BITUMINOUS COAL RESEARCH, INC.
SPONSORED RESEARCH PROGRAM

GAS GENERATOR RESEARCH AND DEVELOPMENT

Progress Report No. 11

(BCR Report L-479)

I. INTRODUCTION

This report summarizes progress achieved during the month on the general program, "Gas Generator Research and Development," being conducted by Bituminous Coal Research, Inc., for the Office of Coal Research. The program which was initiated under Contract No. 14-01-0001-324, December 20, 1963, was transferred to Contract No. 14-32-0001-1207 on August 19, 1971. Thus, this report represents the eleventh report of progress under the new prime contract.

The overall objective of the program continues to be to develop processes for gasifying coal to produce fuel gas and 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.

B. Monthly Progress Charts

Monthly progress charts reflecting proposed rate of effort and expenditures are shown in Appendixes A-1 and A-2.

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

A. Laboratory-scale Process Studies

1. Gas Processing (M. S. Graboski): Work continued in the area of gas processing methanation studies in accordance with the updated time schedule presented in Figure 148. This report summarizes progress achieved in the bench-scale and PEDU gas processing programs during July.

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 107, Progress Report No. 7. 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 program and the PEDU programs is to determine the feasibility of these schemes for the BI-GAS progress.

(1) Catalysts: During the past six months, BCR has negotiated secrecy agreements with Harshaw Chemical Company and Chemetron Corporation with respect to methanation catalysts. In early June, BCR and Harshaw met to plan a course of action to improve upon the catalysts which BCR has found effective for methanation. A similar meeting has been arranged with Chemetron for early August.

Under the Harshaw program, the first step decided upon was to check catalyst supports for activity towards the methanation synthesis. Since the life test unit, as designed, is capable of handling four catalysts at one time, BCR and Harshaw agreed to limit the number of supports to four. These were the following:

BCR No.	Harshaw No.	Description
3013	AL-1401 P	Pure alumina, 200 sq m
3017	AlXL-628A-1-10-2P	Pure alumina, 100 sq m
3014	AlXL-391A-2-1-2P	Pure alumina, 6 sq m
3018	AlXL-365A-2-7-1P	25% alumina, 75% silica, 350 sq m

The wide range of surface areas and the higher acidity of the silica-alumina mixture should indicate any effect of normal catalyst supports on the synthesis.

It was indicated in last month's report that the life test unit was reworked to include a copper liner. The resulting reactor tubes had an internal diameter of 0.16 inches.

Prior to charging the reactor tubes with samples of the supports, a blank test was run. The reactor was operated at 850 F and 1000 psig using a

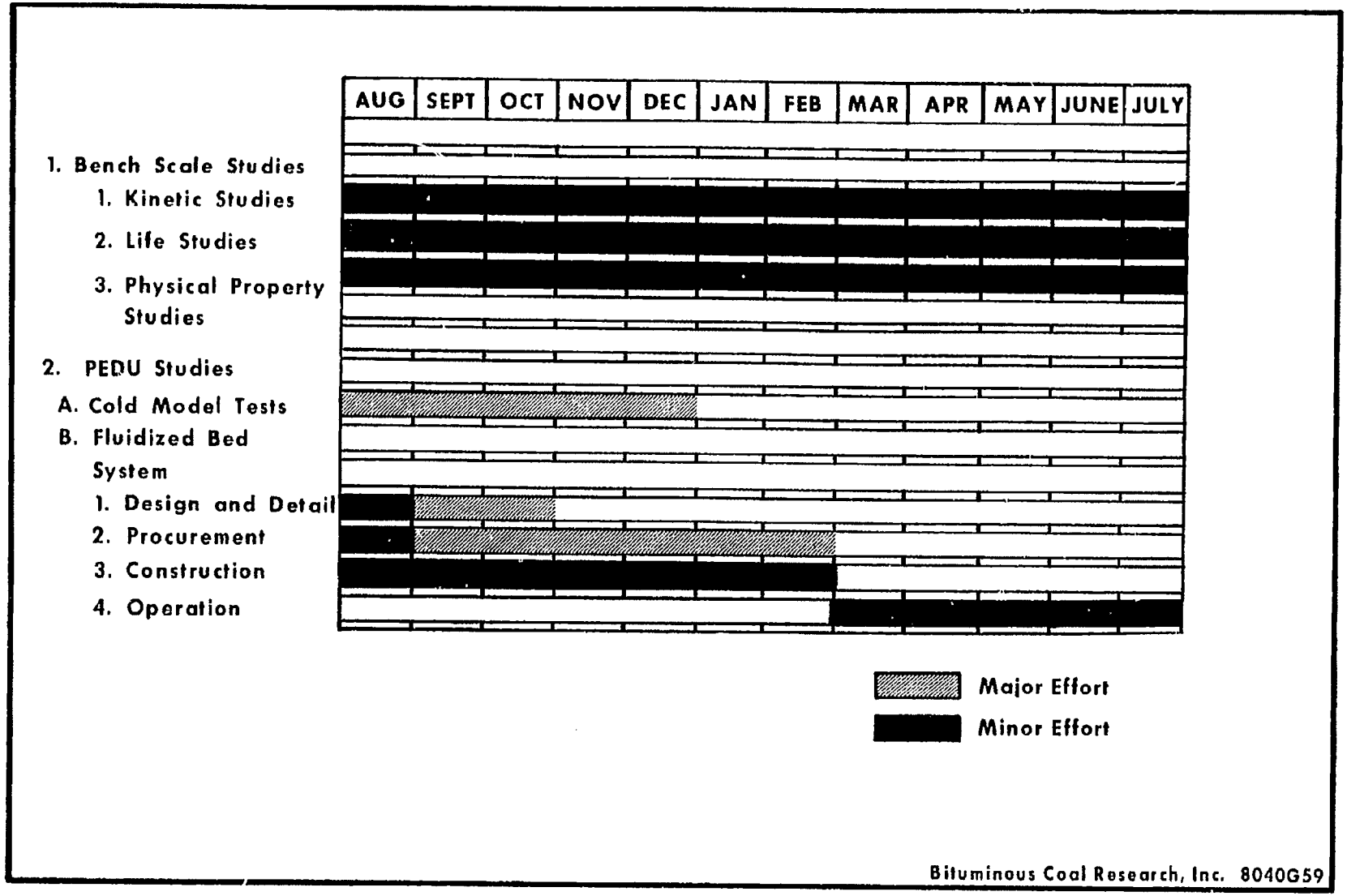

Figure 148. Gas Processing Work Schedule for Calendar 1972

synthesis gas containing 20 percent carbon monoxide, 62 percent hydrogen, 16 percent methane, and 2 percent nitrogen. In the blank test, a small amount of conversion took place in each tube. This amounted to consumption of about 5 percent of the hydrogen in the feed gas, a relatively minor amount.

The life test reactor tubes were charged directly with the alumina catalyst supports to determine their activity. Approximately 8 ml of each support was charged. A flow rate of 30 ml per minute at STP was established through each tube using the same synthesis gas as fed during the blank test. The reactor conditions were the following:

Temperature	- 850 F
Pressure	- 1000 psig
Space Velocity	- 225 vol/vol/hr

The samples were tested for several days at these conditions. Results indicated that no measurable conversion of carbon monoxide and hydrogen occurred during this period. It was thus concluded that alumina acts only as a structural support and that addition of acidity in the form of silica does not materially improve the catalytic support.

The second phase of the program with Harshaw involves testing of several promoted catalyst types found by BCR to be acceptable for methanation. Results of the test program to date have indicated that a catalyst yielding high conversions, at about a space velocity of 1000, would be highly desirable. The catalyst types tested to date with the most success, chromic oxide and molybdenum oxide, are not active enough to meet this criterion. Recent success with a nickel-tungsten catalyst has indicated that promotion of the above oxides with a small amount of nickel might yield a stable, more active methanation catalyst. Thus, based on their past experience in the field of nickel and nickel-promoted catalysts, Harshaw prepared several formulations for BCR to test. The catalysts as purchased from Harshaw were the following:

(a) BCR 3052, Harshaw NIX-623A-1-9-2P: This catalyst is a 0.28 percent nickel-impregnated-on-alumina catalyst AL-1404-P. The purpose of studying this preparation is to determine whether small amounts of highly catalytic nickel spread over a large surface area support will yield a stable catalyst. BCR investigated a catalyst with low nickel content during the early stages of the program with no success. However, that catalyst contained 2 percent nickel on a 6 sq m alundum support and was purchased in pellet form. It is not known whether size reduction and/or the low surface area caused failure of the catalyst.

(b) BCR 3050, Harshaw NIX-623A-1-12-2-P: This catalyst is a 0.92 percent nickel-impregnated-on-chrome catalyst Cr-1404P. The chrome catalyst has shown good life with low activity. The addition of nickel to this stable catalyst could yield a highly acceptable methanation catalyst.

(c) BCR 3049, Harshaw NIX-623A-1-11-2P: This catalyst is a 0.56 percent nickel-impregnated-on-Molybdena catalyst Mo-1101P. As with the chrome catalyst, it is hoped that the addition of nickel will increase the activity of the molybdena-alumina catalyst without affecting stability.

(d) BCR 3051, Harshaw NIX-623-1-10-2P: This is a nickel-molybdena catalyst composed of 6.44 percent MoO_3, 1.38 percent N_iO and alumina support AL-1404P. This catalyst differs from the above nickel-molybdena in that it is prepared by a simultaneous impregnation resulting in more homogenous distribution of nickel over the surface. This type of preparation could prove to be much more stable than the promoted form.

(2) BSM Tests: Four BSM tests, Numbers 74 through 77, are reported below. Three, Numbers 74, 76, and 77, were conducted with respect to the catalyst support evaluation work reported in the previous section. Test 75 was conducted on a sample of nickel molybdate catalyst received from Catalyst and Chemicals, Inc.

BSM Test 74: BSM Test 74 was conducted with microsphere active alumina supplied by Chemetron Corp. Results indicated a possible conversion of 5 percent. However, this minor amount could have resulted from conversion on the reactor wall.

BSM Test 75: BSM Test 75 was conducted using a 115 gram lot of BCR No. 2915 nickel molybdate catalyst. The system pressure was 1010 psig and reaction temperatures of 918 F and 1000 F were used. The feed gas had the following composition:

Component	Volume, percent
Hydrogen	61.8
Carbon Monoxide	20.2
Nitrogen	2.1
Methane	15.9

Results for Test 75: Material balance data for Test 75 are given in Table 132. Overall results are shown in Table 133.

