John Haz

15/06/008/006

# Mobil Research and Development Corporation

RESEARCH DEPARTMENT
PAULSBORO, NEW JERSEY 08066

S. L. MEISEL
MANAGER
APPLIED RESEARCH & DEVELOPMENT

September 1, 1967

K. L. Berry - Pan American Petroleum Corp.
G. A. Blaine - Sinclair Research, Inc.
F. R. Conley - Continental Oil Company
H. P. Dengler - Esso Research & Engineering Co.
R. T. Ellington, Jr. - Sinclair Gas and Oil Company
K. M. Elliott - Mobil Research & Development Corp.
R. Mungen - Pan American Petroleum Corp.
D. C. Smith - Phillips Petroleum Company
J. H. Smith - Continental Oil Company
R. V. Smith - Phillips Petroleum Company
W. O. Taff - Humble Oil & Refining Company

Gentlemen:

Attached is a copy of the minutes of the third special Oil Shale Technical Advisory Committee meeting held in Chicago, Illinois, on August 15, 1967.

S. L. Meisel

S. L. Meisel

ses
Attachment

cc: R. H. Cramer

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MINUTES OF THE THIRD SPECIAL MEETING
OF THE
OIL SHALE TECHNICAL ADVISORY COMMITTEE

O'Hare Inn
Chicago, Illinois

August 15, 1967

The meeting was convened at 8:45 a.m. with the following committee members in attendance:

K. M. Elliott, Chairman, Mobil Research & Development Corp.
S. L. Meisel, Mobil Research & Development Corp.
W. O. Taff, Humble Oil and Refining Company
F. R. Conley, Continental Oil Company
J. H. Smith, Continental Oil Company
R. T. Ellington, Sinclair Oil and Gas Company
G. A.Blaine, Sinclair Research, Inc.
R. V. Smith, Phillips Petroleum Company
R. Mungen, Pan American Petroleum Corporation

F. R. Conley replaced W. L. Jensen as a representative from Conoco. K. L. Berry of Pan American and D. C. Smith of Phillips were absent.

K. M. Elliott announced that since the last meeting two additional retort proposals had been submitted and that there were new developments in the mining program. The purpose of the special meeting was to consider all the retort proposals and decide what action should be taken with regard to the mining program. Elliott then asked Cramer to review the status of the present program.

## I. Status of Program

The status of funds and manpower is shown on Handout No. 1. Discussion of the program was as follows:

### A. Mining

A problem of major proportions has developed in the mining operation since August 1. An unforeseen interaction has occurred between the benching operation and the general condition of the rib pillars in the upper level of the mine. This is shown on Handout No. 2. The scaling requirements increased very substantially after the benching operation was speeded up during the week of July 31. It has been necessary to slow the operation down to maintain safety. The mining program cannot be completed with present funding.

No previous research or commercial experience with full height rooms in oil shale is available. An opportunity is available for study of a novel problem with major bearing on mining costs. This is strong justification for extension.

### B. Bench Scale Retorting

Operations in the 3.6-inch diameter retort have now been carried out with combustion in the bed and with rich shale. These are shown in Handout No. 3.

Via liquid removal, yields of 95% Fischer Assay and higher have now been achieved with combustion in the bed at shale rates of 500 lbs/(hr)(ft$^2$). Operability was excellent.

When no liquid disengagement was attempted, the unit was inoperable at these conditions. By reducing both shale and gas rates substantially, poor operability was achieved. However, a large part of the heat requirement was supplied by the electric heaters on the unit; the results achieved in this case are not very legitimate.

A single attempt to retort 38 gallon per ton shale in the 3.6-inch retort achieved poor operability. Further experimentation on liquid disengagement is necessary.

C. <u>Retort No. 3 Operations</u>

These are described in some detail on Handout No. 4.

