1	10.1	8.8	7.4	9.1
CO to C_3+	61.8	60.9	53.3	56.5	67.8	64.5
CO to Oxygenates	12.7	13.0	14.5	13.4	4.3	10.5
CO to C_3+ Total	74.5	73.9	67.8	69.9	72.1	75.0
H_2 to H_2O Chem.Free	-	40.9	34.8	36.4	43.2	41.3
Wet Gas % Unsats.						
C_2	29.0	50.5	55.7	52.4	36.8	57.7
C_3	85.2	86.7	85.5	86.2	81.1	88.2
C_4	86.2	88.0	90.5	86.3	83.8	90.6
$\frac{(H_2)\ (CO_2)}{(CO)\ (H_2O)}$	23.0	18.9	21.1	21.3	23.5	21.9

BROWNSVILLE RUN #5 (Not used except in Fig. 1, A & B)

Date	1-16-51 (24 Hrs.)	1-17-51	1-18-51	1-20-51	1-21-51	1-22-51	1-23-51	1-24-51 (24 Hrs.)
Mols CO	100	100	100	100	100	100	100	100
CO Conv.	50.71	49.21	52.31	71.74	73.69	71.24	65.62	69.38
CO Unconv.	49.29	50.79	47.69	28.26	26.31	28.76	34.38	30.62
Mols H_2	179	185	182	183	183	183	183	182
H_2 % Conv.	21.79	26.08	24.00	39.18	43.21	39.24	32.92	36.86
H_2 Unconv. %	78.21	73.92	76.00	60.82	56.79	60.76	67.08	63.14
Unconv. Mols	140.0	136.75	138.32	111.30	103.9	111.2	122.8	114.9
Unconv. Lbs.	280	273.5	276.6	222.6	207.8	222.4	245.6	229.8
In Product								
Wt. % H_2	4.72	6.33	6.69	4.99	4.77	4.85	5.32	5.17
Total Prod. Lbs.	5932	4321	4135	4461	4356	4586	4617	4445
Unconv. CO Lbs.	1380	1422	1335	791	737	805	963	857
Unconv. CO Wt. % Calc.	23.3	32.9	32.28	17.73	16.91	17.6	20.9	19.3
Unconv. CO Wt. % Actual	22.18	32.90	30.76	17.50	16.21	17.47	20.75	19.74
CO_2 Wt. %	24.70	31.46	32.76	38.09	38.63	36.43	35.08	37.06
Lbs.	1465	1359	1355	1699	1683	1671	1620	1647
Mols (CO to CO_2)	33.3	30.9	30.8	38.6	38.3	38.0	36.8	37.4
Water Wt. %	32.20	8.96	9.22	12.84	13.21	15.44	14.94	10.63
Lbs.	1910	387	381	573	575	708	690	473
Mols	106	21.5	21.2	31.8	31.9	39.3	38.3	26.3
H_2 to H_2O %	59.2	11.6	11.6	17.4	17.4	21.5	20.9	14.5
C_3+ (Incl. Oxygenates) Wt. %	10.94	13.24	13.22	15.62	15.81	14.75	14.35	15.02
Lbs.	649	572	547	697	689	676	663	668
Mols CH_2 (CO to C_3+)	46.4	40.9	39.1	49.8	49.1	48.3	47.4	47.7
CH_4 Wt. %	0.91	0.98	0.95	3.87	4.53	4.53	3.73	4.12
Lbs.	54	42	39	173	197	208	172	183
Mols (CO to CH_4)	3.4	2.6	2.4	8.1	12.3	13.0	10.8	14.4
C_2s Wt. %	1.14	1.39	1.64	2.68	2.13	1.93	1.57	1.92
Lbs.	67.6	60.0	67.8	120	93	89	72	85
Mols (CO to C_2s)	4.7	4.1	4.7	8.3	6.4	6.1	5.0	5.9
Oxy. Comps. Wt. %	0.58	1.52	1.57	1.96	2.02	2.10	2.21	2.88
Lbs.	34.4	65.7	64.9	8	88	96	102	128
CO to Oxygenates	2.5	4.7	4.6	6.2	6.3	6.9	7.3	9.1
R/FF	1.23	1.10	1.09	1.33	1.34	1.20	1.30	1.31

BROWNSVILLE RUN #6

	3/13/51	3/14/51	3/15/51	3/16/51	3/17/51	3/18/51	3/19/51
Mols. CO	100	100	100	100	100	100	100
CO Conv.	70.78	74.71	75.28		76.51	73.15	73.76
CO Unconv. Mols.	29.22	25.29	24.72		23.49	26.85	26.24
Mols. H_2	185	180	176	176	174	183	183
H_2 % Conv.	43.54	48.14	49.24		48.53	43.36	42.49
H_2 Unconv. %	56.46	51.86	50.76		51.47	56.64	57.51
H_2 Unconv. Mols.	104.45	93.35	89.34		89.56	103.65	105.24
H_2 Unconv. Lbs.	208.9	186.7	178.6		179.1	207.3	210.5
In Product:							
Wt. % H_2	5.36	4.79	4.59		4.60	5.28	5.21
Total Prod. Lbs.	3897	3898	3891		3896	3926	4040
Unconv. CO Lbs.	818.2	708	692.2		657.7	751.8	734.7
Unconv. CO Calc. Wt.%	21.0	18.2	17.8		16.9	19.1	18.2
Actual Wt.%	20.8	17.82	17.63		16.89	19.01	18.89
CO_2 Wt.%	25.46	25.29	21.94		23.62	28.55	28.38
Lbs.	992.2	985.8	853.7		920.2	1120.9	1146.6
Mols CO to CO_2	22.6	22.4	19.4		20.9	25.5	26.1
Water Wt.%	13.11	14.50	16.91		10.74	10.77	12.08
Lbs.	510.9	565.2	658.0		418.4	422.8	488.0
Mols.	28.4	31.4	36.6		23.2	23.5	27.1
H2 to H_2O Mol.%	15.4	17.5	20.8		13.3	12.8	14.8
C_3 Incl. Oxy. Wt.%	11.58	13.32	13.01		13.49	12.59	10.88
Lbs.	451.3	519.2	506.2		525.6	494.3	439.6
Mols CH_2(Mols. CO to C_3^+)	32.2	37.1	36.2		37.5	35.3	31.4
CH_4 Wt. %	5.0	5.93	6.97		10.72	4.40	4.83
Lbs.	198.7	231.2	271.2		417.7	172.7	195.1
Mols.(CO to CH_4)	12.4	17.5	17.0		26.1	10.8	12.2
C_2 Wt. %	2.21	2.20	1.87		2.41	2.41	2.37
Lbs.	86.1	85.8	72.8		93.9	94.6	95.7
Mols. CO to C_2^s	5.9	5.9	5.0		6.5	6.5	6.6
Oxy. Comps. Wt. %	2.20	2.24	2.23		2.55	2.69	2.74
Lbs.	85.7	87.3	86.8		99.3	105.6	110.7
Mols.	6.1	6.2	6.2		7.1	7.5	7.9
R/FF	0.58	.51	.42		.53	.60	.61

BROWNSVILLE RUN #8

	APRIL 22	APRIL 23	APRIL 24	APRIL 25	APRIL 26	APRIL 27	APRIL 28	APRIL 29	APRIL 30	MAY 1	MAY 2
Mols CO	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
CO Conv.	79.5	77.09	75.57	82.22	83.11	81.27	81.89	79.51	82.35	83.22	83.72
CO Unconv.	30.5	22.91	24.43	17.78	16.89	18.73	18.91	20.49	17.65	16.78	16.28
Mols H_2	172.	174.	173.	168.	170.	169.	167.	168.	170.	164.	161.
H_2 % Conv.	58.3	56.80	54.62	60.26	63.42	60.40	61.66	56.57	61.49	63.45	63.34
H_2 % Unconv.	41.7	43.20	45.38	39.74	36.58	39.60	38.34	43.43	38.53	36.55	36.66
H_2 Unconv. Mols	71.7	75.2	78.5	66.76	62.19	66.9	64.0	72.96	65.5	59.9	59.0
H_2 Unconv. Lbs.	143.4	150.4	157.	133.5	124.4	133.2	128.0	145.9	131.0	119.8	118.0
IN PRODUCT:											
Wgt. % H_2	3.82	4.01	4.18	3.57	3.30	3.57	3.44	3.89	3.47	3.20	3.20
Total Prod. Lbs.	3754	3751	3756	3739	3770	3731	3721	3751	3775	3744	3688
Unconv. CO Lbs.	854.0	641	684	499	473	524	529	574	494	470	456
Unconv. CO. Wgt.%	22.75	17.08	18.21	13.35	12.55	14.04	14.21	15.30	13.09	12.55	12.36
Unconv. CO Actual	15.16	16.96	18.11	13.17	12.44	13.53	13.48	15.18	12.97	12.42	12.46
CO_2 Wgt. %	33.16	32.98	31.73	31.79	31.40	32.22	32.19	36.84	31.31	31.61	36.69
Lbs.	1244.80	1237.1	1191.7	1188.6	1183.7	1202.	1197.8	1382.	1182.0	1183.5	1353.1
Mols.	28.29	28.12	29.08	27.01	26.90	27.32	27.22	31.41	26.86	26.90	30.85
Water Wgt. %	16.14	15.44	15.27	16.75	18.39	17.63	17.11	15.84	18.41	24.53	19.92
Lbs.	605.90	579.2	573.5	676.3	693.3	657.8	636.7	594.2	695.0	918.4	734.6
Mols.	33.66	32.18	31.86	34.79	38.52	36.54	35.37	33.01	38.61	51.02	40.81
H_2 to H_2O Mol. %	.2	.18	.18	.2	.22	.22	.21	.20	.23	.31	.25
C_3+ (Incl. water sol. chem.) Wgt. %	17.60	18.18	16.02	19.87	24.62	19.41	20.11	20.12	18.81	23.28	22.62
Lbs.	660.7	686.	601.7	742.9	928.2	724.2	748.3	754.7	710.1	871.6	834.2
Mols CH_2	47.19	48.9	42.98	53.06	66.30	51.73	53.45	53.91	50.72	62.26	59.59
CH_4 Wgt. %	5.60	5.24	7.38	7.57	5.93	5.49	5.55	5.34	6.73	5.50	5.93
Lbs.	210.2	196.6	277.2	283.0	223.6	204.8	206.5	200.3	254.1	205.9	219.
Mols.	13.1	12.28	17.33	17.69	13.98	12.80	12.91	12.52	15.88	12.87	13.69
C_2 Wgt. %	2.06	2.39	2.13	2.61	2.20	2.38	2.49	2.34	2.42	1.80	2.37
Lbs.	77.3	89.65	80.0	97.6	82.9	88.8	92.7	87.8	91.4	67.4	87.4
Mols.	5.26	6.09	5.44	6.64	5.64	6.04	6.31	5.97	6.22	4.59	5.95
Oxy. Comps. Wgt. %	3.14	3.46	3.31	3.59	3.55	3.59	3.88	3.60	3.76	3.54	3.80
Lbs.	117.87	129.8	124.3	134.2	133.8	133.9	144.4	135.0	141.9	132.5	140.1
Mols.	8.42	9.27	8.88	9.59	9.56	9.56	10.31	9.64	10.14	9.46	10.01
R/FF	1.50	1.41	1.24	1.35	1.35	1.32	1.22	1.32	1.32	1.19	1.21

	MAY 3	MAY 4	MAY 5	MAY 6	MAY 7	MAY 8	MAY 9	MAY 10	MAY 11	MAY 12	MAY 13	MAY 14
Mols CO	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
CO Conv.	83.04	82.96	84.30	83.8	78.76	79.47	77.24	77.95	79.19	77.94	79.49	76.82
CO Unconv.	16.96	17.04	15.70	16.2	21.24	20.53	22.76	22.05	20.81	22.06	20.51	23.18
Mols H_2	166.	172.	172.	168.	161.	166.	172.	175.	166.	175.	175.	179.
H_2 % Conv.	62.12	62.31	64.29	63.37	60.30	54.95	52.71	53.63	53.99	54.47	50.46	52.76
H_2 % Unconv.	37.88	37.69	35.71	36.63	39.70	45.05	47.29	46.37	46.01	45.53	49.54	47.24
H_2 Unconv. Mols	62.9	64.8	61.44	61.54	63.9	74.8	81.3	81.1	76.4	79.7	86.7	84.6
H_2 Unconv. Lbs.	125.8	129.6	122.9	123.0	127.8	149.6	162.6	162.2	152.8	159.4	173.4	169.2
IN PRODUCT:												
Wgt. % H_2	3.36	3.43	3.27	3.27	3.44	4.00	4.33	4.30	4.06	4.15	4.54	4.37
Total Prod. Lbs.	3744	3778	3758	3761	3715	3741	3755	3772	3764	3841	3819	3643
Unconv. CO Lbs.	475	477	440	454	595	575	637	617	583	617	574	649
Unconv. CO. Wgt.%	12.69	12.62	11.71	12.07	16.02	15.37	16.96	16.35	15.49	16.06	15.03	17.81
Unconv. CO Actual	12.64	12.51	11.59	11.96	15.90	15.27	16.77	16.27	15.37	16.01	14.92	16.66
CO_2 Wgt. %	31.48	32.33	31.71	32.10	33.62	34.83	34.82	33.12	34.93	35.75	35.40	33.72
Lbs.	1178.6	1221.4	1191.7	1207.3	1248.9	1303.0	1307.5	1249.3	1314.8	1373.2	1351.9	1228.4
Mols.	26.79	27.76	24.81	27.44	28.38	29.61	29.72	28.37	29.88	31.21	30.73	27.92
Water Wgt. %	21.04	12.79	19.10	18.51	16.87	14.51	13.17	16.01	15.33	14.37	14.97	14.93
Lbs.	78.77	483.2	717.8	696.2	626.7	542.8	494.5	603.9	577.0	552.0	571.7	543.9
Mols.	43.76	26.84	39.88	38.68	34.82	30.16	27.47	33.55	32.06	30.67	31.76	30.21
H_2 to H_2O Mol. %	.26	.16	.23	.23	.22	.18	.17	.19	.19	.18	.18	.17
C_3+ (Incl. water sol. chem.) Wgt. %	22.71	16.50	17.96	17.62	14.71	15.14	14.43	14.58	13.99	12.35	11.26	11.68
Lbs.	850.3	623.4	674.9	662.7	546.5	566.4	541.8	549.9	526.6	474.4	430.0	425.5
Mols CH_2	60.74	44.53	48.20	47.34	39.04	40.46	38.70	39.28	37.61	33.89	30.71	30.39
CH_4 Wgt. %	5.55	5.65	5.72	5.71	5.23	5.89	5.87	6.17	6.29	6.22	6.82	5.69
Lbs.	207.8	213.5	214.9	214.8	194.3	220.3	220.4	232.7	236.8	238.9	260.5	207.3
Mols.	12.99	13.34	13.43	13.43	12.14	13.77	13.78	14.54	14.80	14.93	16.28	12.96
C_2 Wgt. %	3.37	3.28	3.08	3.44	3.17	2.77	3.03	3.18	2.19	3.12	3.50	2.27
Lbs.	126.7	123.9	115.7	129.4	117.8	103.6	113.8	119.9	82.4	119.8	133.7	82.7
Mols.	8.62	8.43	7.87	8.80	8.01	7.05	7.74	8.16	5.61	8.15	9.10	5.63
Oxy. Comps. Wgt. %	3.76	4.24	4.62	4.68	4.31	3.89	4.05	4.18	3.55	4.04	4.22	3.78
Lbs.	140.8	160.2	173.6	176.1	160.1	145.5	152.1	157.7	133.6	155.2	161.2	137.7
Mols.	10.05	11.44	12.40	12.58	11.44	10.39	10.86	11.26	9.54	11.09	11.51	9.84
R/FF	1.23	1.28	1.21	1.27	.91	.71	1.0	.91	1.08	1.48	1.69	1.63

BROWNSVILLE RUNS #9 & #10

	RUN #9					RUN #10					
Date	6-5-51 (10 Hrs.)	6-6-51	6-7-51	6-8-51	6-9-51 (9 Hrs.)	7-21-51 (24 Hrs.)	7-22-51	7-23 to 7-28-51	7-29-51	7-30-51	7-31-51 (18 Hrs.)
Mols CO	100	100	100	100	100	100	100	No	100	100	100
CO Conv.	81.47	80.44	71.15	71.91	78.49	76.77	77.04	Data	68.63	72.55	54.96
CO Unconv.	18.53	19.56	28.85	28.09	21.51	23.23	22.96		31.37	27.45	45.04
Mols H_2	184.5	182.9	186.7	178.0	174.7	186.5	186.		175.9	178.4	182.2
H_2 % Conv.	54.71	48.97	41.54	45.50	47.09	51.84	61.87		51.33	52.42	41.08
H_2 Unconv. %	45.29	51.03	58.46	54.50	52.91	48.16	38.13		48.67	47.58	58.92
H_2 Unconv. Mols	83.6	93.3	109.1	97.0	92.4	89.8	70.9		85.6	84.9	107.4
H_2 Unconv. Lbs.	167.2	186.6	218.2	194.0	184.8	179.6	141.8		171.2	169.8	214.8
In Product:											
Wt. % H_2	4.44	5.00	5.80	5.19	4.86	4.76	4.14		4.71	4.61	5.76
Total Prod. Lbs.	3765.7	3732	3762	3738	3802	3773	3425		3635	3683	3729
Unconv. CO Lbs.	518.8	547.7	807.8	786.5	602.3	650.4	642.9		878.4	768.6	1261.1
Unconv. CO Wt. % Calc.	13.77	14.67	21.47	21.04	15.84	17.23	18.77		24.16	20.86	33.81
Unconv. CO Wt. % Actual	13.67	14.55	21.30	20.36	15.73	19.09	16.9		23.99	20.68	33.55
CO_2 Wt. %	25.67	32.39	28.84	26.52	29.16	23.69	21.89		20.07	25.56	11.76
Lbs.	966.7	1208.8	1085.0	991.3	1108.7	893.8	749.7		729.5	941.4	438.5
Mols CO to CO_2	22.0	27.5	24.7	22.5	25.2	20.3	17.0		16.6	21.4	10.0
Water Wt. %	19.41	8.37	9.30	11.28	12.43	-	-		-	-	-
Lbs.	730.9	310.9	349.9	421.6	472.6	-	-		-	-	-
Mols	40.6	17.3	19.4	23.4	26.3	-	-		-	-	-
H_2 to H_2O Mol %	22.0	9.5	10.4	13.1	15.1	-	-		-	-	-
C_3+ incl. Oxyg. Wt. %	13.52	15.25	14.57	14.67	14.76	14.73	17.51		16.03	14.71	14.31
Lbs.	509.1	569.1	548.1	548.4	561.2	555.8	599.7		582.7	541.8	533.6
Mols CH_2 (Mols CO to C_3+)	36.4	40.6	39.1	39.2	40.1	39.7	42.8		41.6	38.7	38.1
CH_4 Wt. %	4.30	5.15	2.71	2.90	3.41	3.09	5.00		2.79	2.82	0.62
Lbs.	161.9	192.2	102.0	108.4	129.6	116.6	171.3		101.4	103.9	23.1
Mols (CO to CH_4)	10.1	12.0	6.4	6.8	8.1	7.3	7.1		6.3	6.5	1.4
C_2s Wt. %	2.01	2.54	1.03	2.12	2.17	1.35	2.17		2.21	4.23	1.14
Lbs.	75.7	94.8	38.7	79.2	82.5	50.9	74.3		80.3	155.8	42.5
Mols CO to C_2s	5.2	6.5	2.7	5.5	5.7	3.5	5.1		5.5	10.7	2.9
Oxy. Comps. Wt. %	1.80	2.94	2.25	2.84	3.07	2.03	3.16		3.31	3.28	3.73
Lbs.	67.8	109.7	84.6	106.2	116.7	76.6	108.2		120.3	120.8	139.1
CO to Oxygenates	4.8	7.8	6.0	7.6	8.3	5.5	7.7		8.6	8.6	9.9
R/FF	1.33	1.50	1.55	0.81	0.63	1.69	1.46		1.60	1.87	1.75

