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ASSESSMENT OF RESEARCH PROJECTS AND EXPENDITURES BY THE COAL INDUSTRY

8th Progress Report for the Period July - September 1979 (BCR Report L-1022)

Bituminous Coal Research, Inc.
Monroeville, Pennsylvania

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Bituminous Coal Research, Inc.
Sponsored Research Program

ASSESSMENT OF RESEARCH PROJECTS AND EXPENDITURES BY THE COAL INDUSTRY

Report No. Fe-3119-8
(BCR Report L-1022)

I. INTRODUCTION AND OBJECTIVES

This is the eighth monthly report on the Department of Energy-sponsored Contract No. ET-78-C-01-3119 entitled "Assessment of Research Projects and Expenditures by the Coal Industry." This report covers the period July through September 1979.

The objective of the program is to obtain information on the research and development expenditures of the coal mining industry. A large portion of the research undertaken by the coal mining industry is informal and, as such, is not well documented; and expenditures are not generally available. It is the aim of this program to determine the extent and areas of research funded by the coal industry. Companies to be contacted include coal producers, equipment manufacturers, and coal resource developers. The program is planned to encompass all phases of mining research, including health and safety, environment, production, and coal preparation.

II. DISCUSSION

A meeting was held July 26, 1979 to review the Phase II report (BCR Report L-994) and discuss the Phase III effort. During the meeting DOE requested a program work plan that was to include a Phase II analysis and sample letters for Phase III. The work plan was prepared and a draft copy was submitted to the contract TPO on August 16, 1979. The draft was reviewed and several changes were suggested on September 4, 1979. The work plan is Appendix A of this report.

One notable addition to the Phase III effort was made as a result of the July 26 meeting. It was agreed that companies would be approached during Phase III to provide additional detailed information on their research efforts. These case studies would involve identification of (1) the amount of formal/informal research conducted and (2) individual research projects or the specific research categories. It is hoped that these case studies will provide sufficient information to allow us to comment on the research efforts of other companies, as well as providing a finer breakdown of specific research projects.

To determine how the limited Phase II data will compare with the overall survey is difficult, but much of the data were as expected. For example, deep mines spent more per ton than surface mines; coal companies reported

expenditures in every category, while equipment manufacturers were more limited and the categories were directly related to their line of business; and equipment manufacturers reported 77 percent of expenditures for basic and development research, while coal producers reported 89 percent of expenditures for demonstration and application engineering research. However, some unexpected results included: R&D expenditures appeared to be related to geographical regions; as the coal reserves of a company increased, the R&D expenditures per ton decreased; and 41 percent of research expenditures by coal producers were reported in the mine systems design and human resources categories. These latter results may be revised in Phase III or the data may continue to support them.

Sufficient monies are available to complete Phase III as outlined in the program plan; however, time is becoming increasingly critical. The contract is scheduled for completion by December 1979; and, with sufficient personnel available, will be completed. It is important that every effort be made to complete the program on schedule.

We are identifying R&D expenditures for calendar year 1978, and it will become increasingly difficult to do this if we continue into 1980. Since many of the expenditures are unrecorded and the information depends on certain individuals who may change jobs, it becomes more probable that projects completed in early 1978 may not be included. It is strongly recommended that we proceed to Phase III rather than jeopardize the study by delaying. Phase III will begin with approval from the Contract Technical Officer.

APPENDIX A. PHASE III WORK PLAN

I. PHASE II ANALYSIS

Information from companies participating in Phase II has been compiled in Tables 1 and 2. The results indicate the participating equipment manufacturers use 77 percent of their research expenditures in basic and development research while the coal producers use 89 percent of their research expenditures in demonstration and application engineering research. These results are not surprising, since equipment manufacturers must develop new products to stay in business while coal producers are forced to pursue more work whose results can be readily applied to a particular problem. Over 75 percent of the research expenditures reported by equipment manufacturers was in the underground equipment design category, while the coal producers expended similar amounts in every category.

The five equipment manufacturers accounted for 58 percent of the total expenditures, while the eight coal producers accounted for the remaining 42 percent. The equipment manufacturers averaged $2,548,180 per company for expenditures on coal mining research in 1978, while the coal producers averaged $1,154,818 per company. This could be attributed to the following:

1. Equipment manufacturers must perform research in order to remain competitive. Coal producers are not affected by the competition which occurs among the equipment manufacturers; therefore, large research expenditures are not needed by many coal producers. Most research by coal producers is performed to solve a local problem which requires a practical solution and not usually requiring an excessive amount of time or money.