The achievements since the July 13 meeting while processing 1/4 to 1 inch shale are:

1. Yields of about 89% Fischer Assay were achieved at a shale rate of 300 lbs/(hr)(ft$^2$) in the conventional operation as a result of improved air distribution.
2. Operability has been achieved at shale rates of 500 lbs/(hr)(ft$^2$) and total gas rates in excess of 20,000 SCF/T, via liquid disengagement. However, yields are not yet satisfactory. Experimentation is continuing. The best operation to date (Run C1053) was the one during which the most liquid was removed.

D. <u>Summary of Program Accomplishments to Date</u>

In <u>mining</u>, the heading operation has been very successful. Operations have met or exceeded prediction. The benching operation is encountering difficulities and requires further work.

Results achieved in <u>Retort No. 3</u> by the conventional Gas Combustion process are as follows:

| | |
|---|---|
| 1 to 2 1/2 inch shale | Yields (87% Fischer Assay with 25 gallon per ton shale) equivalent to those from the Retort No. 2 Demonstration Run were achieved at a shale rate of 400 lbs/(hr)(ft$^2$). In addition, a period of sustained operation at 500 lbs/(hr)(ft$^2$) was achieved. |
| 1/4 to 2 1/2 inch shale | A period of sustained operation was achieved at 500 lbs/(hr)(ft$^2$) shale rate. Yields (82% Fischer Assay with 28 gallon per ton shale) were 3 to 4% below those achieved in the Retort No. 2 Demonstration Run. |
| 1/4 to 1 inch shale | Several periods of sustained operation have been achieved at 300 lbs/(hr)(ft$^2$) shale rate. During one period, a yield of 89% Fischer Assay with 28 gallon per ton shale was achieved. This is 2% below the yield from the Retort No. 2 Demonstration Run at the 500 lbs/(hr)(ft$^2$) rate. |

yields were higher
at lower shale rates

The factor limiting operability and maximum yield is total gas rate. Given the total gas rate limitations on Retort No. 3, we have duplicated or bettered regression equation yields which were based on Retort No. 2 performance.

In addition, operability has been achieved processing 1/4 to 1 inch shale at a rate of 500 lbs/(hr)($ft^2$) in Retort No. 3. Yields are not yet equivalent to those from the 3.6-inch retort and further work is required.

## II. Executive Session

There are at present three proposals of retorts that could be considered in an extension. It was the consensus of the committee that considerable engineering studies were needed before a decision could be made to go ahead with additional retorting work. To this end Elliott was asked to send out a letter proposing that a task force be set up, with a representative from each company participating in the study, to evaluate the practicality of initiating such an engineering study. This task force would report back to the TAC in mid-September. Mobil would furnish the chairman. If an engineering study were started, additional funds would have to be requested.

There was considerable discussion regarding the unexpected spalling that had occurred during the benching operation. The importance of this observation on overall mining procedures and economics was emphasized. Cramer, who was not present during the Executive Session, was asked to call Anvil Points and determine how much money would be needed to complete the mining work to obtain the needed information. Cramer reported back a figure of $248,000. The TAC agreed that additional money should be included for unexpected contingencies and recommended $360,000. After additional discussion, it was the unanimous opinion of the TAC that Mobil send out a letter to all of the parties recommending a mining extension of $360,000. Elliott said he would arrange to do this, but that the latest date for a reply would be August 24, 1967.

Elliott was also asked to contact Crabtree and determine what the minimum costs would be for maintaining the facilities in stand-by condition beyond January 1, 1968. Thus, if it were decided, after the engineering study, that further retorting work should be started, the retorts and other facilities would be available.

The meeting was adjourned at 3:45 p.m.