Results indicated that useful conversion amounted to about 40 percent at a 3250 space velocity for both test periods. Higher conversion would be expected at the 1000 space velocity design criteria. The conversion of (H_2 + CO) to ethane was much higher than has been found for the nickel-tungsten catalyst previously investigated. The shift equilibrium ratio was close to the theoretical shift ratio (5.51 and 4.04 as opposed to 5.15 and 3.75) indicating excellent shift ability.

No further tests will be conducted on Catalyst 2915 since several nickel molybdate catalysts in microsphere form have been received. Results from Test 75 indicated that nickel molybdate should be a good catalyst. This confirms some previous results for this catalyst under fixed bed conditions.

BSM Test 76: BSM Test 76 was conducted using 91.3 grams of Lot 3013, 200 sq m alumina. No activity was found.

BSM Test 77: BSM Test 77 was conducted on 100 grams of silica-alumina Lot 3018 catalyst. No activity was found.

TABLE 132. DATA AND RESULTS FOR BSM TEST 75, PERIOD 1,
CONDUCTED AT 918 F AND 1010 PSIG
NICKEL-MOLYBDATE CATALYST NO. 2915

A. Material Balance

	Feed		Product	
Component	mole percent	g moles/hr	mole percent	g moles/hr
Carbon Monoxide	20.2	4.07	9.03	1.39
Carbon Dioxide	0.0	0.00	5.75	0.89
Hydrogen	61.8	12.45	50.75	7.82
Nitrogen	2.1	0.42	2.89	0.45
Methane	15.9	3.20	30.77	4.74
Ethane	0.0	0.00	0.81	0.12
Propane	0.0	0.00	0.00	0.00
Water	0.0	0.00	-	0.90
Total	100.0	20.14	100.00	16.31
Total Moles Carbon		7.27		7.27
Total Moles Hydrogen		37.70		37.17
Total Moles Oxygen		4.07		4.07

B. Conversion Data

	Raw Data g moles/hr
CO → Products	2.68
H_2 → Products	4.62
Reactants → H_2O	0.90
CO → CH_4	1.54
CO → C_2H_6	0.25
CO → C_3H_8	0.0
CO → CO_2	0.89
α, Percent	42.6
β, Percent	13.9
K_{shift} (experimental)	5.51
K_{shift} (theoretical at outlet)	5.20

TABLE 132. DATA AND RESULTS FOR BSM TEST 75, PERIOD 2, CONDUCTED AT 1000 F AND 1010 PSIG NICKEL-MOLYBDATE CATALYST NO. 2915 (Continued)

A. Material Balance

Component	Feed mole percent	Feed g moles/hr	Product mole percent	Product g moles/hr
Carbon Monoxide	20.2	4.06	11.01	1.75
Carbon Dioxide	0.0	0.00	4.58	0.73
Hydrogen	61.8	12.42	52.23	8.30
Nitrogen	2.1	0.42	2.80	0.44
Methane	15.9	3.20	28.69	4.56
Ethane	0.0	0.00	0.69	0.11
Propane	0.0	0.00	0.00	0.00
Water	0.0	0.00	-	0.86
Total	100.0	20.64	100.00	16.75
Total Moles Carbon		7.25		7.25
Total Moles Hydrogen		37.61		37.19
Total Moles Oxygen		4.06		4.06

B. Conversion Data

		Raw Data g moles/hr
CO	→ Products	2.31
H_2	→ Products	4.12
Reactants	→ H_2O	0.86
CO	→ CH_4	1.36
CO	→ C_2H_6	0.22
CO	→ C_3H_8	0.00
CO	→ CO_2	0.73
α, Percent		37.7
β, Percent		13.9
K_{shift} (experimental)		4.04
K_{shift} (theoretical at outlet)		3.61

TABLE 133. SUMMARY OF RESULTS FOR BSM TEST 75. CATALYST NO. 2915

Period	Temp, F	Pressure, psig	Space Velocity[1]	U/U_{mf} Inlet	U/U_{mf} Outlet	α[3]	θ[3]	K_S[4]	τ, sec[5]
1	918	1010	3252	3.48	2.83	42.6	13.9	5.51	40.7
2	1000	1010	3245	3.67	3.10	37.7	13.9	4.04	37.9

[1] Standard volumes/volume catalyst/hr at inlet conditions

[3] α, useful conversion, 100 x (moles ($CO + H_2$) converted to hydrocarbons)/(total moles ($CO + H_2$) fed)

[3] θ, moles CO to hydrocarbon above methane produced/total moles CO to hydrocarbons produced

[4] K_S, shift constant, $(P_{CO})(P_{H_2})/(P_{CO})(P_{H_2O})$ at outlet

[5] τ, residence time assuming 30% bed expansion and $U = (U_{in} + U_{out})/2$

Results for Tests 74, 76, and 77 confirm the data obtained in the life test reactor and reported previously. That is, alumina shows no major catalytic nature towards methanation.

b. PEDU Studies: Progress continued to be made on the methanation PEDU during July.

(1) Engineering: Koppers continued with the detail engineering of the PEDU during July.

(a) Vessels: Vessel designs were completed in May 1972.

(b) Buildings: Building specifications and modifications were completed in June 1972.

(c) Piping and General Arrangement: Several areas of P and A are outstanding and not completed by Koppers. These are:

Compressor Room

Cooling Water Storage Area

(3) Control Room

(4) High Pressure Stall

(d) Electrical: The electrical package has been submitted in total. It is essentially correct, but must undergo some minor modifications based on the requirements of the thermal oxidizer system.

(e) Instrumentation: Instrumentation work is essentially completed. Some minor alterations in the panel board drawings are necessary before this section of the engineering is finished.

(f) Foundations: Some work remains in the foundations area. BCR has authorized Koppers to proceed with the design of the pad for the carbon dioxide and hydrogen sulfide storage areas based on a Cardox bulletin. OCR approval to rent the Cardox system has been requested. Items to be received include:

(1) Hydrogen sulfide and carbon dioxide storage pad

(2) Thermal oxidizer pad

(3) Reformer enclosure pad

(4) Miscellaneous Building 3 concrete

(5) Compressor room pad

(2) Procurement: Table 134 indicates the status of equipment procurement for the PEDU. The major items remaining to be purchased include

TABLE 134. SUMMARY OF STATUS OF PEDU EQUIPMENT ITEMS

Index	Equipment Item	Status[1]	Estimated Delivery Date
ME-405	Feed Gas Preheater	D	--
ME-410	Filter Blowback Heater	P/A	9/14/72
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	9/22/72
MK-305	Methanator Feed Gas Compressor	P/A	12/04/72
ME-305	Bypass Cooler	P	--
MK-770	Air Compressor	P	--
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_2S 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	7/22/72
MV-620	Demister	P/A	8/25/72
MV-710	Cooling Water Tank	P/A	R
MV-763 A & B	H_2S Removal Towers	P/A	7/21/72
MV-764	Drip Pot	D	--
MV-766	Water Break Tank	P/A	7/28/72
MX-100	Reformer	P/A	11/03/72
MX-500	Therminol System	P/A	8/23/72
MX-720	Steam Boiler	P/A	9/20/72
MX-750	Demineralizer	P/A	--
MX-770	Thermal Oxidizer	P	10/20/72
MY-700	Reformer Enclosure	P	--

[1] D Design Stage
Q Quote Stage
P Procurement Stage
P/A Procured and Vendors Drawings Approved
R Received

the panel board and the gas preheater. Koppers will provide this information in the very near future.

Instrumentation procurement is proceeding. Most equipment for the panel has been purchased and a fair percentage of this has arrived.

(3) Permits: All necessary permits have been acquired. These include permits from Monroeville Borough for excavation and building, and from the Allegheny County Bureau of Air Pollution Control.

(4) Utilities: Duquesne Light drawings have been returned approved. The transformer will be installed in the latter part of the year.

Peoples Gas has been recontacted with respect to the necessary alterations to the gas reducing station to increase its capacity to 11,000 scfh as previously promised by them last year. Peoples will be out to discuss this matter in the near future.

(5) Construction: PEDU construction is proceeding. During July, fencing was installed about the site area. Quotations for some concrete work including (1) pipe rack supports, (2) transformer pad, (3) hydrogen sulfide removal tower pads, and (4) cooling tower piers were solicited. The successful contractor is currently being selected. Steel-bilt Co. was asked to quote as a sole source contractor on the Building 3 alterations due to their familiarity with Armco Steel Buildings. OCR approval is currently being solicited. The electrical bid package, as prepared by Koppers, has been transmitted to four contractors for quotation purposes. No replies have yet been received. BCR has begun to prepare for piping installation. The yard service racks have been fabricated and will be installed after the concrete work is completed. Supplies for the carbon dioxide and hydrogen sulfide piping have been received and initiation of work is anticipated in this area in the near future.

(6) PEDU Problem Areas: Several PEDU problem areas still exist.

(a) Feed Gas Heater: Koppers is proceeding to design this unit. BCR has not yet received any design information.

(b) Reformer: BCR, Koppers, and Gas Atmospheres tentatively will meet August 1 to discuss the status of the unit and transmit necessary information.

(c) Feed Gas Compressor: Delivery of this unit has been revised to early December due to flood-related problems at the Ingersoll Rand manufacturing facility.

c. Model Studies: Due to the heavy PEDU work load, time which had been set aside for Model Studies has not been available for this portion of the program. Work in this area will be continued as time permits.

d. Future Work: Work planned for the coming month includes the following:

(1) Testing of the four new methanation catalysts.

(2) Compretion of PEDU detail engineering.

(3) Strong effort in the area of PEDU construction.