2. Equipment manufacturers have more formalized research budgets than coal producers; therefore, the research expenditures of equipment manufacturers can be readily obtained. Since much research performed by coal producers is informal, some research expenditures become "lost" in production costs. This is the research which coal producers have a difficult time estimating.

The average cost per ton reported by the coal producers was 13¢/ton.

The data were plotted in Figures 1 and 2. Figure 1 shows the R&D cost per ton as related to production, while Figure 2 shows the total reported research expenditures as related to production. Figure 2 shows the data reported from two geographical regions to be distinctly different. Figures 1 and 2 may appear somewhat contradictory; however, this is due to the selected geographical regions. All data points were not included in Figure 2. It must be emphasized that these graphs represent preliminary analysis based on a few data points and are meant as examples only.

Phase III data will be evaluated in terms of production, surface and underground operations, geographical regions, and corporate monies (revenues, total sales, or other available data). All of these comparisons were not possible in Phase II because the data did not include some of the categories.

TABLE 1. AMOUNT AND TYPE OF RESEARCH REPORTED BY PHASE II COMPANIES

Type of Research	Companies		
	Equipment Manufacturers (5)	Coal Producers (8)	Total (13)
Basic			
Amount	$1,049,759	$ 191,965	$1,241,724
Percent of Total	8	2	6
Development			
Amount	$8,801,118	806,881	9,607,999
Percent of Total	69	9	44
Demonstration			
Amount	951,156	4,616,213	5,567,369
Percent of Total	8	50	25
Application Engineering			
Amount	1,938,867	3,623,483	5,562,350
Percent of Total	15	39	25
Total			
Amount	$12,740,900	$9,238,542	$21,979,442
Percent	100	100	100

TABLE 2. CATEGORIES AND AMOUNT OF RESEARCH PERFORMED BY PHASE II COMPANIES

Research Category	Equipment Manufacturers		Coal Producers		Total	
	Amount	Percent	Amount	Percent	Amount	Percent
A. Coal Preparation	$ 35,000	0.3	$ 815,000	8.8	$ 850,000	3.9
B. Rock and Soil Mechanics	40,000	0.3	545,300	5.9	585,300	2.7
C. Environmental	15,000	0.1	495,770	5.4	510,770	2.3
D. Reclamation	-	-	178,980	1.9	178,980	0.8
E. Health and Safety	1,310,500	10.3	769,867	8.3	2,080,367	9.5
F. Innovative Design or Modification of Underground Equip.	9.980,400	78.3	1,397,950	15.1	11,378,350	51.8
G. Innovative Design or Modification of Surface Equip.	960,000	7.5	212,100	2.3	1,172,100	5.3
H. Mine Systems Design	-	-	2,682,692	29.1	2,682,692	12.2
I. Materials Handling	-	-	362,400	3.9	362,400	1.6
J. Human Resources	-	-	1,112,183	12.1	1,112,183	5.1
K. Explosives	-	-	92,000	1.0	92,000	0.4
L. Electrical	50,000	0.4	164,000	1.8	214,000	1.0
M. Materials and Supplies	350,000	2.8	49,500	0.5	399,500	1.8
N. Other	-	-	360,800	3.9	360,800	1.6
	$12,740,900	100.0	$9,238,542	100.0	$21,979,442	100.0