K. M. Elliott
Chairman

S. L. Meisel
Secretary

## STAGE II ESTIMATED EXPENDITURES TO AUGUST 14, 1967

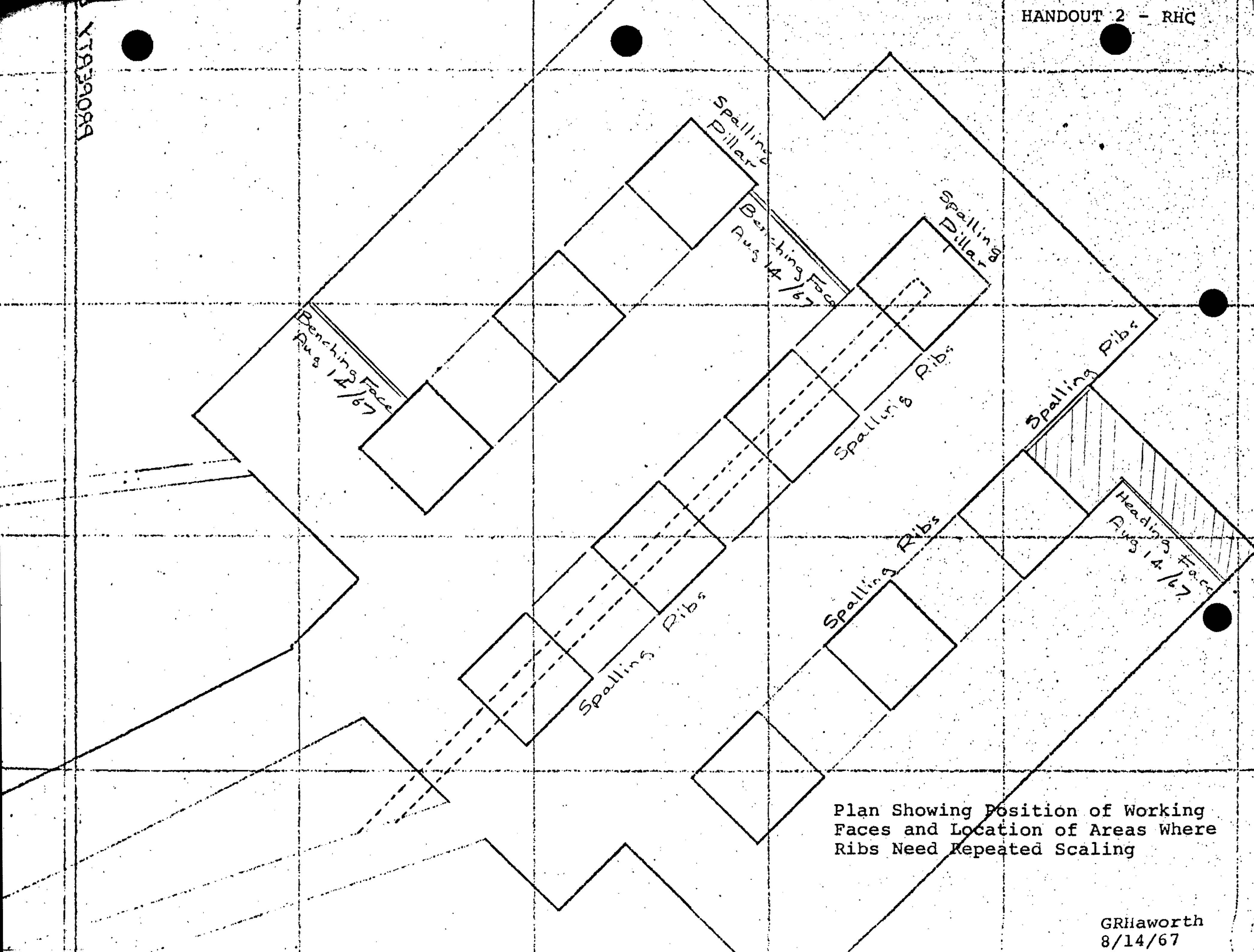
| | |
|---|---|
| Actual Cash Disbursements to 8/14/67 | $3,965,000 |
| Accrued Costs | 175,000 |
| Estimated Total Expenditures to 8/14/67 | $4,140,000 |
| Budget to 8/14/67 | 4,104,000 |
| Variance - Unfavorable | $ (36,000) |

We estimate present Stage II funds to run out approximately October 1 with current rate of expenditure.