2. Analytical Services (J. E. Noll): During the past month, 11 samples were analyzed by gas chromatography. The types of analyses requested were as follows:

Type of Analysis Requested	No. of Samples Analyzed
Gas Chromatography	
Methanation Unit	
Gas Samples	11
Liquid Samples	0
Total	11

3. Gas Chromatographic Procedures (J. E. Noll): Neon was investigated as a possible carrier gas for the analysis of the product and reactant gases for the methanation PEDU. Neon, in comparison to helium, produces higher or equal sensitivities to the gases being analyzed. Neon, however, shows somewhat longer retention times than helium at flow rates which produce maximum sensitivity, thus resulting in longer analytical times.

a. Equipment: The Gow Mac 69-500 gas chromatograph was used for this investigation because similar gas chromatographs will be used in the methanation PEDU. The unit was fitted with an 8 foot x 1/4-inch diameter stainless steel column containing 100/120 mesh Porapak Q at a packing value of 1.74 g/ft and a 6 foot x 1/4-inch diameter stainless steel column containing 80/100 mesh molecular sieve 5A at a packing value of 4.03 g/ft. The signal from the gas chromatograph was recorded on a strip chart recorder and the area under the curves integrated by an Autolab 6250 integrator. Neon or helium was supplied to the gas chromatograph through a T-tube arrangement in the supply line.

b. Determination of Analytical Conditions: Since there were little or no data available on the use of neon as a carrier gas, the parameters necessary for the analysis of the gases under investigation, had to be established. The separation characteristics of the columns were determined at various oven temperatures and neon flow rates.

The response of the system, i.e., the integrator counts for a given percentage of a gas in a mixture, was investigated by varying the detector cell temperature and the filament current. Table 135 lists the experimental results when a gas mixture with the composition indicated below was used:

TABLE 135. RESPONSE FACTORS AND RETENTION TIMES FOR GASES USING NEON AS A CARRIER GAS.

Oven Temperature, C	Carrier Gas Flow, ml/min	Cell Temperature, C	Filament Current, ma	Column*	Response (Integrator Counts) H_2	CH_4	CO	CO_2	Retention Time, seconds H_2	Composite	CH_4	CO_2	O_2	N_2	CO
49	30.3	185	140	PPQ	2390	144.5		1010	130	162	226	442			
				MS5A	1406	131.4	937.4		102		502		184	354	1234
	50.8			PPQ	1526	73.5		738	93	119	171	356			
				MS5A	1360	76.6	552.3		66		360		126	252	932
	96.8			PPQ	832.5	25.4		365	68	85	121	260			
				MS5A	644.8	21.3	275.9		45		236		80	164	626
62.5	35.3	147	110	PPQ	1123	152.3		620	121	146	191	348			
				MS5A	950	139.7	429.1		92		349		148	246	710
		150	145	PPQ	1473	209.9		1255							
				MS5A	1354	197.1	947								
		155	170	PPQ	1864	134.5		1821							
				MS5A	1704	124.5	1419								
73	34.3	89	110	PPQ	1166	254.2		688.6	122	144	185	312			
				MS5A	1129	233.5	485.8		88		298		136	212	536
		90	130	PPQ	2021	375.6		1152.6							
				MS5A	1793	338.3	816.7								
		91	150	PPQ	3021	435.7		1603							
		92	170	PPQ	4329	439.8		2155							
	85.7	95	150	PPQ	1182	144.5		610.3	72	87	111	187			
				MS5A	1102	123.4	433		48		162		74	115	292
73	55.6	94	150	PPQ	1810	245.9		965.8	90	109	140	236			
				MS5A	1720	219.9	715.3		61		212		96	151	384
	32.3	95	150	PPQ	3220	457		1721	135	148	192	323			
				MS5A	3180	416	1248		91		312		142	224	569
	22.7			PPQ	4521	633		2415	155	184	240	403			
				MS5A	4483	620	1802		122		421		191	300	764

* PPQ - Porapak Q
MS5A - Molecular Sieve 5A

Component	Volume, percent
Hydrogen	25.0
Carbon Monoxide	24.9
Methane	24.8
Carbon Dioxide	25.0
Nitrogen, Oxygen, Ethane	0.3

c. Retention Time: Table 136 presents data on retention time as a function of the flow rate of the carrier gas when analyzing a gas having the following composition:

Component	Volume, percent
Hydrogen	20.0
Methane	20.0
Carbon Monoxide	20.0
Carbon Dioxide	20.0
Oxygen	8.0
Nitrogen	8.0
Ethane	4.0

The data from both Tables 135 and 136 are presented in graphical form in Figures 149 and 150. The retention time varied inversely with the flow rate.

Table 137 presents a comparison between retention time for various gases when using helium as the carrier gas in the Hewlett Packard chromatograph under the conditions previously established for this analysis, and retention time when using neon as the carrier gas in the Gow Mac chromatograph at flow rates of 25 ml/min and 50 ml/min. As can be seen, the retention time using neon was, in some cases, twice the retention time when using helium. By doubling the flow rate for neon, the retention time was reduced by almost one half, and with some gases the retention time was actually less than when using helium. Short retention times are desirable, consistent with good separation and sensitivity.

d. Sensitivity: Sensitivity is defined as the number of integrator counts for each percent of gas in the mixture (at a given concentration range). Response is the sensitivity multiplied by the concentration of the gas. Since the sensitivity may not be linear throughout the concentration range, the average concentrations of the samples expected to be analyzed were selected. Thus, hydrogen, methane, carbon monoxide, and carbon dioxide were tested in the 20 to 25 percent range; oxygen and nitrogen, in the 0 to 8 percent range; and ethane, in the 0 to 4 percent range. The data in Table 135 are presented in graphical form in Figure 151. The response decreases rapidly with flow rate. Thus, the flow rate which would yield a response with methane equal to the response obtained on the Hewlett Packard gas chromatograph (490 counts for 25 percent concentration) under BCR standard conditions was selected for further work.

Comparison of the sensitivities of the Gow Mac system, using neon with the Hewlett Packard system, using helium (see Table 138), indicates that most of

TABLE 136. RETENTION TIME FOR SOME GASES USING NEON AS A CARRIER GAS

Oven Temperature, C	Carrier Gas Flow, ml/min	Cell Temperature, C	Filament Current, ma	Column*	Retention Time, seconds							
					H_2	Composite	CH_4	CO_2	O_2	N_2	CO	C_2H_6
75	25	100	150	PPQ	152	176	208	368				
				MS5A	116		358		172	254	592	698
	20	90		PPQ	174	202	261	424				
				MS5A	134		452		204	306	792	806
	10			PPQ	280	320	419	684				
				MS5A	244		820		374	564	840	1278

* PPQ - Porapak Q
MS5A - Molecular Sieve 5A

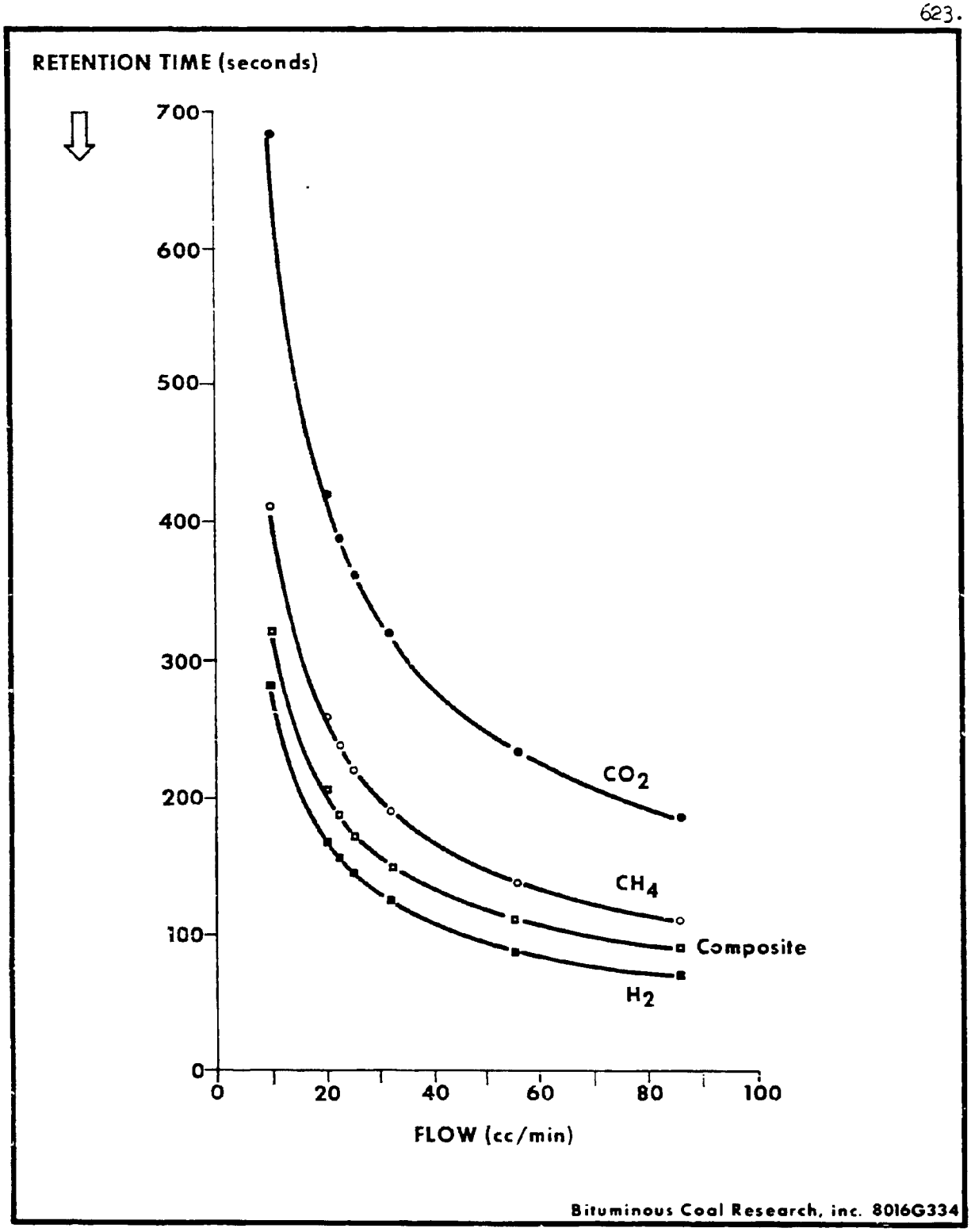

Figure 149. Retention Time for Porpak Q Column as a Function of Flow of Neon Carrier Gas at an Oven Temperature of 75 C

