

BITUMINOUS COAL RESEARCH, INC.  
OCR/AGA-SPONSORED RESEARCH PROGRAM

PIPELINE GAS GENERATOR RESEARCH AND DEVELOPMENT

Progress Report No. 13

(BCR Report L-488)

I. INTRODUCTION

This report summarizes progress achieved during September, 1972, on a part of the program, "Gas Generator Research and Development," being conducted by Bituminous Coal Research, Inc., for the Office of Coal Research. The overall program was initiated under Contract No. 14-01-0001-324, December 20, 1963, and was transferred to Contract No. 14-32-0001-1207 on August 19, 1971. Under the new prime contract, a portion of the work is being sponsored jointly by OCR and the American Gas Association. Thus, this report represents the thirteenth report of progress on the jointly-sponsored OCR/AGA program.

The objective of this part of the program continues to be to develop processes for gasifying coal to produce high-Btu pipeline gas.

Laboratory-scale coal gasification experimentation is to be continued together with process and equipment development. With the aid of engineering subcontractor(s), a multipurpose research pilot plant facility is to be designed, constructed, and test operated.

A. Work Schedule

Work on the project is being conducted according to a schedule reflecting the program outlined under the new prime contract. This schedule was shown in Figure 1, page 2, Progress Report No. 1 and revised according to Figure 160 to reflect only that part of the overall program sponsored by both OCR and AGA.

B. Monthly Progress Charts

Revised monthly progress charts reflecting proposed rate of effort and expenditures on that part of the contract sponsored jointly by OCR and AGA, through Fiscal Year 1974, are shown in Appendixes A-1 and A-2. The projected costs are quarterly costs divided by three to obtain monthly costs, and will be adjusted when anticipated monthly expenditures are received from Stearns-Roger. These progress charts will be further revised to reflect the complete contract period when project planning and expenditure estimates for the period beginning with Fiscal Year 1975 are complete.

II. PHASE II PROGRESS ACHIEVED DURING MONTH ENDING SEPTEMBER 25, 1972

A. Laboratory-scale Process Studies

1. Gas Processing (M. S. Graboski): This report summarizes progress achieved in the bench-scale and PDU gas processing programs during September.

	Fiscal Year	1972	1973	1974	1975	1976	1977
	Calendar Year	1972	1973	1974	1975	1976	
Cold Flow Model (5 T/hr)		█					
Stage 2 Gas Processing							
Laboratory Scale Methanation		█	█	█			
PEDU							
Methanation		█	█	█			
Fluid Bed				█	█		
Other Systems				█	█	█	█
Pilot Plant							
Methanation (Fluid Bed)							
Oxygen-blown Pilot Plant (5 T/hr)							
Secure bids, Procure, and Erect		█	█	█			
Operate				█	█	█	█
General Engineering, Reporting		█	█	█	█	█	█

Bituminous Coal Research, Inc. 8016G341

Figure 160. Proposed Work Schedule: OCR/AGA Gas Generator Research and Development Program

Gas processing methanation studies continued in accordance with the updated time schedule presented in Figure 148, Progress Report No. 12.

a. Bench-Scale Studies: The purpose of the bench-scale program is to investigate methanation catalysts under conditions imposed by the BI-GAS process. These include high carbon monoxide concentrations, high pressure, and a nominal 3/1 hydrogen to carbon monoxide ratio.

Three processing schemes are currently under investigation. These are summarized in Figure 161. Scheme A reflects current planning where methanation follows shift conversion and acid gas removal. Scheme B considers hydrogen sulfide removal before and carbon dioxide removal after methanation, and Scheme C is based on methanation of the synthesis gas containing all acid gas components. The purpose of both the bench-scale and FEDU programs is to determine the feasibility of the schemes for the BI-GAS process.

(1) Harshaw Catalysts: In Progress Report No. 12, physical properties for four new methanation catalysts obtained from Harshaw were reported. During September, work conducted involved activity testing of these catalysts under BI-GAS conditions.

In early September, the life test unit was charged with batches of each catalyst. Failure of the type 304 stainless steel tubes at the outlet of the reactor occurred shortly after startup. The tubes were replaced but the same result occurred. The type 304 tubing was replaced with type 316 stainless steel, but this, too, failed shortly after the unit was placed into service.

Analysis of both types of stainless steel tubes indicated that chloride stress cracking was taking place. Inconel, which resists chloride attack, was used as a replacement and no problems have been encountered since the change. The source of chlorides has not been determined; however, the catalysts used are suspect and are being investigated. Identification of the source of trouble is important in order to avoid similar problems with the FEDU.

In mid-September the life test unit was charged in the following manner:

<u>Tube</u>	<u>Catalyst, BCR Lot</u>	<u>Charge, gm</u>
1	3049	3.04
2	3050	3.06
3	3051	2.98
4	3052	3.04

Synthesis gas with a nominal composition of 25 percent carbon monoxide and 75 percent hydrogen was fed at a rate equivalent to a space velocity of 1000 under conditions of 800 F and 1000 psig. After 48 hours of operation, catalysts 3050