BROWNSVILLE RUN #11

Date	11-11-51 (24 Hrs.)	11-12-51	11-13-51	11-14-51	11-15-51	11-16-51	11-17-51	11-18-51	11-19-51 (24 Hrs.)
Mols CO	100	100	100	100	100	100	100	100	100
Mols CO Conv.	85.3	88.1	86.6	84.4	81.4	82.7	80.5	80.8	81.5
Mols CO Unconv.	14.7	11.9	13.4	15.6	18.6	17.3	19.5	19.2	18.5
Mols H_2	183	185	184	185	186	178	176	176	188
% H_2 Conv.	63.3	67.7	67.2	65.0	61.3	63.4	58.7	62.0	63.8
Mols H_2 Unconv.	67.2	59.8	60.4	64.8	72.0	65.1	72.7	66.9	63.7
Lb. H_2 Unconv.	135.4	119.6	120.8	129.6	144.0	130.2	145.4	133.8	127.4
Product									
Wt. % H_2	3.57	3.16	3.24	3.43	3.86	3.50	3.92	3.61	3.56
Total Prod. Lb.	3800	3780	3730	3780	3730	3720	3710	3710	3580
Unconv. CO. Lb.	412	333	375	437	521	484	546	538	518
Unconv. CO Wt. % Calc.	10.82	8.81	10.05	11.56	13.97	13.01	14.72	14.50	14.47
Unconv. CO Wt. % Actual	10.82	8.73	9.95	11.50	13.82	12.85	14.58	14.30	13.44
CO_2 Wt. %	24.98	23.22	23.08	21.71	23.97	22.76	22.14	22.68	20.60
CO_2 Lb.	949	878	861	821	894	847	821	841	737
CO_2 Mols	21.56	19.95	19.56	18.65	20.31	19.24	18.65	19.11	16.74
CO to CO_2 Mol %	21.6	20.0	19.6	18.7	20.3	19.2	18.7	19.1	16.7
Water Wt. %	19.25	23.78	22.74	22.20	16.83	20.36	18.34	19.62	20.11
Lb.	732	899	848	839	628	759	680	728	720
Mols	40.7	49.9	47.1	46.6	34.9	42.2	37.8	40.4	40.0
Mol %	22.2	27.0	25.6	25.2	18.8	23.7	21.5	23.0	21.3
C_3+ Wt. %	17.69	16.74	18.28	18.88	19.94	17.24	18.39	17.92	18.56
Lb.	672	633	682	714	744	641	682	665	664
Mols CH_2 Mol %(CO to C_3+)	48.0	45.2	48.7	51.0	53.1	45.8	48.7	47.5	47.4
CH_4 Wt. %	3.31	4.01	3.37	2.94	2.95	3.50	3.40	3.18	3.21
Lb.	126	152	126	111	110	130	126	118	115
Mols Mol %	7.88	9.50	7.88	6.94	6.88	8.13	7.88	7.38	7.19
C_2 Wt. %	2.65	2.98	2.58	2.41	2.44	2.44	2.57	2.65	2.74
Lb.	101	113	96	91	91	91	95	98	98
Mols Mol %	7.0	7.8	6.6	6.2	6.2	6.2	6.6	6.8	6.8
Oxyg. Wt. %	4.06	3.99	4.24	4.36	4.22	4.45	4.08	4.33	4.14
Lb.	154	151	158	165	157	166	151	161	148
Mols Mol %	11.0	10.8	11.3	11.8	11.2	11.9	10.8	11.5	10.6
R/FF	1.49	1.37	1.31	1.42	1.53	1.43	1.13	1.36	1.16

BROWNSVILLE RUN #12

Date		11-29-51 (24 Hrs.)	11-30-51	12-1-51	12-2-51	12-3-51	12-4-51	12-5-51	12-6-51	12-7-51 (6 Hrs.)
Mols CO		100	100	100	100	100	100	100	100	100
Mols CO Conv.		82.41	85.28	85.87	85.11	85.22	84.48	84.34	86.13	85.90
Mols CO Unconv.		17.59	14.72	14.13	14.89	14.78	15.52	15.66	13.87	14.10
Mols H_2		180	178	183	184	185	184	186	192	190
% H_2 Conv.		59.53	65.36	66.92	66.71	65.21	66.56	64.61	67.45	67.29
Mols H_2 Unconv.		72.8	61.7	60.5	61.3	64.4	61.5	65.5	62.5	62.1
Lb. H_2 Unconv.		145.6	123.4	121.0	122.6	128.8	123.0	131.6	125.0	124.2
Product										
Wt. % H_2		3.88	3.26	3.11	3.10	3.24	3.08	3.31	3.10	3.18
Total Prod. Lb.		3750	3785	3891	3955	3975	3994	3976	4032	3906
Unconv. CO Lb.		493	412	396	417	414	435	438	388	395
Unconv. CO Wt. % Calc.		13.15	10.88	10.17	10.56	10.44	10.89	11.01	9.62	10.12
Unconv. CO Wt. % Actual		12.99	10.79	10.07	10.45	10.31	10.74	10.92	9.55	9.60
CO_2 Wt. %		23.90	21.47	19.65	17.90	20.09	17.47	19.16	17.76	18.22
CO_2 Lb.		896	813	765	708	799	698	762	716	912
	Mols Mol %	20.4	18.5	17.4	16.1	18.2	15.9	17.3	16.3	16.2
Water	Wt. %	19.17	22.04	24.11	24.14	18.48	22.73	20.40	21.56	22.79
	Lb.	719	834	938	955	735	908	811	869	890
	Mols	39.9	46.3	52.1	53.0	40.8	50.4	45.0	48.3	49.4
	Mol %	22.2	26.0	28.5	28.8	22.0	27.4	24.2	25.2	26.0
C_3+	Wt. %	17.13	19.00	17.27	18.10	20.18	18.26	18.03	17.48	17.19
	Lb.	642	719	672	716	802	729	717	705	671
	Mols Mol %	45.9	51.4	48.0	51.1	57.3	52.1	51.2	50.4	47.9
CH_4	Wt. %	2.85	2.86	2.78	2.67	3.18	2.91	3.39	6.21	4.09
	Lb.	107	108	108	106	126	116	135	250	160
	Mols Mol %	6.7	6.8	6.8	6.6	7.9	7.3	8.4	15.6	10.0
C_2	Wt. %	2.49	2.21	2.45	2.46	2.67	2.54	2.64	2.65	2.78
	Lb.	93	84	95.3	97.3	106	101	105	107	109
	Mols Mol %									
Oxyg.	Wt. %	4.06	4.30	4.57	4.58	4.34	4.08	4.21	4.22	3.74
	Lb.	152	163	178	181	173	163	167	170	146
	Mols Mol %	10.8	11.3	12.8	12.9	12.7	11.3	12.0	12.2	10.7
R/FF		1.60	1.41	1.31	1.41	1.55	1.40	1.52	1.50	1.42

BROWNSVILLE RUN #13

Date	12-21-51 (13 Hrs.)	12-22-51	12-23-51	12-24-51	12-25-51	12-26-51	12-27-51	12-28-51	12-29-51	12-30-51	12-31-51	1-1-52	1-2-52 (3 Hrs.)
Mols CO	100	100	100	100	100	100	100	100	100	100	100	100	100
Mols CO Conv.	81.25	84.28	82.84	79.98	80.81	79.50	79.99	77.27	74.10	75.66	76.03	76.53	76.85
Mols CO Unconv.	18.75	15.72	17.16	20.02	19.19	20.50	20.01	22.73	25.90	24.34	23.97	23.47	23.15
Mols H_2	181	187	186	185	183	189	186	189	189	189	190	189	189
% H_2 Conv.	61.55	64.65	63.24	59.22	59.37	60.21	58.06	53.38	51.27	53.52	53.37	54.45	55.09
Mols H_2 Unconv.	69.6	66.1	68.4	75.4	74.4	75.2	78.0	88.1	92.1	87.8	88.6	86.1	84.9
Lbs. H_2 Unconv.	139.2	132.2	136.8	150.8	148.8	150.4	156	176.2	184.2	175.6	177.2	172.2	169.8
In Product													
Wt. % H_2	3.56	3.36	3.44	3.80	3.79	3.74	3.89	4.44	4.53	4.36	4.32	4.24	4.18
Total Prod. Lb.	3910	3930	3980	3970	3930	4020	4010	3970	4066	4030	4100	4060	4060
Unconv. CO Lb.	525	440	480	561	537	574	560	636	725	682	671	657	648
Unconv. CO Wt. % Calc.	13.43	11.20	12.06	14.13	13.66	14.28	13.97	16.02	17.83	16.97	16.37	16.18	15.96
Unconv. CO Wt. % Actual	13.31	11.11	11.97	13.99	13.51	14.15	13.87	15.86	17.64	16.62	16.32	16.03	15.81
CO_2 Wt. %	17.71	20.25	17.98	18.07	18.93	17.09	18.42	21.51	19.49	19.64	19.43	19.81	19.34
CO_2 Lb.	692	796	716	717	744	687	739	854	792	791	797	804	785
CO_2 Mols - Mol %	15.7	18.1	16.3	16.3	16.9	15.6	16.8	19.4	18.0	18.0	18.1	18.3	17.8
Water Wt. %	20.13	19.50	34.39	21.81	21.55	21.01	19.78	18.04	16.66	16.73	18.51	17.85	19.43
Lb.	787	766	1369	866	847	845	793	716	677	674	759	725	789
Mols	43.7	42.6	76.0	48.1	47.1	47.0	44.1	39.8	37.6	37.4	42.2	40.3	43.8
Mol %	24.1	22.8	40.9	26.0	25.7	24.9	23.7	21.1	19.9	19.8	22.2	21.3	23.2
C_{3+} Wt. %	20.06	19.54	16.65	16.67	17.22	18.20	17.62	14.67	15.08	16.83	14.27	15.29	14.66
Lb.	784	768	662	662	677	732	707	582	613	678	585	621	595
Mols Mol %	56.0	54.9	47.3	47.3	48.4	52.3	50.5	41.6	43.8	48.4	41.8	44.4	42.3
CH_4 Wt. %	3.00	3.26	2.20	2.31	2.62	1.85	2.07	2.29	1.34	2.18	1.64	1.56	1.49
Lb.	117	128	88	92	103	74	83	91	55	88	67	63	61
Mols Mol %	7.3	8.0	5.5	5.8	6.4	4.6	5.2	5.7	3.4	5.5	4.2	3.9	3.8
C_2 Wt. %	1.78	2.45	2.35	2.20	2.25	2.26	2.34	2.21	2.28	2.15	2.15	2.54	2.50
Lb.	70	96	94	87	88	91	94	88	93	87	88	103	102
Mols Mol %	4.8	6.6	6.5	6.0	6.1	6.3	6.5	6.1	6.4	6.0	6.1	7.1	7.0
Oxy. Wt. %	3.04	4.33	4.21	4.04	4.05	4.12	3.72	3.97	4.57	4.10	3.71	4.02	4.33
Lb.	119	170	168	160	159	166	149	158	186	165	152	163	176
Mols Mol %	8.5	12.1	12.0	11.4	11.4	11.9	10.6	11.3	13.3	11.8	10.9	11.6	12.6
R/FF	1.55	1.66	1.38	1.38	1.49	1.65	1.32	1.42	1.47	1.41	1.47	1.41	1.28

BROWNSVILLE RUN #14	1-9-52 (13 Hrs.)	1-10-52	1-11-52	1-12-52	1-13-52	1-14-52	1-15-52	1-16-52	1-17-52	1-18-52	1-19-52	1-20-52	1-21-52	1-22-52 (5 Hrs.)
Mols CO	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
CO Conv.	83.53	83.27	83.00	82.09	81.92	83.25	86.78	86.54	85.92	83.88	84.94	85.53	80.41	74.34
CO Unconv. Mols	16.47	16.73	17.00	17.91	18.08	16.75	13.22	13.46	14.08	16.12	15.06	14.47	19.59	25.66
Mols H_2	187	184	188	185	185	190	187	185	186	179	186	186	190	193
H_2 % Conv.	63.51	61.74	60.10	57.05	57.85	61.46	67.25	67.21	62.66	61.78	62.83	63.42	56.91	48.71
H_2 % Unconv.	36.49	38.26	39.90	42.95	42.15	38.54	32.75	32.79	37.34	38.22	37.17	36.58	43.09	51.29
H_2 Unconv. Mols	68.24	70.40	75.01	79.46	77.98	73.23	61.24	60.66	69.45	68.41	69.14	68.04	81.87	99.00
H_2 Unconv. Lbs.	136.48	140.80	150.02	158.92	155.96	146.46	122.48	121.32	138.90	136.82	138.28	136.08	163.74	198.00
IN PRODUCT														
Wt. % H_2	3.32	3.48	3.71	3.94	3.95	3.61	3.02	3.07	3.51	3.51	3.44	3.40	4.10	4.86
Total Product Lbs.	4111	4046	4044	4034	3948	4057	4056	3952	3957	3898	4020	4002	3994	4074
Unconv. CO Lbs.	461.2	468.4	476.0	501.5	506.2	469	370.2	376.9	394.2	451.4	421.7	405.2	548.2	718.5
Unconv. CO Wt. %	11.22	11.58	11.77	12.43	12.82	11.56	9.13	9.54	9.96	11.58	10.49	10.12	13.73	17.64
Actual	11.14	11.49	11.70	12.36	12.74	11.48	9.06	9.48	9.90	11.03	10.40	10.02	13.60	17.82
CO_2 Wt. %	16.44	20.51	20.87	23.30	24.16	21.41	17.66	17.30	21.24	17.09	19.19	16.80	20.29	20.40
Lbs.	675.8	829.8	844.0	940	953.8	868.6	716.3	683.7	840.5	666.2	771.4	672.3	810.4	831.1
Mols.	15.4	18.9	19.2	21.4	21.7	19.7	16.3	15.5	19.1	17.1	17.5	15.3	18.4	18.9
Water Wt. %	21.78	18.28	19.08	14.32	15.43	19.11	24.6	26.92	22.93	23.65	22.44	27.81	22.94	21.44
Lbs.	895.4	739.6	771.6	577.7	609.2	775.3	997.8	1063.9	907.3	921.9	902.1	1113.0	916.2	873.5
Mols	49.7	41.1	42.9	32.1	33.8	43.1	55.4	59.1	50.4	51.2	50.1	61.8	50.9	48.5
H_2 to H_2O Mol %	26.5	22.3	22.8	17.4	18.3	22.7	29.6	31.9	27.1	28.6	26.2	33.2	26.8	25.1
C_3+ Wt. %	19.49	18.30	16.95	19.15	16.97	17.05	18.15	17.32	16.70	17.03	16.42	16.47	14.02	11.29
Lbs.	801.2	740.4	685.5	772.5	670.0	691.7	736.2	684.5	660.8	663.8	660.1	659.1	560.0	460.0
Mols CH_2 (Mol % CO to C_3+)	57.2	52.9	49.0	55.2	47.9	49.4	52.6	48.9	47.2	47.4	47.2	47.1	40.0	32.9
CH_4 Wt. %	2.40	3.36	2.72	2.55	2.89	2.54	2.79	2.15	2.74	2.58	2.94	1.83	2.25	1.25
Lbs.	98.7	135.9	110.0	102.9	114.1	103	113.2	85.0	108.4	100.6	118.2	73.2	89.9	50.9
Mols - Mol %	6.2	8.5	6.9	6.4	7.1	6.4	7.1	5.3	6.8	6.3	7.4	4.6	5.6	3.2
C_2 Wt. %	2.19	2.46	2.61	2.55	2.47	2.76	2.47	2.50	2.48	2.45	2.37	2.12	2.17	1.95
Lbs.	90.0	99.5	105.5	102.9	97.5	112	100.2	98.8	98.1	95.5	95.3	84.8	86.7	79.4
Mols - Mol %	6.2	6.9	7.3	7.1	6.7	7.7	6.9	6.8	6.8	6.6	6.6	5.8	6.0	5.5
Oxy. Comps. Wt. %	3.39	4.16	4.46	3.82	3.35	4.21	4.65	4.19	4.26	4.13	4.36	4.53	3.86	3.37
Lbs.	139.4	168.3	180.4	154.1	132.3	170.8	188.6	165.6	168.6	161.0	175.3	181.3	154.2	137.3
Mols	10.0	12.0	12.9	11.0	9.5	12.2	13.5	11.8	12.0	11.5	12.5	13.0	11.0	9.8
R/FF	1.81	1.74	1.66	1.68	1.64	1.88	2.00	1.95	1.45	1.75	1.80	1.60	1.13	0.97

BROWNSVILLE RUN #15

Date	2-2-52 (21-1/2 Hours)	2-3-52	2-4-52	2-5-52	2-6-52	2-7-52	2-8-52	2-9-52	2-10-52	2-11-52 (10-1/2 Hours)
Mols CO	100	100	100	100	100	100	100	100	100	100
CO Conv.	91.19	83.70	82.89	79.81	78.04	81.68	78.41	83.30	82.62	84.40
CO Unconv. Mols	8.81	16.30	17.11	20.19	21.96	18.32	21.59	16.70	17.38	15.60
Mols H_2	182	185	185	186	188	183	189	187	191	186
H_2 % Conv.	80.35	62.08	60.15	51.31	50.58	53.87	53.68	60.52	59.92	61.57
H_2 Unconv. %	19.65	37.92	39.85	48.69	49.42	46.13	46.32	39.48	40.08	38.43
H_2 Unconv. Mols	35.76	70.15	73.72	73.73	92.91	84.42	87.54	73.83	76.55	71.48
H_2 Unconv. Lbs.	71.52	140.30	147.44	147.46	185.82	168.84	175.08	147.66	153.10	142.96
In Product										
Wt. % H_2	1.42	3.54	3.66	4.56	4.60	4.24	4.06	3.64	3.80	3.50
Total Prod. Lbs.	5037	3963	4028	3234	4040	3982	4312	4057	4029	4085
Unconv. CO Lbs.	246.7	456.4	479.1	565.3	614.9	513.0	604.5	467.6	486.6	436.8
Unconv. CO Wt. % Calc.	24.90	11.52	11.8	17.4	15.22	12.88	14.01	11.53	12.08	10.69
Actual	4.82	11.41	11.78	14.07	15.15	12.90	14.99	11.49	11.97	10.59
CO_2 Wt. %	9.94	20.79	20.76	25.77	24.66	24.08	23.31	18.04	19.63	19.42
Lbs.	500.7	823.9	836.2	833.4	996.3	956.9	1005.1	731.9	790.9	793.3
CO to CO_2 Mol %	11.4	18.7	19.0	18.9	22.6	21.7	22.8	16.6	18.0	18.0
Water Wt. %	21.04	20.22	18.49	14.73	14.95	17.01	15.49	24.98	22.39	20.89
Lbs.	106.0	801.3	744.8	476.4	604.0	677.3	667.9	1013.4	902.1	853.4
Mols	58.8	44.5	41.4	26.5	33.6	37.6	37.1	56.3	50.1	47.4
H_2 to H_2O Mol %	32.3	24.1	22.4	14.2	17.9	20.5	19.6	30.1	26.2	25.5
C_3+ (incl. water chems.) Wt.%	13.65	17.11	17.95	13.17	13.08	17.01	13.12	14.43	14.62	16.22
Lbs.	687.6	678.1	723.0	425.9	528.4	677.3	565.7	585.4	589.0	662.6
Mols CH_4(Mol % CO to C_3+)	49.1	48.4	51.6	30.4	37.7	48.4	40.4	41.8	42.1	47.3
CH_4 Wt. %	8.65	3.57	3.00	3.92	3.08	2.69	4.21	2.39	3.14	2.91
Lbs.	435.7	141.5	120.8	126.7	124.4	107.1	181.5	97.0	126.5	118.9
Mols Mol %	7.2	8.8	7.6	7.9	7.9	6.7	11.3	6.1	7.9	7.4
C_2 Wt. %	1.63	2.11	2.36	2.25	2.27	2.40	2.56	2.29	2.37	2.60
Lbs.	82.1	83.6	95.1	72.8	91.7	95.6	110.4	92.9	95.5	106.2
Mols Mol %	5.6	5.7	6.5	5.0	6.2	6.5	7.5	6.3	6.5	7.2
Oxy. Comps. Wt. %	2.49	3.23	3.95	2.97	2.62	2.58	2.69	4.03	3.61	4.25
Lbs.	125.4	128.0	159.1	96.0	105.8	102.7	116.0	163.5	145.4	173.6
Mols	9.0	9.1	11.4	6.9	7.6	7.3	8.2	11.7	12.6	12.4
R/FF	1.23	1.34	1.32	0.93	0.76	0.83	0.64	1.53	1.65	1.78

BROWNSVILLE RUN #16

Date	2-19-52 (17-1/2 Hours)	2-20-52	2-21-52	2-22-52 (3-1/2 Hrs.)
Mols CO	100.00	100.00	100.00	100.00
CO Conv.	82.44	81.38	76.81	75.19
CO Unconv. Mols	17.56	18.62	23.19	24.81
Mols H_2	178	182	184	193
H_2 % Conv.	56.98	55.58	45.89	43.54
H_2 % Unconv.	43.02	44.42	54.11	56.46
H_2 Unconv. Mols	76.58	79.07	96.32	100.52
H_2 Unconv. Lbs.	153.16	158.14	192.64	201.04
In Product				
Wt. % H_2	3.71	4.04	4.94	5.24
Total Prod. Lbs.	4128	3914	3900	3837
Unconv. CO Lbs.	491.7	521.4	649.3	694.7
Unconv. CO Wt. %	11.91	13.32	16.65	18.11
Actual	11.83	12.91	16.03	16.55
CO_2 Wt. %	22.97	23.45	24.96	23.22
Lbs.	948.2	917.8	973.4	891.0
Mols	21.6	20.9	22.1	20.3
Water Wt. %	25.18	16.42	14.69	11.13
Lbs.	1039.4	642.7	572.9	427.1
Mols	57.7	35.7	31.8	23.7
H_2 to H_2O Mol %	32.4	19.6	17.3	12.3
C_3^+ Wt. %	15.00	14.24	11.87	13.47
Lbs.	619.2	557.4	462.9	516.8
Mols CH_2 (Mol % CO to C_3^+)	44.2	39.8	33.1	36.9
CH_4 Wt. %	2.75	4.04	2.84	2.97
Lbs.	113.5	158.1	110.8	114.0
Mols Mol %	7.1	9.9	6.9	7.1
C_2 Wt. %	2.90	2.61	2.29	2.34
Lbs.	119.7	102.2	89.3	89.8
Mols Mol %	8.3	7.0	6.2	6.2
Oxy. Comps. Wt. %	3.76	3.56	2.88	3.57
Lbs.	155.2	139.3	112.3	137.0
Mols	11.1	10.0	8.0	9.8
R/FF	1.74	1.05	0.59	0.73