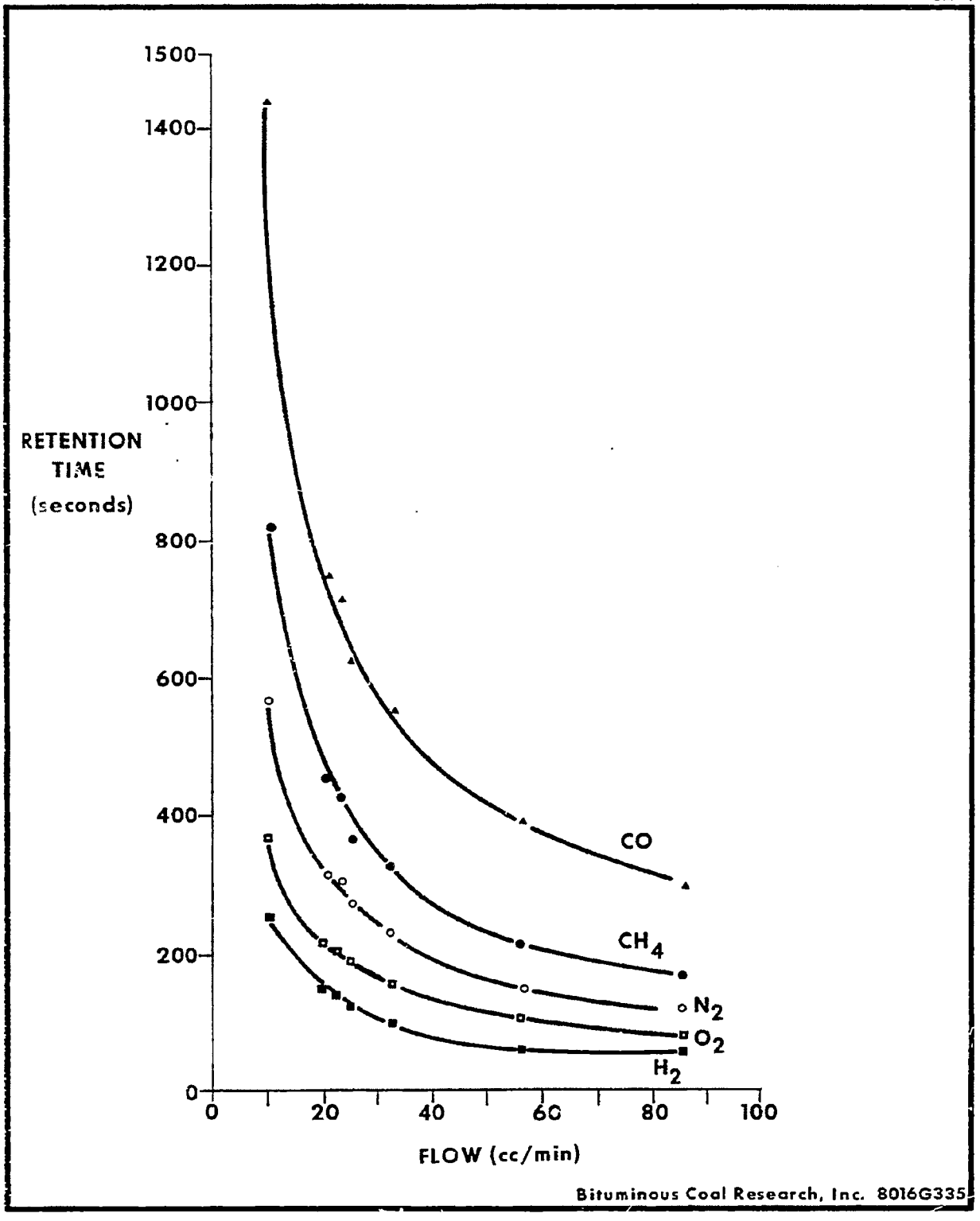

Figure 150. Retention Time for Molecular Sieve 5A Column as a Function of Flow of Neon Carrier Gas at an Oven Temperature of 75 C

TABLE 137. COMPARISON OF RETENTION TIMES USING HELIUM AND NEON AS CARRIER GAS

Carrier Gas		Helium‡	Neon			
Flow rate, ml/min		50	25		50	
Component Gas	Column†	Retention Time, (H.P.) Sec.	Retention Time, Sec.	Ratio Ne/He	Retention Time, Sec.	Ratio Ne/He
Hydrogen	PPQ	65	145	2.23	90	1.39
Methane	PPQ	120	220	1.84	140	1.16
Carbon Dioxide	PPQ	210	362	1.73	245	1.16
Ethane	PPQ	510	698	1.32	2400	.57
Hydrogen	MS5A	60	125	2.08	70	1.17
Oxygen	MS5A	105	180	1.71	115	1.10
Nitrogen	MS5A	180	270	1.50	165	.92
Methane	MS5A	270	390	1.44	230	.85
Carbon Monoxide	MS5A	600	650	1.08	420	.70

† PPQ - Porapak Q
MS5A - Molecular Sieve 5A

‡ Those retention times are for the conditions used for analytical work at BCR on the Hewlett Packard 700 gas chromatograph.

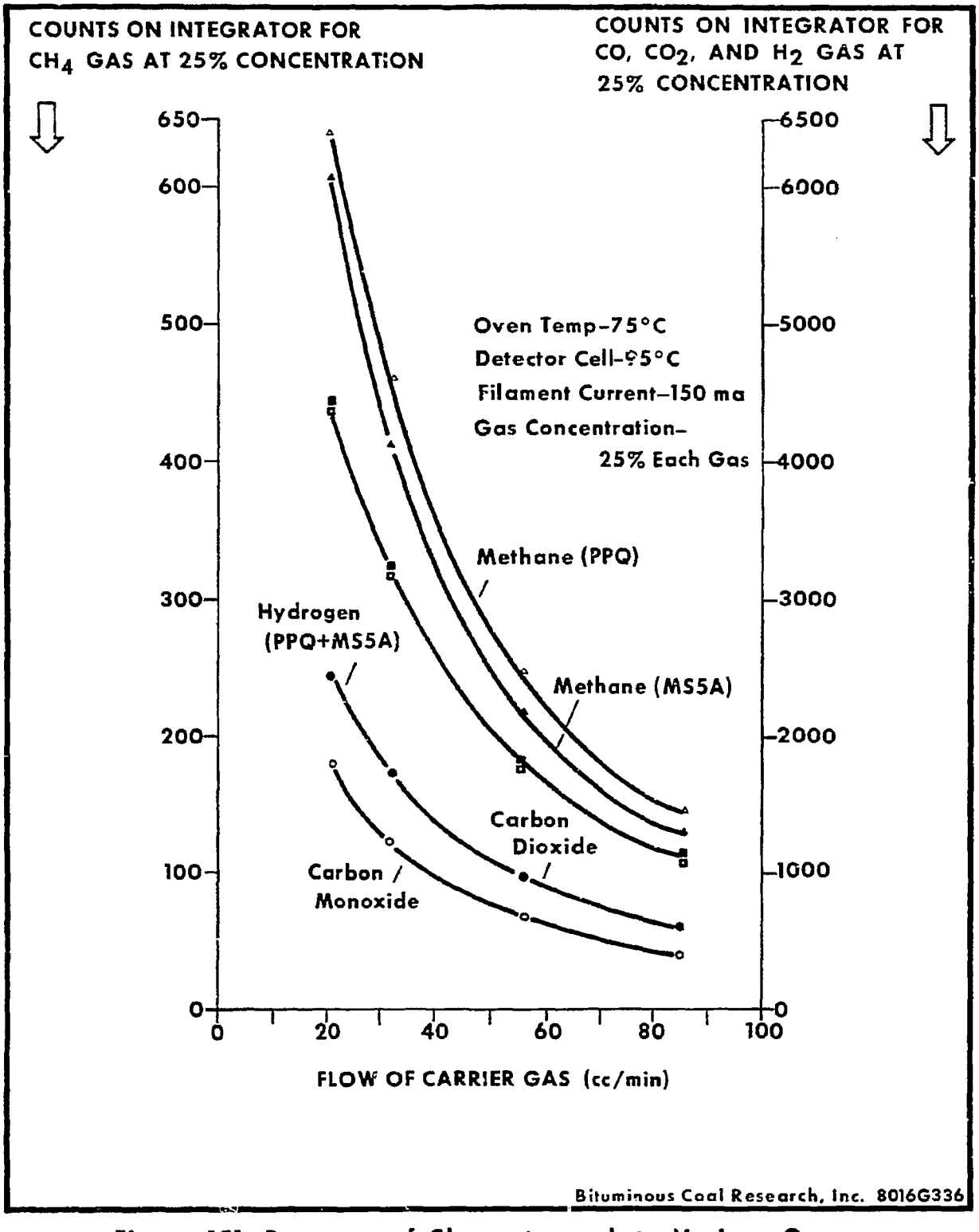

Figure 151. Response of Chromatograph to Various Gases with Neon Carrier Gas

TABLE 138. COMPARISON OF RESPONSE VALUES USING HELIUM AND NEON AS CARRIER GASES

Carrier Gas			Helium	Neon	
Gas Analyzed	Concentration level, Percent	Column	Response Counts/percent Gas	Response 25 ml/min	Ratio, Ne/He
Hydrogen	20-25	PPQ	--	157.0	--
Methane	20-25	PPQ	50.20	22.1	0.44
Carbon Dioxide	20-25	PPQ	66.90	89.0	1.33
Ethane	4	PPQ	74.25	63.7	0.86
Hydrogen	20-25	MS5A	1.80	157.0	83.50
Oxygen	8	MS5A	19.87	55.0	2.77
Nitrogen	8	MS5A	21.28	66.8	3.14
Methane	20-25	MS5A	19.54	21.3	1.09
Carbon Monoxide	20-25	MS5A	21.59	57.6	2.67

the gases yielded a higher sensitivity with neon (25 ml/min flow). This would result in more accurate analytical data.

Filament current is also directly related to response. Figure 152 shows how response changes with filament current under given conditions. The methane curve flattens above 150 milliampers and was selected as the current for analytical work to obtain the maximum sensitivity (to methane) with the longest cell life (minimum current).

The linearity of the response of the Gow Mac system using neon was approximated by injecting volumes of hydrogen or methane into the gas chromatograph with a hypodermic syringe. Since a 1 ml gas sample is generally used, the volume injected can also represent percentage. Figure 153 indicates that the hydrogen response is linear but the methane response is not, especially below 0.35 ml.

e. Future Work

(1) Gas samples will be analyzed as required.