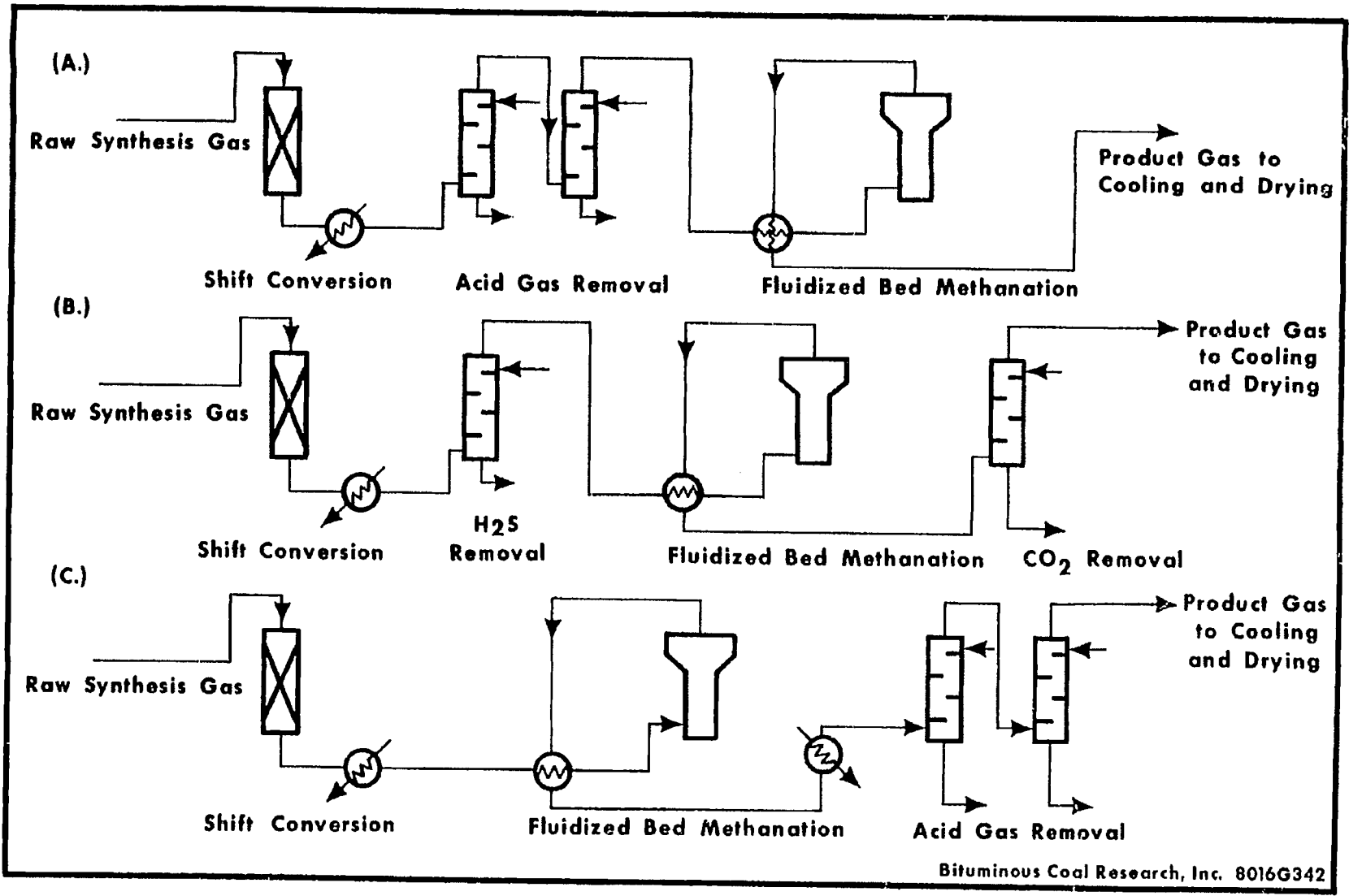


Figure 161. BI-GAS Gas Processing Systems

(0.92 percent  $N_2O$  on  $Cr_2O_3-Al_2O_3$ ) and 3052 (0.28 percent  $N_2O$  on  $Al_2O_3$ ) stopped functioning. At 190 hours, the feed gas was changed to 15 percent  $CO_2$ , 17 percent  $CO$ , 51 percent  $H_2$ , 14 percent  $CH_4$ , and 3 percent  $N_2$ . The two active catalysts, 3049 (0.56 percent  $N_2O$  - 11 percent  $MoO_3-Al_2O_3$ ) and 3051 (1.38 percent  $N_2O$  - 6.44 percent  $MoO_3-Al_2O_3$ ), have been operating for a total of 240 hours with each exhibiting a useful conversion of ( $CO + H_2$ ) in the range of 65 to 70 percent.

After about 350 hours of operation, all four catalysts will be removed and returned to Harshaw for post-test analysis. Detailed data for the entire test will be reported next month.

(2) Chemetron Catalysts: As a result of the August meeting with Chemetron Corporation, arrangements have been made to test some special catalysts under the existing secrecy agreement. During September, they have indicated a plan for catalyst studies which is acceptable to BCR, and samples should be available in the near future.

b. PEDU Studies: Progress continued to be made on the methanation PEDU during September. The projected construction schedule for the methanator, based on currently available delivery data, is given in Figure 162.

(1) Engineering: Koppers continued detail engineering during September. As Figure 162 indicates, the engineering should be completed by the end of October.

During September, the engineering was essentially completed. Currently all vessel details, foundation drawings, and electrical drawings have been received. Minor process changes have resulted in a need to revise several instrument specifications. Also, the design of the analyzer panel must be completed in October. All piping drawings have been received. Conduit routings for the instrumentation signals are still being detailed by Koppers.

(2) Procurement: Table 141 shows the delivery status of the major PEDU equipment items. The graphic and recorder sections of the instrument panel have been purchased and scheduled for shipment in mid-December. All major items are on schedule except for the reformer which has been rescheduled from late October to mid-December.

(3) Construction: PEDU construction is proceeding according to the schedule shown in Figure 162.

(4) Work completed: During September, Steelbilt Co. completed work on a portion of the foundations including yard rack piers, cooling tower pads, hydrogen sulfide removal tower pads, and the transformer pad. BCR installed the electrical conduit underneath the pad as required for the transformer and switchgear connections.

Piping of the PEDU system continued during September. The yard rack piping supports were mounted and leveled. Tubing for carbon dioxide,

ITEM	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	JAN
<b>1. ENGINEERING</b>	[Completed]			[Scheduled]			
<b>2. PROCUREMENT</b>							
A. REFORMER FEED COMPRESSOR	[Completed]			[Scheduled]			
B. REFORMER	[Completed]			[Scheduled]	[Scheduled]	[Scheduled]	
C. METHANATOR FEED COMPRESSOR	[Completed]			[Scheduled]	[Scheduled]	[Scheduled]	
D. METHANATOR FEED HEATER	[Completed]			[Scheduled]	[Scheduled]	[Scheduled]	
E. REACTOR	[Completed]			[Scheduled]	[Scheduled]	[Scheduled]	
F. COOLER-CONDENSER	[Completed]			[Scheduled]	[Scheduled]	[Scheduled]	
G. BOILER	[Completed]			[Scheduled]	[Scheduled]	[Scheduled]	
H. THERMINOL SYSTEM	[Completed]			[Scheduled]	[Scheduled]	[Scheduled]	
I. DEMISTER	[Completed]			[Scheduled]	[Scheduled]	[Scheduled]	
J. THERMAL OXIDIZER	[Completed]			[Scheduled]	[Scheduled]	[Scheduled]	
K. PANEL BOARD	[Completed]			[Scheduled]	[Scheduled]	[Scheduled]	
L. OTHERS	[Completed]			[Scheduled]	[Scheduled]	[Scheduled]	
<b>3. ERECTION</b>							
A. EXCAVATION	[Completed]	[Completed]	[Completed]	[Scheduled]	[Scheduled]	[Scheduled]	[Scheduled]
B. FOUNDATIONS	[Completed]	[Completed]	[Completed]	[Scheduled]	[Scheduled]	[Scheduled]	[Scheduled]
C. EQUIPMENT INSTALLATION	[Completed]	[Completed]	[Completed]	[Scheduled]	[Scheduled]	[Scheduled]	[Scheduled]
D. PIPING AND INSTRUMENTATION	[Completed]	[Completed]	[Completed]	[Scheduled]	[Scheduled]	[Scheduled]	[Scheduled]
E. BUILDING ALTERATIONS	[Completed]	[Completed]	[Completed]	[Scheduled]	[Scheduled]	[Scheduled]	[Scheduled]
F. REFORMER ENCLOSURE	[Completed]	[Completed]	[Completed]	[Scheduled]	[Scheduled]	[Scheduled]	[Scheduled]
G. ELECTRICAL	[Completed]	[Completed]	[Completed]	[Scheduled]	[Scheduled]	[Scheduled]	[Scheduled]
<b>4. TESTING AND OPERATION</b>							

[Solid Black Box] COMPLETED OR RECEIVED

[Cross-hatched Box] SCHEDULED

Figure 162. Methanation PEDU Schedule

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TABLE 141. SUMMARY OF STATUS OF PEDU EQUIPMENT ITEMS

<u>Index</u>	<u>Equipment Item</u>	<u>Status<sup>1</sup></u>	<u>Estimated Delivery Date</u>
ME-405	Feed Gas Preheater	Q	--
ME-410	Filter Blowback Heater	P/A	10/04/72
ME-605	Cooler Condenser	P/A	10/06/72
ME-700	Water Cooler	P/A	R
MF-420	Catalyst Filters	Q	--
MK-102	Natural Gas Compressor	P/A	10/09/72
MK-305	Methanator Feed Gas Compressor	P/A	12/04/72
ME-305	Bypass Cooler	P/A	12/04/72
MK-770	Air Compressor	P/A	R
MP-710	Cooling Water Pump	P/A	R
MR-420	Fluid Bed Methanator	P/A	12/04/72
MV-104	Reformer Feed Gas Receiver	P/A	R
MV-260	H <sub>2</sub> S Flash Tank	P/A	R
MV-307	Oil Separator	P/A	R
MV-310	Methanator Feed Gas Receiver	P/A	R
MV-610	Water Metering Tank	P/A	R
MV-615	Water Letdown Tank	P/A	10/15/72
MV-620	Demister	P/A	R
MV-710	Cooling Water Tank	P/A	R
MV-763 A & B	H <sub>2</sub> S Removal Towers	P/A	R
MV-764	Drip Pot	D	--
MV-766	Water Break Tank	P/A	10/15/72
MX-100	Reformer	P/A	12/15/72
MX-500	Therminol System	P/A	10/30/72
MX-720	Steam Boiler	P/A	R
MX-750	Demineralizer	P/A	--
MX-770	Thermal Oxidizer	P	10/20/72
MY-700	Reformer Enclosure	P	10/15/72
	Panel	P	12/15/72

- <sup>1</sup> Q Quote Stage  
P Procurement Stage  
P/A Procured and Vendors Drawings Approved  
R Received  
D Design Stage

hydrogen sulfide, and vent gas were routed from the gas storage area to the yard rack. Cooling tower water piping is being located and welded into place on the yard rack. All rack piping, except for the ties to the reformer, hydrogen sulfide removal system, and thermal oxidizer, should be completed within the next three weeks.