BROWNSVILLE RUN #17

Date	21 Hours 3-4-52	3-5-52	3-6-52	3-7-52	3-8-52	3-9-52	3-10-52	3-11-52	3-12-52	Shut Down 2 PM 3/13 8 Hours 3-13-52
Mols CO	100	100	100	100	100	100	100	100	100	100
Mols CO Conv.	84.13	67.17	66.46	70.94	63.51	66.30	56.55	63.43	67.78	65.57
Mols CO Unconv.	15.87	32.83	33.54	29.06	36.49	33.70	43.45	36.57	32.22	34.43
Mols H_2 from H_2/CO ratio	180.9	189.4	183.1	188.3	183.6	185.1	184.7	183.1	180.2	183.7
% H_2 Conv.	57.23	41.57	40.26	44.39	35.52	39.19	35.78	38.25	42.5	44.14
H_2 Unconv. %	42.77	58.43	59.74	55.61	64.48	60.81	64.22	61.75	57.50	55.86
H_2 Unconv. Mols	77.37	110.67	109.38	104.71	118.39	112.56	118.61	113.06	103.62	102.61
H_2 Unconv. Lbs.	154.74	221.34	218.76	209.42	236.78	225.12	237.22	226.12	207.24	205.22
In Product										
Wt. % H_2	3.86	5.52	5.51	5.28	5.95	5.73	5.98	5.77	5.23	5.19
Total Prod. Lbs.	4008.8	4009.7	3970.2	3966.2	3979.4	3928.7	3966.8	3918.8	3962.5	3954.1
Unconv. CO Lbs.	444.4	919.24	939.1	813.7	1021.7	943.6	1216.6	1024.0	902.2	964.0
Unconv. CO Wt. % Calc.	11.08	23.92	23.65	20.51	25.67	24.0	30.66	26.13	22.76	24.37
Wt. % Actual	10.99	22.75	23.49	20.35	25.48	23.84	30.44	25.91	22.58	24.18
CO_2 Wt. %	22.32	23.38	22.49	24.91	21.7	23.61	17.06	21.70	20.86	17.77
CO_2 Lbs.	894.8	937.5	892.9	988.0	863.5	927.6	676.7	850.4	826.6	702.6
CO_2 Mols (CO to CO_2)	20.3	21.3	20.3	22.5	19.6	21.1	15.4	19.3	18.8	16.0
Water Wt. %	19.87	11.97	12.10	12.53	12.23	12.25	13.73	13.57	16.98	20.88
Lbs.	796.5	480.0	480.4	497.0	486.7	481.3	544.6	531.8	672.4	825.6
Mols.	44.2	26.7	26.7	27.6	27.0	26.7	30.3	29.5	37.4	45.9
H_2 to H_20 Mol %	24.4	14.1	14.6	14.7	14.7	14.4	16.4	16.1	20.8	25.0
C_3+ Wt. % (incl. wsc)	14.50	10.97	10.73	10.18	8.54	9.66	8.34	7.64	9.49	7.76
Lbs.	581.3	439.9	426.0	403.8	339.8	379.5	330.8	299.4	376.0	306.8
Mols CH_2 (CO to C_3+)	41.5	31.4	30.4	28.8	24.3	27.1	23.6	21.4	26.9	21.9
CH_4 Wt. %	3.16	2.05	3.33	3.38	2.68	2.76	2.01	3.04	2.40	2.21
Lbs.	126.7	82.2	132.2	134.0	106.6	108.4	79.7	119.1	95.1	87.4
Mols (CO to CH_4)	7.9	5.1	8.3	8.4	6.7	6.8	5.0	7.4	5.9	5.5
C_2 Wt. %	2.41	1.94	2.04	2.00	1.76	1.83	1.39	1.73	1.88	1.63
Lbs.	96.6	77.8	81.0	79.3	70.0	71.9	55.1	67.8	74.5	64.5
(CO to C_2)	6.7	5.4	5.6	5.5	4.8	5.0	3.8	4.7	5.1	4.4
Oxy. Comps. Wt. %	2.87	2.60	2.57	2.95	2.24	2.30	2.30	1.93	2.33	2.42
Lbs.	115.1	104.3	102.0	117.0	89.1	90.4	91.2	75.6	92.3	95.7
Mols	8.2	7.4	7.3	8.4	6.4	6.5	6.5	5.4	6.6	6.8
R/FF	1.00	0.51	0.66	0.59	0.56	0.67	0.69	0.67	0.62	0.63

TABLE II

BROWNSVILLE REACTOR DATA

	Run #5	Sp. Vel.	C_3^+ Yield* BPH	C_3^+ Yield* BPH/MMSCF FF	Reactor Bed Temp.	Reactor Effluent T.	Reactor Btm. T. Feed	R/FF	Pressure Reactor Top	Cat. Holdup Tons	Cat. Dens.	Bed** Htg.	F.F. to Reactor MMSCFH	Tot. Feed	% Contr.	% H_2 + CO. Conv.	% Fe.	C_3^+/C_1^+ Selectivity	$\frac{(H_2)}{(CO)}$ $\frac{(CO_2)}{(H_2O)}$
	1/16/51	801	39.2	21.6	665		574	1.23	260	131	134	10.6	1.81	4.04	24.71	31.9	74.2		
	17	1012	42.0	19.5	630		610	1.10	305	137	137	10.6	2.16	4.54	23.66	34.2	71.8		
	18	972	40.3	18.9	647		639	1.08	310	183	150	10.9	2.13	4.44	22.93	33.8	74.0		
Proc.	19	- -	- -	- -	- -	- -	-No data-	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -		
Engr.	20	770	48.8	24.6	659		615	1.33	318	177	149	12.8	1.98	4.63	32.21	50.6	75.0		
Calcs.	21	782	50.1	24.9	659		610	1.34	318	178	150	12.8	2.01	4.70	34.47	53.7	74.3		
Water Sol.	22	840	51.2	23.7	646	No data	583	1.20	320	180	152	12.8	2.16	4.75	31.87	50.6	74.0	No data	No data
Chems.	23	707	49.5	23.2	612		579	1.30	320	203	145	14.9	2.13	4.90	28.15	44.5	72.7		
305#/Bbl.	24	761	49.8	23.2	610		554	1.31	320	210	154	14.0	2.14	4.95	30.22	48.6	76.8		
Ave.	2 days 17 & 18	992	41.2	19.2	639		625	1.09	318	160	144	10.8	2.15	4.49	23.30	34.0	72.9	No data	No data
Ave. 1st day Sep.	5 days 20 to 25	772	49.9	23.9	637		588	1.30	319	190	150	13.5	2.08	4.79	31.38	49.6	74.6		
	Run #6																		
	3/13/51	1365	35.6	11.8	660	660	624	0.59	310	131	128	11.0	3.03	4.80	34.85	53.1	--		
	14	1347	61.0	19.1	693	675	650	0.51	305	118	104	12.2	3.20	4.90	34.65	57.6	--		
	15	1222	59.8	18.5	653	670	630	0.42	305	121	99	13.1	3.24	4.60	37.30	58.7	75.0		
	16	--	--	--	645	645	610	--	305	153	105	15.6	--	4.80	--	--	75.2	No data	No data
	17	753	55.7	18.6	664	666	575	0.53	305	189	104	19.5	2.30	4.60	12.18	58.8	75.8		
	18	772	54.0	17.6	656	655	515	0.60	305	185	102	19.5	3.06	4.90	32.10	53.9	--		
	19	840	49.1	16.1	659	660	505	0.61	290	183	102	19.2	3.05	4.90	29.40	53.9	73.3		
Ave.	2 days 14 & 15	1285	60.4	18.8	673	673	640	0.47	305	120	102	12.7	3.22	4.75	35.98	58.2	75.0	No data	No data
Ave.	3 days 17,18,19	788	52.9	17.4	660	660	531	0.58	300	186	103	19.4	2.80	4.80	24.6	55.5	74.6		
	Run #7																		
	4/8/51	Data																	
	9	not																	
	10	worked up.																	
	11																		
	12																		
	13																		

* Including water sol. chemicals. Actg. Dept. WSC=318 #/Bbl.

** Effective reactor area= 187 sq. ft.

Run #8	Sp. Vel.	% H_2 Conv.	C_3+ Yield BPH	C_3+ Yield BPH/ MMSCF	Reactor Bed Temp.	Reactor Effl. Temp.	Reactor Btm. T.	R/FF	Pressure Reactor Top	Cat. Holdup Tons	Reactor Vel.	Cat. Dens.	Bed Htg.	FF to Reactor MMSCFH	Tot. Feed	% Contr.	% H_2+ CO Conv.	% Fe	C_3+/ C_1+ Select.	(H_2) $(CO_2$ / (CO) $(H_2O$
4/22/51	1197		74.9	25.1	675	680	270	1.50	365	132	0.50	112	12.6	2.981	7.463	47.5	66.1	75.6		
23	1272		79.15	25.4	675	678	285	1.40	365	122	.54	107	12.2	3.116	7.507	46.8	64.2	74.3		
25	1093		87.39	28.4	680	670	281	1.36	358	146	.50	112	14.0	3.074	7.240	47.1	68.5			
26	1141		93.36	28.9	670	684	360	1.29	355	147	.52	114	13.8	3.231	7.406	43.8	70.7	75.4		
27	1125		77.1	24.4	675	668	375	1.32	358	142	.50	108	14.1	3.157	7.348	50.1	68.4	76.7		
28	1148		96.11	29.8	670	670	380	1.21	359	138	.50	105	14.0	3.222	7.148	50.5	69.2	75.6		
29	1237		95.07	30.0	685	675	380	1.31	360	126	.50	105	12.8	3.168	7.342	47.0	65.2	74.9		
30	1030		83.94	26.0	678	679	380	1.26	360	154	.50	108	15.2	3.224	7.295	48.3	69.2			
5/1/51	1001		87.56	27.3	675	670	382	1.19	358	162	.50	110	15.7	3.205	7.010	48.3	70.9	74.3	78.6	2.402
2	1085		85.82	25.8	680	696	370	1.21	350	151	.51	106	15.3	3.326	7.353	48.6	71.5		76.3	2.336
3	1142		86.53	25.6	680	676	380	1.22	355	141	.51	104	14.5	3.382	7.528	45.8	70.0	74.7	76.9	2.265
4	1029		82.83	25.8	671	682	380	1.29	350	151	.54	106	15.2	3.216	7.374	47.7	69.9	73.9	78.0	2.681
5	1027		91.98	27.8	668			1.23	350	166	.51	112	15.8	3.307	7.394	48.8	71.6	74.0	79.3	2.666
6	1087		94.95	28.4	683			1.24	350	158	.51	110	15.4	3.339	7.477	47.4	71.0	70.7	79.17	2.697
7	1146		82.03	24.1	673		370	0.91	345	149	.51	110	14.5	3.402	6.514	43	67.4	73.2	75.81	3.582
8	1186		83.89	24.2	672	663	425	0.87	350	146	.51	108	14.5	3.460	6.467	38	63.8	73.9	75.56	3.878
9	1162		79.22	23.4	677	675	420	1.02	355	141		106	14.2	3.390	6.850	37.3	61.7	74.0	75.56	3.878
10	1188		82.46	23.8	660	671	395	0.94	365	145		107	14.5	3.465	6.715	36.1	62.5	73.2	74.35	3.110
11	1183		68.86	21.8	672	676		0.93	350	156		123	13.6	3.159	7.100	31.8	63.5	73.7	71.02	3.462
12	1081		64.49	21.1	669	669		.51	350	156		120	13.9	3.062	4.628	36.3	63.0	73.2	72.0	3.669
13	941		57.21	19.6	678	685		.68	350	163		114	15.3	2.924	4.906	34.3	61.0	74.9	67.33	4.092
14	979		55.19	18.6	680	674		.66	350	160		113	15.2	2.973	4.931	34.9	61.4	73.8	71.86	3.374
15 days Ave 22 to 7	1115		86.91	27.05	676	677	352	1.29	357	145		109	14.3	3.211	7.342	47.7	69.0	74.6	78.05	2.508
8 days Ave 7 to 15	1108		71.7	22.1	673	673	489	0.91	352	152		113	14.4	3.229	6.014	36.5	63.0	73.7	72.94	3.631
5 days 7 to 11	1167		78.49	23.46	671	671	402	.93	353	146		111	12.3	3.373	6.729	37.2	63.7	73.6	74.46	3.582
3 days 12 to 14	1000		58.96	19.76	676	676	605	.62	350	160		116	14.8	2.986	4.821	35.7	61.8	74.0	70.39	3.711
Run #9 6/5/51 10 Hrs.	1411	57.71	50.3	17.8	675	648	675		290	152	0.58	160	10.2	2.825	3.716	42.2	64.1	81.6	70.16	3.267
6	1384	48.97	57.1	20.3	660	643	630		350	156	.52	160	10.4	2.814	4.212	35.4	60.1	79.6	67.78	
7	2146	41.54	97.4	19.5	650	630	325		350	147	.88	141	11.2	5.003	7.779	30.6	51.9	78.4	81.23	6.475
8	2347	45.50	98.3	20.6	650	641	350	0.80	350	139	.98	139	10.7	4.769	8.609	35.5	53.0	77.5	75.65	4.649
9	2471	47.09	99.8	20.8	650	644	385	0.84	350	139	.92	156	9.6	4.806	8.196	37.1	58.5	77.1	73.43	5.758
2 days Ave 5 and 6	1398		53.7	19.1	668	646	652		320	154		160	10.3	2.820	3.964	38.8	62.1	80.6	68.97	3.267
3 days Ave 7,8 and 9	2321		98.5	20.3	650	638	353	0.82	350	142		145	10.5	4.857	8.195	34.4	54.5	77.7	76.57	5.63

Run #10	CO Conv.	Sp. Vel.	H_2 Conv.	C_3^+ BPH	C_3^+ BPH/ MMSCF	Reactor Bed Temp.	Reactor Effl. Temp.	Reactor Btm. T. Nozzle O	R/FF	Pressure Reactor Top	Cat. Holdup Tons	Reactor Vel.	Cat. Dens.	Bed Htg.	FF to Reactor MMSCFH	Tot. Feed	% Contr.		% H_2+CO Conv.	% Fe	C_3^+/C_1^+ Select.	$\frac{(H_2)}{(CO)}\frac{(CO_2)}{(H_2O)}$
24 Hrs. 7/21/51	76.77	699	51.84	51.3	20.4	600	600		1.69	350	254	.86	150	18.2	2.51	6.76	38.7		60.54	88.6	76.81	2.66
22	77.04	812	61.87	62.2	22.1	620	630		1.46	350	252	.77	158	17.1	2.82	6.48	39.5		66.85	84.7	70.96	2.40
23		761		'		600	630		1.39	350	248	.78	158	16.8	2.61	6.25	38.0			84.1		
24		769		'		600	614		1.47	350	245	.81	160	16.4	2.57	6.37	40.0			83.5		
25		791		No		610	636		1.38	350	233	.81	156	16.0	2.68	6.40	36.1			83.5		
26		736		data		600	639		1.78	350	230	.82	150	16.4	2.53	7.04	35.5			83.0		
27		827		'		590	626	455	1.63	350	223	.84	146	16.4	2.70	7.10	36.9			83.0		
28		919		'		600	627	460	1.32	350	218	.81	144	16.2	2.96	6.88	32.4			83.7		
29	68.63	849	51.33	58.9	22.0	620	591	470	1.60	350	213	.81	144	15.8	2.67	6.85	33.3		57.60	81.4	76.24	2.26
30	72.55	794	52.42	52.8	21.0	650	628	475	1.84	350	209	.85	142	15.7	2.51	7.14	37.9		59.65	81.4	74.57	3.39
31	54.96	807	41.08	47.2	19.1	640	644		1.85	350	208	.67	143	15.6	2.48	7.06	33.6		46.	81.5	89.04	1.222
Ave 4 days (11 day run) 1st day Sep.		816		55.3	21.1	633	624	465	1.69	350	221		147	16.1	2.62	6.91	36.1		57.5	82.3	77.52	2.39
Run #11																						
6 AM 11/11/51	85.3	826	63.3	75.2	28.1	647		495	1.49	350	231	.83	152	16.3	2.68	Gradual decrease	55.3	6.68	71.0	85.1	74.83	3.42
12	88.1	939	67.7	69.4	23.1	660	660	560	1.37	350	226	.84	154	15.7	3.00		56.2	7.12	74.9	83.5	70.55	2.89
13	86.6	999	67.2	75.2	24.4	655	655	430	1.31	350	220	.88	152	15.5	3.08		55.4	7.13	74.0	82.7	75.47	2.63
14	84.4	1019	65.0	80.5	26.0	645	655	431	1.42	350	213	.89	150	15.2	3.10		53.9	7.51	71.8	82.6	77.93	2.43
15	81.4	1014	61.3	82.1	26.7	630	660	475	1.53	350	210	.94	148	15.2	3.07		51.4	7.16	68.3	81.8	78.70	3.10
16	82.7	1073	63.4	69.9	23.3	650	630	412	1.43	350	203	.91	154	14.1	2.99		53.0	7.25	70.4	81.0	74.35	2.44
17	80.5	865	58.7	80.3	26.3	620	630	443	1.13	345	262	.84	158	17.8	3.05		48.8	6.50	66.6	80.1	75.51	2.62
18	80.8	988	62.0	82.4	27.3	640	590	465	1.36	350	255	.87	168	16.3	3.09		49.9	7.11	68.8		75.56	2.30
19	81.5	1054	63.8	83.0	25.7	655	650	410	1.16	350	248	.85	168	15.8	3.23		49.0	6.96	69.9	81.4	78.02	2.35
8 days Ave 12 & 20 1st day Sep.		994		77.9	25.4	644	641	453	1.34	350	230		157	15.7	3.08		52.2	7.09	70.6	81.9	74.55	2.68

Run #12	CO Conv.	Sp. Vel.	H_2 Conv.	C_3+ BPH	C_3+ BPH/ MMSCF	Reactor Bed. Temp.	Reactor Effl. Temp.	Reactor Btm. Temp.	R/FF	Pressure Reaction Top	Cat. Holdup Tons	Reactor Vel.	Cat. Dens.	Bed Htg.	FF to Reactor MMSCFH	Tot. Feed	% Contr.	% H_2+ CO Conv.	% Fe	C_3^+/C_1^+ Select.	$\frac{(H_2)}{(CO)}\frac{(CO_2)}{(H_2O)}$
11/29/51	82.41	1040	59.53	68.3	23.5	650	618	455	1.60	350	215	.97	162	14.2	2.91	7575	50.41	67.69	85.9	76.22	3.00
30	85.28	1081	65.36	81.6	26.9	650	648	468	1.41	350	210	.94	160	14.1	3.03	7298	53.75	72.51	86.1	78.92	2.49
12/1/51	85.87	832	66.92	73.1	24.2	660	628	478	1.31	350	210	.89	168	13.4	3.02	6975	50.46	73.62	85.4	76.76	2.31
2	85.11	882	66.71	76.1	25.4	650	638	473	1.41	350	281	.91	168	17.9	3.00	7222	51.07	73.19	82.6	77.93	2.17
4	84.48	891	66.56	76.1	26.2	630	645	470	1.40	350	252		166	16.3	2.90	6950	50.21	72.85	81.6	76.99	2.24
5	84.34	891	64.61	71.8	25.6	630	657	455	1.52	350	246		166	15.9	2.81	7067	49.76	71.50	81.5	74.91	2.74
6	86.13	918	67.45	68.5	24.5	650	670	447	1.50	350	243		168	15.5	2.80	6999	50.92	73.84	80.9	66.37	2.70
7	85.90	956	67.29	66.1	24.2	650	650	460	1.42	350	236		168	13.4	2.73	6598	41.60	73.53	80.5	71.40	2.69
~~3~~	~~85.22~~	~~820~~	~~65.21~~	~~78.2~~	~~28.9~~	~~650~~	~~648~~	~~470~~	~~1.55~~	~~350~~	~~266~~	~~.89~~	~~168~~		~~2.71~~	~~6916~~	~~51.66~~	~~72.23~~	~~82.4~~	~~77.53~~	~~3.22~~
Ave 29 & 30 - 2 days		1061		75.0	25.2	650	633	462	1.51	350	213		161	14.2	2.97	7436	52.1	70.1	86.0	77.60	2.75
6 days Ave 1 to 8		895		72.0	25.0	645	648	464	1.43	350	245		168	15.4	2.88	6969	49.0	73.1	82.1	75.59	2.48
Run #13																					
12/21/51	81.25	1004	61.55	77.6	27.3	640	615	545	1.55	330	195	1.0	150	13.9	2.84	7247	44.3	68.56	84.9	80.76	2.30
22	84.28	1050	64.65	73.5	26.6	620	606	455	1.65	350	188	.92	148	13.6	2.76	7345	54.4	71.49	85.4	77.40	2.87
23	82.84	1043	63.24	68.4	22.8	625	617	477	1.38	350	200	.90	150	14.3	3.00	7144	50.6	70.08	82.1	78.52	2.06
24	79.98	993	59.22	68.4	23.4	635	640		1.38	350	204	.88	150	14.6	2.93	6984	46.8	66.50	80.4	78.72	2.10
25	80.81	944	59.37	71.9	24.1	635			1.48	350	211	.88	148	15.3	2.98	7355	47.1	66.92	80.9	77.94	2.29
26	79.50	971	60.21	76.5	27.5	620	640	425	1.65	350	210	.95	148	15.2	2.79	7400	47.0	66.91	80.5	81.59	2.19
27	79.99	1128	58.06	81.0	25.5	620	630	450	1.32	350	200	.93	148	14.5	3.17	7359	46.8	65.73	80.3	79.98	2.57
28	77.27	1115	53.38	63.8	20.0	615		380	1.42	350	192	.98	146	14.1	3.17	7678	43.7	61.63	80.2	76.52	3.03
29	74.10	1071	51.27	61.3	20.4	612		450	1.47	350	183	.94	144	13.6	3.03	7483	43.1	59.16	79.9	80.92	2.91
30	75.66	1044	53.52	65.7	21.9	620			1.41	350	190	.92	144	14.1	2.99	7221	42.1	61.23	80.4	78.66	2.93
31	76.03	947	53.37	58.0	19.8	610		480	1.47	350	203	.91	146	14.8	2.92	7205	42.8	61.32	80.3	79.02	2.70
1/1/52	76.53	1039	54.45	63.4	21.3	660	625	480	1.40	350	200	.91	144	14.9	2.98	7165	43.7	62.08	80.7	78.88	2.88
2	76.85	1000	55.09	61.6	20.5	654	625	480	1.28	350	215	.84	158	14.5	3.02	6888	43.7	62.61	80.9	78.58	2.61
6 days Ave 22 to 28		1022		73.3	25.0	626	625	452	1.48	350	202		148	14.6	2.94	7260	48.8	67.9	81.6	79.00	2.36
6 days Ave 28 to 3		1036		62.3	20.1	629	625	454	1.41	350	197		147	14.3	3.02	7273	43.2	61.3	80.4	78.76	2.86
1st day Sep.		1029																			