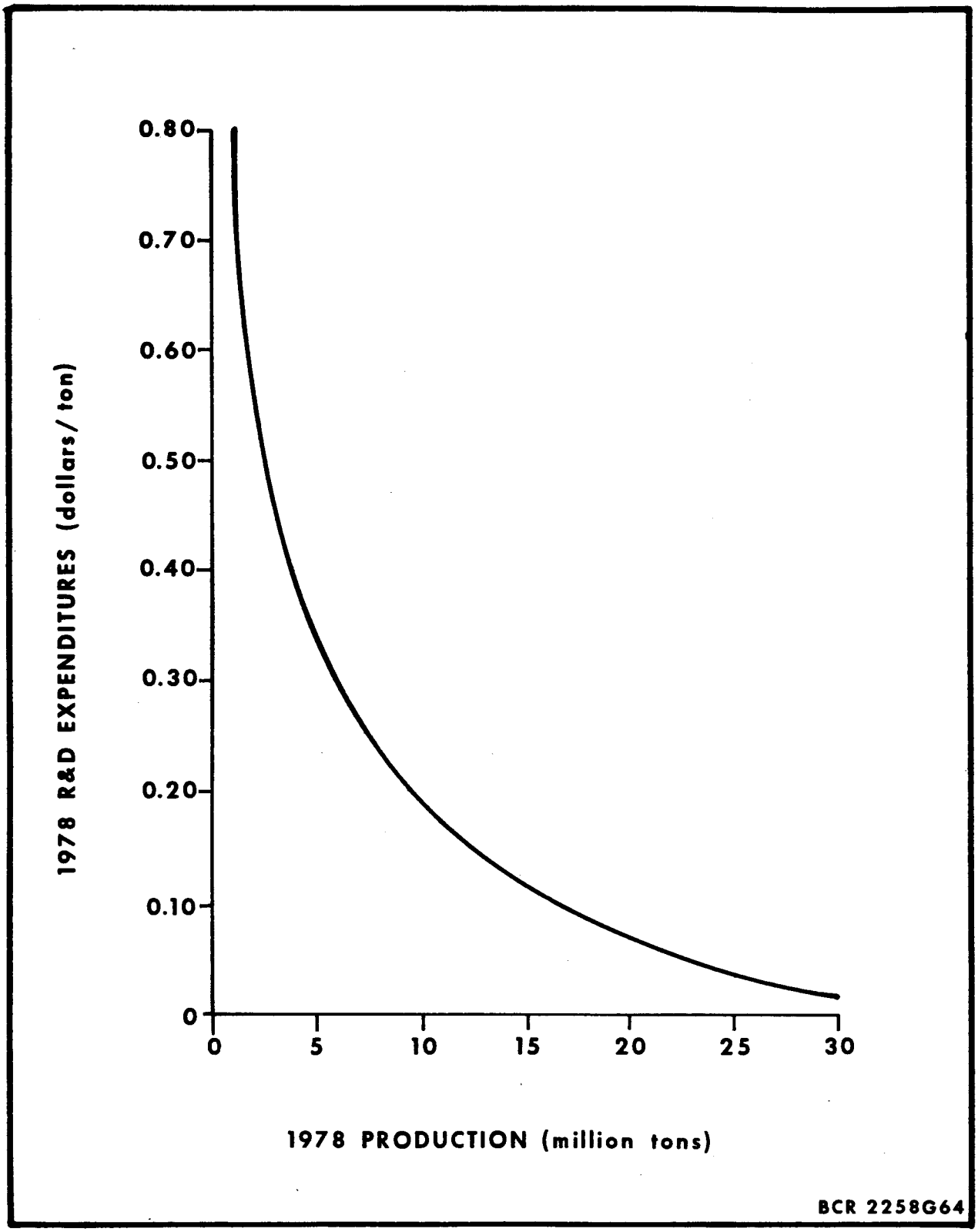

Figure 1. R&D Cost Per Ton as Related to 1978 Production (Preliminary Data Analysis-Phase II)