(5) Work Scheduled: Electrical installation work by Lord Electric Co. is scheduled to begin October 9, 1972. As of late September, subcontract approval has not been received from OCR/AGA but is expected before the end of the month.

Bids were requested and received on a detailed construction package covering the remainder of the foundations and all structural steel and rigging work. A contractor is currently being selected.

c. Model Studies: No model study work was conducted during September.

d. Future Work: Work planned for October includes the following:

(1) Bench-scale testing of methanator catalysts.

(2) PEDU construction including:

- (a) Completion of most foundations.
- (b) Completion of building alterations.
- (c) Completion of all outside yard rack piping.
- (d) Initiation of electrical work.

(3) Minor engineering effort from Koppers.

2. Analytical Services (J. E. Noll): During the past month, eighteen (18) samples from the methanation unit were analyzed by gas chromatography.

3. Gas Chromatographic Procedures (J. E. Noll): No work was done on the automated gas analysis system for the methanation PEDU during the past month because of an equipment breakdown.

Standardization of the flame ionization gas chromatograph is continuing.

B. Cold Flow Model Studies - 5 tcn/hr Two-stage Gasifier (R. J. Grace, R. D. Harris, R. L. Zahradnik, and E. E. Donath)

The summary report on the cold flow model studies is undergoing final editing and will be issued as Special Report No. 3. The model equipment is being maintained in working condition for occasional demonstrations and in anticipation of future modeling programs.

C. Data Processing (R. K. Young and D. R. Hauck)

1. Automated Data Acquisition: As indicated in the progress report for August, the BCR real time software system and the bench-scale methanator data acquisition program have been completely debugged. Because the methanation unit has been down for repair for the past month, the data acquisition programs have not yet been actually utilized. It is anticipated that the bench-scale methanation unit will be back in operation soon, and at that time the computer system will be able to handle all data generated.

A complete description of both the real time software system and the BSM data acquisition program will be included in the next progress report.

2. BI-GAS Process: No commercial gasifier simulation runs were requested during this period.

In accordance with OCR's request (letter of August 30, 1972, from Mr. Neal P. Cochran to Mr. John W. Igoe) a copy of the BCR computer gasifier simulation program deck was given to Foster Wheeler Corporation. Included with the computer program was a complete description of the calculational schemes used and all other support material that might be helpful to them. In addition, Foster Wheeler personnel visited BCR on September 13 to discuss in detail the utilization of this computer program.

3. Methanation Recycle Calculation: A Fortran computer program was written to calculate the product gas composition from the methanation unit for a preset gas recycle rate and methane conversion rate. Program inputs include the feed gas analysis, the recycle rate, the methane conversion rate, and the water-gas shift constant. The program calculates and prints the total feed (initial feed gas plus recycled product gas) and the product gas composition at equilibrium. A sample printout is given in Table 142.

4. Future Work: Plans for the next report period include:

- a. Logging and processing data from the bench-scale methanation unit.
- b. Writing a complete description of the real time software system and the BSM data acquisition program.
- c. Generation of simulation runs with subroutine GASIFY as requested and authorized.
- d. Begin investigation of possible problem areas that might arise in interfacing the PDP8/E computer with PEDU methanation unit.

D. Multipurpose Research Pilot Plant Facility (MPRF)

1. Pilot Plant: Stearns-Roger has issued instructions to bidders, scope of work, and specifications covering the following work at the Homer City pilot plant site:

- a. Site Survey and Topography
- b. Site Clearing and Grubbing
- c. Subsurface Investigation and Mining Study

TABLE 142. METHANATION RECYCLE CALCULATION PRINT-OUT

Input

Moles CO = 17  
Moles H<sub>2</sub> = 51  
Moles CO<sub>2</sub> = 15  
Moles CH<sub>4</sub> = 17  
Moles H<sub>2</sub>O = 0  
K = 9.03  
% Conversion = 50  
Recycle Rate = 1

Output (Moles)

	CO	H <sub>2</sub>	CO <sub>2</sub>	CH <sub>4</sub>	H <sub>2</sub> O	Total
Feed	24.7	73.4	38.6	63.4	0.0	200.0
Product	12.6	36.5	38.5	75.6	12.4	175.5

Stearns-Roger has received competitive bids, and has completed the bid evaluations and recommended a contractor for each phase of work. These recommendations will be submitted in early October for OCR/AGA approval.

The plant scale model has been received by Stearns-Roger. They plan to use the model during the engineering phase of the project.

Plans have been made for review of preliminary process flow sheets at Stearns-Roger engineering offices on October 2-3, 1972.

a. Stearns-Roger, Inc.: Stearns-Roger's current engineering effort is reported in their Project Status Report No. 2, Appendix B of this report.

b. Blaw-Knox Chemical Plants, Inc.: Blaw-Knox continues to provide management and surveillance services in connection with the Homer City pilot plant. The project manager has relocated to the offices of Stearns-Roger in Denver, Colorado, to facilitate the conduct of the project.

Blaw-Knox has been reviewing Stearns-Roger's engineering procedures and following the progress of the project. They have been expediting the work, especially in the areas of project schedules, gasifier specification, general project specifications, and flow diagrams. A review of a portion of the preliminary flow diagrams has been scheduled for October 2 and 3, 1972, and first project review meeting is scheduled for October 13, 1972.

2. Determination of Solids Contents of Pumpable Coal, Lignite, and Char Slurries (R. J. Grace, R. D. Harris)

Stearns-Roger, Inc., was instructed to evaluate water slurry feeding for injecting coal or recycled char into the pilot plant. For the initial evaluation, a 50 percent or higher water content was assumed to comprise a pumpable slurry. It was found, however, that there was insufficient information on the effect of coal type on the amount of water required to make a pumpable coal slurry and no information on char.

To aid in this evaluation, therefore, BCR made some short-term tests on slurries of various coals, especially subbituminous and lignite, and on a char.

It was concluded from observations that the following solids concentrations could be effectively pumped:

<u>Solid</u>	<u>Solids Concentration in Water, Percent by Weight</u>
Pittsburgh seam coal	60
Subbituminous Elkol	50
North Dakota Lignite	45
Char from Pittsburgh seam coal	35

Solids concentrations up to five percent higher could perhaps be possible by using an additive to optimize the results.

E. Literature Search (V. E. Gleason)

No literature references were completed during the month.

F. Outside Engineering and Services

1. Koppers Company, Inc.: Koppers continues to provide engineering assistance as required and as reported in their Progress Report No. 38, Appendix C of this report.

G. Other

1. Prime Contract Matters: By letter dated September 25, 1972, we submitted to OCR a list transferring equipment from Contract No. 14-01-0001-324 to Contract No. 14-32-0001-1207 in accordance with Mr. Thunberg's letter of April 18, 1972. Also included was a list of all equipment, whether declared surplus or already shipped to other agencies.

As requested by OCR, Stearns-Roger, Inc., transmitted information to Mr. G. Edward Larson on August 31, 1972, for the Department's Office of Equal Opportunity; this information included the completed form as furnished by OCR and a copy of Stearns-Roger's "Affirmative Action Compliance Program for Equal Employment Opportunity."

Per telephone request of Mr. Jack Ryan, on September 22, 1972, we forwarded to OCR a Construction Cash Flow Planning Chart based on estimates which we are currently using.