Run #14	CO Conv.	Sp. Vel.	H_2 Conv.	C_3+ BPH	C_3+/BPH MMSCF F.F.	Aveg. bed by process	Reactor Bed Temp.	Reactor Effl. Temp.	Reactor Btm. Temp.	R/FF	Pressure Reactor Top	Cat. Holdup Tons	Reactor Vel. Ft./Sec.	Cat. Dens.	Bed Hgt.	FF to Reactor MMSCFH	Tot. Feed	% Contr.	% H_2+CO Conv.	% Fe	C_3^+/C_1^+ Select. %	$\frac{(H_2)}{(CO)}$ $\frac{(CO_2)}{(H_2O)}$
1/9/52	83.53	791	63.51	72.0	27.1		639	605	630	1.80	350	225	.95	146	16.5	2.65	7.44	50.15	70.49	82.9	81.0	2.375
10	83.27	801	61.74	61.4	24.1		671	620	480	1.74	350	210	.96	144	15.6	2.55	6.99	51.11	69.32	79.7	74.9	3.204
11	83.00	876	60.10	60.3	22.6		676	660	500	1.65	350	200	.92	144	14.9	2.65	7.04	46.34	68.06	79.8	76.1	3.227
12	82.09	872	57.05	65.9	25.9		676	660	525	1.68	350	190	.90	142	14.3	2.54	6.80	48.68	65.85	79.2	78.4	4.614
13	81.92	894	57.85	59.5	23.7		682	635	490	1.64	350	181	.87	140	13.8	2.50	6.61	47.64	66.31	79.4	76.0	4.10
14	83.25	867	61.46	57.9	24.1		669	660	475	1.87	350	172	.86	136	13.5	2.40	6.90	48.02	68.98	79.9	76.9	3.207
15	86.78	850	67.25	59.2	25.6		667	650	495	2.00	350	164	.90	134	13.1	2.31	6.93	56.76	74.06	80.0	77.5	2.396
16	86.54	924	67.21	57.0	24.0		671	650	460	1.95	350	156		130	12.8	2.38	7.03	52.26	74.00	79.7	78.8	2.066
17	85.92	1044	62.66	59.9	23.1		674	660	470	1.45	350	152		132	12.3	2.59	6.35	48.31	70.80	79.4	76.2	2.967
18	83.88	1003	61.78	58.5	23.3		667	645	445	1.75	350	143		124	12.3	2.51	6.91	49.48	69.50	79.5	77.3	2.453
19	84.94	978	62.83	59.9	23.0		669	635	470	1.80	350	115		130	11.5	2.60	7.28	48.99	70.55	80.2	75.9	2.738
20	85.53	1220	63.42	60.9	22.2		679	645	470	1.60	350	122		120	11.0	2.74	7.02	48.64	71.14	79.0	80.7	2.079
21	80.41	1734	56.91	63.5	18.9		669	645	450	1.13	350	106		116	9.5	3.35	7.13	42.86	65.00	79.8	76.1	2.45
22	74.34	2115	48.71	64.4	17.0		653	595	445	0.99	350	110	2.8	134	8.8	3.77	7.43	38.11	57.56	80.6	78.0	2.42
7 days Ave 10 to 17th		869		60.2	24.3		673	665	489	1.79	350	182		139		2.48	6.90	50.1	69.5	79.7	76.9	
3 days Ave 17,18 19 Others Sep.		1008		59.4	23.1		670	647	462	1.67	350	137		129		2.57	6.85	48.9	70.3	79.7	76.5	
Run #15																						
20½ Hrs. 2/2/52	91.19	1168	80.35	71.0	24.3	650	650	645	695	1.57	350	141	0.82	128	12.3	2.92	6.52	55.07	84.2	78.0	56.67	
3	83.70	1220	62.05	68.5	23.9	690	645	635	490	1.35	350	137	.84	126	11.5	2.86	6.70	46.19	69.7	80.3	75.15	
4	82.89	1280	60.15	74.5	18.8		640		500	0.73	350	133	.88	122	11.3	3.95	6.83	44.61	68.1	79.4	77.02	
5	79.81	1587	51.31	67.9	18.2	675	650	655	495	0.93	355	131	.90	120	11.5	3.73	7.21	38.03	61.3	79.9	67.99	
6	78.04	1769	50.58	81.4	18.3	700	690	650	470	0.76	380	129	0.98	114	12.3	4.45	7.82	40.72	60.1	77.5	70.96	
~~7~~	~~81.68~~	~~1809~~	~~53.87~~	~~111.7~~	~~24.6~~	~~700~~	~~670~~	~~650~~	~~455~~	~~0.83~~	~~380~~	~~129~~	~~1.1~~	~~112~~	~~12.3~~	~~4.53~~	~~8.28~~	~~40.37~~	~~63.7~~	~~79.6~~	~~76.99~~	
8	78.41	1676	53.68	75.5	18.4	700	650	650	540	0.65	250	140	1.18	124	12.0	4.10	6.76	29.42	62.3	78.3	65.99	
9	83.30	998	60.52	47.7	20.2	675	500	625	165	1.53	242	124	1.0	116	11.5	2.36	5.98	48.75	68.5	81.9	75.54	
10	82.62	1043	59.92	54.4	20.4	675	600	640	675	1.65	350	136	0.86	116	12.5	2.66	7.06	39.80	67.7	78.5	72.64	
10½ Hrs. 11	84.40	1114	61.59	57.4	22.8	675	630	640	470	1.78	350	132	0.87	128	11.0	2.52	7.02	45.97	69.6	78.2	74.60	
4 days Ave 3,9, 10 & 11		1094		57.0	21.8		594		450	1.58	323	132		122		2.60	6.69	45.2	68.9	79.7	74.6	
4 days 4,5,6 & 8 5 day period 1st day Sep.		1578		74.8	18.4		658		501	0.77	334	133		120		4.06	7.16	38.2	63.0	78.8	70.5	

H_2CO/ in FF	Run #16	CO Conv.	Sp. Vel.	H_2 Conv.	C_3+ Yield BPH	C_3 Yield BPH/ MMSCF FF	Reactor Bed Temp.	FF Preheat	R/FF	Pressure Reactor Top	Cat. Holdup Tons	Reactor Vel. Ft./Sec.	Cat. Dens.	Bed Hgt.	FF to Reactor MMSCFH	Tot. Feed	% Contr.	% H_2+ CO Conv.	% Fe	% C	C_3+/ C_1+ Select.
1.780	17½ Hrs. 2/19/52	82.44	818	56.98	51.9	22.2	650		1.74	350	153	0.78	120	13.6	2.34	6.40	58.1	66.1	80.9		72.7
1.824	20	81.38	1288	55.58	66.9	20.2	680		1.05	350	142	0.81	120	12.7	3.30	6.75	43.1	64.7	79.3		67.8
1.836	21	*76.81	1808	45.89	75.9	16.8	650		0.59	350	134	0.79	114	12.7	4.51	7.16	35.0	56.8	77.6		69.8
1.931	3½ Hrs. 22	75.19	1606	43.54	76.4	18.8	620	470	0.73	350	137	0.42	134	10.8	4.06	7.04	33.3	54.3	80.5		71.1
H_2CO/ in FF	Run#17																				
1.809	21 Hrs. 3/4/52	84.13	1414	57.23	63.4	20.8	685	640	1.00	350	91		94	10.5	3.043	6.08	47.06	66.80	78.9	9.0	72.25
1.894	5	67.17	2516	41.57	68.8	15.3	500	420	0.51	350	73		92	8.75	4.49	6.76	28.52	50.42			78.23
1.831	6	66.46	2357	40.26	63.5	15.1	650	580	0.66	375	68		86	8.25	4.20	6.98	32.77	49.52			66.64
1.883	7	70.34	2726	44.39	63.3	14.3	660	635	0.59	375	51		64	8.00	4.44	7.06	31.48	53.60			65.42
1.836	8	63.51	2552	35.52	53.7	12.1	675	640	0.56	375	83		104	8.50	4.42	6.92	28.90	45.39	no samples		65.82
1.851	9	66.30	2696	39.19	60.1	13.7	690	635	0.67	375	67		88	8.00	4.38	7.31	28.26	48.70			67.81
1.847	10	56.55	2614	35.78	55.1	12.2	665	635	0.69	375	50		58	8.50	4.52	7.65	24.08	43.08			71.08
1.831	11	63.43	2846	38.25	50.4	10.9	650	635	0.67	370	72		98	8.00	4.62	7.70	24.55	47.14			61.60
1.802	12	67.78	2708	42.5	62.6	13.7	645	635	0.62	375	55		72	8.25	4.56	7.40	30.68	51.52			68.73
1.837	8 Hrs. 13	65.57	3027	44.14	49.0	11.0	645	640	0.63	375	41		60	7.25	4.47	7.30	33.71	51.70			66.91

* Started reducing preheat temp. stepwise at 3 PM.

EFFECT OF SPACE VEL. IN LABS.

PR TDC802 37 P

TABLE V

Run No.	Sp. Vel.	C_3^+#/ MMSCF Y H_2+CO Fed.	% H_2+CO Present In Gas	C_3^+#/MMSCF of FF	C_3^+Bbls./ MMSCF *	H_2+CO Conv.%
46-1	2825	5960	91.51	5454	22.82	58.4
46-2	2314	6460	"	5912	24.84	64.6
46-3	2178	6640	"	6076	25.52	67.5
45-1	1646	7070	"	6469	27.18	71.4
49-2	1215	8210	"	7513	31.56	76.4
49-1	1072	8370	"	7659	32.18	78.0
29-3/6	939	8570	"	7842	32.95	85.1

* Use ave #/Bbl. of C_3^+ = 238#/Bbl.

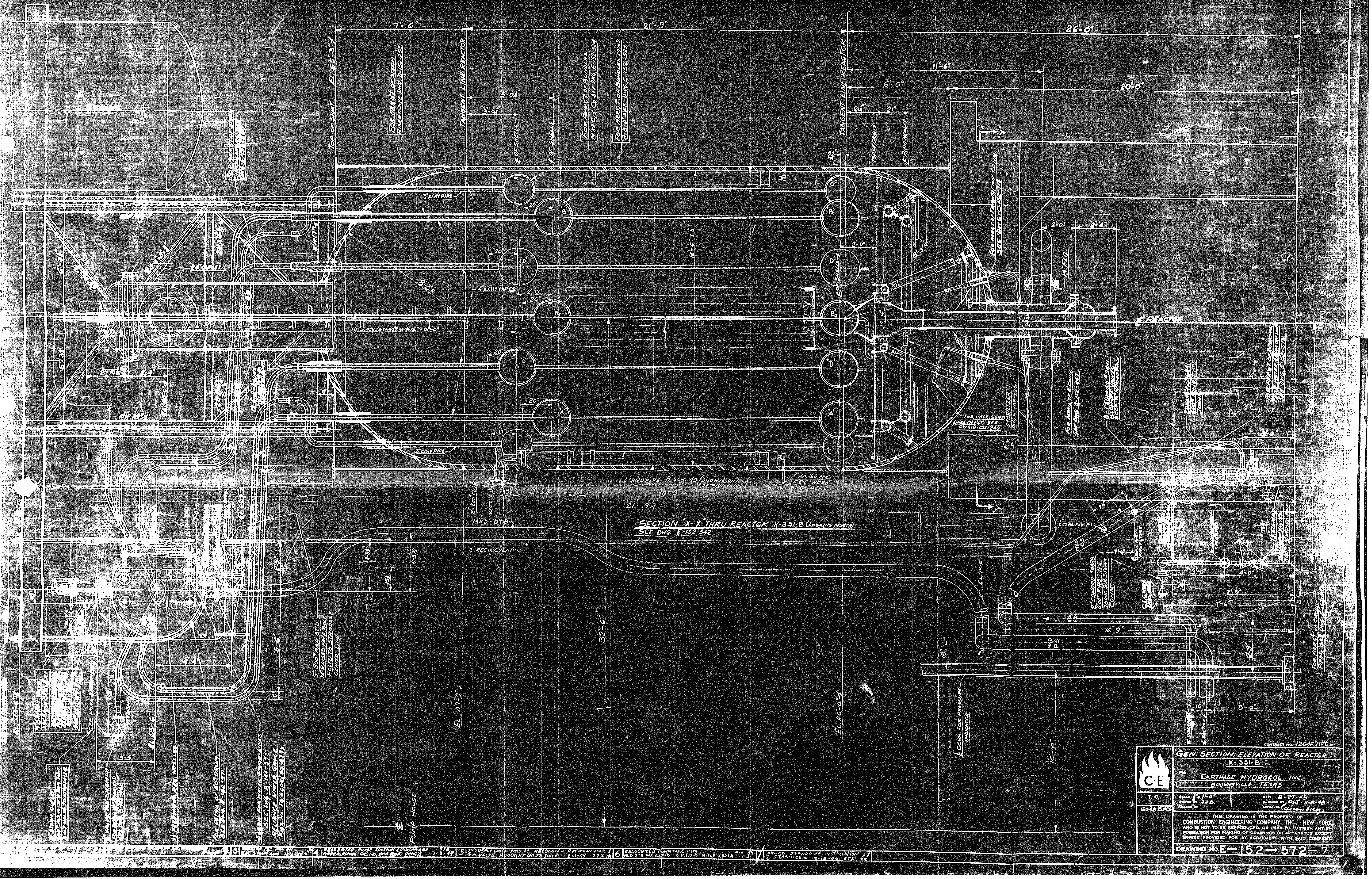
REFERENCE DRAWINGS

HYDROCARBON DRAWINGS.

NOZZLE ORIENTATION	350-K-Q-C
STRUCTURAL DETAILS	350-K-Q-D
STRUCTURAL DETAILS OF TOWER AT UPPER SKIRT	350-C-H-A
DETAILS OF GRID SUPPORT CASTINGS	350-K-F-L
ASSEMBLY SECTION THRU GRID	350-K-F-M
DETAILS GRID CASTINGS	350-K-F-N
ASSEMBLY PLAN OF GRID	350-K-F-O
TUBE & BUNDLE ARR'G'T	350-K-F-Q
TUBE LAYOUT	350-K-F-J
TYPICAL SECTION THRU, REACTOR	350-K-F-P

COMBUSTION ENG. DRAWINGS

DETAIL OF 60" STEAM DRUM	[illegible]
GEN. SECTIONAL ARR'G'T OF REACTOR	E-152-[illegible]
ARR'G'T OF TUBE BUNDLES MK'D A, B & D	E-152-570
ARR'G'T OF TUBE BUNDLES MK'D C & C'	E-152-574
ARR'G'T OF CIRCULATING PIPING	[illegible]
ARR'G'T OF INTERNAL FEED WATER LINES	D-152-240
ARR'G'T OF EXTERNAL FEED WATER & BLOW-OFF LINES	E-152-573
ARR'G'T OF STEAM CIRCULATORS	[illegible]-152-580
ARR'G'T OF STEAM RISERS	D-152-255
DETAIL OF DRUM HANGER ROD	C-146-453
SAFETY VALVE DISCHARGE PIPING	A-141-782
DETAIL OF TOP SPHERE FOR BUNDLES 'A' 'B' 'D'	D-152-239
DETAIL OF BOTTOM SPHERE FOR BUNDLES 'A' 'B' 'D'	D-152-235
DETAIL OF 19¼" OD SPHERES FOR BUNDLES 'C' & 'C''	E-152-53[illegible]
TOP & BOTTOM ARR'G'T OF [illegible]	E-152-535
SIDE ELEVATION OF REACTOR K-351-B	E-152-575
DET. & ASS'Y OF STANDPIPES	D-146-762



SECTION "X-X" THRU REACTOR K-351-B (LOOKING NORTH)
SEE DWG. E-152-542

4	RELOCATED PUMP SUCTION & DISCHARGE ADDED PIPING DC. No. AND REF. DWG'S 1-3-49 JJB
5	2" SUPPLY LINES WAS 2". RELOCATED RECIRCULATOR & S.H. VALVE, BROUGHT UP TO DATE 2-1-49 JJB
6	RELOCATED DOWNTAKE PIPE MKD-DTB FOR K351-B & MKD-DTA FOR K351A 4-11-49 CSJ
7	ADDED STANDPIPE INSTALLATION & STABILIZER 9-15-49 BTF

CONTRACT NO. 12048 BFCS

GEN. SECTION, ELEVATION OF REACTOR
K-351-B

FOR
CARTHAGE HYDROCOL INC.
BROWNSVILLE, TEXAS

T. C.
12048 BFCS

SCALE ¾" = 1'-0"
DRAWN BY J.J.B.
TRACED BY
DATE 8-27-48
CHECKED BY CSJ 11-8-48
APPROVED

DRAWING No. E-152-572-7

SUMMARY OF OPERATIONS

Run No.	Starting Date	Shutdown Date	Days Duration	Charge Rate - % of Design Capacity Reached			Production		Type of Gas Generator Burner	Type of Catalyst Charge % Reduced Catalyst		Cause of Shutdown	Corrective Steps Taken Prior to Succeeding Run
				Oxygen Plant (for 1 Unit) *	Generator *	Reactor (for 1 Reactor) *	Barrels Raw Primary Oil (Total Run)	Chemicals to Stanolind Lbs. per Day *		Start	Finish		
1	8-24-50	8-26-50	2	52 (58)	19 (23)	-	Nil		First Slot Type	0	0	Blade failure Steam Turbine Oxygen Plant V-201 B Air Compressor	1. Replacement of zirconia brick lining of generator combustion space with Alundun. 2. Oxygen slots of burners were filled by welding, and replacing by drilling smaller (5/16") holes.
2	9-16-50	9-17-50	1	63 (70)	21 (31)	-	Nil		Modified First Slot Type Field Drilled Oxygen Holes	0	0	Fire, resultant from split in 14" synthesis gas discharge line to B Reactor.	1. Extensive steps taken in Section 350 to avoid trapping of catalyst and to protect metal walls where it occurs, such as elimination of dead ends, removal of insulation from feed lines, installation of check and control valves, and new purge connections and lining inside bottom of reactors with insulating cement. 2. Repair of fire damage. 3. Changes in pipe work and instrumentation in Section 300 to avoid spontaneous fires in synthesis gas lines. 4. Installed gas oil flushing connections to eliminate plugging in M-352 Exchangers.
3	10-28-50	11-3-50	6	67 (72)	29 (31)	30 (-)	690		Same	0	0	Failure of Gas Generator Burner cooling water supply.	1. Installed emergency boiler feed supply to burner cooling water circuit and continuous use of 2 pumps in this service. 2. Replaced corroded 25-20 soot blower with chrome alloy and patched baffles and initiated engineering of water cooled soot blowers and refractory protected baffles. 3. Installed new slot type burners with 3 rows of oxygen holes and placed castable refractory on burners. 4. Installed small K-303 Gas Generator to permit reduction of catalyst between runs. 5. Resurfaced gasket area of M-352 Exchangers.

				Charge Rate - 1% of Design Capacity Reached			Production			Type of Catalyst Charge			
Run No.	Starting Date	Shutdown Date	Days Duration	Oxygen Plant (for 1 Unit) *	Generator *	Reactor (for 1 Reactor) *	Barrels Raw Primary Oil (Total Run)	Chemicals to Stanolind Lbs. per Day *	Type of Gas Generator Burner	% Reduced Catalyst Start	Finish	Cause of Shutdown	Corrective Steps Taken Prior to Succeeding Run
4	12-28-50	1-1-51	4	71 (73)	30 (33)	30 (-)	1461	-	Second Slot Type 3 Rows Oxygen Holes	25 50 Tons A.W. used in Run#3 142 Tons Raw A.W. 30 Tons 76% Fe A.W. 75 Tons 91% Fe A.W.	25	Failure of Thrust Bearing V-202 B Oxygen Compressor	1. Enlarged Balance Piston and Thrust Bearing on Oxygen Compressor V-202 B and made certain changes to oil system. 2. Installed cross-over piping so that the A & B Oxygen Compressors could be used on opposite units. 3. Retubed V-201 A Surface Condenser. 4. Installed Centrifix in low pressure Tower A Oxygen Unit. 5. Patched generator baffles and connected steam purge to oxygen header.
5	1-16-51	1-25-51	9	72 (76)	33 (35)	47 (63)	4167	36,840 (57,000)	Same	24 140 Tons used in #4 Added during run. (40 Tons MS Red. (to 88% Fe (40 Tons MS Red. (to 90.5%	44	Failure of Baffles and Soot Blowers due to corrosion.	1. Retubed V-201 B Surface Condenser and made miscellaneous changes to attempt increased capacity of oxygen unit. 2. Installed new water cooled soot blowers and refractory protected baffles in Gas Generator. 3. Installed new type slot burners with 2 rows oxygen holes. 4. Removed all steam bundles from both reactors, removed baffles from bundles, welded up holes in bundles and reassembled reactors without baffles.
6	3-11-51	3-20-51	9	80 (83)	38 (39)	58 (66)	6287	62,200 (68,800)	Third Slot Type 2 Rows Oxygen Holes	100 115 Tons Freshly reduced Mill Scale + 55 Tons red. cat. 100 Tons Mill Scale of red. cat. added during run.	80	Failure by burn-out of Gas Generator #5 Burner.	1. Plugging end oxygen holes to decrease exposure of slot cooling chamber. 2. Repaired castable refractory on #3 Baffle.