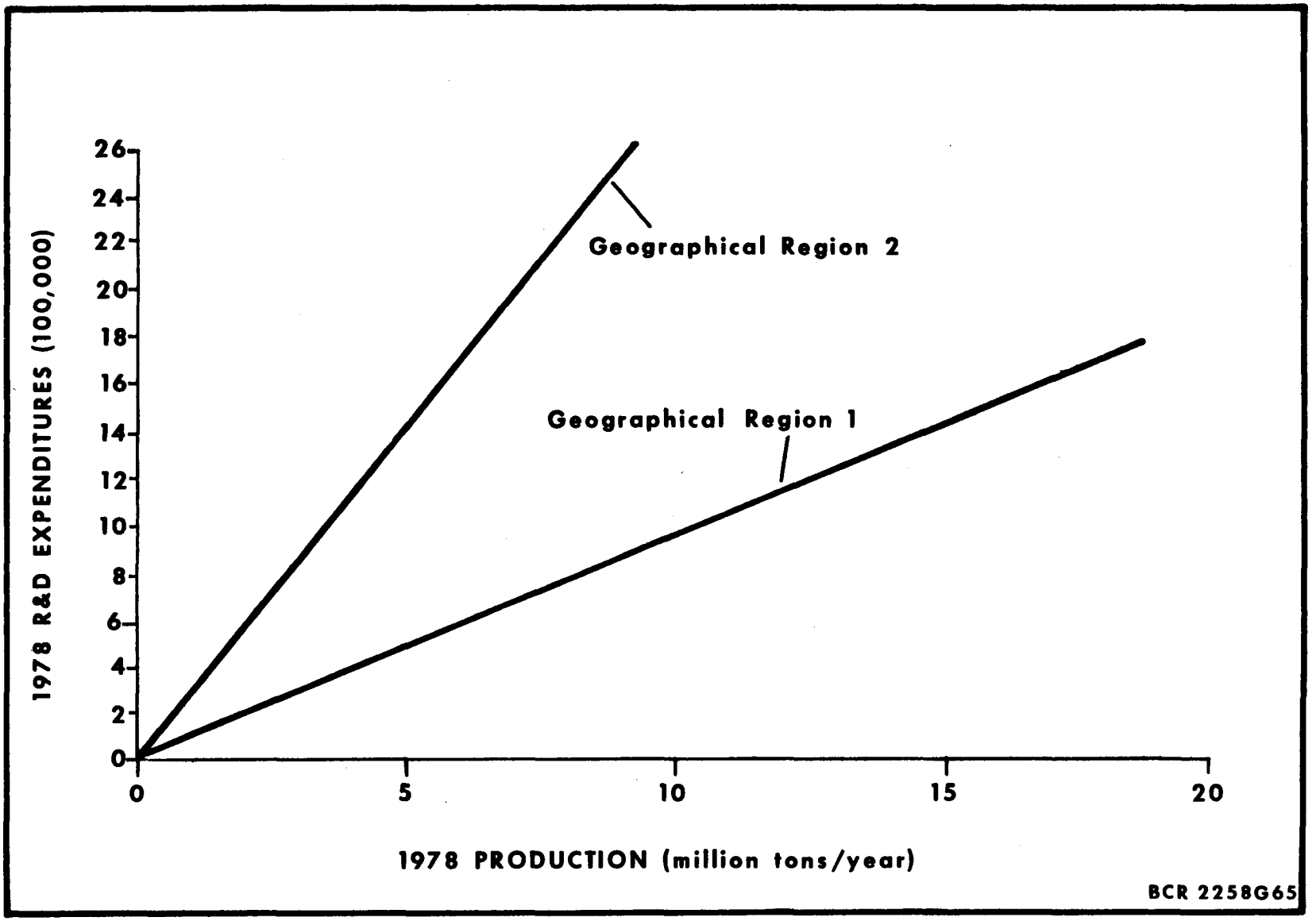

Figure 2. Research Expenditures as Related to 1978 Production
(Preliminary Data Anaylsis-Phase II)

The data can be summarized as follows:

1. Coal producers reported 56.3 percent of expenditures in the categories Innovative Design or Modification of Underground Equipment, Mine Systems Design, and Human Resources; the remaining eleven categories each averaged 4 percent of expenditures. The investment of research dollars by coal companies includes all aspects of coal production.

2. Research expenditures are a function of production and also of where the mine is located.

3. Research categories reported by equipment manufacturers are a function of the companies requested to participate in Phase II.

II. PHASE III WORK PLAN

BCR has classified the coal industry into three classes based on the production shown below. The coal producers in each of the three classes will be handled with one of the three specific strategies formulated from the Phase II results. The three classes and strategies will hopefully maximize the response rate and quality of data received.

Coal Industry Classification

Class	1977 Production Range	Number of Coal Producing Organizations
Class 1	4,000,000 Tons and Over	30
Class 2	500,000 - 3,999,999	102
Class 3	100,000 - 499,999	454
		586

A. Coal Producers

Interviews yielded the highest response rate in Phase II; therfore, they will continue to be used in Phase III whenever necessary to obtain the required participation.

In 1978, 30 companies each produced greater than 4,000,000 tons. The top 30 coal producers represented 47 percent of the coal production in the United States. BCR expects to obtain a minimum response rate of approximately 60 percent from this group; this will represent 28 percent of the production in 1978.

The following sequence of tasks will be used for the top 30 coal producers, half of which have already agreed to cooperate.