In accordance with OCR letter of September 1, 1972, commencing with last month's Progress Report No. 12, research activities conducted at Bituminous Coal Research, Inc., under OCR Contract No. 14-32-0001-1207 are now reported in two separate reports. Work sponsored jointly by OCR and AGA are covered in one report, and work sponsored solely by OCR is reported separately. Also, revised Manhour and Expenditure Charts have been prepared for both reports.

2. Patent Matters: Worthwhile ideas continue to be written as invention disclosures for submission to OCR for consideration. Status of the various disclosures is as follows:

a. OCR-866 and OCR-1078: A U.S. patent application entitled "Gasification of Carbonaceous Solids," containing nine claims, was filed together with the Assignment on September 22, 1971, and given Serial No. 182,652.

Patent applications have been filed in Australia, India, South Africa, Canada, and Great Britain. On September 18, 1972, an application was filed in West Germany under Serial No. P-22-45-735-8, and on September 20, 1972, a patent application was filed in Japan. An application is also being prepared for filing in France. Confirmatory license to the government was executed by BCR on January 12, 1972.

b. OCR-1860 and OCR-1861: These disclosures were combined into a single patent application entitled "Two-stage Gasification of Pretreated Coal." This application, containing 12 claims, was filed together with Assignment on March 23, 1972, and given Serial No. 237,332.

Patent applications are being prepared for filing in France, West Germany, and Japan. Confirmatory license was executed by BCR on May 8, 1972.

c. OCR-1862: A U.S. patent application entitled "Three Stage Gasification of Coal," containing eight claims, was filed together with Assignment on March 23, 1972, and assigned Serial No. 237,333.

Patent applications are being prepared for filing in France, West Germany, and Japan. Confirmatory license was executed by BCR on May 8, 1972.

d. OCR-1863: A U.S. patent application was prepared for this disclosure entitled "Two-stage Downflow Gasification of Coal." This application, containing seven claims, was filed together with Assignment on March 23, 1972, and given Serial No. 237,454.

Applications are being prepared for filing in France, West Germany, and Japan. Confirmatory license was executed by BCR on May 8, 1972.

e. OCR-1864: A U.S. patent application entitled "Two-stage Gasification of Coal with Forced Reactant Mixing and Steam Treatment of Recycled Char," was prepared for this disclosure. The application contains 13 claims and was filed on March 23, 1972, together with the Assignment, and assigned Serial No. 237,360.

Patent applications are being prepared for filing in France, West Germany, and Japan. Confirmatory license to the government was executed by BCR on May 8, 1972.

f. OCR-2044: An Invention Disclosure (Form DI 1217) entitled "Combined Methanation - Shift Reaction Process," was submitted to OCR for consideration on June 14, 1972. Use of this process simplifies and reduces the cost of making synthetic pipeline gas, especially from coal, using the BI-GAS or other coal gasification processes.

In a memorandum dated July 20, 1972, Mr. M. Howard Silverstein, Branch of Patents, notified OCR that this Invention Disclosure has been assigned Interior Case No. OCR-2044. BCR will prepare and file a U.S. patent application for this disclosure as authorized in OCR letter of August 14, 1972, to Mr. S. J. Price, BCR's patent attorney.

3. Reports and Papers: As approved by OCR, R. J. Grace will present a paper entitled "BI-GAS Program Enters Pilot Plant Stage" at the forthcoming AGA Synthetic Pipeline Gas Symposium, October 30, 1972, at Chicago, Illinois. Authors of the paper will be R. J. Grace and R. L. Zahradnik. An advance copy of the paper will be submitted to OCR when available.

By OCR letter dated September 21, 1972, we have received approval to present the following papers:

"New Markets - Coal Gasification" to be authored and presented by John W. Tieman at the annual meeting of the Coal Mining Institute of America, Pittsburgh, Pennsylvania, December 7-8, 1972.

"The Chemistry and Physics of Entrained Coal Gasification" by R. L. Zahradnik and R. J. Grace; this presentation will be made at the 1973 Gordon Conference on Coal Science.

H. Visitors During September, 1972

September 1, 1972

Mr. T. J. Buirgy  
Mr. Walter J. Crabb  
Stearns-Roger, Inc.  
P.O. Box 5888  
Denver, Colorado 80217

September 8, 1972

Mr. R. W. Whiteacre  
Koppers Company, Inc.  
Koppers Building  
Pittsburgh, Pa. 15219

September 14, 1972

Mr. S. M. Tymiak  
Mr. J. M. Nelson  
Mr. R. E. Miller  
Koppers Company, Inc.  
Koppers Building  
Pittsburgh, Pa. 15219

September 20, 1972

Mr. J. M. Marsten  
Mr. R. F. Mikolajczak  
Mr. A. R. Jenny  
Combustion Engineering, Inc.  
Raymond Division  
427 West Randolph St.  
Chicago, Illinois 60606

September 27, 1972

Mr. Noel F. Boyd  
Blaw-Knox Chemical Plants, Inc.  
One Oliver Plaza  
Pittsburgh, Pa. 15222

Mr. Arel L. Langston  
Mr. Walter Kowalchik  
Stearns-Roger, Inc.  
P.O. Box 5888  
Denver, Colorado 80217

September 28, 1972

Mr. Arel L. Langston  
Stearns-Roger, Inc.  
P.O. Box 5888  
Denver, Colorado 80217

I. Trips and Meetings During September, 1972

September 12, 1972

OCR/AGA Project Advisors Meeting  
BCR Laboratory  
Monroeville, Pennsylvania

J. Requests for Information

Mr. Roger Schonewald, Manager  
New Ventures - Utilities  
Ingersoll-Rand Research, Inc.  
Box 301  
Princeton, New Jersey 08540



### III. WORK PLANNED FOR OCTOBER, 1972

The work planned for October will basically be a continuation of the on-going program which has been underway for the past few months.

Bench-scale testing of methanation catalysts will continue. After about 350 hours of operation, the four Harshaw catalysts will be returned for post-test analysis. Work on the methanation PEDU will continue. Building alterations, yard rack piping, and most foundations will be completed. The electrical work will be started.

Special Report No. 3 will be issued.

The data acquisition program for the bench-scale methanator should begin. A complete description of this program will be written.

Meetings with Stearns-Roger and Blaw-Knox will continue to discuss various technical details.

#### A. Trips and Meetings Planned

October 2-3, 1972	Stearns-Roger, Inc. Denver, Colorado	R. J. Grace J. P. Tassoney E. E. Donath
October 12-13, 1972	Stearns-Roger, Inc. Denver, Colorado	J. P. Tassoney R. K. Young