* Figures not in parenthesis are average for run.

* Figures in parenthesis are maximum attained during run.

INSERT

OVS

[2 PTS. .)

SUMMARY OF OPERATIONS

				Charge Rate - % of Design Capacity Reached			Production						
Run No.	Starting Date	Shutdown Date	Days duration	Oxygen Plant (for 1 Unit) *	Generator *	Reactor (for 1 Reactor) *	Barrels Raw Primary Oil (Total Run)	Chemicals to Stanolind Lbs. per day *	Type of Gas Generator Burner	Type of Catalyst Charge - % Reduced Catalyst. Start	Finish	Cause of Shutdown	Corrective Steps Taken Prior to Succeeding Run.
7	4-8-51	4-13-51	6	76 (83)	22 (40)	56 (62)	4,450	79,300 (1) (85,000)	Third Slot Type - plugged end holes	80	88	Sticking of air reversing valve Oxygen Plant - Oxygen Compressor kicked out.	1. Replaced #1 Burner. 2. Installed Perlite packing in Regenerator "A" Oxygen Unit. 3. Installed ferrules in holes of grid of "A" Reactor. 4. Modified seal system of V-202-B Oxygen Compressor.
8	4-21-51	5-15-51	24	83 (86)	40 (58)	62 (65)	22,391	103,000 (1) (134,000)	Same	100(2) 126 Tons used in #7 + 57 of freshly red. cat. 84% iron at beginning.	100	Failure of Gas Generator Burner.	1. Installed fourth slot-type burners (V-slot). 2. Replaced castable refractory on center and water cooled baffles of generator. 3. Repaired finger baffles. 4. Installed ferrules in holes of grid of "B" Reactor.
9	6-5-51	6-9-51	4	A 61 (67) B 72 (74)	52 (62)	80 (100)	3,059	74,000 (1) (109,500)	Fourth Slot Type - V Slot	100(2)	100	Bad start-up. Excessive soot blowing caused by by-passing of generator baffles.	1. Installed Enco finger baffles. 2. Reverted to use of Third type slot burners. 3. Installed new rotors in Recycle Compressors for higher compression ratio. 4. Modified seal system V-202-A Oxygen Compressor.
10	7-20-51	8-1-51	11	70 (72)	25 (26)	50 (52)	11,692(a)	66,630 (1) (75,200)	Third Slot Type - Same as Runs 7&8	100(3)	100	Hot spot in Boiler section of Generator.	1. Completely dismantled generator internals. Installed new brick piers and inconel shields at water tube wall joints. Installed new inconel baffles in steam bundles.
11	11-10-51	11-20-51	10	82 (87)	39 (40)	60 (63)	12,517(b)	98,250 (1) (106,800)	Third Slot Type - Inconel	100	100	Power failure shutting down Oxygen Plant. (Burners found with carbon toadstools and badly burned in Oxygen slots.)	1. Installed emergency power generator for Oxygen Plant. 2. Decided use 5% Steam in gas to generator and up to 500°F gas preheat and to raise temperature burner cooling water - all in effort reduce carbon forming tendency. 3. Replaced burners with new third slot type burners of same design.

* Figures in parenthesis are maximum for run, those not in parenthesis are average.

(1) Total Chemicals production:

Run 7 - 396,300	Run 10 - 737,300
Run 8 - 2,460,159	Run 11 - 982,500
Run 9 - 355,461	

(2) Theoretical only - batch was not started fresh.

(3) Reduced to 95% Fe.

(a) Includes 3,399 Poly Gaso.

(b) Includes 4,256 Poly Gaso.

11-26-51
FAM

SUMMARY OF OPERATIONS

				Charge Rate - % of Design Capacity Reached			Production			Type of Catalyst Charge			
Run No.	Starting Date	Shutdown Date	Days Duration	Oxygen Plant (for 1 Unit)	Generator	Reactor (for 1 Reactor)	Barrels Raw Primary Oil (Total Run)	Chemicals to Stanolind Lbs. per Day	Type of Gas Generator Burner	% Reduced Start	Catalyst Finish	Cause of Shutdown	Corrective Steps Taken Prior to Succeeding Run
				*	*	*		*					
12	11-28-51	12-7-51	9	79 (83)	36 (38)	58 (60)	9330 (1)	94,000 (2) (112,400)	Third Slot Type - Inconel	100 (3)	100	Tube failures on M-352 A&B Exchangers caused loss of Boiler Feed Water to K-301 Generator steam drum.	1. Installed automatic valve to tie generator boiler feed water line into 600 area. To provide boiler feed in emergency. 2. Installed gunite liners in channel and floating heads of M-352 Exchangers on K-351 B reactor and are Monel lining similar parts of M-352 Exchangers on K-351 A Reactor. 3. Planning installation of catalyst scrubbers on Reactor Effluent and attempting locate six field boilers to increase 175# steam availability.
13	12-20-51	1-2-52	13	83 (87)	34 (37)	62 (67)	10,246 (1)	89,500 (2) (113,000)	Third Slot Type - Inconel	100 (4)	100	Thrust bearing failure of third stage of V-202 A oxygen compressor.	1. V-202 B compressor with 12.5% over sized thrust bearing placed in service while V-202 A undergoing repairs. 2. V-202 A compressor third stage thrust bearing rebuilt with 50% larger bearing surface.
14	1-8-52	1-22-52	14	A B 71 52 (78) (58)	36 (48)	54 (76)	11,205 (1)	88,200 (2) (104,600)	Third Slot Type - Stainless Steel	100 (5)	100	Failure of "D" cooling water circuit on #3 burner.	1. Installed improved instrumentation for measuring generator burner pressure drop. 2. Finished installation acetylene absorbers on both oxygen plants. 3. Switched from K-351 B to K-351 A reactor in order stainless steel line channel and floating heads on reactor exchanger system (B Unit), since gunnite lining not giving desired corrosion protection.
15	2-1-52	2-11-52	10	70 75 (72) (82)	35 (48)	67 (91)	11,445 (1) 1313 BPD	90,800 (96,000) 16.6% of design	Third Slot Type - Stainless Steel without capillary tubes.	79 Tons from Run 14 & 121 Tons Reduced & 96% Cat. added during run was carbided before adding. Before run cat. conditioned and carbided.		Leak at upstream flg. of valve on inlet & M-352 A. Leak in #5 Burners. Niggerheads found on all burners. Installed 3 new burners.	
16	2-18-52	2-22-52	4	50 75 (68) (78)	38 (49)	71 (91)	3355 (1)	103,000 (106,900) 34.3% of design	Third Slot Type - Inconel. No capillaries.	104 Tons from previous run and 24 Tons new.		Hot Spot around generator nozzle due to running with two O_2 plts. All three burners badly burned at ends of slots.	
17	Started Generator 9 AM 3-3-52	3-13-52 2 PM Burner failure Leak in M-352								Entire run with low cat. level. Added 40 Tons 80% Fe poorly reduced cat. & a little more later didn't do any good.			

*Figures in parenthesis are maximum for run, those not in parenthesis are average.

(1) **Includes poly gasoline - Run 12 - 3070 Barrels** Run 14 - 2817 Barrels
Run 13 - 5093 Barrels

(2) **Total chemicals production Run 12 -** 800,000 Run 14 - 1,146,000
Run 13 - 1,165,000

(3) **Reduced to 96% Fe. - Same catalyst as used in Run 11.**

(4) **Comprised 130 tons used catalyst from Run 12 and 127 tons fresh reduced catalyst.** 60 tons reduced mill **scale and 49 tons reduced and carbided mill scale** added during run.

(5) **Comprised used catalyst from Run 13 plus 55 tons fresh reduced (245°F.) mill scale catalyst. Entire batch conditioned before run for 24 hrs. with fresh feed rate of 500 MSCFH in circulating natural gas stream at 620°F. bed temperature.**

Form CHB-118

TABLE 1

K-251-R REACTOR RUN #6 OPERATING & YIELD SUMMARY

PERIOD		13 MAR	14 MAR	15 MAR	16 MAR	17 MAR	18 MAR	19 MAR
Operating Conditions	Point No.							
Total Reactor Feed	MMSCFH	4.80	4.90	4.60	4.80	4.60	4.90	4.90
Synthesis Gas (1)	MMSCFH	3.03	3.20	3.24	-	[illegible]	3.06	3.05
Recycle Gas	MMSCFH	1.77	1.62	1.36	-	1.60	1.84	1.85
Reactor Top Pressure	PSI	310	305	305	305	305	305	290
Reactor Gas Feed	°F	420	516	535	540	440	540	560
Reactor Bed	°F	660	693	653	645	664	656	659
Catalyst Holdup	Tons	131	118	121	153	189	185	183
Catalyst Density	#/CF	128	104	99	105	104	102	102
% Fe in Catalyst		no sample	no sample	75.01	75.17	75.78	no sample	73.27
% Reduced Catalyst Charged to Reactor		100	100	100	88.38	79.85	79.85	79.85
Spare Velocity - V/V/Hr.		1365	1347	1222	-	753	772	840
RESULTS								
Conversion	CO	70.78	74.71	75.28	-	76.51	73.15	73.76
	H_2	43.54	48.138	49.24	-	48.53	43.36	42.49
	H_2+CO	53.08	57.62	58.67	-	58.79	53.89	53.86
Contraction	%	34.85	34.65	37.30	-	12.18	32.10	29.40
Production - Gals C_3 +/MSCF CO+H_2 FF		0.629	0.737	0.736	-	0.787	0.674	0.600
Yields - Output Basis		Wt.% BPH	Wt% BPH	Wt.% BPH		WT% BPH	WT.% BPH	WT. % BPH
CO		20.80	17.82	17.63		16.89	19.01	18.[illegible]
H_2		5.36	4.79	4.59		4.60	5.28	5.21
CO_2		~~36.75~~ 25.46	~~36.75~~ 25.29	~~32.43~~ 21.94		~~33.49~~ 23.62	~~29.12~~ 20.44	~~30.11~~ 28.38
N_2		4.05	3.31	4.33		4.30	4.74	5.87
CH_4		6.14 6.10	~~7.51~~ 2.93	~~9.12~~ 6.97		~~12.75~~ 10.97	~~6.03~~ 4.40	~~6.57~~ 4.83
C_2H_4		1.41	1.39	1.21		1.30	1.67	1.57
C_2H_6		0.80	0.81	0.66		1.11	0.74	0.80
C_3H_6		2.07 11.6	1.72 10.61	1.84 11.29		1.70 9.74	2.06 11.80	1.73 9.98
C_3H_8		0.59 3.36	0.97 6.10	0.59 3.68		0.77 4.52	0.42 2.45	0.75 4.41
C_4H_8		1.64 7.95	1.68 8.97	1.52 8.08		1.40 6.94	1.77 8.76	1.77 8.85
C_4H_{10}		0.18 0.92	0.29 1.61	0.59 2.84		0.29 1.50	0.46 2.36	0.34 1.77
C_5 + RPO		4.90 4.70	6.42 25.78	6.24 26.14		6.78 24.69	5.19 19.83	3.55 15.04
Water Soluble Chemicals (3)		2.20 22417#	2.24 25167#	2.23 2479#		2.55 2652#	2.69 2790#	2.74 2867#
Process Water (3)		13.11 7.10	14.50 7.91	16.91 7.84		10.74 8.34	10.77 8.77	12.08 9.02
	Tot C_3+ Incl Chems	55.63	60.95	52.83		55.73	53.27	42.07
(1) Calculated by Output Basis	Dom/mm	11.76	12.06	18.47		18.55	17.64	16.09
(2) Methane Bleed Gas Subtracted								
(3) Stanolind Data								

Note; Periods are 6AM To 6AM, except till 4:50AM March 20 for March 19 Period.

8-1 #1

TABLE 1

K-351-A REACTOR RUN #7 OPERATING & YIELD SUMMARY

PERIOD		22 Apr	23 Apr	24 Apr	25 Apr	26 Apr	27 Apr	28 Apr	29 Apr	30 Apr	1 May	2 [illegible]
Operating Conditions	Point No.											
Total Reactor Feed FI 303	MMSCFH	3.920	2.947	3.936	3.882	4.006	3.988	3.981	4.041	4.014	3.797	[illegible]
Synthesis Gas (1)	MMSCFH	2.981	3.114	3.368	3.074	3.231	3.157	3.222	3.68	3.224	2.205	3.3[illegible]
Recycle Gas from V-351	MMSCFH	.939 ~~3.543~~	.831 3.560	.568 ~~3.451~~	.904 ~~3.358~~	.775 ~~3.400~~	.831 3.360	.759 ~~3.167~~	.473 ~~3.301~~	.790 3.[illegible]	.792 ~~3.322~~	.678 ~~3.378~~
Reactor Top Pressure	PSI	7.472 ~~365~~	4.391 ~~365~~	~~380~~	4.166 ~~360~~	4.175 ~~360~~	4.191 ~~350~~	3.926 ~~339~~	4.194 ~~360~~	4.071 360	4.114 350	4.027 350
Reactor Gas Feed	°F	~~440~~	~~450~~	~~445~~	~~450~~	~~560~~	~~605~~	~~610~~	~~620~~	620	620	620
Reactor Bed	°F	675	675	670	680	670	675	670	685	670	675	695
Catalyst Holdup	Tons	132	122	115	146	147	142	138	126	154	152	15[illegible]
Catalyst Density	#/CF	112	107	105	112	114	108	105	105	109	110	10[illegible]
% Fe in Catalyst		75.6	74.3	74.3	no sample	75.34	76.71	75.56	74.94	No sample	74.3	No sample
% Reduced Catalyst Charged to Reactor		88.5			91.3					93.8		
Spare Velocity - V/V/Hr.		1197	1272	1399	1093	1141	1125	1148	1237	1030	1051	1085
RESULTS Selectivity		76.4	77.2	75.8	72.9	82.4	61.2	78.0	72.7	74.4	71.3	76.3
Conversion	CO	79.5	77.09	75.57	82.22	83.11	81.77	81.59	79.51	82.35	83.22	83.72
	H_2	53.28	56.80	54.62	60.26	63.42	60.40	61.66	56.57	61.44	63.45	63.34
	H_2 + CO	66.08	64.20	62.30	68.45	70.72	68.42	69.22	65.15	69.22	70.94	71.47
Contraction	%	~~47.5~~	46.8	46.4	47.1	43.8	50.1	50.5	47	[illegible].3	47.3	48.[illegible]
Recycle Ratio (total recycle:fresh feed)		1.5	1.41	1.22	1.36	1.32	1.33	1.22	1.32	1.29	1.26	1.23
Production-Gals C_3+/MSCF CO+H_2 FF		0.972	0.965	0.88	1.094	1.150	1.055	1.103	1.132	1.009	1.139	1.0[illegible]
Yields - Output Basis		wt% BPH	wt% BPH	wt% BPH	wt% BPH	wt% BPH	wt% BPH	wt% BPH	wt% BPH	wt% BPH	wt% BPH	wt% BPH
A		2.52	2.43	2.29	2.44	2.37	2.40	2.36	2.32	2.38	2.42	2.25
CO		15.16	16.96	18.4	13.19	12.44	13.53	13.48	16.8	13.[illegible]	12.4[illegible]	[illegible]
H_2		3.82	4.01	4.18	3.57	3.30	3.57	3.44	3.89	3.57	3.2[illegible]	3.2[illegible]
CO_2		~~33.16~~ 23.[illegible]	~~32.48~~ 23.41	~~31.29~~ 22.[illegible]	~~34.79~~ 22.15	~~31.40~~ 21.92	~~32.22~~ 23.01	~~32.14~~ 22.70	~~34.84~~ 22.6[illegible]	~~[illegible]~~ 21.97	~~[illegible]~~ 22.40	~~[illegible]~~ 22.04
N_2		3.94	3.79	2.89	2.67	3.29	3.26	3.27	3.13	3.51	3.[illegible]	[illegible]
CH_4		~~5.60~~ 4.05	~~5.34~~ 3.70	~~4.38~~ 2.98	~~3.67~~ 5.5[illegible]	~~5.43~~ 4.05	~~5.19~~ 3.75	~~5.56~~ 3.82	~~5.34~~ 3.52	~~5.73~~ 4.69	~~5.58~~ 3.59	~~5.47~~ 3.88
C_2H_4		1.41	1.71	1.37	1.93	1.46	1.62	1.70	1.60	1.59	1.68	[illegible]
C_2H_6		0.65	0.68	0.76	0.68	0.74	0.76	0.79	0.74	0.93	0.72	0.74
C_3H_6		2.30 13.28	1.96 11.58	2.09 13.21	2.36 14.18	2.31 14.18	2.30 14.4	2.31 14.2	2.45 15.15	2.43 16.09	2.[illegible] 13.4[illegible]	2.5 [illegible]
C_3H_8		0.63 3.70	0.64 3.85	1.04 6.69	1.59 3.64	0.62 3.84	0.68 4.24	0.78 4.[illegible]	0.73 4.62	0.68 4.2[illegible]	0.7 4.5	0.7 4.[illegible]
C_4H_8		1.91 9.52	1.94 9.94	1.64 8.99	1.73 8.90	2.59 13.74	1.77 9.39	2.04 11.07	1.88 10.07	1.78 [illegible]	2.[illegible] [illegible]	[illegible]
C_4H_{10}		0.32 1.65	0.34 1.00	0.35 1.96	0.73 3.87	0.32 1.76	0.31 1.71	0.33 1.6	0.34 1.87	0.29 1.[illegible]	[illegible]	[illegible]
C_5 + RPO		9.30 36.29	[illegible] 39.7[illegible]	7.59 33.54	10.87 [illegible]	16.63 46.81	[illegible] 34.52	10.77 44.51	11.12 56.13	9.1 [illegible]	[illegible] 43.9	[illegible]
Water Soluble Chemicals (2) 305#/Bbl		3.14 37.08	[illegible] 6.18 37.25	3.31 37.96	3.59 39.17	~~3.55~~ [illegible]	3.59 [illegible]	3.18 [illegible]	3.60 [illegible]	3.74 [illegible]	2.7 [illegible]	3.[illegible] [illegible]
Process Water (2)		11.14 10.51	15.44 12.20	15.27 11.75	16.25 11.[illegible]	18.39 13.01	17.18 13.13	17.11 14.52	15.84 11.27	16.4 [illegible]	24.53 13.03	14.92 17.27
Catalyst Bed Age - Days		29.7	30.7	24.1	26.1	26.1	27.1	28.1	20.1	2[illegible].1	2[illegible].1	[illegible]
(1) Calculated by Output Basis												
(2) Stanolind Data		74.9	79.15	76.73	89.32	93.36	77.1	96.11	95.07	83.94	87.56	85.82
Ton DPH BPH / MMSCF →		25.1	25.4	22.8	28.4	28.9	24.4	29.8	30.0	26.0	27.3	25.8

