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ECONOMICS OF LARGE-SCALE SURFACE COAL MINING
USING SIMULATION MODELS

USER'S MANUAL FOR NONSTRIPPING MINING FUNCTION MICROMODELS

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ECONOMIC SYSTEM ANALYSIS OF
COAL PRECONVERSION TECHNOLOGY

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ABSTRACT

Large-scale surface coal mining will play a key role in meeting the future energy needs of the United States, especially in affecting the costs of coal conversion and advanced combustion processes being developed by the U.S. Energy Research and Development Administration (ERDA). Fluor Utah, Inc., with Bonner & Moore Associates, Inc. as subcontractor, was contracted by ERDA to determine and define the problems that future large-scale surface mines would encounter in meeting these energy needs. The project resulted in a series of computer models for use by the industry in mine planning and analysis, and by government in estimating future energy costs.

This report contains User's Manuals for computer models which simulate the following surface coal mining operations:

- Overburden or coal drilling and blasting
- Overburden or coal hauling in trucks
- Overburden or coal loading with shovels, or front-end loaders, and hauling in trucks
- Topsoil removal, spoil pile grading, topsoil spreading, general dozing, revegetation and land management
- Coal handling and preparation
- Administrative functions; premining activities, central facilities, operating staff, and taxes and royalties

These models provide detailed information suitable for mine design and equipment selection. The User's Manuals explain how to formulate problems for model solution, how the models process the problem statements, and the content of all model output. The report also contains User's Manuals for the equipment data files which support the simulation models.

These models are part of a series developed for mine planning and economic analysis of surface coal mines. The complete series, designed for use by government or private industry, permits examination of large-scale surface coal mining under a variety of terrain conditions and overburden depths. Each major operation in the coal mining process is represented in these models so that the best methods and equipment may be selected, and so that the impact of such selections will be reflected in estimates of capital investment, operating costs and sales price.

This report also presents background information on the project and references to other project models and reports.

PART 1.0
INTRODUCTION

1.1 PURPOSE AND SCOPE OF THIS REPORT

This report presents User's Manuals for computer models which simulate surface coal mining operations and provide mine layout, equipment selection and cost information. Each User's Manual explains how to formulate problems for model solution, the manner in which the model processes the problem statements, and the content of all model output. The report also presents User's Manuals for the equipment data files which support the simulation models.

The report has ten parts. Part 1.0, Introduction, provides an overview of the project and its results. Part 1.2 contains the project overview. Part 1.3 summarizes the project objectives. Part 1.4 reviews all models, Part 1.5 describes potential applications, and Part 1.6 reviews public access to the models. Part 1.7 contains an overview description of the simulation models.

Part 2 is the User's Manual for the Drilling and Blasting (DAB) Model which simulates drilling and blasting either overburden or coal. Part 2 contains four sections.

Part 3 is the User's Manual for the Haul Unit Simulation (HUS) model which simulates the operation of trucks, hauling either coal or overburden, over user-defined haul roads. Part 3 contains four sections.

Part 4 is the User's Manual for two Load and Haul (LAH) simulation models. The CLH model simulates the use of loading shovels, and FLH simulates the use of front-end loaders. Both models simulate the loading and hauling operation for either overburden or coal. Part 4 contains four sections.

Part 5 is the User's Manual for the Land Reclamation Simulation (LRS) Model which simulates topsoil removal, spoil pile regrading, topsoil spreading, general dozing, revegetation and land management. Part 5 contains four sections.

Part 6 is the User's Manual for the Preparation/General and Administrative (PGA) Model. PGA is actually two models; 1) Coal Preparation Factoring (CPF) which develops size and cost data for coal handling and preparation, and 2) General and Administrative (GAA) which develops size and cost data for the general support functions. Part 6 contains three sections and three appendices.

1.2 PROJECT OVERVIEW

Realizing that large-scale surface coal mines would be needed to supply feedstocks for conversion processes currently under development, the U.S. Energy Research and Development Administration sponsored this project to be better able

to determine expected costs for coal, and

to provide industry with planning and analysis models to aid in meeting future increased production needs.