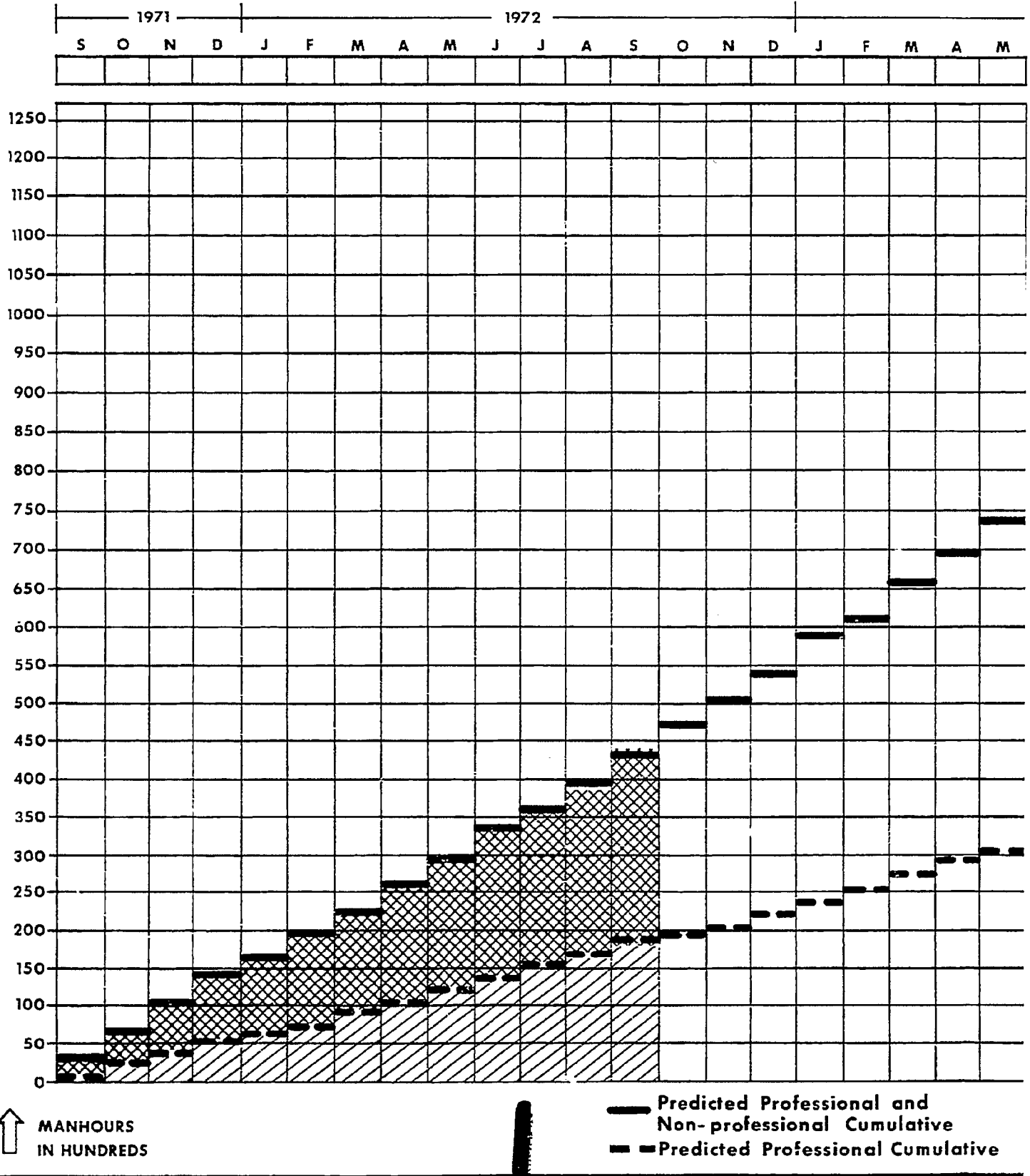
#### B. Papers to be Presented

October 30, 1972	AGA Synthetic Pipeline Gas Symposium Chicago, Illinois	"BI-GAS Program Enters Pilot Plant Stage" R. J. Grace R. L. Zahradnik
December 7, 1972	Annual Meeting of the Coal Mining Institute of America Pittsburgh, Pennsylvania	"New Markets - Coal Gasification" J. W. Tieman

#### C. Visitors Expected

October 9, 1972	Steinkohlenbergbauverein Bergbau-Forschung GmbH 43 Essen-Kr2y GERMANY	Dr. Werner Peters Mr. K. H. Hawner
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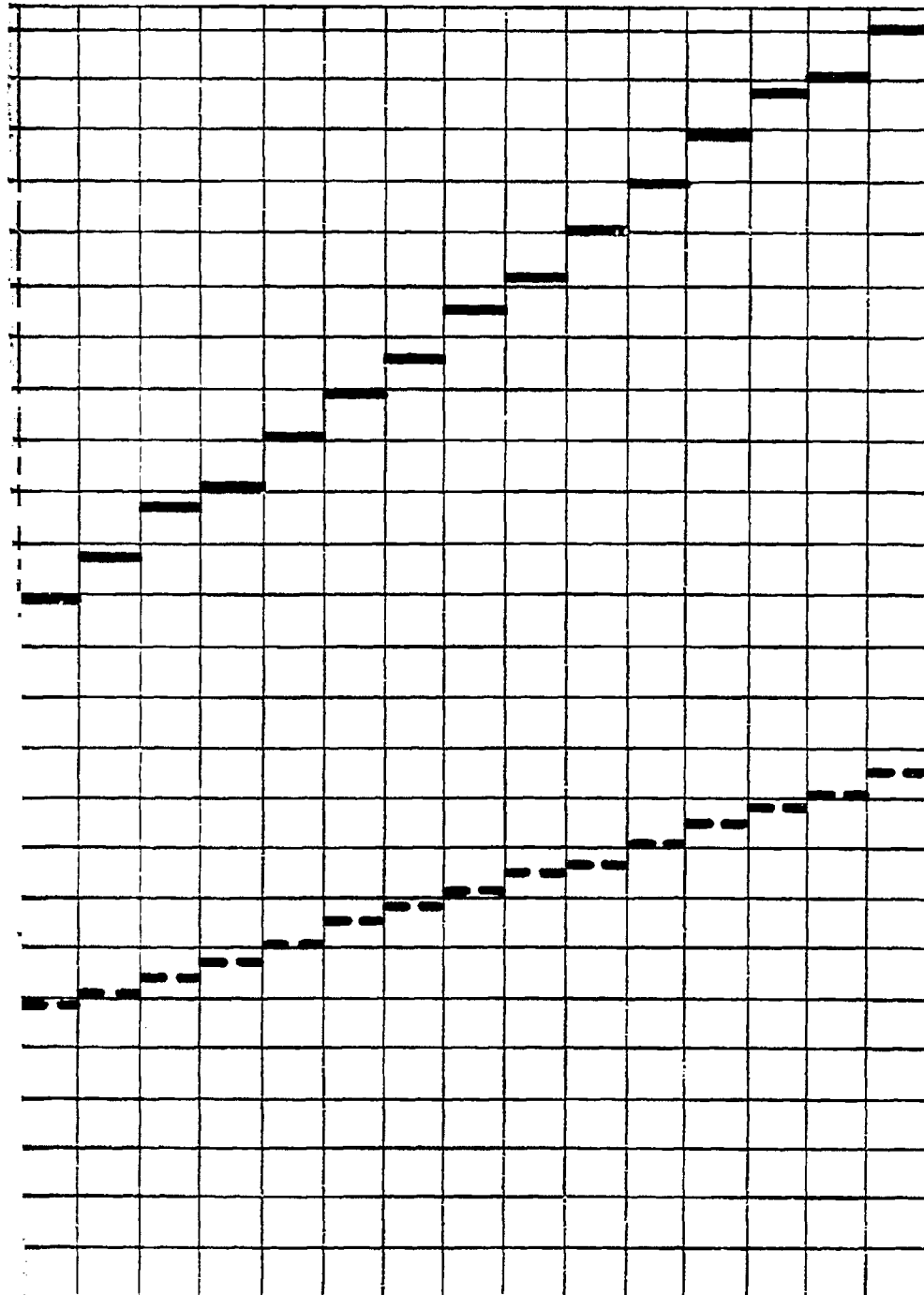
# OCR/AGA PIPELINE GAS GENERATOR RESEARCH AND DEVELOPMENT