Form CHB-118

TABLE 1

K-351-A REACTOR RUN #7 OPERATING & YIELD SUMMARY

PERIOD		3 May 51	4 May 51	5 May 51	6 May 51	7 May 51	8 May 51	9 May 51	10 May 51	11 May 51	12 May 51	13 May 51
Operating Conditions	Point No.											
Total Reactor Feed FI 303	MMSCFH	4.038	4.034	3.932	3.959	3.980	3.952	3.985	3.997	4.437	4.628	4.906
Synthesis Gas (1)	MMSCFH	3.382	3.216	3.307	3.339	3.402	3.460	3.390	3.465	3.159	3.062	2.924
Recycle Gas from V-351	MMSCFH	.658 3.490	.818 3.340	.625 3.462	.620 3.518	.578 2.534	.492 2.515	.595 2.865	.532 2.718	.278 2.669	.564 [illegible]	.982 1.982
Tot. Recycle		4.148	4.158	4.087	4.138	3.112	3.007	3.460	3.250	2.947	[illegible]	2.964
Reactor Top Pressure	PSI	355	350	350	350	345	350	355	365	350	350	350
Reactor Gas Feed	°F	~~620~~	640	640	640	640	640	640	640	630	650	640
~~Reactor Bed~~	°F	680	671	668	683	673	672	677	660	672	669	678
Catalyst Holdup	Tons	141	151	166	158	149	146	141	145	156	15[illegible]	163
Catalyst Density	#/CF	104	106	112	110	110	108	106	107	123	120	114
% Fe in Catalyst		74.7	73.9	74.0	72.7	73.2	72.9	74.0	73.2	73.7	73.2	74.9
% Reduced Catalyst Charged to Reactor				95.5						96.8		
Space Velocity - V/V/Hr.		1142	1029	1027	1087	1146	1186	1162	1188	1183	1081	941
RESULTS Selectivity		76.9	73.0	79.3	79.2	77.67	75.81	75.56	74.35	71.02	72.0	67.33
Conversion	CO	83.04	82.96	84.30	83.8	78.76	79.47	77.24	77.95	79.19	77.94	79.49
	H_2	62.12	62.31	64.29	63.37	60.30	54.95	52.71	53.63	53.99	54.47	50.46
	H_2 + CO	70.0	69.91	71.64	70.99	67.38	63.81	61.71	62.48	63.46	63.01	61.0[illegible]
Contraction	%	45.8	47.7	48.8	47.4	43	38	37.3	36.05	31.81	36.3	34.3
~~Recycle Ratio (total recycle:fresh feed)~~		1.23	1.29	1.23	1.24	0.92	0.87	1.02	0.94	1.25	0.19	0.68
~~Production-Cals C_3+/MSCF CO+H_2 FF~~		1.039	1.084	1.159	1.176	0.999	1.007	0.958	0.967	0.915	0.856	0.785
Yields - Output Basis		Wt% BPH	Wt% BPH	Wt% BPH	Wt% BPH	Wt% BPH	Wt% BPH	Wt% BPH	Wt% BPH	Wt% BPH	Wt% BPH	Wt% BPH
A		2.31	2.37	2.36	2.32	2.41	2.44	2.41	2.29	2.44	2.30	2.37
CO		12.64	12.51	11.59	11.96	15.90	15.27	16.77	16.27	15.37	16.01	14.92
H_2		3.36	3.43	3.27	3.27	3.44	4.00	4.33	4.30	4.06	4.15	4.54
CO_2		~~31.48~~ 22.69	~~32.33~~ 22.45	~~31.71~~ 22.79	32.10 23.17	~~33.62~~ 25.23	~~34.48~~ 26.21	~~34.82~~ 25.73	~~33.12~~ 24.86	~~34.43~~ 25.84	~~35.75~~ 26.64	~~35.40~~ 26.97
N_2		3.39	3.03	3.59	3.69	3.18	3.56	3.52	2.32	3.89	4.28	4.71
CH_4		~~5.55~~ 3.60	~~5.65~~ 3.88	5.72 3.69	5.71 3.71	~~5.23~~ 3.36	5.09 3.83	~~5.87~~ 3.84	6.17 4.11	~~6.29~~ 4.43	6.22 4.31	[illegible] 4.22
C_2H_4		1.08	1.51	1.64	1.58	1.47	1.61	1.67	1.76	1.69	1.47	1.46
C_2H_6		0.78	0.74	0.78	0.73	0.81	0.66	0.64	0.69	0.79	0.70	1.00
C_3H_6		2.59 16.74	2.54 15.44	2.30 14.31	2.71 12.26	2.36 15.59	2.11 13.94	2.39 15.26	2.49 16.09	1.40 8.51	2.42 14.01	2.50 13.89
C_3H_8		0.72 4.73	0.62 3.86	0.72 4.33	0.74 [illegible]	0.56 3.79	0.58 3.94	0.71 4.60	0.53 2.52	0.55 3.39	0.57 3.94	0.57 3.25
C_4H_8		1.94 10.87	2.49 13.09	2.06 11.06	2.12 11.65	1.43 9.30	1.79 10.26	2.11 14.62	1.57 8.76	1.67 9.74	2.02 10.10	1.63 7.80
C_4H_{10}		0.53 1.92	0.26 1.54	0.32 1.76	0.60 3.4	0.35 2.02	0.46 2.65	0.24 1.34	1.0 5.75	1.64 7.90	0.72 3.70	.31 1.54
C_5 + RPO		15.96 34.87	8.87 55.54	10.24 43.24	9.48 44.11	7.86 32.44	8.43 37.90	7.32 31.02	7.30 32.26	[illegible]	[illegible] 44.5	4.53 16.88
~~Water Soluble Chemicals (2)~~		3.76 #4412	4.24 #4675	4.62 #5209	4.60 #5[illegible]	4.31 #3161	3.89 #4435	4.05 #4690	4.10 #4905	3.55 #3911	4.04 #4335	4.22 4.29
~~Process Water~~	(2)	21.04 14.41	18.79 17.36	19.10 17.03	18.51 17.[illegible]	16.87 18.49	14.51 15.20	13.17 15.38	16.01 14.09	15.33 12.42	14.37 13.97	14.97 13.94
Catalyst Bed Age - Days		24.5	19.7	20.7	21.7	22.7	23.7	24.7	18.7	19.7	20.7	21.7
~~(1) Calculated by Output Basis~~ (Tot DPH)		96.53	92.73	91.98	94.95	92.03	93.47	79.22	82.46	68.96	64.49	57.21
DPH/MMSCF		25.6	25.4	27.8	24.7	24.1	24.2	23.4	23.8	21.8	21.1	19.6

Sheet #3

TABLE 1

X-351-A REACTOR RUN .7 OPERATING & YIELD SUMMARY

PERIOD		14 May 51	15 May 51
Operating Conditions	Point No.		
Total Reactor Feed FI 303	MMSCFH	4.931	
Synthesis Gas (1)	MMSCFH	2.973	
Recycle Gas from V-351	MMSCFH		
Reactor Top Pressure	PSI	350	355
Reactor Gas Feed	°F	640	640
Reactor Bed	°F	650	680
Catalyst Holdup	Tons	160	157
Catalyst Density	#/CF	113	120
% Fe in Catalyst		73.8	74.3
% Reduced Catalyst Charged to Reactor			
Spare Velocity - V/V/Hr.		979	
RESULTS Selectivity		71.86	
Conversion	CO	7682	
	H_2	5276	
	H_2 + CO	6139	
Contractions	%	349	
Recycle Ratio (total recycle:fresh feed)		0.71	
Production-Gals C_3+/MSCF CO+H_2 FF		0.795	
Yields - Output Basis		wt% BPH	
A		2.28	
CO		16 66	
H_2		4 37	
CO_2		~~33.72~~ 25.14	
N_2		6 43	
CH_4		~~5.64~~ 3.84	
C_2H_4		1.60	
C_2H_6		0.67	
C_3H_6		2.16 11.98	
C_3H_8		0.66 3.76	
C_4H_8		1.81 8.68	
C_4H_{10}		0.48 2.36	
C_5 + RPO		4.95 18.27	
Water Soluble Chemicals (2)		3.78 30.89	
Process Water (2)		1493 10.13	
Catalyst Bed Age - Days		227	237
(1) Calculated by Output Basis			
(2) Stoneline Data		55.19	

18.6

2 Hr OFF

Form CHB-11[illegible]

Started 8PM R-351-1 [illegible] RUN 8 OPERATING & YIELD SUMMARY

		60.568 32.523		60.93 32.31		61.38 32.88		60.42 33.03		59.63 34.02	
PERIOD		2 10 Hrs 5 June 51		6 June		7 June		8 June		9½ Hrs 9 June	
Operating Conditions	Point No.							3447		3:15 PM 3031	
Total Reactor Feed FI 303	MMSCFH	3.766		4.212		† 7.779		5.097		4.407	
Synthesis Gas (1)	MMSCFH	2.825		2.814		5.003		4.762		4.826	
Recycle Gas from V-351	MMSCFH	1.293		[illegible]		1.55		3.318 0.51		3.310 0.63	
Reactor Top Pressure	PSI	290		350		350		350		350	
Reactor Gas Feed	°F	705		650		350		640		640	
Reactor Bed	°F	675		660		650		650		650	
Catalyst Holdup	Tons	152		156		147		139		139	
Catalyst Density	#/CF	160		160		141		139		156	
% Fe in Catalyst		80.55		79.6		78.4		77.5		77.1	
% Reduced Catalyst Charged to Reactor											
Space Velocity - V/V/Hr.		1411		1384		2146		2591		2471	
RESULTS Selectivity		70.16		67.78		81.23		75.43		73.43	
Conversion	CO	81.47		80.44		71.15		76.41		78.49	
	H_2	54.71		48.97		41.54		45.59		47.09	
	H_2 + CO	64.11		60.09		51.86		55.00		58.52	
Contraction	%	42.24		35.35		30.56		[illegible]		37.14	
Recycle Ratio (total recycle: fresh feed)		0.317		0.496		0.555		[illegible]		0.705	
Production-Gals C_3+/MSCF CO+H_2 FF		0.747		0.843		0.803		0.83		0.858	
Yields - Output Basis		Wt%	BPH	Wt%	BPH	Wt%	BPH	Wt%	BPH	Wt%	BPH
A		2.30		2.60		2.31		2.41		2.31	
CO		18.07		16.55		21.30		20.81		15.73	
H_2		4.44		5.00		5.80		5.19		4.86	
CO_2		~~34.55~~ 35.67		~~[illegible]~~ 32.39		~~33.09~~ 28.84		~~[illegible]~~ 26.57		~~[illegible]~~ 29.16	
N_2		3.04		3.34		3.29		2.91		3.13	
CH_4		~~6.15~~ 4.30		~~6.34~~ 5.15		~~3.58~~ 2.71		~~3.46~~ 2.90		~~2.44~~ 3.41	
C_2H_4		1.33		1.88		0.78		1.76		1.49	
C_2H_6		0.68		0.66		0.25		0.54		0.34	
C_3H_6		1.57	7.72	1.86	8.51	1.89	10.16	2.16	18.72	2.14	14.57
C_3H_8		0.61	3.20	0.62	3.22	0.60	5.70	0.51	4.50	0.59	5.50
C_4H_8		1.26	[illegible]	1.43	6.83	1.39	10.90	1.94	14.05	1.54	12.10
C_4H_{10}		0.31	1.43	0.55	2.60	0.23	1.88	0.44	5.07	0.42	3.79
C_5 + RPO		8.05	21.13	7.85	21.15	[illegible]	50.92	6.63	40.23	7.0	43.71
Water Soluble Chemicals (2)		1.80	5.26	2.94	8.4	2.25	11.66	2.94	14.35	3.07	15.48
Process Water (2)		19.44		8.37		9.30		11.20		11.43	
Cat Age Days		27.4		28.4		29.4		30.4		31.4	
(1) Calculated by Output Basis											
(2) Stanolind Data											

* 5 June 8PM to 6AM 6 June

** 9 June 6AM to 3PM 9 June

† Bartow at F[illegible]

Form CHB-118 Y0 ML

32.66 60.93 | 30.53 60.52 | 32.45 60.40 | 32.09 60.14 | 31.03 60.04 | 30.18 59.44 | 33.56 60.80 | 33.56 60.80 | 34.42 60.56 | 33.95 60.59 | 33.43 60.94 18 hrs + 35 mins 12 35 AM

TABLE 1

K-351-B REACTOR RUN ~~#9~~ 10 OPERATING & YIELD SUMMARY

12 Hrs

PERIOD		7/21/51	7/22/51	7/23/51	7/24/51	7/25/51	7/26/51	7/27/51	7/28/51	7/29/51	7/30/51	7/31/51
Operating Conditions	Point No.	GPM										
Total Reactor Feed PCR-301 FR-352	MMSCFH	6.76	6.48	6.25	6.37	6.40	7.04	7.10	6.88	6.95	7.14	7.06
Synthesis Gas (1) Reactor Effluent +	MMSCFH FFRate	2.51 4.25	2.82* 4.12	2.61 3.64	2.57 3.60	2.68 3.72	2.53 4.51	2.70 4.40	2.96* 3.92	2.67 4.28	2.51 4.03	2.48 4.58
Recycle Gas from V-351	MMSCFH R/FF	2.53 1.69	2.35 1.46	2.22 1.39	2.29 1.44	2.19 1.39	2.45 1.78	2.45 1.63	2.28 1.72	2.28 1.60	2.47 1.61	2.61 1.75
Reactor Top Pressure	PSI	350	350	350	350	350	350	350	350	350	350	350
Reactor Gas Feed	°F	625	625	640	640	640	660	660	660	660	660	640
Reactor Bed	°F	600	620	600	600	610	600	590	600	620	650	640
Catalyst Holdup	Tons	254	252	248	245	233	230	223	218	213	209	208
Catalyst Density	#/CF	150	158	158	160	156	150	146	144	144	142	143
% Fe in Catalyst		88.6	84.7	84.1	83.5	83.5	83.0	83.0	83.7	81.4	81.4	81.5
% Reduced Catalyst Charged to Reactor		100	No	additional	catalyst		added			→		→
Space Velocity - V/V/Hr.		699	812	761	769	791	736	827	919	849	794	807
Recycle ratio		1.69	1.46	1.39	1.77	1.38	1.78	1.63	1.32	1.60	1.84	1.85
Selectivity		76.81	70.96	-	-	-	-	-	-	76.24	74.57	89.04
Conversion	CO	76.77	77.04	-	-	-	-	-	-	68.63	72.55	54.96
	H_2	51.84	61.87	-	-	-	-	-	-	51.33	52.42	41.08
	$H_2 + CO$	60.54	66.85	-	-	-	-	-	-	57.60	59.65	46.00
Contraction	%	38.72	39.47	37.96	40.00	36.10	35.45	36.94	32.43	33.27	37.87	33.56
Recycle Ratio (total recycle:fresh feed)		1.70	1.30	1.40	1.48	1.39	1.78	1.63	1.32	1.60	1.84	1.83
Production-Gals C_3+/MSCF CO + H_2 FF		0.832	0.920	-	-	-	-	-	-	0.886	0.852	0.781
Yields - Output Basis		wt% BPH	wt% BPH							wt% BPH	wt% BPH	wt% BPH
A		2.2	2.14							2.0	2.0	1.58
CO		17.09	16.9							23.97	20.68	32.55
H_2		4.76	4.14							4.71	4.61	5.76
CO_2		23.69	21.89							20.07	25.56	11.76
N_2		1.43	2.75	←	NO	ANALYSES			→	4.0	3.7	2.61
CH_4		2.09	5.0							2.79	2.82	0.62
C_2H_4		0.58	1.41							1.23	1.41	0.52
C_2H_6		0.77	0.76							0.98	0.92	0.62
C_3H_6		2.19 9.9	2.11 10.0							2.34 11.5	1.83 8.4	1.49 6.7
C_3H_8		0.81 2.8	0.78 3.8							0.74 3.7	0.68 3.2	0.63 2.9
C_4H_8		1.93 7.6	1.98 8.1	-	-	-	-	-	-	1.77 7.5	2.26 9.0	1.76 6.9
C_4H_{10}		0.21 0.8	0.59 2.5	-	-	-	-	-	-	0.43 1.9	0.60 2.4	0.36 1.5
C_5 + RPO		7.56 23.7	8.89 28.9	-	-	-	-	-	-	7.44 24.7	6.06 19.8	6.34 19.2
Water Soluble Chemicals (2)	lb/hr	2.03 1669	3.16 2721	2758	2263	3133	2658	3021	2742	3.31 2946	3 1.28 3050	3.73 3058
Process Water (2)	lb/hr	12,124	15,625	14,000	13,792	13,021	10,029	14,604	11,646	12,646	10,783	14,233
		51.3	62.2							58.9	52.8	47.2
(1) Calculated by Output Basis		20.4	22.1							22.1	21.0	19.1
(2) Stanolind Data												

Periods are from 6AM Day Shown
To 6AM Next Day

obviously should be 3.28

COPY

Run #11

CARTHAGE HYDROCOL, INC.

P.O. BOX 1913

Brownsville, Texas

November 28, 1951

Mr. L. G. Kemp, Jr.
The Texas Company
135 East 42nd Street
New York 17, N. Y.

Dear Mr. Kemp:

The following letter presents history and identity of catalyst samples shipped to Beacon from the recent Run 10 11 on our K-351A Reactor. As noted below, a copy of this letter and its attachments has been sent to Dr. C. E. Moser at the Beacon Laboratories for his information.

Table 1 presents results of tests obtained locally on catalyst samples submitted, and Table 2 is a summary of results obtained on the reactor. The catalyst charge to the subject Run consisted of catalyst which had been reduced to 96% plus iron content prior to charging to the reactor. The catalyst was fluidised in the reactor for several days with a methane hydrogen mixture prior to introduction of synthesis gas at 12:30 P.M. on November 10th. Please advise if you desire any additional information on the catalyst samples covered by this letter.

Following termination of the above synthesis run on November 20th, the catalyst was retained in the reactor and kept in a fluidized state by circulation of methane and hydrogen. It is our intention to submit additional catalyst samples from the next reactor run for evaluation at Beacon

Very truly yours,

R. H. AITKEN
Superintendent

WRS:mr
Encl.
Cc: Mr. F. M. Dawson

Dr. C. E. Moser

TABLE 1

DESCRIPTION OF SAMPLES SENT TO BEACON

Sample No.	1	2	3	4	5	6
Lab. No.	B-30725	B-30740	B-30854	B-30940	B-31190	B-31464
Date	11-10-51	11-10-51	11-14-51	11-15-51	11-17-51	11-19-51
Time	12:00 N.	12:00 M.	10:00 AM	12:00 M.	12:00 M.	12:00 N.
Reactor Hrs.	0	12	94	132	180	216
% Fe	95.93	85.86	83.6	82.73	81.6	80.1
% K_2O	0.97	0.63	0.62	0.64	0.67	-
% C	-	5.2	6.7	7.0	7.3	6.9
Dry Sieve On 40	3.4	5.6	2.8	2.8	3.2	2.0
60	20.6	16.8	16.2	16.2	19.4	15.0
80	16.4	13.6	14.6	13.2	16.4	15.4
100	17.0	12.6	15.8	11.2	14.4	14.8
120	14.0	18.2	18.8	20.0	21.8	24.2
200	21.4	26.0	27.0	29.4	22.6	25.6
Pan	8.0	8.2	5.8	6.8	2.4	3.0

Form CHB-118

R-251A REACTOR RUN OPERAT[illegible] & YIELD SUMMARY

TABLE 2

[illegible]RIOD (6 AM - 6 AM)	11-11-51	11-12-51	11-13-51	11-14-51	11-15-51	11-16-51	11-17-51	11-18-51	11-19-51		
OPERATING CONDITIONS											
SYNTHESIS GAS - MMSCFH 3)	2.68	3.00	3.08	3.10	3.07	2.99	3.05	3.09	3.23		
RECYCLE GAS - MMSCFH	4.00	4.12	4.05	4.41	4.69	4.26	3.45	4.02	3.73		
RECYCLE RATIO	1.49	1.37	1.31	1.42	1.53	1.43	1.13	1.36	1.16		
REACTOR TOP PRESSURE-PSI	350	350	350	350	350	350	345	350	350		
REACTOR BED TEMP. - °F	647	660	655	645	630	650	620	640	655		
CATALYST HOLDUP - TONS	231	226	220	213	210	203	262	255	248		
" DENSITY - #/CF	152	154	152	150	148	154	158	168	168		
°/o Fe & °/o C	85.1 -	83.5 -	82.7/7.3	82.6/7.2	81.8/6.9	81.0/7.3	80.1/7.5		81.4/7.00		
SPACE VELOCITY - V/V/HR	826	939	999	1019	1014	1073	865	988	1054		
H_2/CO RATIO OR FRESH FEED	1.83	1.35	1.84	1.85	1.86	1.78	1.76	1.76	1.88		
CONVERSIONS-- CO °/o	85.3	88.1	86.6	84.4	81.4	82.7	80.5	80.8	81.5		
H_2 °/o	63.3	67.7	67.2	65.0	61.3	63.4	58.7	6.20	63.8		
$CO+H_2$ °/o	71.0	74.9	74.0	71.8	68.3	70.4	66.6	68.8	69.9		
CONTRACTION °/o	55.3	56.2	55.4	53.9	51.4	53.0	48.8	49.9	49.0		
SELECTIVITY C_3^+/C_1^+ °/o	74.8	70.5	75.5	77.9	78.7	74.3	75.5	78.6	78.0		
PRODUCTION - OUTPUT BASIS											
GALS C_3^+/M CF H_2+CO									2)		
COMPONENT YIELDS 1)	Wt% BPH	Wt% BPH	Wt°/o BPH	Wt°/o BPH	Wt°/o BPH	Wt°/o BPH	Wt°/o BPH	Wt°/o BPH	Wt°/o BPH		
A	2.23	2.11	2.07	2.04	2.13	2.20	2.16	2.26	2.14		
CO	10.62	8.73	9.95	11.50	13.82	12.85	14.58	14.30	13.44		
H_2	3.57	3.16	3.24	3.43	3.36	3.50	3.92	3.61	3.56		
CO_2	24.98	23.22	23.06	21.71	23.97	22.76	22.14	22.68	20.60		
N_2	3.33	3.02	3.54	3.11	3.13	3.85	3.32	3.16	2.90		
CH_4	3.31	4.01	3.37	2.94	2.95	3.50	3.40	3.18	3.21		
C_2H_4	1.67	1.85	1.50	1.51	1.39	1.44	1.48	1.54	1.72		
C_2H_6	0.98	1.13	1.08	0.90	1.05	1.00	1.09	1.11	1.02		
C_3H_6	2.76 13.5	3.09 16.8	2.35 15.9	3.09 17.4	3.00 16.0	2.17 12.0	3.17 18.0	2.43 14.1	2.39 14.1		
C_3H_8	0.89 4.5	0.92 5.1	0.92 5.2	1.02 5.9	0.96 5.4	0.67 3.7	1.20 6.9	0.77 9.5	.92 5.5		
C_4H_8	2.16 9.1	2.06 9.7	2.47 11.9	2.40 11.7	2.20 10.5	2.00 9.5	2.69 13.1	2.48 12.2	2.75 14.0		
C_4H_{10}	0.22 1.1	0.31 1.5	0.31 1.5	0.49 2.5	0.49 2.4	0.69 3.4	0.48 2.4	0.51 2.6	.24 1.3		
C_5^+ RPO	7.60 25.0	6.37 23.9	7.49 27.2	7.52 29.0	9.07 33.9	7.26 27.3	6.77 26.7	7.40 29.9	8.12 34.2		
WATER SOLUBLE CHEMICALS	4.06 11.4	3.99 12.4	4.24 13.5	4.30 14.0	4.22 13.3	4.45 14.0	4.08 13.2	4.33 14.1	4.14 13.9		
PROCESS WATER	19.25	23.78	22.74	22.20	16.33	20.36	18.34	19.62	20.11		

1) AERATION GAS SUBTRACTED FROM OUTPUT FIGURES ALSO CH_4 & CO_2 DATA ARE [illegible] EXCLUSIVE OF GAS GENERATOR
[illegible] BASIS 11-19 [illegible] MS ANALYSIS 3) CALCULATED ON AN OUTPUT BASIS

Run #12

January 3, 1951

Mr. L. C. Kemp, Jr.
The Texas Company
135 East 42nd Street
New York 17, N. Y.

blind: The Texas Company
<u>K-351-A Catalyst Samples</u>

Dear Sir,

Please refer to our letter of November 28, 1951 wherein we gave you operating data on Run No. 10 K-351-A Reactor, and tests on the samples of catalyst of different bed-life which were sent to Beacon Laboratory for possible evaluation. This letter gives similar data and tests for Run No. 11, November 28, 1951 through December 7, 1951.