(2) The flame ionization detector gas chromatograph will be assembled and standardized.

(3) The automated system of gas analysis, using neon as a carrier gas, will be assembled and standardized when the equipment is obtained.

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

All the planned experiments were completed in June. The unit was run twice for demonstration to staff members of Stearns-Roger, Blaw-Knox, and C. F. Braun Co.: first as a 4-foot Stage 2 model with cork dust injection, and second as a 4-foot Stage 1 model with glycerine spray.

The first draft of the Summary Report on the cold model experiments was completed. It is expected that this report will be included in the next monthly progress report.

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

1. Automated Data Acquisition: The software executive system for real time data acquisition has been completely debugged.

Debugging of the programs written to log, process, report, and store data from the methanation unit has been initiated. This work should be completed during August, 1972. At that time the computer will be utilized for collection, processing, and reporting of selected data from the methanation unit.

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

a. Completion of debugging work on the data logging and processing routines for the methanation unit.

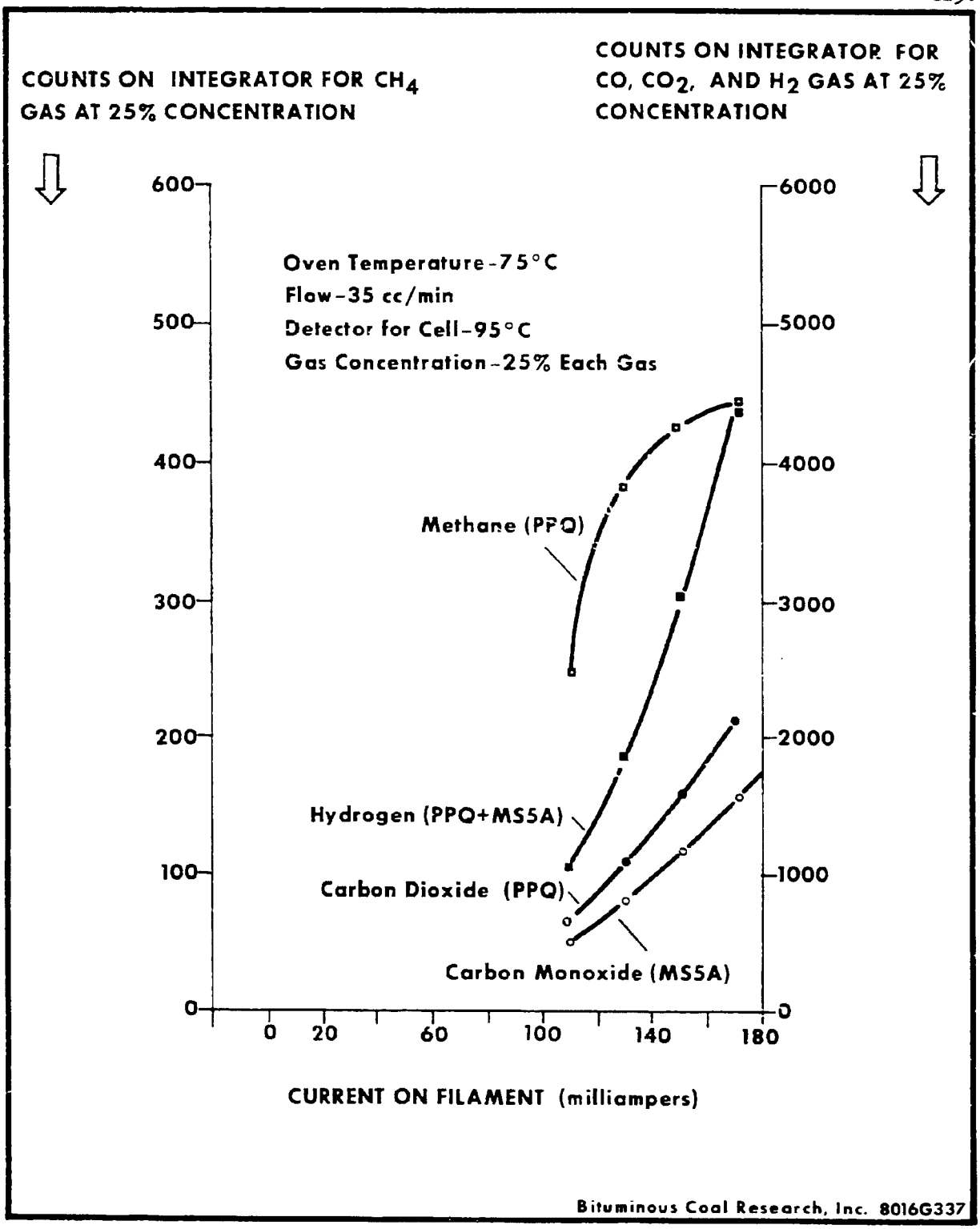

Figure 152. Response of Chromatograph to Various Gases with Neon Carrier Gas at Various Filament Currents

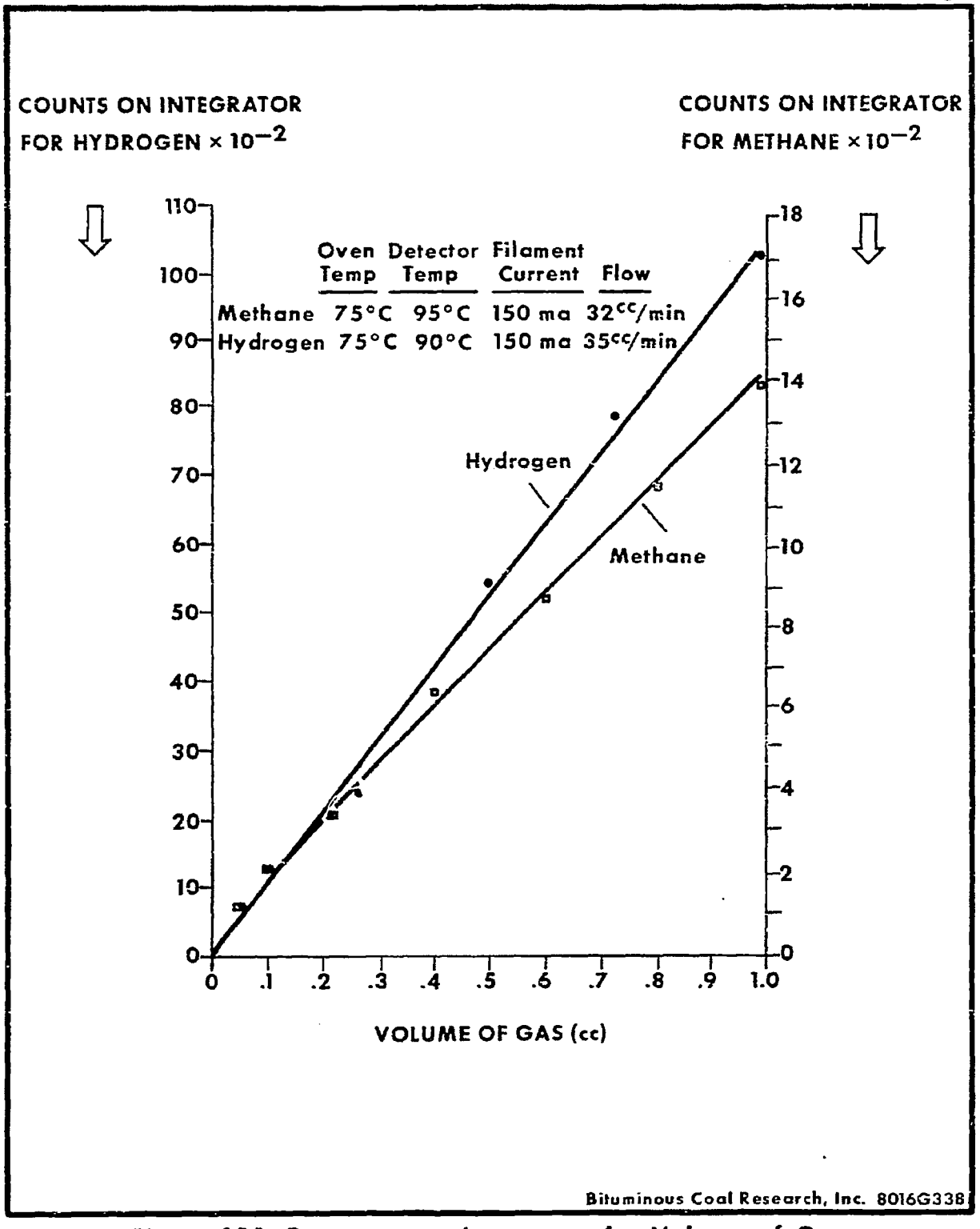

Figure 153. Response on Integrator for Volume of Gas Injected with Neon Carrier Gas

b. Acquisition of data from the methanation unit.

c. Generation of simulation runs with subroutine GASIFY as requested and authorized.

D. Engineering Design and Evaluation

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

2. OCR/BCR Gasification--Power Generation: No inquiries were received this month concerning application of an air-blown version of the BI-GAS gasifier for the production of low-Btu fuel gas.

E. Multipurpose Research Pilot Plant Facility (MPRF)

1. Pilot Plant: As approved by OCR and AGA, Stearns-Roger Corporation of Denver, Colorado, has been selected as the engineering contractor for construction and operation of the BI-GAS pilot plant at Homer City. Blaw-Knox Chemical Plants, Inc., Pittsburgh, Pa., was chosen to assist in project management services during construction of the plant.

In order to expedite activation of the project, several technical and procedural meetings were held during July in Monroeville and Denver with personnel from Stearns-Roger, Blaw-Knox, OCR, AGA, Babcock and Wilcox, and C. F. Braun.

The groundbreaking ceremony for the pilot plant was held in Homer City on July 27, 1972. News releases and press kits were issued prior to the ceremony to major journals, news services and newspapers. Approximately 350 persons attended the ceremony.

2. Materials Evaluation Program: Several members of the Task Group met on May 26, 1972, at the Institute of Gas Technology, Chicago, Illinois, to discuss inorganic coatings and refractory materials which should be considered for testing in Phase I of the Task Group's material test program. The following coatings and materials considered were:

(1) Plasma sprayed oxides: alumina, chromia, magnesia, and zirconia

(2) Enamels: application for 1000 to 2000 F

(3) Refractories: prefired tiles and castables

F. Literature Search (V. E. Gleason)

Annotated literature references completed during the month are listed in Appendix B.