The project encompassed 42 months of work at a cost of \$2.5 million involving both the mining and process engineering staff of Fluor Utah, Inc. as prime contractor and the consulting and programming staff of Bonner & Moore Associates, Inc. as the major subcontractor.

Successful completion of the project has provided the following immediate benefits:

Both government and industry now have a number of powerful analytical planning tools available to aid in future expansion of surface coal mining.

Information provided by the models will aid in proper planning, equipment selection and exploitation techniques so the coal industry can efficiently scale up to meet the energy needs of the United States.

1.3 PROJECT OBJECTIVES

The first objective is to develop, test and document simulation models representative of current surface mining techniques. The models provide mine designers, policy planners and engineering management with the ability to analyze a surface coal mine at two levels of detail:

Detailed Micro Level. The micromodels simulate individual mining operations using specific types of equipment, and provide detailed information for mine design and equipment selection.

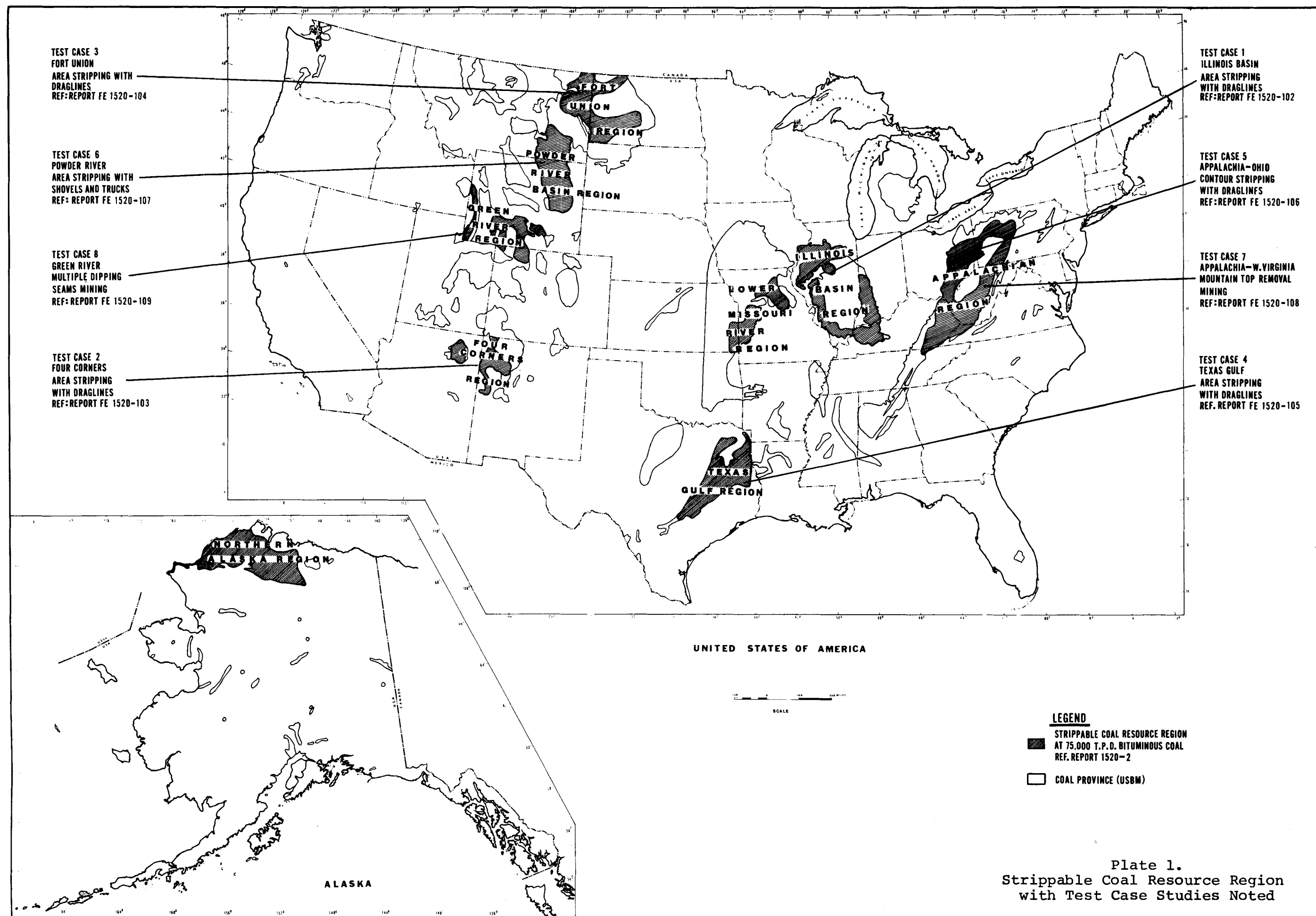
Broad Macro Level. The macromodels simulate an entire mine using a specified mining method identified by the overburden removal method, and provide first-order estimates for the mining complex.