Table I is a tabulation of results of tests on the catalyst samples and is self explanatory. Table II is a summary of results obtained on the reactor. The catalyst charge for this run was essentially the same as at the end of Run No. 10, previously covered, but the catalyst was kept fluidized with a mixture of methane and hydrogen prior to cutting in synthesis gas on November 28, 1951. Additional catalyst was added during the run.

Samples of catalyst are being sent to Beacon during the current Run No. 12 which started December 20, 1951 and similar data will be furnished in the near future.

Yours very truly,

Signed: V. K. BRANDENBURG

V. K. BRANDENBURG
Superintendent

WHR:ms
Encl.
cc: FMD
Dr. C.E.Moser, TTCO, Beacon

TABLE I

DESCRIPTION OF SAMPLES SENT TO BEACON

Date Caught	11-28-51	11-29-51	12-1-51	12-3-51	12-5-51	12-7-51
Time Caught	4:30PM	6:00AM	8:00AM	6:00AM	6:00AM	6:00AM
Bed Life Hrs	Zero	12	62	108	156	204
Lab No. B -	32087	32127	32426	32701	33068	33430
Sample No.	12-1	12-2	12-3	12-4	12-5	12-6
% Fe	90.71	85.52	84.16	81.93	81.36	81.73
% K_2O	0.52	0.51	0.40	0.61	0.70	0.71
% C	5.88	-	7.30	7.02	7.34	7.24
Dry Dieve						
On 40	2.4	2.8	2.2	1.8	3.0	2.0
60	15.4	16.6	16.8	15.6	25.2	15.8
80	14.8	15.0	14.8	15.2	16.6	16.0
100	9.6	9.0	8.6	10.4	5.6	9.8
120	23.2	24.2	25.4	25.8	29.2	22.6
200	30.8	28.6	31.2	29.0	19.2	31.4
Pan	3.6	3.6	2.8	3.0	1.0	2.2

TABLE 11

K-351-A REACTOR RUN 11 OPERATING & YIELD SUMMARY

DATE	11-29-51		11-30-51		12-1-51		12-2-51		12-3-51		12-4-51		12-5-51		12-6-51		12-7-51	
OPERATING CONDITIONS																		
SYNTHESIS GAS - MMSCFH 2)	2.91		3.03		3.02		3.00		2.71		2.90		2.81		2.80		2.73	
RECYCLE GAS - MMSCFH	4.66		4.26		3.95		4.22		4.21		4.05		4.26		4.20		3.87	
REACTOR TOP PRESSURE - PSI	350		350		350		350		350		350		350		350		350	
REACTOR BED TEMP. - °F	650		650		660		650		650		630		630		650		650	
CATALYST HOLDUP - TONS	215		210		210		281		266		252		246		243		236	
" DENSITY - #/CF	162		160		168		168		168		166		166		168		188	
% Fe & %C	85.9		86.1		85.4		82.6		82.4		81.6		81.5		80.9		80.5	
SPACE VELOCITY - V/V/HR	1040		1081		832		882		820		891		891		918		956	
H_2/CO RATIO OR FRESH FEED	1.80		1.78		1.83		1.84		1.85		1.84		1.86		1.92		1.90	
CONVERSIONS - CO %	82.41		85.28		85.87		85.11		85.22		84.48		84.34		86.13		85.90	
H_2 %	59.53		65.36		66.92		66.71		65.21		66.56		64.61		67.45		67.29	
$CO+H_2$ %	67.69		72.51		73.62		73.19		72.23		72.85		71.50		73.84		73.53	
CONTRACTION %	50.41		53.75		50.46		51.07		51.66		50.21		49.76		50.92		41.60	
SELECTIVITY C_3+/C_1+ %	76.22		78.92		76.76		77.93		77.53		76.99		74.91		66.37		71.40	
PRODUCTION - OUTPUT BASIS																		
GALS C_3+ /M CF H_2+CO																		
COMPONENT YIELDS 1)	Wt%	BPH	Wt%	BPH	Wt%	BPH	Wt%	BPH	Wt%	BPH	Wt%	BPH	Wt%	BPH	Wt%	BPH	Wt%	BPH
A	1.99		2.20		2.05		1.93		2.13		1.94		2.34		2.05		2.10	
CO	12.99		10.79		10.07		10.45		10.31		10.74		10.92		9.55		9.60	
H_2	3.88		3.26		3.11		3.10		3.24		3.08		3.31		3.10		3.18	
CO_2	23.90		21.47		19.65		17.90		20.09		17.47		19.16		17.76		18.22	
N_2	3.31		3.04		3.88		3.68		4.10		4.20		4.05		3.58		3.13	
CH_4	2.85		2.86		2.78		2.67		3.18		2.91		3.39		6.21		4.09	
C_2H_4	1.54		1.23		1.40		1.42		1.58		1.50		1.60		1.52		1.47	
C_2H_6	.95		.98		1.05		1.04		1.09		1.04		1.04		1.13		1.31	
C_3H_6	2.74		2.62		2.75		2.74		2.84		2.66		2.95		2.76		3.09	
C_3H_8	.82		1.69		.86		.83		.96		.97		1.04		.84		.94	
C_4H_8	2.04		2.32		2.11		2.21		2.95		2.65		2.31		2.30		2.36	
C_4H_{10}	.26		.36		.28		.2[illegible]		.41		.30		.30		.37		.33	
C_5+ RPO	7.21	262	7.71	30.2	6.70	26.2	7.48	29.1	8.68	31.2	7.60	29.2	7.22	26.2	6.99	25.2	6.73	23.4
WATER SOLUBLE CHEMICALS	4.06	12.4	4.30	13.8	4.57	14.7	4.58	14.7	4.34	12.6	4.08	12.8	4.21	12.6	4.22	12.5	3.74	10.7
PROCESS WATER	19.17	-	22.04	-	24.11		24.14		18.48		22.73		20.40		21.56		22.79	

1) AERATION GAS SUBSTRACTED FROM OUTPUT FIGURES ALSO CH_4 & CO_2 DATA ARE NET EXCLUSIVE OF GAS GENERATOR 2) CALCULATED ON AN OUTPUT BASIS

CARTHAGE HYDROCOL, INC
P O BOX 1913
BROWNSVILLE, TEXAS

GUY GEORGE GABRIELSON President
FRANK M DAWSON Executive Vice President
ALLEN K BREHM Vice President and Treasurer
R H AITKEN Vice President
ALBERT L WOLFE Secretary

January 25, 1952

TE[illegible] & RES DIV.
FEB 4 1952

	WEK	LK
	L[illegible]	[illegible]
	WA[illegible]	[illegible]
	GK	[illegible]
	TCH	F[illegible]S
	W[illegible]C	HF[illegible]
	WLD	M[illegible]D
3/5	L[illegible]	LC
	IFG	[illegible]H
	JHG	EJR
	WRH	[illegible]D
	[illegible]	GM
	PJK	Hd1

MEV

Mr. L. C. Kemp, Jr.
The Texas Company
135 East 42nd Street
New York 17, N. Y.

Dear Sir:

Please refer to the file of correspondence which covers operating data on previous Synthesis Reactor runs and tests on special catalyst samples submitted. This letter gives similar data for the Reactor Run No.12-A, Plant Run No. 13, December 21, 1951 to January 2, 1952 inclusive.

Table I is a tabulation of the results of tests covering six samples obtained as shown during the run. The catalyst in this reactor consisted of catalyst transferred from K-351-A used on the previous run (Reactor Run No. 11, Plant Run No. 12) and about 100 tons fresh catalyst. The catalyst was subjected to a "pretreating cycle" then to a 24-hour carbiding cycle immediately prior to starting the synthesis reaction and approximately 50 tons of fresh catalyst were added near the end of this run.

Samples of catalyst from Reactor Run 12-B, Plant Run 14 have been submitted to Beacon and operating data will be furnished in the near future.

Yours very truly,

RH Aitken

R. H. AITKEN,
Vice President

WHR:ms
Encl-2
cc: Dr. C.E.Moser,Beacon
Mr. du B. Eastman, Montebello

WMS-KGM
CFL

LCKJr (LJ) 2/7/52

TABLE I

DESCRIPTION OF CATALYST SAMPLES SUBMITTED

PLANT RUN NO. 13 REACTOR RUN NO. 12-A

Date Caught	12-20-51	12-21-51	12-23	12-26	12-29	12-31
Bed Life Hrs.	Note 1	Note 2	72 Hrs.	120 hrs.	188 hrs.	236 hrs
Lab No. B -	34271	34297	34584	34905	35274	35646
Sample No.	13-1	13-2	13-3	13-4	13-5	13-6
%Fe	90.4	83.5	81.6	80.5	80.2	80.9
$\%K_2O$	0.61	0.58	0.69	0.69	-	0.58
%C	3.4	4.2	6.0	7.3	7.50	6.5
Dry Sieve						
On 40	2.0	1.6	1.8	2.4	-	1.2
60	19.6	14.8	17.4	16.0	-	14.6
80	15.6	15.8	17.8	17.4	-	17.0
100	0.2	0.2	1.0	8.6	-	27.0
120	37.8	37.0	29.6	21.4	-	9.4
200	20.8	25.8	26.2	26.4	-	28.4
Pan	4.8	4.4	6.2	8.6	-	2.6

Note 1 - Sample obtained after "pretreating cycle" and before "carbiding cycle".

Note 2 - Sample obtained after "carbiding cycle" and prior to start of Synthesis.

PLANT RUN 13

K-351-B REACTOR RUN 12-A OPERATING & YIELD SUMMARY

TABLE II

Sheet #1

DATE	12-21	12-22	12-23	12-24	12-25	12-26	12-27	12-28	12-29
OPERATING CONDITIONS									
SYNTHESIS GAS - MMSCFH	2.84	2.76	3.00	2.93	2.98	2.79	3.17	3.17	3.03
RECYCLE GAS - MMSCFH	4.40	4.58	4.14	4.05	4.43	4.61	4.19	4.50	4.46
REACTOR TOP PRESSURE - PSI	330	350	350	350	350	350	350	350	350
REACTOR BED TEMPERATURE - °F	640 603	620 605	625 617	635	635	620 640	620 630	615 [illegible]	612
CATALYST HOLDUP - TONS	195	188	200	204	211	210	200	192	183
" DENSITY - #/CF	150	148	150	150	148	148	148	146	144
% Fe & % C	84.9 - 7.9	85.4 - 6.1	82.11 - 4.8	80.4 - 6.0	80.9 - 5.9	80.5 - 4.2	80.3 - 5.3	80.2 - 6.6	79.9 - 7.5
SPACE VELOCITY - V/V/Hr	1004	1050	1043	993	944	971	1128	1115	1071
H_2/CO RATIO OF FRESH FEED	1.81	1.87	1.86	1.85	1.83	1.89	1.86	1.89	1.89
CONVERSIONS - CO %	81.25	84.28	82.84	79.98	80.81	79.50	79.99	77.27	74.10
H_2 %	61.55	64.65	63.24	59.22	59.37	60.21	58.06	53.38	51.27
CO/H_2 %	68.56	71.49	70.08	66.50	66.92	66.91	65.73	61.63	59.16
CONTRACTION %	44.3	54.4	50.6	46.8	47.1	47.0	46.8	43.7	43.1
SELECTIVITY C_3/C_1%	80.76	77.4	78.52	78.72	77.94	81.59	79.98	76.52	80.92
Reactor Btm. Temp. Side Nozzle C	545 [illegible]	455	417			425	450	390	450

PRODUCTION -- OUTPUT BASIS

COMPONENT YIELDS	12-21 Wt%	BPH	12-22 Wt%	BPH	12-23 Wt%	BPH	12-24 Wt%	BPH	12-25 Wt%	BPH	12-26 Wt%	BPH	12-27 Wt%	BPH	12-28 Wt%	BPH	12-29 Wt%	BPH
A	2.03		2.31		2.13		2.08		2.00		1.98		2.08		2.23		2.17	
CO	13.31		11.11		11.97		13.99		13.51		14.15		13.87		15.86		17.64	
H_2	3.56		3.36		3.44		3.80		3.79		3.74		3.89		4.44		4.53	
CO_2	17.71		20.25		17.98		18.07		18.93		17.09		18.42		21.51		19.49	
N_2	2.95		3.62		3.44		3.28		3.21		3.19		3.43		2.76		3.49	
CH_4	3.00		3.26		2.20		2.31		2.62		1.85		2.07		2.29		1.34	
C_2H_4	1.21		1.51		1.54		1.36		1.45		1.46		1.51		1.46		1.43	
C_2H_6	.57		.94		.81		.84		.80		.80		.83		.75		.85	
C_3H_6	2.79	15.0	2.69	13.8	2.08	11.7	2.56	14.1	2.86	15.7	2.80	15.5	2.86	17.0	2.40	14.1	2.17	12.3
C_3H_8	.98	5.3	.93	4.8	.74	4.2	.97	5.4	.86	4.8	.92	5.2	1.33	8.1	.78	4.7	.75	4.4
C_4H_8	2.10	9.7	2.03	9.0	1.84	8.9	2.08	9.9	2.71	12.9	2.73	13.0	2.41	12.4	1.65	8.4	1.15	5.6
C_4H_{10}	.27	1.3	.32	1.5	.50	2.5	.19	.9	.28	1.4	.23	1.1	.76	4.0	.26	1.3	.26	1.3
C5/ RPO	10.88	37.0	9.24	31.8	7.28	27.6	6.83	25.4	6.46	24.4	7.40	28.7	6.54	26.9	5.61	22.0	6.18	22.9
WATER SOLUBLE CHEMICALS	3.04	9.3	4.33	12.6	4.21	13.5	4.04	12.7	4.05	12.7	4.12	13.0	3.72	12.6	3.97	13.3	4.57	14.8
PROCESS WATER	20.13	-	19.50	-	34.39	-	21.81	-	21.55	-	21.01	-	19.78	-	18.04	-	16.66	-
Tot. C_3+		77.6		73.5		68.4		68.4		71.9		76.5		81.0		63.4		61.3

PLANT RUN 13

K-351-B REACTOR RUN 12-A OPERATING & YIELD SUMMARY

TABLE II

Sheet #2

DATE	12-30		12-31		1-1-52		1-2-52									
OPERATING CONDITIONS																
SYNTHESIS GAS - MMSCFH	2.99		2.92		2.98		3.02									
RECYCLE GAS - MMSCFH	4.23		4.29		4.19		3.86									
REACTOR TOP PRESSURE - PSI	350		350		350		350									
REACTOR BED TEMPERATURE - °F	620		610		660		654									
CATALYST HOLDUP - TONS	190		203		200		215									
" DENSITY - #/CF	144		146		144		158									
% Fe & % C	80.4 - 6.7		80.3 - 6.7		80.7 - 5.8		80.9 - 5.8									
SPACE VELOCITY - V/V/Hr	1044		947		1039		1000									
H_2/CO RATIO OF FRESH FEED	1.89		1.90		1.89		1.89									
CONVERSIONS - CO %	75.66		76.03		76.53		76.85									
H_2 %	53.52		53.37		54.45		55.09									
CO+H_2 %	61.23		61.32		62.08		62.61									
CONTRACTION %	42.1		42.8		43.7		43.7									
SELECTIVITY C_3+/C_1+%	78.66		79.02 480		78.88 410		78.58 480									
PRODUCTION - OUTPUT BASIS																
COMPONENT YIELDS	Wt%	BPH	Wt%	BPH	Wt%	BPH	Wt%	BPH	Wt%	BPH	Wt%	BPH	Wt%	BPH	Wt%	BPH
A	2.14		2.17		2.11		2.08									
CO	16.62		16.32		16.03		15.81									
H_2	4.36		4.32		4.24		4.18									
CO_2	19.64		19.43		19.81		19.34									
N_2	4.02		3.84		3.17		3.13									
CH_4	2.18		1.64		1.56		1.49									
C_2H_4	1.42		1.27		1.80		1.77									
C_2H_6	.73		.88		.74		.73									
C_3H_6	2.14	11.9	2.35	12.9	2.52	14.1	2.48	14.1								
C_3H_8	.92	5.2	.91	5.1	.84	4.8	.83	4.8								
C_4H_8	1.63	7.9	1.39	6.6	1.74	8.4	1.72	8.4								
C_4H_{10}	.13	.6	.30	1.5	.20	1.0	.20	1.0								
C_5+ RPO	7.91	27.0	5.61	20.3	5.97	22.3	5.10	19.3								
WATER SOLUBLE CHEMICALS	4.10	13.1	3.71	11.6	4.02	12.8	4.33	14.0								
PROCESS WATER	16.73	--	18.51	--	17.85	--	19.43	--								
Tot C_3+		65.7		58.0		63.4		61.6								

OPERATING & YIELD SUMMARY OF

K-351-B REACTOR - RUN NO. 12-B

PLANT RUN NO. 14

WRS

HHM

HTJ

TABLE I

DESCRIPTION OF CATALYST SAMPLES SUBMITTED

PLANT RUN NO 14 REACTOR RUN 12-B

Date Caught	1-8-52	1-9-52	1-10-52	1-12-52	1-14-52	1-16-52	1-18-52	1-20-52
Bed Life Hrs	Note 1	Note 2	12	60	108	156	204	252
Lab No. B -	35998	36068	36153	36374	36657	37112	37220	37386
Sample No.	14-1	14-2	14-3	14-4	14-5	14-6	14-7	14-8
% Fe	84.8	81.3	79.9	80.1	79.9	79.2	79.5	79.2
% K_2O	0.55	0.49	0.31	0.29	0.39	0.15	9.29	0.30
% C	5.2	7.2	6.9	8.1	-	8.5	8.1	8.5
Dry Sieve Ana.								
On 40	1.2	1.6	1.2	2.2	2.8	2.0	1.6	1.4
60	10.2	11.4	11.4	15.6	18.0	16.4	14.8	12.2
80	13.6	13.0	14.0	15.0	18.2	17.2	17.2	16.6
100	23.8	20.6	24.6	29.2	28.8	27.4	29.2	35.6
120	8.2	10.8	9.8	4.2	6.6	8.4	9.0	6.4
200	31.2	31.4	29.0	28.6	24.4	27.6	27.8	26.2
Pan	12.6	12.0	9.4	5.8	1.6	1.4	1.2	1.2

Note 1 - This sample obtained at end of H_2 "Pretreat" and prior to "Carbiding cycle".

Note 2 - This sample obtained at end of "carbiding cycle" and just prior to start of Synthesis reaction.