G. Outside Engineering and Services

1. Koppers Company, Inc.: Koppers continues to provide engineering assistance as required and as reported in their Progress Report No. 36 in Appendix C.

2. Brigham Young University: The project entitled "Study of High Rate, High Temperature Pyrolysis of Coal" with joint funding by Brigham Young University and BCR is now in its sixteenth month. The letter report of progress made during July, which was forwarded from Brigham Young University on August 4, has not been received. As a consequence, and in order not to delay the overall report, the Monthly Progress Chart, Expenditures, and detailed report of progress during July will be combined with those for August and given in the next progress report.

H. Other

1. Prime Contract Matters: A list of all nonexpendable equipment on the inventory as of the expiration date of Contract No. 14-01-0001-324 is being developed. This list will indicate what equipment should be transferred to Contract No. 14-32-0001-1207 and what should be declared as scrap.

In a letter dated July 10, 1972, Mr. Howard Thunberg requested inventory controls on total pilot plant costs. Nonexpendable equipment should be tagged with an OCR inventory tag number. The cost of such equipment will be listed as a capital expenditure at the time of purchase and be reported as "equipment." All plant construction (i.e., engineering and design costs, site preparation, erection costs, bricks, mortar, steel, etc.) will be reported under the heading of "plant."

2. FPC National Gas Survey - Economics of Manufacturing SNG from Coal: In view of the information received from Air Products and Chemicals, Inc., on June 26, 1972, the sulfur recovery costs have been updated to include sulfur recovery from flue gas; therefore, a revised report(1) has been issued to OCR for review. In addition, Tables 119 and 120 presented in Monthly Progress Report No. 9, May 1972, have been revised for Western Kentucky No. 11 coal and are shown in Tables 139 and 140 for the plant investment and capital requirements and summary of gas costs for the manufacture of SNG from both Montana subbituminous and Western Kentucky No. 11 coal using the BCR/OCR BI-GAS coal gasification process to produce 250 MM scfd of pipeline gas.

3. Patent Matters: Worthwhile ideas continue to be written as invention disclosures for submission to OCR for consideration. Action taken on 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 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, and applications are being prepared for filing in France, Japan, and West Germany. 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.

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(1) "Economics of Manufacturing SNG by BCR/OCR BI-GAS Coal Gasification Process Using Western Kentucky No. 11 Bituminous Coal," July 5, 1972.

TABLE 139. PLANT INVESTMENTS AND CAPITAL REQUIREMENTS -- BCR/OCR BI-GAS PROCESS FOR SYNTHETIC GAS-COAL TASK FORCE REVIEW

Timing: Mid 1971 Startup Completion

	Montana Subbituminous Coal	West Kentucky No. 11 Bituminous Coal
Plant Size, Billion Btu/SD Pipeline Gas	237.0	236.1
Investment Breakdown, MM Dollars		
Process Onsites Investment		
Coal Storage & Preparation*	14.3	14.3
Pretreatment	--	--
Feed System	6.6	6.6
Gasification & CO Shift	20.6	20.8
Gas Purification	21.8	21.8
Methanation	12.4	12.4
Compression	--	--
Auxiliary Onsites Investment		
Oxygen Manufacture	32.0	32.0
Sulfur Recovery	2.0	11.7**
Water Pollution Control	10.0	10.0
Steam and Power Plant Investment	17.8	17.8
General Utilities Investment	14.0	14.0
General Offsites Investment	10.0	10.0
Subtotal, Excluding Contingencies	161.5	171.4
Project Contingency	24.1	25.7
Development Contingency	11.3	12.0
Total Plant Investment	196.9	209.1
Capital Requirement Breakdown, MM Dollars		
Total Plant Investment	196.9	209.1
Interest During Construction	33.2	35.3
Startup Costs	8.1	10.95
Working Capital	8.1	11.34
Total Capital Requirement	246.3	$ 266.69
Adjusted for 250 Billion Btu/SD	259.8	$ 282.37

* Coal storage and preparation investment includes added $2 MM allowance for particulate emission control and coal cleaned and crushed to a size of 1 1/2 inch x 0 at the battery limits.

** Includes sulfur recovery from flue gas.

TABLE 140. SUMMARY OF GAS COSTS--BCR/OCR BI-GAS PROCESS
FOR SYNTHETIC GAS-COAL TASK FORCE REVIEW

Gas Costs, Dollars/MM Btu	Montana Subbituminous Coal	West Kentucky * No. 11 Bituminous Coal
For Mid-1971 Startup Completion		
20-year Average Cost without escalation	.843	1.105
20-year Average Cost with escalation	.981	1.314
Constant Cost @ 12% DCF‡ return without escalation	1.058	1.339
with escalation	1.161	1.494
For Mid-1975 Startup Completion		
20-year Average Cost without escalation	.954	1.260
20-year Average Cost with escalation	1.070	1.433
Constant Cost @ 12% DCF‡ return without escalation	1.189	1.514
with escalation	1.272	1.637
For Mid-1980 Startup Completion		
20-year Average Cost without escalation	1.070	1.408
20-year Average Cost with escalation	1.198	1.600
Constant Cost @ 12% DCF‡ return without escalation	1.338	1.700
with escalation	1.430	1.835

* Gas costs revised to include sulfur recovery from flue gases.

‡ Discount Cash Flow

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 had been assigned Interior Case No. OCR-2044. BCR will prepare and file a U.S. patent application for this disclosure.

g. Invention Disclosure--Brigham Young University: During the course of work under Subcontract No. 3, Professor R. L. Coates, Brigham Young University, developed a new concept of pyrolyzing coal which may be patentable.

An Invention Disclosure (Form DI 1217) entitled "Process for High Temperature Pyrolysis of Coal," was submitted to Mr. George Fumich for his consideration on January 6, 1972. OCR has acknowledged receipt of this disclosure and forwarded it for processing.

4. 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.

I. Visitors During July, 1972

July 6-7, 1972

Mr. V. L. Brant	Stearns-Roger Corporation
Mr. V. D. Kliewer	P.O. Box 5888
Mr. A. L. Langston	Denver, Colorado 80217
Mr. C. M. Stone	

July 6-7, 1972

Mr. Stanley Kasper
Mr. Noel Boyd
Mr. F. S. Glessner
Blaw-Knox Chemical Plants, Inc.
One Oliver Plaza
Pittsburgh, Pennsylvania 15222

July 11, 1972

Mr. W. A. Gibeaut
Mr. D. E. Price
Mr. T. W. Holzberger
Mr. E. M. Winter
Columbia Gas Systems Service Corp.
Research Department
1600 Dublin Road
Columbus, Ohio 43215

July 17, 1972

Mr. J. R. Garcia-Conde, Director
Mr. R. Diaz-Silva
Mr. R. Garcia Pintos
Instituto Nacional Del Carbon
Y Sus Derivados
Oviedo, SPAIN

July 24, 1972

Mr. G. Edward Larson
Chief, Division of Contracts
and Administration
Office of Coal Research
U.S. Department of the Interior
Washington, D. C. 20240

July 27, 1972

Mr. Jack E. Ryan
Engineer
Division of Research and Development
Office of Coal Research
U.S. Department of the Interior
Washington, D. C. 20240

J. Trips, Visits, and Meetings During July, 1972

July 13-14, 1972	Stearns-Roger Corp. Denver, Colorado	E. E. Donath R. J. Grace J. P. Tassoney R. L. Zahradnik
July 17-18, 1972	Stearns-Roger Corp. Denver, Colorado	E. E. Donath R. J. Grace J. P. Tassoney R. L. Zahradnik J. W. Igoe R. K. Young
July 25, 1972	Foster Wheeler Corp. Livingston, New Jersey	E. K. Diehl J. T. Stewart

K. Requests for Information

Mr. Frank M. Chapman
Consulting Editor
GAS INDUSTRIES
P.O. Box 57177
Los Angeles, California 90057

Mr. S. W. Ehrlich
Engineer, Development and Planning
Brooklyn Union Gas
195 Montague Street
Brooklyn, New York 11201

Mr. H. G. Jacobson
Room 4551
United States Bureau of Mines
Department of the Interior
Washington, D. C. 20240

III. WORK PLANNED FOR AUGUST, 1972

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

Four new catalysts are scheduled for test in the bench-scale methanator to continue the catalyst evaluation program. Life tests will be run on those catalysts which show promise. PEDU detail engineering will be completed and emphasis will be placed on construction. Bids on equipment will continue to be solicited and approved items will be purchased.

The draft of the summary report on the results of the cold model studies of the 5 ton/hr two-stage gasifier will be edited in preparation for inclusion in next month's report.

Debugging of the programs written to log, process, report, and store data from the bench-scale methanator will continue. At the completion of this work, acquisition of data will begin. Simulation runs with subroutine GASIFY will be generated as requested.

Meetings with Stearns-Roger and Blaw-Knox will be held during the month to continue discussion of various technical details.