1. A briefing package on the program will be sent to the top 30 coal producers. This briefing package will contain a cover letter to explain the program and specify the information requested. The package will also contain a response form and examples of the type of research needed (Attachment 1.).

2. Follow-up telephone calls will be made beginning approximately three weeks after the letter is mailed.

In 1978, approximately 100 companies produced between 500,000 and 3,999,999 tons of coal; they represent almost 21 percent of the U.S. coal production for that year. A 50-percent response rate was obtained from the Phase II companies which fell in this production class. The letter sent to companies in this production class will be slightly different from the letters sent the largest and smallest producers.

The letter sent to coal producers in this production class (Attachment 2) will briefly explain the program, emphasize the need for participation of companies in this production range, include a response form, and provide a format to report the information.

For the 100 coal producers which produced between 500,000 and 3,999,999 tons of coal in 1978, the following tasks will be pursued:

1. A letter and briefing package on the program will be sent to approximately 100 coal producers in this production class.

2. A follow-up telephone call will be made to each company approximately three weeks after they receive the letter and briefing package on the program. The telephone call will be used to encourage participation and answer any questions about the program.

3. Depending on the response received over the telephone from a company, additional telephone calls may be made to obtain company participation.

In 1978, almost 500 companies produced between 100,000 and 499,999 tons of coal. They represent approximately 15 percent of the U.S. coal production for that year. During Phase II of the program, five companies which fell in this production class were requested to participate. However, no information was received from these companies although the same amount of effort was given to obtain information from them as from the larger coal producers. In Phase III, a mass mailing will be used to cover all 500 companies in this production class.

The letter to be sent to these 500 companies will be slightly different from either of the two letters sent to the larger coal producers (Attachment 3). The letter will emphasize the need for participation of the smaller producers. It will also include a BCR-addressed and stamped envelope in which a company may return the response form.

Based on the expected response rates for each production class, the R&D expenditures should represent 42 percent of 1978 coal production, from 31 percent of the companies producing 100,000 to 500,000 tons per year and 52 percent of those companies producing more than 500,000 tons per year.

B. Case Studies

Selected companies will be approached in Phase III to provide detailed information on research expenditures. This information will include data on informal expenditures and identification of specific research categories. These data will be used as supporting information for the overall study.

Early in Phase III, meetings will be arranged with selected companies to discuss this phase of the project and obtain a sufficient number of mines. The total number will be dependent upon the degree of cooperation and the time and effort required by BCR to complete the effort.

If sufficient information can be acquired from the case studies, it will be compared to the complete data set and analyzed for trends which can help to define R&D expenditures by the coal industry.

C. Equipment Manufacturers

Equipment manufacturers responded to the Phase II information requests better than coal producers; therefore, a slightly different plan will be used to obtain research cost information from them. The response rate for equipment manufacturers in Phase II was over 70 percent. The cooperation of 65 equipment manufacturers will be requested through the same letter to be sent to companies which produce between 500,000 and 3,999,999 tons of coal annually. This should yield the participation of approximately 45 equipment manufacturers.

Approximately three weeks after the letter has been received by the equipment manufacturers, follow-up telephone conversations will be made to encourage participation and answer any questions about the program.

BITUMINOUS COAL RESEARCH, INC.

PITTSBURGH, PENNSYLVANIA

STONIE BARKER JR.
CHAIRMAN OF THE BOARD

JAMES R. GARVEY
PRESIDENT

D. PAUL McCLOSKEY
SECRETARY & TREASURER

PLEASE ADDRESS REPLY TO:
350 HOCHBERG ROAD
MONROEVILLE, PA.
15146
PHONE: 412 327-1600

Attachment 1 - Letter to be sent to top 30 producers

Bituminous Coal Research, Inc. (BCR), and the National Coal Association (NCA), are requesting your help to determine the type and cost of research conducted by the coal industry. This program will attempt to provide accurate information to respond to critics of the coal industry who question what research the industry is conducting to help itself. We feel the study is very important, and deserves the support of industry for several reasons.

First, existing data on coal industry research are only qualitative and do not provide the necessary information to show that the mining industry is supporting coal research. Second, whenever dollar amounts are quoted, they do not reflect the full cost of all research undertaken by coal companies, particularly the very informal research work carried on at the mine level. Third, in order to coordinate industry and government research, a better understanding is needed as to what industry is doing and how that work can be complemented by the federal research programs.