* Process Engrs Operating Sum

* From here on Effluent Temp from "Operating Sum" Process Engrs

PLANT RUN 14
K-351-B REACTOR RUN 12-B OPERATING & YIELD SUMMARY

TABLE II

Sheet No. 1

Feed being cut down *

DATE	1-9-52	1-10-52	1-11-52	1-12-52	1-13-52	1-14-52	1-15-52	1-16-52	1-17-52
OPERATING CONDITIONS —									
SYNTHESIS GAS - MMSCFH	2.65	2.55	2.65	2.54	2.50	2.40	2.31 *	2.38	2.59
RECYCLE GAS - MMSCFH	4.79 7.74	4.44 6.99	4.39 7.04	4.26 6.40	4.11 6.61	4.50 6.90	4.62 6.93	4.65 7.03	3.76 6.35
REACTOR TOP PRESSURE - PSI	325	350	350	350	350	350	350	350	350
REACTOR BED TEMPERATURE - ° F	639	671	676	676	682	669	667	671	674
Reactor Effl Temp CATALYST HOLDUP - TONS	608 225 228	640 210 222	653 200 213	660 190 198	633 181 184	660 172 152	650 164 177	650 156 165	660 152 152
" DENSITY - #/CF	146	144	144	142	140	136	134	130	132
%Fe & %C	82.9 - 6.0	79.7 - 7.8	79.8 - 8.3	79.2 - 7.5	79.4 - 7.9	79.9 - 8.1	80.0 - 8.4	79.7 9.7	79.4 - 8.7
SPACE VELOCITY - V/V/Hr	791	801	876	872	894	867	850	924	1044
H_2/CO RATIO OF FRESH FEED	1.87	1.84	1.88	1.85	1.85	1.90	1.87	1.85	1.86
CONVERSIONS - CO %	83.53	83.27	83.00	82.09	81.92	83.25	86.78	86.54	85.92
H_2 %	63.51	61.74	60.10	57.05	57.85	61.46	67.25	67.21	62.66
$CO \neq H_2$ %	70.49	69.32	68.06	65.85	66.31	68.98	74.06	74.00	70.80
Reactor Btm Temp. CONTRACTION %	610 50.15	490 51.11	500 46.34	525 48.68	490 47.64	475 48.02	595 ? 56.76	460 52.26	420 48.31
SELECTIVITY $C_3 \neq C_1 \neq$ %	80.95	74.93	76.06	78.41	76.02	76.89	77.51	78.81	76.21
PRODUCTION - OUTPUT BASIS	Wt% BPH	Wt% BPH	Wt% BPH	Wt% BPH	Wt% BPH	Wt% BPH	Wt% BPH	Wt% BPH	Wt% BPH
COMPONENT YIELDS	wt% BPH								
A	2.05 ✓	2.26 ✓ 2.02	2.36	2.29 ✓	2.24	2.13	1.97	1.98	2.11
CO	11.14 ✓	11.49 ✓	11.7	12.36 ✓	12.74	11.48	9.06	9.48	9.90
H_2	3.22 2.32	3.48 ✓	3.71	3.94 ✓	3.95	3.61	3.02	3.07	3.51
CO_2	16.44	20.51 ✓	20.87	23.30 ✓	24.16	21.41	17.66	17.30	21.24
N_2	3.61 ✓	4.38 ✓	3.50	4.15 ✓	4.57	5.10	4.26	4.12	3.23
CH_4	2.40 ✓	3.36 ✓	2.72	2.55 ✓	2.89	2.54	2.79	2.15	2.74
C_2H_4	1.40 ✓	1.56 ✓	2.29	1.69 ✓	1.66	1.57	1.66	1.66	1.68
C_2H_6	.79 ✓	.90 ✓	.32	.86	.81	.79	.81	.84	.80
C_3H_6	2.51 ✓ 12.6	2.47 ✓ 12.0	1.59 7.9	2.74 13.1	2.43 11.7	2.39 10.7	2.76 12.0	2.07 9.3	2.46 11.9
C_3H_8	1.01 ✓ 5.2	.90 ✓ 4.5	.91 4.6	.93 4.6	.89 4.2	.85 3.9	.98 4.3	.85 3.9	.89 4.4
C_4H_8	1.98 8.6	1.36 ✓ 5.7	1.72 7.4	1.91 7.9	1.88 7.6	1.57 6.1	2.02 7.6	1.83 7.1	1.68 7.0
C_4H_{10}	.25 ✓ 1.1	.28 ✓ 1.2	.23 1.0	.25 1.0	.40 1.7	.35 1.4	.25 1.0	.31 1.2	.26 1.1
$C_5 \neq$ RPO 1949	9.13 +30.0 1.22 ✓ 4.8	7.70 24.5 1.43 ✓ 2.0	7.20 23.5 .84 3.3	7.90 25.0 1.60 3.8	6.70 20.6 1.32 4.9	5.86 17.5 1.72 3.51	6.27 18.5 1.22 4.2	6.15 18.0 1.92 6.8	6.08 18.5 1.07 4.2
WATER SOLUBLE CHEMICALS	10.74 3.39 ✓ 9.7	10.60 4.16 ✓ 11.5	9.75 4.46 12.6	11.28 3.82 10.5	10.29 3.35 8.9	11.09 4.21 10.8	11.38 4.65 11.6	11.47 4.19 10.7	10.62 4.26 11.8
PROCESS WATER	21.78 ✓ --	18.28 ✓ --	19.08 --	14.32 --	15.43 --	19.11 --	24.60 --	26.92 --	22.93 --
	37.0	36.9 61.4	36.4 60.3	40.9 65.9	39.0 59.5	40.4 57.9	40.7 59.2	39.0 57.0	40.4 59.9

PLANT RUN 14

K-351-B REACTOR RUN 12-B OPERATING & YIELD SUMMARY

TABLE II

Sheet No. 2

DATE	1-18-52		1-19-52		1-20-52		1-21-52		1-22-52	
OPERATING CONDITIONS										
SYNTHESIS GAS - MMSCFH	2.51		2.60		2.74		3.35		3.77	
RECYCLE GAS - MMSCFH	4.40	6.91	4.68	7.24	4.38	7.02	3.78	7.13	3.66	7.43
REACTOR TOP PRESSURE - PSI	350		350		350		350		350	
REACTOR BED TEMPERATURE - ° F	667		669		679		669		653	
Reactor Effluent	645		635		635		630		595	
CATALYST HOLDUP - TONS	143	153	115.	140	122	131	106	131	110	107
" DENSITY - #/CF	124	✓124	130		120		116		134	
% Fe & % C	79.5	8.9	80.2	4.9	79.0	11.2	79.8	9.1	80.6	9.5
SPACE VELOCITY - V/V/Hr	1003		978		1220		1734		2115	
H_2/CO RATIO OR FRESH FEED $\frac{58.92}{32.9}$	1.79		1.86		1.86		1.90		1.93-	$\frac{59.70}{30.92}$
CONVERSIONS - CO %	83.88		84.94		85.53		80.41		74.34	
H_2 %	61.78		62.83		63.42		56.91		48.71	
CO≠H_2 %	69.50		70.55		71.14		65.00		57.56	
Reactor Ch. Temp.	445		470		470		450		445	
CONTRACTION %	49.48		48.99		48.64		42.86		38.11	
SELECTIVITY C_3≠C_1 %	77.28		75.92		80.66		76.07		77.97	
PRODUCTION - OUTPUT BASIS	Wt%	BPH	Wt%	BPH	Wt%	BPH	Wt%	BPH	Wt%	BPH
COMPONENT YIELES										
A	1.97		2.10		1.89		1.92		1.89	
CO	11.03		10.40		10.02		13.60		17.82	
H_2	3.51		3.44		3.40		4.10		4.86	
CO_2	17.09		19.19		16.80		20.29		20.40	
N_2	3.63		4.25		3.76		3.47		3.06	
CH_4	2.58		2.94		1.83		2.25		1.25	
C_2H_4	1.63		1.61		1.48		1.55		1.48	
C_2H_6	.72		.76		.64		.62		.47	
C_3H_6	2.40	11.4	2.22	12.3	1.89	9.7	2.10	13.0	1.62	11.4
C_3H_8	.81	3.9	1.15	5.7	.73	3.8	.65	4.1	.56	4.0
C_4H_8	1.78	7.3	1.29	5.5	1.44	6.4	1.32	7.1	.91	5.5
C_4H_{10}	.31	1.3	.24	1.1	.40	1.8	.24	1.3	.11	7.7
	6.20	19.5	[illegible]	29.0	6.49	27.5	5.08	20.6	3.86	18.0
C_5 ≠ RPO	1.30	3.9	.29	1.1	1.08	4.4	.77	3.8	.77	4.3
WATER SOLUBLE CHEMICALS	10.99 4.13	11.2	9.55 4.36	12.2	10.07 4.53	13.3	8.98 3.86	13.7	7.34 3.37	13.5
PROCESS WATER	23.65	--	22.44	--	27.81	--	22.94	--	21.44	--
		39.0 58.5		37.9 59.9		39.9 60.9		43.0 62.5		46.4 67.4

K-351-A ~~REACTOR~~ PLANT RUN 15 OPERATING & YIELD SUMMARY TABLE II

Sheet No 1

DATE	2-2-52		2-3-52		2-4-52		2-5-52		2-6-52		2-7-52		2-8-52	
OPERATING CONDITIONS														
SYNTHESIS GAS - MMSCFH	2.92		2.86		2.95		3.73		4.45		4.53		4.11	
RECYCLE GAS - MMSCFH	3.60		3.84		3.88		3.48		3.18		3.75		2.65	
REACTOR TOP PRESSURE - PSI	350		350		350		355		380		380		250	
REACTOR BED TEMPERATURE - ° F	650		645		640		650		690		670		650	
CATALYST HOLDUP - TONS	141		137		133		131		129		129		140	
" DENSITY - #/CF	128		126		122		120		114		112		124	
% Fe & % C	77.95- 9.4		80.31- 11.3		79.43- 13.0		79.85- 11.2		77.47- 13.6		79.6 -13.2		78.33- 10.4	
SPACE VELOCITY - V/V/Hr	1168		1220		1280		1587		1769		1809		1676	
H_2/CO RATIO OF FRESH FEED	1.82		1.85		1.85		1.86		1.88		1.83		1.89	
CONVERSIONS - CO %	91.19		83.70		82.89		79.81		78.04		81.68		78.41	
H_2 %	80.35		62.08		60.15		51.31		50.58		53.87		53.68	
$CO+H_2$ %	84.20		69.66		68.12		61.26		60.13		63.20		62.25	
CONTRACTION %	55.07		46.19		44.61		38.03		40.72		40.37		29.42	
SELECTIVITY C_3+/C_1 %	56.67		75.15		77.02		67.97		70.96		76.99		65.99	
PRODUCTION - OUTPUT BASIS														
~~BASIS C_3+/ M CF H_2+CO~~														
COMPONENT YIELDS	wt% -	BPH	wt%	BPH	wt%	BPH	wt%	BPH	wt%	BPH	wt%	BPH	wt%	BPH
A	1.73		1.99		2.06		2.15		2.07		2.00		2.07	
CO	4.82		11.41		11.78		14.07		15.15		12.80		14.99	
H_2	1.42		3.54		3.66		4.58		4.60		4.24		4.06	
CO_2	9.94		20.79		20.76		25.77		24.66		24.03		23.31	
N_2	3.61		3.59		3.54		3.74		3.93		2.94		3.01	
CH_4	8.65		3.57		3.00		3.92		3.08		2.69		4.21	
C_2H_4	.54		1.44		1.63		1.57		1.64		1.72		1.78	
C_2H_6	1.09		1.67		.73		.68		.63		1.68		.78	
C_3H_6	1.99	12.5	1.71-	9.1	1.98	11.1	2.38	16.0	1.67	13.9	1.98	16.9	2.54	19.4
C_3H_8	.90	6.4	.78-	4.3	.81	4.6	.73	5.1	.53	4.5	.80	7.0	.83	6.4
C_4H_8	1.57	9.5	2.90	13.4	2.55	12.3	1.44	8.5	1.88	13.5	2.75	20.3	.92	6.1
C_4H_{10}	.38	2.4	.37	1.7	.28	1.4	.21	1.3	.32	2.4	.45	3.4	.31	2.1
C_5+ RPO	6.32	30.3	8.12	30.2	8.38	32.5	5.47	25.2	6.06	34.7	7.45	51.5	5.83	25.8
WATER SOLUBLE CHEMICALS	2.49	9.9	3.23 -	9.8	3.95	12.6	2.97	11.8	2.62	12.4	2.58	12.6	2.69	11.7
PROCESS WATER	21.04	—	20.22	—	18.49	—	14.73	—	14.95	—	17.01	—	15.49	—
		71.0		68.5		74.5		67.9		91.4		111.7		75.5
R/FF	1.23		1.34		1.32		0.93		0.76		0.83		0.64	

K-351- ~~REACTOR~~ PLANT RUN 15 OPERATING & YIELD SUMMARY TABLE II

Sheet 102

DATE	2-9-52		2-10-52		2-11-52	
OPERATING CONDITIONS						
SYNTHESIS GAS - MMSCFH	2.36		2.66		2.52	
RECYCLE GAS - MMSCFH	3.62		4.40		4.49	
REACTOR TOP PRESSURE - PSI	242		350		350	
REACTOR BED TEMPERATURE - ° F	500		600		630	
CATALYST HOLDUP - TONS	124		136		132	
" DENSITY - #/CF	116		116		128	
% Fe & % C	81.9 - 9.1		78.5 - 10.1		78.2 - 9.1	
SPACE VELOCITY - V/V/Hr	998		1043		1114	
H_2/CO RATIO OR FRESH FEED	1.87		1.91		1.86	
CONVERSIONS - CO %	83.30		82.62		84.40	
H_2 %	60.52		59.92		61.57	
$CO+H_2$ %	68.47		67.71		69.55	
CONTRACTION %	48.75		39.80		45.97	
SELECTIVITY C_3/C_1 %	75.54		72.64		74.60	
PRODUCTION - OUTPUT BASIS						
~~GALS C_3+ /M OF H_2/CO~~						
COMPONENT YIELDS	WT %	BPH	WT %	BPH	WT %	BPH
A	1.93		2.62		2.71	
CO	11.43		11.97		10.59	
H_2	3.64		3.80		3.20	
CO_2	18.04		19.63		19.42	
N_2	2.86		2.97		3.68	
CH_4	2.89		3.14		2.91	
C_2H_4	1.52		1.58		1.80	
C_2H_6	.77		.79		.80	
C_3H_6	2.41	10.7	2.58	12.4	2.27	10.9
C_3H_8	.77	3.5	.81	4.1	.78	3.8
C_4H_8	1.76	6.7	1.84	7.9	1.61	6.7
C_4H_{10}	.30	1.2	.30	1.3	.27	1.2
C_5+ RPO	5.16	15.4	5.56	18.5	7.04	23.2
WATER SOLUBLE CHEMICALS	4.03	10.7	3.61	10.2	4.25	11.6
PROCESS WATER	24.98	—	22.39	—	20.89	—
		47.7		54.4		57.4
RIFF	1.53		1.65		1.78	

TABLE I

DESCRIPTION OF CATALYST SAMPLES SUBMITTED

PLANT RUN NO.16

Date Caught	2-17-52	2-18-52	2-19-52	2-20-52	2-22-52
Bed Life Hrs	Note 1	Note 2	Note 3	24	72
Lab No. B-	39415	39477	39545	39642	39799
Sample No.	16-1	16-2	16-3	16-4	16-5
% Fe	86.07	87.57	83.5	79.71	80.48
% K_2O	1.45	0.78	0.69	0.48	0.52
% C	3.58	6.57	7.56	10.01	10.26
Dry Sieve Analysis					
On 40	0.8	0.2	1.0	0.8	1.2
60	7.8	11.0	12.0	9.8	10.6
80	11.2	16.0	17.6	14.6	16.4
100	11.2	13.0	14.4	12.2	13.4
120	7.6	9.2	11.0	8.6	9.2
200	31.0	31.6	28.4	35.8	38.8
Pan	30.6	19.0	15.8	17.6	11.4

Note 1 - This sample obtained at end of loading.

Note 2 - This sample obtained at end of H_2 "Pretreat" and prior to "Carbiding Cycle".

Note 3 - This sample obtained at end of "Carbiding Cycle".

TABLE 11

K-351-A PLANT RUN NO. 16 OPERATING & YIELD SUMMARY

DATE	2-19-52		2-20-52		2-21-52		-Note 1- 2-22-52						
OPERATING CONDITIONS													
SYNTHESIS GAS - MMSCFH	2.34		3.30		4.51		4.06						
RECYCLE GAS - MMSCFH	4.06	1.48	3.45	1.25	2.65	2.16	2.98	2.04					
REACTOR TOP PRESSURE - PSI	350		350		350		350						
REACTOR BED TEMPERATURE - °F	650		680		650		620						
CATALYST HOLDUP - TONS	153		142		134		137						
" DENSITY - #/CF	120	4.C	120		114		114						
% Fe & %C	80.86	11.5	79.33	12.3	77.60	11.3	80.48	10.3					
SPACE VELOCITY - V/V/Hr	818		1288		1808		1606						
H_2/CO RATIO OF FRESH FEED	1.780		1.824		1.836		1.931						
CONVERSIONS - CO %	82.44		81.38		76.81		75.19						
H_2 %	56.98		55.58		45.89		43.54						
CO≠H_2 %	66.14		64.71		56.79		54.34						
CONTRACTION %	58.08		43.09		35.04		33.26						
SELECTIVITY C_3≠C_1 ≠%	72.67		67.83		69.80		71.07						
PRODUCTION - OUTPUT BASIS	Wt%	BPH	Wt%	BPH	Wt%	BPH	Wt%	BPH					
COMPONENT YIELDS	wt%	BPH	wt%	BPH	wt%	BPH	wt%	BPH					
A	2.32		2.12		2.10		2.16						
CO	11.83		12.91		16.03		16.55						
H_2	3.71		4.04		4.94		5.24						
CO_2	22.97		~~23~~22.45		24.96		23.22						
N_2	5.52		4.15		3.51		3.80						
CH_4	2.75		4.04		2.84		2.97						
C_2H_4	1.82		1.70		1.61		1.68						
C_2H_6	1.08		.91		.68		.66						
C_3H_6	2.26	10.3	2.57	16.1	1.93	16.4	1.83	14.0					
C_3H_8	.67	3.1	.78	5.0	.57	5.0	.53	4.1					
C_4H_8	2.28	9.0	1.94	10.5	1.58	11.6	1.78	11.8					
C_4H_{10}	.59	2.4	.28	1.5	.28	2.1	.35	2.4					
C_5 ≠ RPO	5.44	17.30	5.11	21.8	4.63	26.8	5.41	28.5					
WATER SOLUBLE CHEMICALS	3.76	9.8	9.24 3.56	12.0	11.87 2.88	14.0	13.97 3.57	15.6					
PROCESS WATER	15.90 25.18	54.9	16.42	66.9	14.69	73.9	11.13	76.4					
	82.19		83.94		83.23		90.88						

Note 1 - Unit Shut-down 9:30AM 2/22/52 after 3½ hours on this operating day.

100% based H_2+CO in

TABLE I

DESCRIPTION OF CATALYST SAMPLES SUBMITTED

PLANT RUN NO. 17

Date Caught	3-3-52	3-4-52	3-5-52	3-14-52
Bed Life Hrs	Note 1	Note 2	24	Note 3
Lab No. B -	40286	40328	40404	41399
Sample No.	17-1	17-2	17-3	17-4
% Fe	84.5	79.3	75.9	75.6
% K_2O	0.49	0.30	0.54	0.38
% C	9.25	13.0	11.3	12.3
Dry Sieve Analysis				
On 40	0.6	2.0	12.0	1.4
60	10.2	10.0	15.2	12.6
80	19.4	18.0	25.6	59.4
100	11.4	8.4	7.2	0.2
120	7.4	7.0	2.6	0.4
200	37.0	32.4	29.6	24.2
Pan	14.2	21.0	18.0	1.4

Note 1 - This sample caught at end of "Pretreat" cycle. See attached letter.

Note 2 - This sample caught at end of "Carbiding" cycle. See attached letter.

Note 3 - This sample caught when emptying Reactor at end of Run 17. No intermediate samples obtained due to low bed level in Reactor.

K-351-A REACTOR RUN 17 OPERATING & YIELD SUMMARY

TABLE II

DATE	3-4-52		3-5-52		3-6-52		3-7-52		3-8-52		3-9-52		3-10-52		3-11-52		3-12-52		3-13-52	
OPERATING CONDITIONS																				
SYNTHESIS GAS - MMSCFH	3.04		4.49		4.20		4.44		4.42		4.38		4.52		4.62		4.56		4.47	
RECYCLE GAS - MMSCFH	3.04		2.27		2.78		2.62		2.50		2.93		3.13		3.07		2.84		2.83	
REACTOR TOP PRESSURE - PSI	350		350		375		375		375		375		375		370		375		375	
REACTOR BED TEMPERATURE - °F	685		500		650		660		675		690		665		650		645		645	
CATALYST HOLDUP - TONS	91		73		68		51		83		67		50		72		55		41	
" DENSITY - #/CF	94		92		86		64		104		88		58		98		72		60	
% Fe & % C	78.9	9.0	-- *		-- *		-- *		-- *		-- *		-- *		-- *		-- *		-- *	
SPACE VELOCITY - V/V Hr	1414		2516		2357		2726		2552		2696		2614		2846		2708		3027	
H_2/CO RATIO OF FRESH FEED	1.809		1.894		1.831		1.883		1.836		1.851		1.847		1.831		1.802		1.837	
CONVERSIONS - CO %	84.13		67.17		66.46		70.94		63.51		66.30		56.55		63.43		67.78		65.57	
H_2 %	57.23		41.57		40.26		44.39		35.52		39.19		35.78		38.25		42.50		44.14	
$CO{\neq}H_2$ %	66.80		50.42		49.52		53.60		45.39		48.70		43.08		47.14		51.52		51.70	
CONTRACTION %	47.06		28.52		32.77		31.48		28.90		28.26		24.08		24.55		30.68		33.71	
SELECTIVITY $C_3{\neq}C_1{\neq}$ %	72.25		78.23		66.64		65.42		65.82		67.81		71.08		61.60		68.73		66.91	
PRODUCTION - OUTPUT BASIS	Wt%	BPH	Wt%	BPH	Wt%	BPH	Wt%	BPH	Wt%	BPH	Wt%	BPH	Wt%	BPH	Wt%	BPH	Wt%	BPH	Wt%	BPH
COMPONENT YIELDS																				
A	2.13		2.13		2.12		2.12		2.18		2.05		1.93		2.10		2.05		1.88	
CO	10.99		22.75		23.49		20.35		25.48		23.84		30.44		25.91		22.58		24.18	
H_2	3.86		5.52		5.51		5.28		5.95		5.73		5.98		5.77		5.23		5.19	
CO_2	22.32		23.38		22.49		24.91		21.69		23.61		17.06		21.70		20.86		17.77	
N_2	3.89		2.83		2.93		3.20		3.24		3.36		3.17		3.27		2.84		2.95	
CH_4	3.16		2.05		3.33		3.38		2.68		2.76		2.01		3.04		2.40		2.21	
C_2H_4	1.74		1.56		1.55		1.54		1.35		1.26		1.11		1.28		1.34		1.32	
C_2H_6	.67		.38		.49		.46		.41		.57		.28		.45		.54		.31	
C_3H_6	2.81	16.3	1.37	11.4	2.02	15.9	2.14	17.6	1.33	11.1	2.11	17.2	1.75	14.9	1.58	13.6	1.35	11.7	1.66	13.9
C_3H_8	.88	5.2	.41	3.5	.47	3.8	.48	4.1	.57	4.9	.60	5.0	.82	7.1	.38	3.3	.46	4.0	.47	4.0
C_4H_8	1.60	8.0	1.77	12.7	1.34	9.2	1.34	9.5	1.17	8.4	1.28	9.0	1.11	8.1	1.02	7.6	1.49	11.2	.98	7.1
C_4H_{10}	.25	1.3	.23	1.7	.23	1.6	.34	2.5	.30	2.2	.17	1.2	.49	3.7	.36	2.8	.33	2.6	.10	0.7
$C_5{\neq}$ RPO	6.09	23.1	4.59	27.10	4.10	21.4	2.93	15.8	2.93	16.5	3.20	17.0	1.87	10.3	2.37	13.6	3.53	21.6	2.13	11.7
WATER SOLUBLE CHEMICALS	2.87	9.5	2.60	12.4	2.57	11.6	2.95	13.8	2.24	10.6	2.30	10.7	2.30	11.0	1.93	9.5	2.33	11.5	2.42	11.6
PROCESS WATER	19.87	-	11.97	-	12.10	-	12.53	-	12.23	-	12.25	-	13.73	-	13.57	-	16.98	-	20.88	-

* No Sample obtained due to low bed level in Reactor.