## ESTIMATED MANPOWER AUGUST 14, 1967

| | | | |
|---|---|---|---|
| Participating Parties | | | 22 |
| Research Foundation | Authorized | 149 | |
| | Actual | 137 | 137 |
| Total | | | 159 |

CJVerdeur
8/14/67




Plan Showing Position of Working Faces and Location of Areas Where Ribs Need Repeated Scaling

GRHaworth
8/14/67

# 3.6-INCH RETORT OPERATIONS

## (1/4 to 1/2 Inch Raw Shale)

| | Non Combustion Operations | | | | Combustion Operations | | | Rich Shale Operation |
|---|---|---|---|---|---|---|---|---|
| | With Disengager | | Without Disengager | | With Disengager | | Without Disengager | With Disengager |
| No. of Runs | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Operating Conditions** | | | | | | | | |
| Raw Shale, lbs/(hr)(ft$^2$) | 930 | 450-500 | 930 | 450 | 500 | 500 | 300 | 300 |
| Fischer Assay, gal/ton | 27.1 | 27.4 | 28.2 | 27.1 | 28.6 | 28.2 | 29.1 | 37.7 |
| Air, SCF/T | 0 | 0 | 0 | 0 | 4,500 | 4,500 | 4,500 | 6,000 |
| Recycle, SCF/T | 20,000 | 20,000 | 20,000 | 20,000 | 20,000 | 20,000 | 4,500 | 10,000 |
| Disengager Temp., $^{o}F$ | 600 | 600 | -- | -- | 600 | 400 | -- | 500-600 |
| **Products Recovered** | | | | | | | | |
| Yield, Vol % FA | 87 | 99 | -- | 52 | 95 | 100 | (100) | 85 |
| Vol % Collected With | | | | | | | | |
| Disengager | 60 | 55 | -- | 0 | 55 | 56 | 0 | 48 |
| Demister | 40 | 45 | -- | 100 | 45 | 44 | 100 | 52 |
| Gas Yield, SCF/T | 208 | 565 | -- | -- | ( ) | ( ) | ( ) | ( ) |
| **Product Properties** | | | | | | | | |
| Gravity ($^{o}API$) | | | | | | | | |
| Composite | 21.9 | 22.7 | -- | 24.0 | 21.4 | 20.4 | ( ) | 2[illegible]4 |
| Disengager | 16.9 | 15.9 | -- | -- | 15.2 | 14.0 | ( ) | 1[illegible].9 |
| Demister | 29.5 | 33.1 | -- | 24.0 | 29.4 | 29.3 | ( ) | 27.9 |
| Spent Shale | | | | | | | | |
| Fischer Assay, gal/ton | 0.9 | 0.1 | -- | -- | 0.0 | 0.5 | ( ) | ( ) |
| **Overall Operating Performance** | Very Good | Excellent | Inoperable | Inoperable | Excellent | Good | Poor | Poor |

KIJagel
DLiederman
8/11/67

## Conclusions

- Inconclusive as to operability and yield because of line burner difficulties.

- Yoked distributor did improve yield through more effective gas distribution BUT operability may have been affected adversely.
- With further work satisfactory operability probably could be achieved with an air distributor of this type.
- Streamlined air distributor is desirable from standpoint of operability.
- There is not much hope of substantially improving yields from 1/4 to 1 inch shale over 89% Vol by <u>conventional</u> means.

- Inconclusive but encouraging.
- Unit operated at 15,000 SCF/T recycle which is highest yet for any shale size.
- Unit operated at 500 mass rate - a first in Retort No. 3 with 1/4 to 1 inch shale.
- Unit operated with a 54 bayonet distributor which was unsuccessful previously.