It is obvious that the program depends on data from industry, and it cannot be successful without the participation of a large number of companies. Thus far, over 10 percent of the 1978 production has been represented by companies that have provided information on research efforts. By obtaining data from a large percentage of the coal industry, accurate information can be compiled and used to respond to critics of the coal industry who question what research the industry is conducting to help itself.

Information will be gathered from coal producers and equipment manufacturers and suppliers. Specifically, the information needed is your company's research expenditures for 1978, reported by subject categories and the type of research. The attachment describes both formats and our broad definition of research. Also needed will be some additional data from a few various sized mines. These mines will be used to determine how research efforts relate to mine size and approximate the amount of mine-level research being performed by the U.S. coal industry.

I want to emphasize the broad definition of research because we believe all companies conduct some research, particularly at the mine. People are always looking for better ways of doing something, or for a solution to a problem. In this context, research includes the trial-and-error approaches used in the mines because of lack of technology or when the available technology is not applicable to your particular conditions. Some types of such in-mine research would be development of cabs and canopies on underground equipment, testing various types of roof bolts in a particular section with bad roof, or modifications of equipment to suit your particular needs. Quite often the work is not reported and the mine superintendent simply incorporates successful results into daily operations. All phases of the mining operation are included, from innovative exploration techniques to coal preparation.

We realize data may be available for some programs, while estimates must be made for others. All information provided BCR will be regarded as confidential, and only aggregated amounts will be reported.

In order to produce a well-documented summary of ongoing coal industry research, it is obvious that we need the cooperation of companies such as yours. We hope to obtain the information by , so we will call in about three weeks to answer any questions you may have concerning the type of research needed for study.

Sincerely yours,

R. D. Saltsman
Manager, Mining Research

RDS:em
2258

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Attachment 2 - To be sent to companies which produce between 500,000 and 3,999,999 tons/year, and equipment manufacturers. Has same attachments as Attachment 1.

Bituminous Coal Research, Inc. (BCR), and the National Coal Association (NCA), are requesting your help to determine the type and cost of research conducted by the coal industry. This program will attempt to provide accurate information to respond to critics of the coal industry who question what research the industry is conducting to help itself. We feel the study is very important, and deserves the support of industry for several reasons.

First, existing data are only qualitative and do not provide the necessary information to show that the mining industry is supporting coal research. Second, whenever dollar amounts are quoted, they do not reflect the full cost of all research undertaken by coal companies, particularly the very informal research work carried on at the mine level. Finally, in order to coordinate industry and government research, a better understanding is needed as to what industry is doing and how it can be complemented by the federal research programs.

Information will be gathered from both coal producers and equipment manufacturers and suppliers. Specifically, the information needed is your company's research expenditures for 1978, reported by subject categories and the type of research. The attachment describes both formats and our broad definition of research.

I want to emphasize the broad definition of research because we believe all companies conduct some research, particularly at the mine. People are always looking for better ways of doing something, or a solution to a problem. In this context, research includes the trial-and-error approaches used in the mines because of lack of technology or when the available technology is not applicable to your particular conditions. Some types of such in-mine research would be development of cabs and canopies on underground equipment, testing various types of roof bolts in a particular section with bad roof, or modifications of equipment to suit particular needs. Quite often the work is not reported and the mine

superintendent simply incorporates successful results into daily operations. All phases of the mining operation are included--from innovative exploration techniques to coal preparation.

We realize data may be available for some programs, while estimates must be made for others. All information provided BCR will be regarded as confidential, and only aggregated amounts will be reported.

In order to produce a well-documented summary of ongoing coal industry research, it is obvious that the participation of companies such as yours will be needed. We hope to obtain the information by so we will call in a few weeks to discuss the program and answer any questions you may have.

Sincerely yours,

R. D. Saltsman
Manager, Mining Research

RDS:em
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PHONE: 412 327-1600

Attachment 3 - Letter to be sent to companies which produce less than 500,000 tons per year. Has same attachment as Attachment 1.

Bituminous Coal Research, Inc. (BCR), and the National Coal Association (NCA), are requesting your help to determine the type and cost of research conducted by the coal industry. This program will attempt to provide accurate information to respond to critics of the coal industry who question what research the industry is conducting to help itself.