The Cash Flow Model is designed to analyze a mining project which has been developed using the micromodels, the macromodels, manually prepared data or some combination.

The models, supporting information and User's Manuals are available to all interested private and public organizations.

The second objective is to use these computer models to estimate mining costs for hypothetical test situations in the eight major United States coal resource regions where coal is likely to be surface mined. The coal resource regions investigated are shown on Plate 1. Results of these analyses, including the sensitivity of coal costs to different mining and financial parameters, are presented in eight separate reports listed in Appendix A.

The objective of Phase I was to delineate the large deposits of surface minable coal in the United States, collect equipment costs and performance data needed to calculate surface coal mining costs, describe major surface mining and coal preparation methods, and investigate the socio-economic impact of large mining complexes. This information provided a framework for achieving the project objectives. A six-volume Phase I report, listed in Appendix B, was issued.



1.4 COMPARISON OF MACROMODELS AND MICROMODELS

Plate 2 is a flow diagram of the micromodeling and macromodeling systems as applied to the area stripping with draglines mining method. The diagram would have the same form for the other mining methods but would show different models as appropriate to the mining operations. It can be seen that the micromodel system involves using seven models, while the macromodel system involves a single model preceding the cash flow analysis. With the micromodel system, the user must analyze the model results and prepare the cash flow input, whereas that input is developed directly by the macromodel system.

Both systems begin with a tract description and end with a cash flow analysis. The major difference is the number of steps required to reach a solution.

The macromodel system requires only one manual step, i.e., defining the case study parameters. The computer programs perform all calculations required to obtain a solution. Thus, first-order cost estimates can be obtained in a single step. The macromodels are designed to provide answers even for cases where little verified field data are available about the site or region under study. The macromodel user may define all mining and financial parameters; however, each model uses default values, typical of the mining method and region, for all parameters not supplied by the user.

In contrast, the micromodel system requires several manual steps, since each mining operation is examined separately with the user interpreting the results from each model. This procedure permits interactive use of the computer with decisions being made by the user at each stage of the analysis. The micromodels are designed for use where considerable field data are available. However, they may be used in less-well-defined situations since each micromodel also has default values which may be acceptable substitutes for unavailable field data.

In summary, the macromodel system is intended for the user who

has little available field data,

does not wish to intervene in the decision process,
and

requires less detail about the operations.