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### CUMULATIVE MANHOURS

1973												1974					JULY 1974...AUG 1976		
A	M	J	J	A	S	O	N	D	J	F	M	A	M	J					



NOT YET ESTIMATED

2

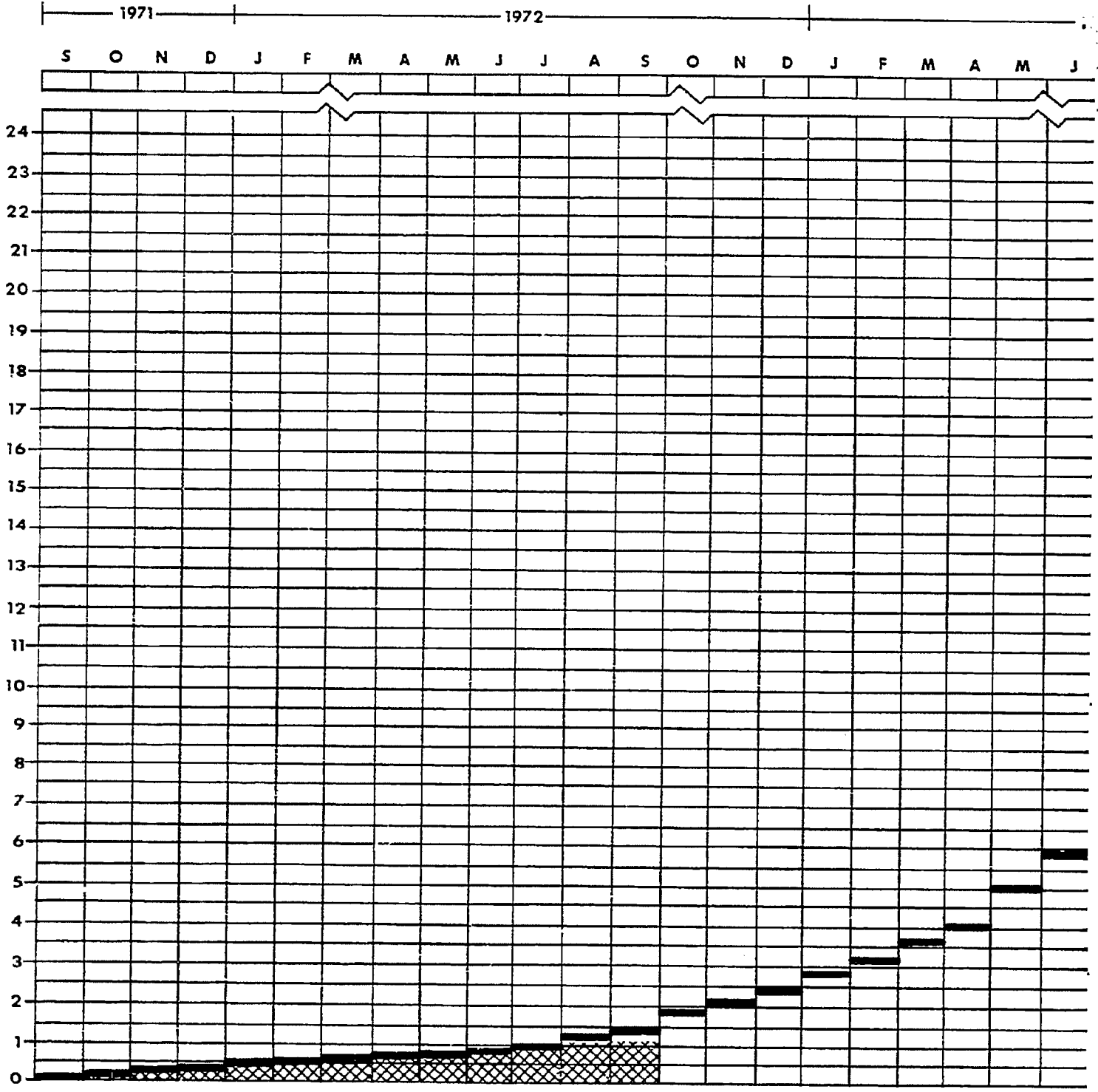
 Actual Non-professional Cumulative  
 Actual Professional Cumulative

OCR/AGA PIPELINE GAS GENERATOR RESEARCH AND DEVELOPMENT  
Schedule of Predicted and Actual Manhours

Month	This Month				Cumulative			
	Professional		Non-Professional		Professional		Non-Professional	
	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual
Sept. '71		1,606.5		2,253.5		1,606.5		2,253.5
Oct. '71		1,144.0		1,716.0		2,750.5		3,969.5
Nov. '71		1,490.0		2,126.5		4,240.5		6,096.0
Dec. '71		1,290.5		1,875.5		5,531.0		7,971.5
Jan. '72		1,465.0		1,612.5		6,996.0		9,584.0
Feb. '72		1,285.0		1,656.5		8,281.0		11,240.5
Mar. '72		1,337.0		2,042.5		9,618.0		13,283.0
Apr. '72		1,400.0		2,026.0		11,018.0		15,309.0
May '72		1,506.0		1,884.5		12,524.0		17,193.5
June '72		1,555.0		2,054.0		14,079.0		19,247.5
July '72		1,224.5		1,370.0		15,303.5		20,617.5
Aug. '72	1,432.0	1,193.0	2,136.0	1,573.5	16,735.5	16,496.5	22,753.5	22,191.0
Sept. '72	1,544.0	1,301.5	2,152.0	1,549.5	18,279.5	17,798.0	24,905.5	26,455.0
Oct. '72	1,456.0		2,144.0		19,735.5		27,049.5	
Nov. '72	1,448.0		2,136.0		21,183.5		29,185.5	
Dec. '72	1,44.0		2,048.0		22,623.5		31,233.5	
Jan. '73	1,664.0		2,328.0		24,287.5		33,561.5	
Feb. '73	1,664.0		2,336.0		25,951.5		35,897.5	
Mar. '73	1,672.0		2,344.0		27,623.5		38,241.5	
Apr. '73	1,624.0		2,280.0		29,247.5		40,521.5	
May '73	1,632.0		2,280.0		30,879.5		42,801.5	
June '73	1,632.0		2,288.0		32,511.5		45,089.5	
July '73	1,656.0		2,328.0		34,167.5		47,417.5	
Aug. '73	1,656.0		2,320.0		35,823.5		49,737.5	
Sept. '73	1,656.0		2,320.0		37,479.5		52,057.5	
Oct. '73	1,640.0		2,288.0		39,119.5		54,345.5	
Nov. '73	1,656.0		2,288.0		40,775.5		56,633.5	
Dec. '73	1,656.0		2,264.0		42,431.5		58,897.5	
Jan. '74	1,672.0		2,328.0		44,103.5		61,225.5	
Feb. '74	1,656.0		2,320.0		45,759.5		63,545.5	
Mar. '74	1,640.0		2,320.0		47,399.5		65,865.5	
Apr. '74	1,640.0		2,280.0		49,039.5		68,145.5	
May '74	1,656.0		2,288.0		50,695.5		70,433.5	
June '74	1,656.0		2,272.0		52,351.5		72,705.5	
July '74 to								
Aug. '76								