Basically, the program is to identify research programs and expenditures by the coal industry during 1978. We feel the program is very important for several reasons. First, existing data on coal industry research are only qualitative and do not provide the necessary information to show that the mining industry is supporting coal research. Second, in order to coordinate industry and government research, a much better understanding is needed of what industry is doing and how that work can be complemented by the federal research programs. Third, the small coal producers appear to be the most overlooked when the research needs of the coal industry are evaluated.

The third reason is why BCR is requesting the participation of your company in this program. Whenever research expenditures are quoted, they do not reflect the full cost of all research undertaken by the coal companies, particularly the very informal research work carried on at the mine level. The amount a coal producer spends on research efforts should not determine participation in the program since the areas in which research is conducted are important for direction in the planning and carrying out of future research. Even if your company does not have any R&D expenditures, a response is still needed since it is equally important to know if small coal producers do not perform research as it is if they do.

It is obvious that the program depends on data from industry, and it cannot be successful without the cooperation of both large and small coal producers. Specifically, the information needed is your

company's research expenditures for 1978 reported by subject categories and the type of research. The attachment describes both formats and our broad definition of research.

I want to emphasize the broad definition of research because we believe all companies conduct some research, particularly at the mine. People are always looking for better ways of doing something, or a solution to a problem. In this context, research includes the trial-and-error approaches used in the mines because of lack of technology or when the available technology is not applicable to your particular conditions. Some types of such in-mine research would be development of cab and canopies on underground equipment, testing various types of roof bolts in a particular section with bad roof, or modifications of equipment to suit particular needs. Quite often the work is not reported and the mine superintendent simply incorporates successful results into daily operations. All phases of the mining operation are included, from innovative exploration techniques to coal preparation.

We realize data may be available for some programs, while estimates must be made for others. All information provided BCR will be regarded as confidential, and only aggregated amounts will be reported.

In order to produce a well-documented summary of the ongoing coal industry research performed by both large and small coal producers, it is obvious that we need the participation of companies such as yours. Therefore, we are requesting the information by

Sincerely yours,

R. D. Saltsman
Manager, Mining Research

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INSTRUCTIONS FOR REPORTING RESEARCH AND DEVELOPMENT EXPENDITURES

A. Definitions

1. Research and Development - Any effort or project undertaken to solve mining problems, improve mining systems, or develop new products. The purpose may be to decrease costs, increase production, improve safety, or comply with regulations. Research would include: (1) the design, fabrication, or utilization of concepts and equipment; (2) tests of alternate products not routinely employed in the mining cycle; (3) first-time modifications and re-designs of existing equipment; and (4) studies conducted to develop methods to comply with regulations (once the procedure for compliance is developed, the costs are no longer R&D expenditures). For government research projects, include only the company's contribution; not the total cost of the program. Do not include engineering tasks and planning studies normally involved in the production of coal or implementation of concepts previously demonstrated in your mine.

In order to judge whether research has been conducted, keep in mind that the work should be innovative, involve a non-routine approach, or be a trial-and-error method as viewed by your operating personnel. You do not have to be the first person to conduct research, as long as the program is unique to your operating conditions.

We feel it is extremely important, in order to truly represent the coal industry, that you estimate the costs of informal research programs that go on in your mines or shops every day but are never formally reported.

Research expenditures, for calendar year 1978 only, should be reported in Table 2 in two ways--research categories and types of research.

2. Research Categories - Table 1 contains 14 major headings (A-N) and many subheadings. The subheadings do not include every possible research category, but they do indicate many common areas of research and should help you to classify expenditures under the 14 major categories.

Research expenditures for each major heading (A-N) should be totaled and reported on Table 2, R&D Expenditures for 1978.

3. Type of Research - The following defines four types of research:

I. Basic Research - Investigation or experimentation aimed at the discovery and interpretation of facts or revision of accepted theories in the light of new facts.

e.g., - Study of electrostatic charge of respirable dust.

- Investigation of rheologic properties of shales.

II. Development Research - Studious effort to develop practical application of new or revised theories developed through research.

e.g., - Finite element investigation of the effect of square vs. rounded corner rectangular entries on roof stability in the Pittsburgh coalbed in Greene County, Pennsylvania.

- Investigation of wear properties of sintered-diamond applied to small-diameter rotary drill bits.

III. Demonstration Research - Work directed at the reduction to practice and proof of performance of initial device(s) or technique(s) based on the results of research and development.

e.g., - Field trial of self-drilling roof bolts in the roof rock of the Ajax Coal Mine, Gilpin Co., Colorado.