A. Trips and Meetings Planned

August 14, 1972	Chemetron Corp. Louisville, Kentucky	M. S. Graboski
August 18, 1972	Dedication Ceremonies Consol Pilot Plant Rapid City, South Dakota	J. P. Tassoney J. W. Tieman

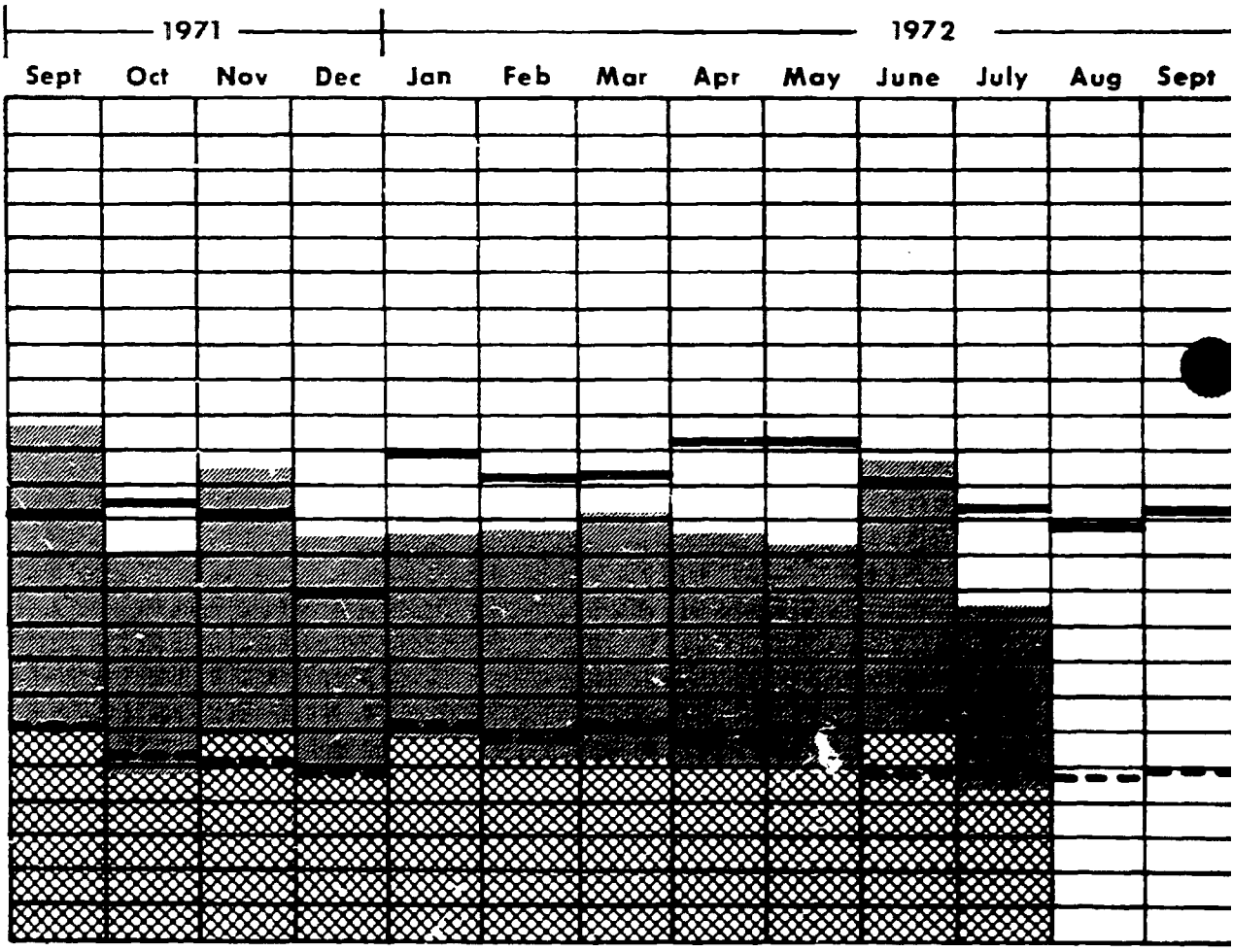
B. Papers to be Presented

October 30, 1972	AGA Synthetic Pipeline Gas Symposium Chicago, Illinois	"BI-GAS Program Enters Pilot Plant Stage" R. J. Grace R. L. Zahradnik

C. Visitors Expected

August 25, 1972	Brigham Young University Provo, Utah	Prof. R. L. Coates

MANHOURS


1971
1972
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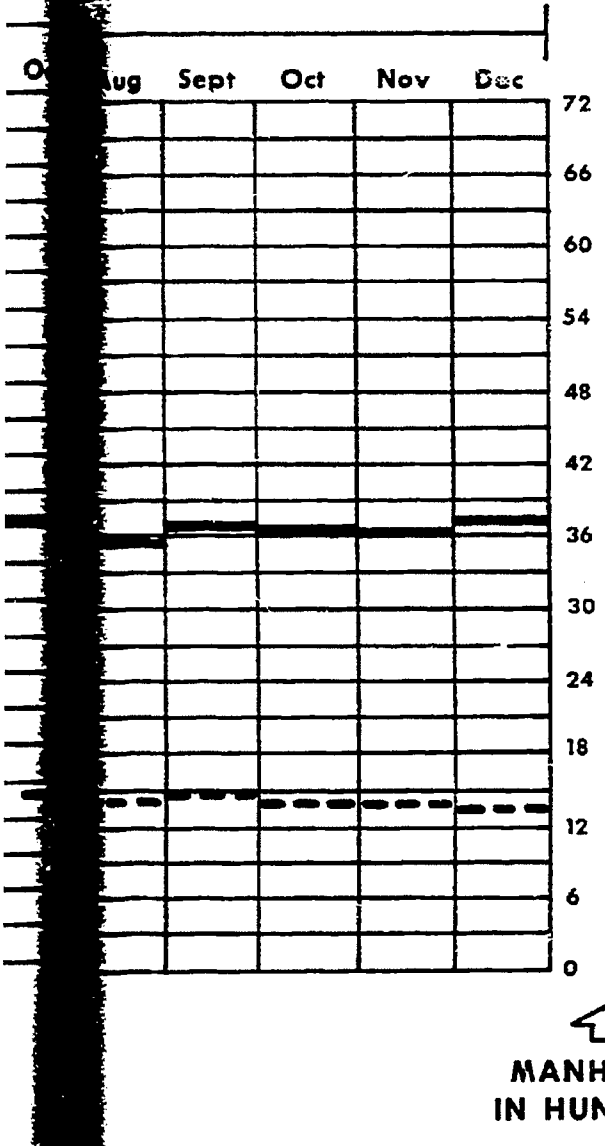


MONTHLY PROGRESS CHART
PART 1 MANHOURS

Bituminous Coal Research, Inc.
350 Hochberg Road Monroeville, Pa.

OFFICE OF COAL RESEARCH
DEPARTMENT OF THE INTERIOR

CONTRACT NO. 14-32-0001-1207

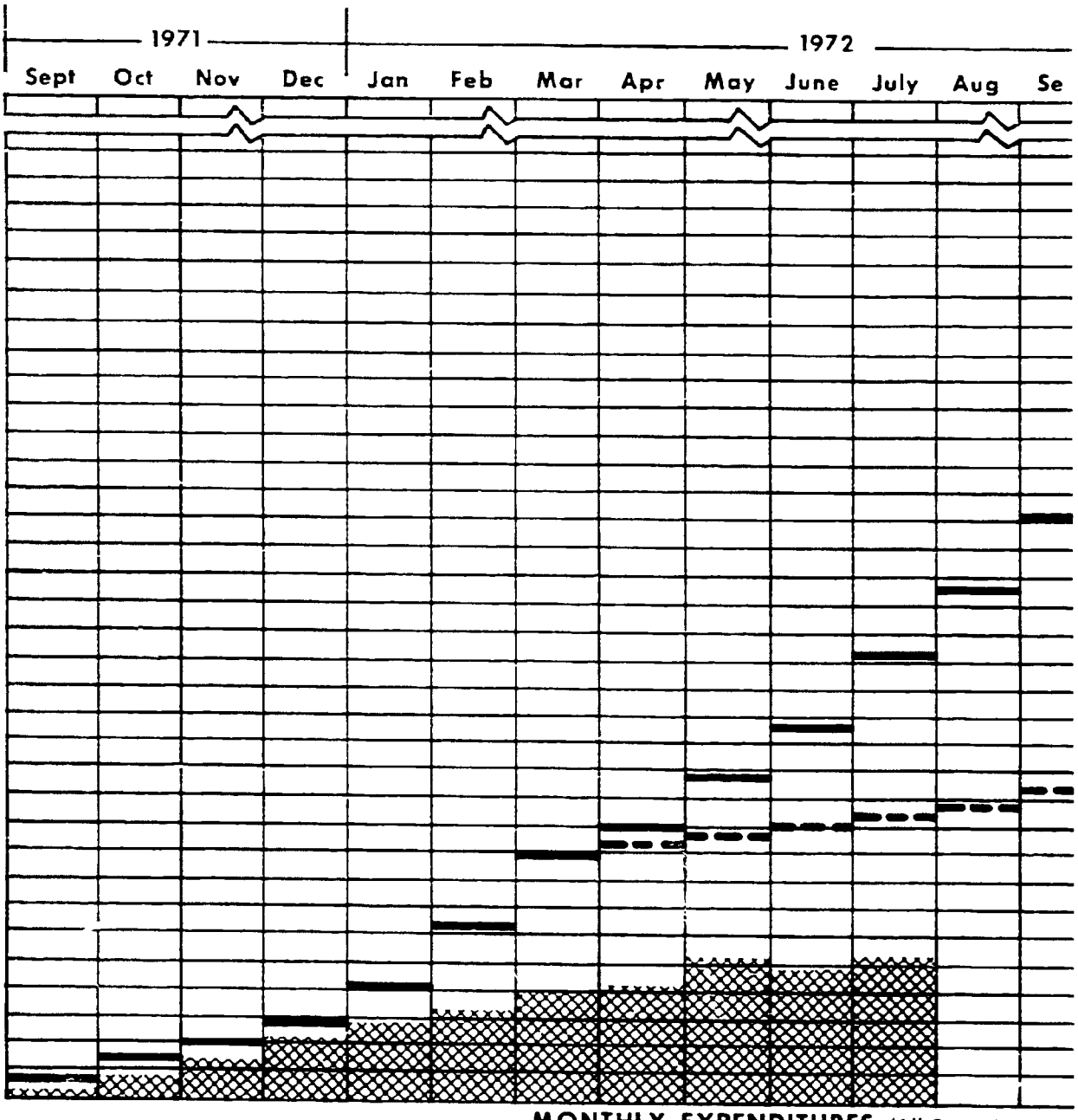
— Predicted Professional and Non-professional

– – Predicted Professional

Actual Non-professional

Actual Professional

2



MONTHLY EXPENDITURES (All Costs, in Dolla

		Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Ma
Monroeville	Predicted	129,991	129,991	129,991	129,991	323,486	382,228	558,454	105,058	86,2
	Actual	63,610	121,696	146,834	144,590*	103,147	86,250*	113,036	50,685*	73,1
Homer City	Predicted								154,000	215,
	Actual									
Total	Predicted	129,991	129,991	129,991	129,991	323,486	382,228	558,454	259,058	301,
	Actual	63,610	121,696	146,834	144,590*	103,147	86,250*	113,036	50,685*	73,4