NOT YET ESTIMATED

# OCR/AGA PIPELINE GAS GENERATOR RESEARCH AND DEVELOPMENT



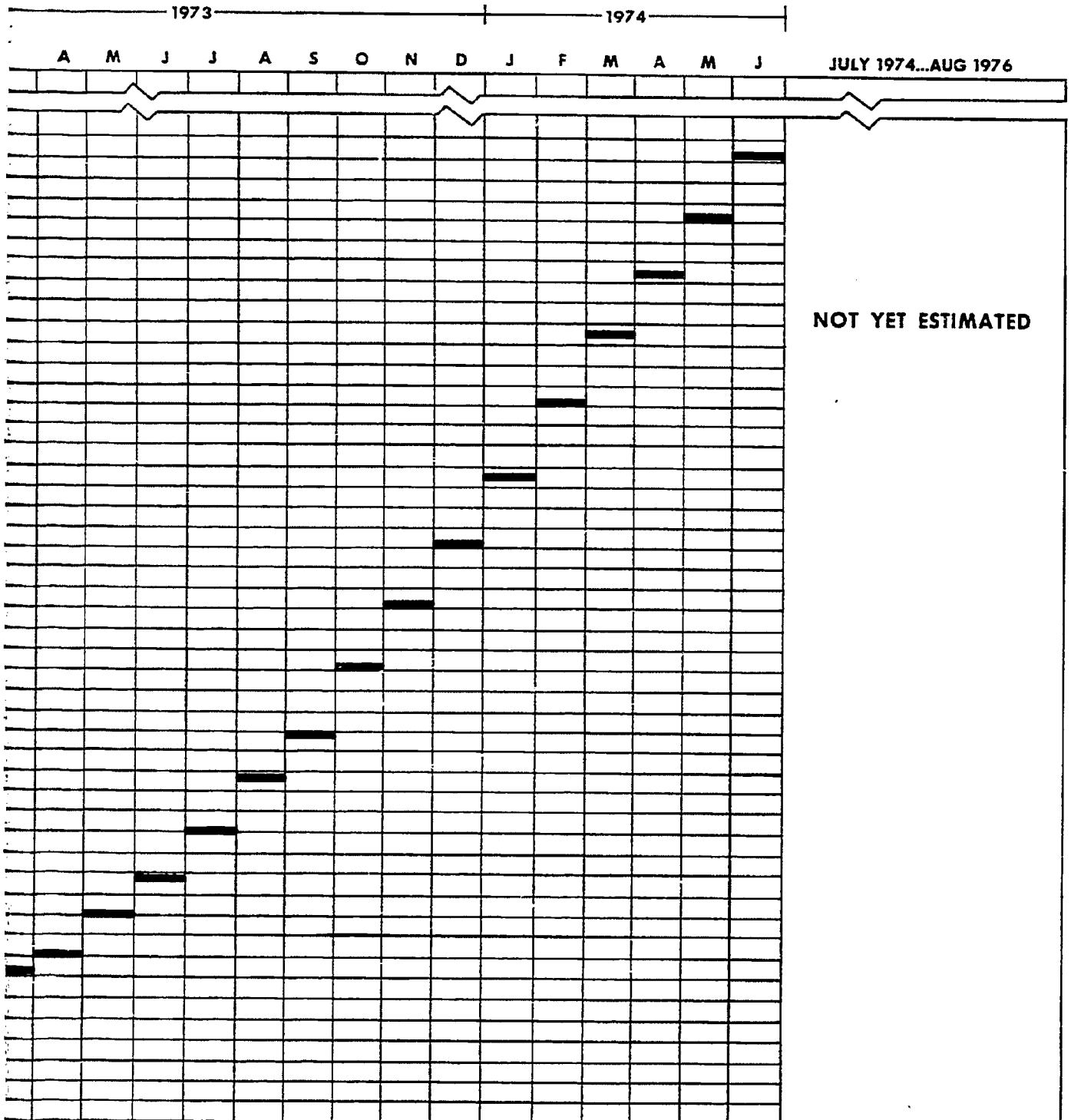
↑  
DOLLARS  
IN MILLIONS

— Predicted Expenditures, Cumulative  
 Actual Expenditures, Cumulative

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DEVELOPMENT

CUMULATIVE EXPENDITURES



Expenditures, Cumulative

Expenditures, Cumulative

2



OCR/AGA PIPELINE GAS GENERATOR RESEARCH AND DEVELOPMENT  
Schedule of Predicted and Actual Expenditures

<u>Month</u>	<u>Current Month</u>		<u>Cumulative to Date</u>	
	<u>Predicted</u>	<u>Actual</u>	<u>Predicted</u>	<u>Actual</u>
1971				
Sept.		57,900		57,900
Oct.		98,983		156,883
Nov.		129,083		285,966
Dec.		138,572		424,538
1972				
Jan.		95,161		519,699
Feb.		71,459		591,158
March		96,682		687,840
April		47,253		735,093
May		73,220		808,313
June		78,521		886,834
July		79,366		966,200
Aug.	205,974	79,220	1,172,174	1,045,420
Sept.	296,974	79,036	1,469,148	1,124,456
Oct.	335,032		1,804,180	
Nov.	335,031		2,139,211	
Dec.	331,672		2,470,883	
1973				
Jan.	357,220		2,828,103	
Feb.	357,220		3,184,423	
March	357,219		3,542,542	
April	758,369		4,300,911	
May	758,389		5,059,300	
June	758,400		5,817,700	
July	1,219,816		7,037,516	
Aug.	1,219,816		8,257,332	
Sept.	1,219,818		9,477,150	
Oct.	1,531,333		11,008,483	
Nov.	1,531,333		12,539,816	
Dec.	1,531,284		14,071,100	
1974				
Jan.	1,720,869		15,791,969	
Feb.	1,720,866		17,512,835	
March	1,720,865		19,233,700	
April	1,456,866		20,690,566	
May	1,456,866		22,147,432	
June	1,456,868		23,604,300	
July to Aug. '76	NOT YET ESTIMATED			

APPENDIX B

HOMER CITY, PENNSYLVANIA  
COAL GASIFICATION PILOT PLANT

JOB NO. C-11630

STEARNS-ROGER PROJECT STATUS REPORT  
NO. 2  
OCTOBER 6, 1972

GENERAL

This report covers job progress from September 8, 1972 to October 6, 1972.

The major effort this month has been devoted to the process work required for preparation of flow sheets and compiling the gasifier specification requirements.

Preliminary flow sheet review meetings were held with the Customer on October 1-2, 1972.

The B&W gasifier proposal was received the week of October 6, 1972 and has been forwarded to BCR, OCR and AGA for consideration. Receipt of the proposal was approximately two weeks later than promised by B&W.

The OCR/AGA Advisory Committee met with Stearns-Roger in Denver on October 5, 1972. This group was advised concerning current job status by representatives of Stearns-Roger.

PHYSICAL DESIGN

Approval has been requested to award the initial site clearing, topographical surveying and soil testing work. This work will be started upon approval to proceed.

PROCESS ENGINEERING

Process engineering is approximately 15% complete. Process manhour requirements for cost trends submitted to date have been recognized in evaluating process engineering completion.

1. Coal Handling

The flow sheets with basic instrumentation requirements have been developed and reviewed with the Customer. The major problem in this area is resolution of equipment suitable to accomplish crushing-drying of the coal. Currently, vendors are studying this problem with respect to the basic equipment which will be required. Lignite drying and combination coal - limestone grinding are being investigated. Actual equipment selections will determine the required flow sheet revisions.

2. Coal Feed

Basic process design is essentially complete. Minor changes were made during preliminary review with the Customer. Equipment specifications for inquiry of major equipment items are being prepared. Selection of lock hopper valves appears the major problem in this area.

3. Gasification

The B&W gasifier proposal for furnishing the gasifier was received the week of October 6, 1972. This was approximately two weeks later than promised. There are problems concerning acceptance of this proposal which have been brought to BCR-OCR-AGA attention. An early meeting has been recommended to resolve these problems.

The conceptual drawings, which are the basis of the B&W proposal, have been distributed for Customer and C. F. Braun comments.

B&W advised Stearns-Roger on October 4, 1972, of a fabrication problem which may require selection of new material for gasifier shell, heads, forgings, etc. B&W is currently exploring alternates for five (5) different possible cases with their fabrication people and steel supplier. An alternate material will be selected as soon as possible.

The required burners for the gasifier are considered to be a potential problem area. These burners were excluded by B&W from the basic scope of the B&W proposal. At this point, there is no schedule for any required burner development, design or fabrication.

Flow sheets for gasification and the char separation systems have been reviewed with the Customer. Flow sheets for the water cooling circuits can be started. However, firm process data will be required from B&W before equipment can be sized and process calculations completed. Firm unit standby and start-up procedures are essential to completing this work.

Overall process work is approximately 10% complete in the gasification area.

4. Gas Wash

Work in this area has been delayed to some extent until start-up procedures and the full range of design conditions is determined. BCR is working on supplying the necessary data to Stearns-Roger. During meetings on October 1-2, 1972, it was decided to design these facilities for an 800°F quenched gas temperature to lower equipment and piping costs. This decision necessitates some process redesign work in this area.

5. Char and Lime Systems

Process design is approximately 80% complete. Equipment specifications are in progress for inquiry of equipment.