- Endurance testing of the X24 HR continuous miner in the Herrin #5 seam.

IV. Application Engineering Research - Effort devoted to solving site or application specific problems associated with use of commercial technology necessitated by wide variability of mining conditions.

e.g., - Reconfiguration of water sprays on the Coal Maker 12 CM miner in 3 left to bring section to compliance.

- Assessment of CaCl solutions in reducing haul road dust.

- Experimentation with one web-back system on the new Apex longwall face.

On Table 2, estimate to the nearest 5 percent, the amount of each type research conducted. For example:

Basic Research	0%
Development Research	10
Demonstration Research	50
Application Engineering Research	40
	100%

TABLE 1. RESEARCH CATEGORIES

A. Coal Preparation (up to but not including any chemical alteration of the coal)

1. Chemical cleaning processes
2. Drying
3. Blending
4. Non-ASTM (non-standard) coal analysis
5. Sulfur and impurities removal
6. Refuse disposal
7. Other

B. Rock and Soil Mechanics

1. Hazard detection
2. Subsidence
3. Geological and structural studies
4. Roof control (bolting, supports, sealants, pillar design; and includes bottom and ribs)
5. Slope stability
6. Other

C. Environmental

1. Surface pollution (air, noise, water)
2. Acid mine drainage

D. Reclamation

1. Vegetation
2. Erosion and sedimentation control (soil stability)
3. Planning
4. Other

E. Health and Safety

1. Ventilation (face and mine)
2. Dust control
3. Control of methane and other gases (including methane drainage)
4. Fire and explosion prevention
5. Noise
6. Illumination
7. Cabs and canopies
8. Mine environmental monitoring
9. Rescue and escape
10. Other

F. Innovative Design or Modifications of Underground Equipment

1. Extraction equipment
2. Haulage equipment
3. Roof support equipment
4. Transportation equipment
5. Auxiliary equipment
6. Remote control
7. Other

G. Innovative Design or Modifications of Surface Equipment

1. Extraction equipment (draglines, shovels)
2. Haulage equipment
3. Drills
4. Auxiliary equipment
5. Other

H. Mine Systems Design

1. (New) mining methods (a good indicator is when an MSHA variance is required)
2. Exploration (non-standard tecnniques)
3. Shaft and slope sinking
4. Operations research (e.g., computer applications, simulation, etc.)
5. Hoisting systems
6. Other

I. Materials Handling (includes materials in and materials out)

1. Face haulage
2. Slurry
3. Belt and track
4. Haulage roads
5. Transport of men and supplies
6. Overburden transport
7. Other

J. Human Resources

1. Incentive programs
2. Development of innovative training programs (both union and salary workers)
3. Man/machine relationships
4. Other

K. Explosives

1. Blast pattern design
2. Detonation
3. Fragmentation
4. Vibration effects
5. Other

L. Electrical

1. Communications
2. Power distribution
3. Ground monitoring
4. Other

M. Materials and Supplies (expendables)

1. Bits
2. Splices
3. Hydraulic oils
4. Tires
5. Other

N. Other (please specify)

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TABLE 2. R&D EXPENDITURES FOR 1978

(please refer to Table 1, Research Categories, and definitions of the types of research)

Research Expenditures by Category

		Expenditures in Each Category for 1978 (dollars)
A.	Coal Preparation	$
B.	Rock and Soil Mechanics	
C.	Environmental	
D.	Reclamation	
E.	Health and Safety	
F.	Innovative Design or Modifications of Underground Equipment	
G.	Innovative Design or Modifications of Surface Equipment	
H.	Mine Systems Design	
I.	Materials Handling	
J.	Human Resources	
K.	Explosives	
L.	Electrical	
M	Materials and Supplies	
N.	Other (please specify) _____	
	TOTAL EXPENDITURES	$

Expenditures by Type of Research

Of the total expenditures, what percentage falls into each of the following four types of research (definitions are attached)

Type	Percent of Total Expenditures
I. Basic	
II. Development	
III. Demonstration	
IV. Application Engineering	
Total (Should be 100%)	

Company _____

Name _____

Telephone No. _____

Date _____

Please return to:

Robert D. Saltsman
Manager, Mining Research
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350 Hochberg Road
Monroeville, PA 15146

2258-46 3/16/79