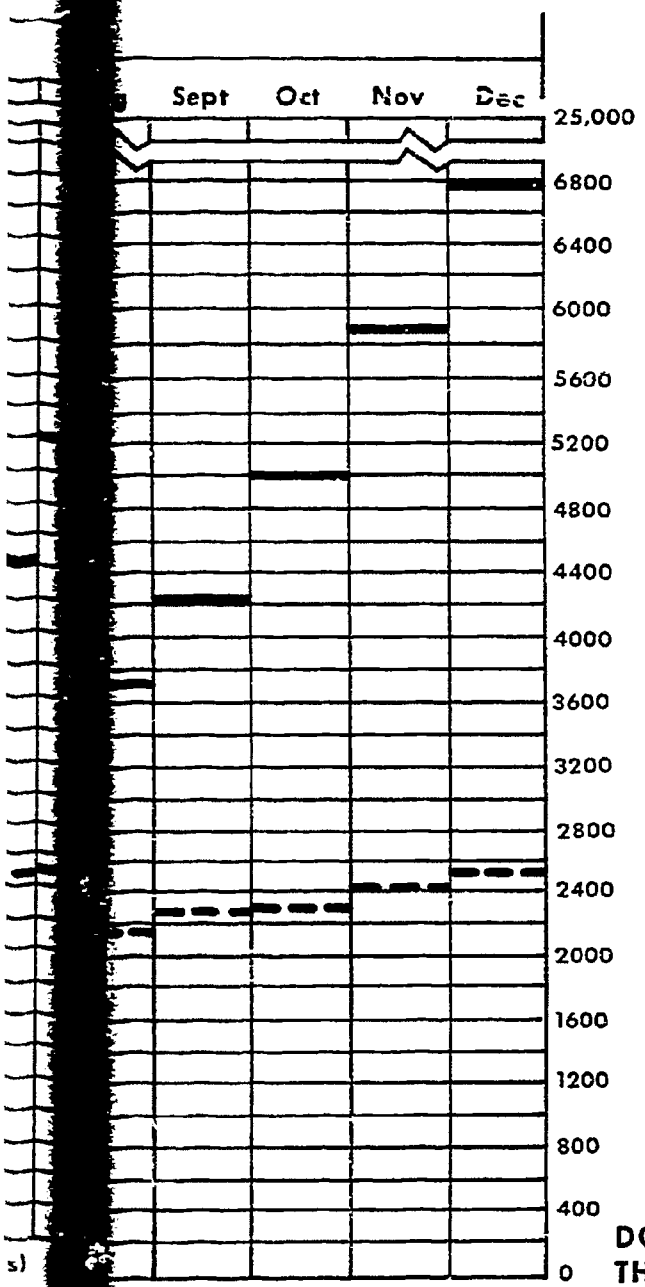
CUMULATIVE EXPENDITURES

MONTHLY PROGRESS CHART
PART 2 EXPENDITURES

Bituminous Coal Reseqrch, Inc.
350 Hochberg Road Monroeville, Pa.

OFFICE OF COAL RESEARCH
DEPARTMENT OF THE INTERIOR

CONTRACT NO. 14-32-0001-1207



Expenditures, Cumulative

- Actual, Monroeville
- Actual, Homer City

Predicted Expenditures, Cumulative

- Total, Monroeville and Homer City
- Monroeville

in Dollars)

	May	June	July	Aug	Sept	Oct	Nov	Dec
38	86,238	86,240	65,813	65,813	74,746	62,273	62,273	62,275
00*	73,400*	86,600	85,300					
500	215,600	280,400	444,300	444,300	444,400	760,600	760,600	760,800
38								
0*	301,838	366,640	510,113	510,113	519,146	822,873	822,873	823,075
	73,400*	86,600	85,300					

* Estimated

2

APPENDIX B

ADDITIONS TO ABSTRACT FILE, JULY 1972

Finneran, J. A., "SNG-Where will it come from, and how much will it cost?" Oil Gas J. 70 (29), 83-88 (1972). 540.000 72-4

Thermal efficiency is used to compare the advantage of using partial-oxidation/methanation, hydrogenation, or steam reforming reactions in producing SNG. Processes under development or presently in commercial use are discussed.

Pulsifer, A. H. and Wheelock, T. D., "Production of hydrogen from coal char in an electrofluid reactor," I & EC Process Design Develop. 11 (2), 229-37 (1972); ACS Div. Petrol. Chem. Preprints 16 (2), C5-C19 (1971). 540.000 Journal

A potential industrial process for producing a hydrogen-rich synthesis gas by reacting coal char and steam in an electrofluid reactor is described. The characteristics of this type of reactor are reviewed, and a reaction model which appears to fit experimental results is proposed. Product gas compositions and energy requirements predicted by the model for the gasification process are presented for various possible operating conditions. The present state of development of the reaction system and foreseeable problems which must be worked out are reviewed. In addition, the adaptation of the process to the production of various products such as hydrogen, methane, and methanol is discussed. (Authors' abstract)

PATENT

Dent, F. J., Thompson, B. N., and Conway, H. L. (to The Gas Council, London, England), "Process for the hydrogenation of coal," U.S. Pat. 3,607,158 (Sept. 21, 1971). 4 pp.

A process for the hydrogenation of coal to produce a methane-containing gas is described. Powdered coal is introduced into a recycling fluidized bed of noncaking material. The coal is rapidly heated and at least partly hydrogenated, and converted to a non-caking powdered char. The process is generally operated at temperatures of 600° to 1000° C and pressures of 10 to 200 atmospheres. (Abstract of the disclosure)

APPENDIX C

PROGRESS REPORT #36

Bituminous Coal Research, Inc.
Coal Gasification

July 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. Messrs. M. S. Graboski, BCR, and R. W. Whiteacre and R. C. Dorsey, Koppers, met July 13, 1972 in Koppers offices to review the instrument interconnection diagrams and detail engineering.

2. The following Fluid Bed Methanation PEDU drawings and specifications were transmitted by Koppers Company, Inc. to BCR:

Drawing No.	Rev. No.	Title	Date Trans.
2415-9F303 Shts. 1 to 3 incl.	2	Annunciator	7/6/72
2415-9F308 Shts. 1 to 4 incl.	2	Pressure Indicators-Local	7/6/72
2415-9F311 Shts. 1 and 2	0	Level Controllers and Transmitters	7/6/72

Drawing No.	Rev. No.	Title	Date Trans.
2415-9F312	0	Level Switches	7/6/72
2415-9F329 Shts. 1 to 7 incl.	1	Relief Valves	7/6/72
2415- 335	0	Rupture Discs	7/6/72
2415-2	1	Engineering & Purchasing Schedule	7/11/72
2415-9F304 Shts. 1 to 13 incl.	2	Flow Elements	7/11/72
2415-9F328 Shts. 1 to 21 incl.	0	Control Valves	7/11/72
2415-9F316 Shts. 1 to 3 incl.	0	Thermocouple Lead Wire	7/11/72
2415-9F327	0	Controllers-Local	7/11/72
2415-9F331	0	Purgemeters	7/11/72
2415-9F334	0	Pressure Control Valves (Self-Acting)	7/11/72
2415-9F399 Shts. 1 to 3 incl.	1	Instrument Specification Index	7/11/72
2415-9F603	2	Temperature Recorders (MV) Alterations	7/11/72
2415-6A700	2	Lighting	7/11/72
2415-6A702	1	Single Line Diagram	7/11/72
2415-6A705	0	Power and Control Conduits Exposed and Embedded	7/11/72
2415-6A706	0	Building No. 3 Power and Control Conduits	7/11/72

Drawing No.	Rev. No.	Title	Date Trans.
2415-6A707	1	750 KVA Transformer & Switch Gear Pwr. & Cont. Embedded Conduits & Grd.	7/11/72
2415-6A708	0	Distribution Panel "B" Wiring Connection Diagram	7/11/72
2415-6A709	0	Instrumentation Interconnection Diagram Sheet No. 1	7/11/72
2415-6A710	0	Instrumentation Interconnection Diagram Sheet No. 2	7/11/72
2415-6A711	0	Instrumentation Interconnection Diagram Sheet No. 3	7/11/72
2415-6A712	0	Instrumentation Interconnection Diagram Sheet No. 4	7/11/72
2415-6A713	0	Instrumentation Exposed Conduits Sheet No. 1	7/11/72
2415-6A714	0	Instrumentation Exposed Conduits Sheet No. 2	7/11/72
2415-2A734	1	Vent Gas and H_2S Removal Flow Diagram	7/11/72
2415-5F700 Shts. 1 to 5 incl.	0	Specifications for Structural Concrete & Foundation Design	7/21/72
2415-5F701	0	General Notes Foundations Section	7/21/72
2415-9F335	1	Rupture Discs	7/28/72

3. During this period, at BCR's request, Koppers reviewed and approved certain portions of vendor drawings and information, which BCR received through their procurement. The following memoranda were transmitted by Koppers Company, Inc. to BCR:

Date	Letter No.	Title	Remarks
7/6/72	C-412	Thermal Oxidizer	Request information necessary to complete detail engineering
7/6/72	C-413	Approval Drawing	Comments on National Annealing Box Co. Drawing NB5602 & letter to BCR 6/21/72 pertaining to Demister M-V620
7/13/72	C-420	Electrical & Instrumentation	Submitted additional design notes to be considered by BCR in soliciting bids
7/17/72	C-422	Approval Drawings	Comments on Nooter Corp. approval drawings for Methanation Reactor (M-R420)
7/20/72	C-423	Approval Drawings	Comments on Gardner Denver approval drawings for Adams' Heat Exchanger (ME103) (And Fisher Controls' Regulator)
7/21/72	C-424	Approval Drawings	Comments on Thermal Research and Engineering Corp. approval drawings, bills of mat. and sequence of operation for Thermal Oxidizer (M-X770)

Date	Letter No.	Title	Remarks
7/21/72	C-425	Approval Drawings	Comments on Ingersoll-Rand Co. drawings and sheets for Methanator Feed Gas Compressor (M-K305)
7/21/72	C-427	Approval Drawings	Comments on Steel-Bilt Construction Co. drawing A-940-72 for Reformer Bldg.
7/28/72	C-429	Approval Drawing	Comments on National Annealing Box Co. drawing NB5605 pertaining to Filter Blow Back Heater (M-E410)

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. 14-32-0001-1207.

II. 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.

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