6. CO Shift

Since the last report, alternate catalysts have been investigated. This resulted in discovering a major problem involving over-shift in the guard chambers. This necessitated a new approach involving a complete new process design. The new design has been reviewed with BCR and the approach which will be taken is now considered firm. A new flow sheet will now be prepared on this basis. Process completion in this area is now considered to be approximately 10% complete.

7. Acid Gas Removal

Upon receiving the required cost data from the vendor of the Rectisol Process, an economic evaluation will be prepared and a process recommended for selection. Stearns-Roger is estimating installed costs for the SELEXOL Process. Alkacid data is on hand. A dead-line for cost data has been given to Rectisol. If Rectisol data is not received by the time SELEXOL costs are estimated, Rectisol will be excluded from the evaluation.

8. Methanation

Since the last report, Stearns-Roger has been advised by BCR to proceed per the original scope of work as defined by July meetings. Process design is progressing on this basis and is approximately 10% complete.

9. Utilities

Preliminary plant fuel gas requirements have been developed. BCR is handling the problem of arranging a fuel gas supply.

Data received within the past month indicates that it will be possible to utilize Homer City water for plant requirements. If so, this will allow the creek pumping station and associated water treating facilities to be eliminated from the plant design.

10. Process Flow Diagrams and Material Balances

Process flow diagrams and material balances for the various areas are being up-dated and will be submitted for approval concurrent with the appropriate P&I flow diagrams.

APPENDIX C

C-704.

PROGRESS REPORT #38

Bituminous Coal Research, Inc.  
Coal Gasification

September 1972

Koppers Contract 2415

I. STATUS OF CONTRACT

A. Pilot Plant Engineering Bid Packages

Step No. 1: Pilot Plant for oxygen-blown, two stage coal gasification system, including general facilities: design and models.  
For additional information see Part II: Contract Evaluation.

(Work Completed)

Step No. 2: Fluidized bed system.

(Work Deferred)

B. Engineering Assistance And Recommendations For PEDU Program Methanation PEDU

1. Meetings were held with BCR and Koppers personnel on September 8 and 20, 1972 to review the process and instrumentation changes requested by BCR (Conference Report #228).
2. The following Fluid Bed Methanation PEDU drawings, bills of materials, and specifications were transmitted by Koppers Company, Inc. to BCR:

<u>Drawing No.</u>	<u>Rev. No.</u>	<u>Title</u>	<u>Date Trans.</u>
2415-5A702	0	H. P. Stall Equipment Foundations	9/5/72
2415-2A743	0	Therminol Unit and Water Storage Tank - General Arrangement and Piping Design	9/5/72
B/M 2415-2A743	0	Therminol Unit and Water Storage Tank-General Arrangement & Piping Design Bills of Materials	9/5/72

C-705.

<u>Drawing No.</u>	<u>Rev. No.</u>	<u>Title</u>	<u>Date Trans.</u>
2415-2A715	3	Utilities - Flow Diagram Sheet 1 of 3	9/8/72
2415-2A716	4	Utilities - Flow Diagram Sheet 2 of 3	9/8/72
2415-2A717	3	Utilities - Flow Diagram Sheet 3 of 3	9/8/72
2415-2A742	1	H <sub>2</sub> S, CO <sub>2</sub> and Vent Gas From Storage Area	9/8/72
2415-2A743	1	Therminol Unit and Water Storage Tank-General Arrangement and Piping Design	9/8/72
B/M 2415-2A743	1	Therminol Unit and Water Storage Tank-General Arrangement and Piping Design Bill of Materials	9/8/72
2415-5A703	0	Thermal Oxidizer Foundations	9/8/72
2415-5A704	0	Reformer Building Foundations	9/8/72
DA2.2A (Shts. 1 and 2)	2	Details for Pressure Tanks	9/8/72
DA7.2 (Shts. 1-8 incl.)	2	Specification for Non-Code Welded Apparatus and Tanks- Stainless Steel	9/8/72
2415-6A701	2	Grounding	9/13/72
2415-6A702	2	Single Line Diagram	9/13/72
2415-6A703	2	Specification Schematics and Connection Diagram Sheet 1	9/13/72
2415-6A704	1	Specification Schematic and Connection Diagram Sheet 2	9/13/72

C-706.

<u>Drawing No.</u>	<u>Rev. No.</u>	<u>Title</u>	<u>Date Trans.</u>
2415-6A705	1	Power and Control Conduits Exposed and Embedded	9/13/72
2415-6A706	1	Building No. 3 Power and Control	9/13/72
2415-6A711	1	Instrumentation Interconnection Diagram Sheet 3	9/13/72
2415-6A712	1	Instrumentation Interconnection Diagram Sheet 4	9/13/72
2415-6A713	1	Instrumentation Exposed Conduits Sheet 1	9/13/72
2415-6A714	1	Instrumentation Exposed Conduits Sheet 2	9/13/72
2415-2A701	2	Material Balance Sheet 1 of 2	9/25/72
2415-2A702	2	Material Balance Sheet 2 of 2	9/25/72
2415-2A727	0	Material Balance (With H <sub>2</sub> S and CO <sub>2</sub> Addition)	9/25/72
2415-2A728	0	Material Balance (With H <sub>2</sub> S and CO <sub>2</sub> Addition)	9/25/72
2415-2A733	4	Plot Plan	9/25/72
2415-6A707	1	Electrical Wiring 750 KVA Transformer and Switchgear Pwr. and Cont. Embedded Conduits and Grd.	9/27/72
2415-6A708	0	Electrical Wiring Distribution Panel "B" Wiring Connection Diagram	9/27/72

C-707.

<u>Drawing No.</u>	<u>Rev. No.</u>	<u>Title</u>	<u>Date Trans.</u>
2415-6A709	0	Electrical Wiring Instrumentation Interconnection Diagram Sheet 1	9/27/72
2415-6A710	0	Electrical Wiring Instrumentation Interconnection Diagram Sheet 2	9/27/72

3. The following memorandum was transmitted by Koppers Company, Inc. to BCR:

<u>Date</u>	<u>Letter No.</u>	<u>Title</u>	<u>Remarks</u>
9/29/72	C455	Vendor's Approval Drawings	Comments on Ingersoll-Rand Co. Dwgs. for Feed Gas Compressor (M-K305) and E. L. Weigand Co. Dwgs. for Therminol System

C. Fluid Bed Gasification PEDU

1. BCR's letter of June 26, 1972 relieved Koppers of the responsibility for fluidized-bed gasification engineering under Amendments No. 6 and No. 7, Subcontract No. 2, OCR Contract No. 14-32-001-1207.

D. General Engineering Assistance & Consultation

1. Koppers Company, Inc. Inspection Section inspected vessel M-V620 (Demister) on September 15, 1972 at National Annealing Box Co. with personnel from BCR. An Inspection Report was submitted to BCR in a memorandum (C452) dated September 25, 1972.
2. Koppers Company, Inc. reviewed the various instrument Vendor's quotations for control valves and submitted comments to BCR in a memorandum (C450) dated September 20, 1972.

CONTRACT EVALUATION

Four (4) copies of Amendment No. 7 to Amended Subcontract No. 2, including Appendices I through VIII, signed by Mr. J. D. Rice, Vice President, Engineering and Construction Division, Koppers Company, Inc., were transmitted to BCR in our letter C-183 dated October 18, 1971. Receipt of these copies was acknowledged by BCR in their letter dated October 18, 1971.



C-708.

Pilot Plant Engineering Bid Package (Volumes I through VI) was completed in accordance with the scope of work specified under Appendix I - Revised Appendix A, Par. IIIA-5. Step a.: "General Facilities Plus Oxygen-Blown Two-Stage System" of Amendment No. 7 to Amended Subcontract No. 2 (originated under OCR Contract No. 14-01-0001-324 and transferred to OCR Contract No. 14-32-0001-1207) between Bituminous Coal Research, Inc., and Koppers Company, Inc.

J. F. Farnsworth  
Project Manager