## SUMMARY OF OPERATIONS WITH 1/4 TO 1 INCH SHALE - JULY 15 - AUGUST 15,

| Run No. | Hardware Configuration | Target Run Conditions | Remarks |
|---|---|---|---|
| C1050 | 36 Bayonets on double yokes - improved gas distribution compared to streamlined 36 bayonet distribution used in C1040 | Conventional 700/900 F 300 mass rate<br>Air - 5,200 SCF/T<br>Recycle - 11,600 SCF/T<br>Dilution - 1,600 - 2,000 SCF/T @ 850 F<br>Essentially repeat of C1040-1 through 4 which had streamlined air distributor | Slow startup - offgas temperatures split early - severe shale bridging continuous problems keeping line burner lit - shutdown in about 36 hours with a large clinker |
| C1051 and C1052 | Same as above | Same as above for C1051 then transition to a hot air operation at<br>Air - 4,800 SCF/T @ 850 F<br>Recycle - 13,000 SCF/T | During the first two days of operation (Run C1051) the yields averaged just under 89% Vol RSFA. This is 3% Vol greater than the highest yield series obtained previously. On third day, made transition to hot air operation (C1052). Yields and operability deteriorated shortly thereafter. Unit shut down badly clinkered after fourth day. Some evidence (offgas split) that operation began to deteriorate during C1051 - therefore, difficult to conclude as to hot dilution versus hot air operation. |
| C1053 | Installed grates to drain liquid from condensing zone. Installed internal cyclones to reduce mist loading leaving retorting zone. Installed 54 bayonet air distributor | Conventional 700/900 F startup at 300 mass rate. Move directly to 500 mass rate at<br>Air - 4,300 SCF/T (cold)<br>Recycle - 15,000 SCF/T | Smooth fast startup - early operation looked good until bearing failure on recycle motor terminated run after 18 hours. Liquid production from grates and cyclones averaged about 7.5% of total oil production compared to 50% in bench scale unit. Possible reasons: Grates severely plugged and liquid disengager temperature only 350 to 400 F rather than desired 600 F - no clinker. Preliminary data indicated yield level was 85% Vol during startup and spent shale was free of oil. |

(Continued)

(CONTINUED)

## Conclusions

- Bed height reduction aggravated gas channeling.
- Improved grate design necessary to reduce plugging tendency.
- More instrumentation necessary for improved understanding.

- Modified chute design has made bed temperatures more uniform.
- Modified grid design improved plugging problem although there were considerable shale chips on the deck.
- Oil recovery from disengaging section did not improve even though temperature was raised to level which was effective in bench scale unit.

TCLyons
8/14/67

SUMMARY OF OPERATIONS WITH 1/4 TO 1 INCH SHALE - JULY 15 - AUGUST 15, 1967

| Run No. | Hardware Configuration | Target Run Conditions | Remarks |
|---|---|---|---|
| C1054 | Same as above but reduced retorting bed height six inches to raise liquid disengaging temperature | Same as above | Startup smooth but slow - liquid production at a low level (2 to 3% of total) from outset. Liquid disengager temperature still low - no change from C1053 - attributed to gas channeling. Yields started at the 81% level and deteriorated with time - corresponding increase of oil in spent shale - unit shut down because of low yields and liquid production rather than operability problems. Small clinker present - grates severely plugged. |
| C1055 | Same general configuration as C1054. Revised grate design to reduce plugging problem. Separated gravity liquid drain from cyclone system to pin point oil production. Modified chute design to provide a more level shale bed in retorting zone (reduce gas channeling). | Same as C1053 and C1054 | Startup smooth but slow as in C1054. Lateral temperatures in combustion zone more uniform in early stages. Temperatures in liquid disengager raised to 450 to 600 F level from 350 to 450 F. No measurable oil recovered from grid or cyclones from outset - high oil in spent shale (about 5 gallons per ton) throughout operation - increased severity in attempt to clean up spent shale - operation deteriorated quickly and unit was shut down with clinkers about 36 hours after startup. |

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8/14/67