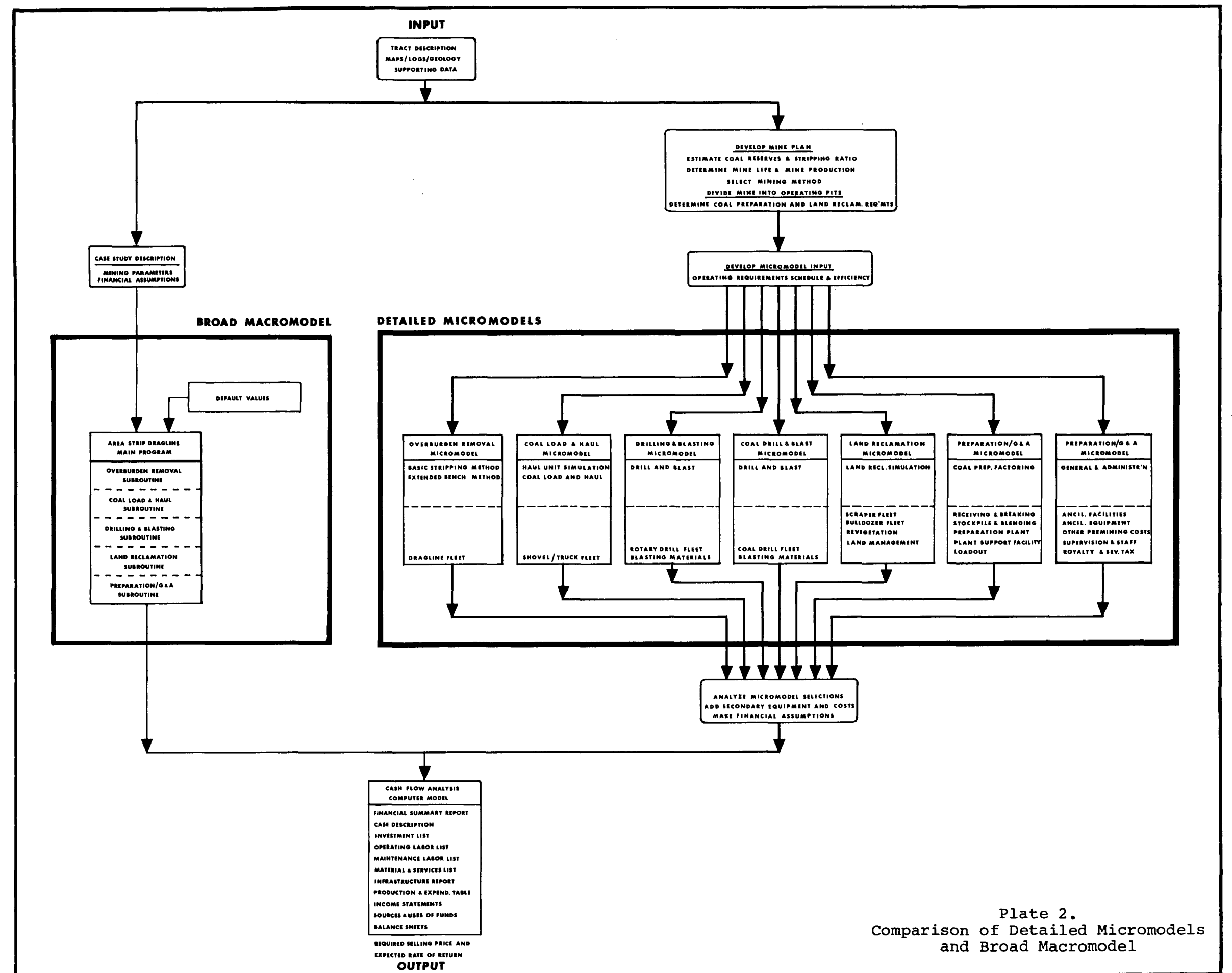


Plate 2.
Comparison of Detailed Micromodels
and Broad Macromodel

The micromodel system is intended for the user who
has considerable field data available,
wishes to make selection and design decisions,
and
requires mine design and equipment detail.

In the normal progression of mine development, a macromodel would be most useful during early planning and the micro-models would be most useful at a later stage during detailed feasibility and engineering studies. Each is potentially very useful at the appropriate stage of a project or study.

The total set of models is listed in Plate 3 which shows the mining functions simulated by each model. It will be noticed that the macromodels simulate all mining functions, while the micromodels simulate one function each. The three shovel/truck micromodels are exceptions since each simulates both overburden removal and coal load and haul. The Cash Flow Analysis model, which examines a mining project, is intended to be used with both systems.

1.5 POTENTIAL APPLICATIONS

1.5.1 DETERMINATION OF COAL COSTS FOR COAL CONVERSION AND COMBUSTION

The cost of coal comprises a significant portion of the selling price of synthetic gas, liquid products or electricity produced from coal. Because the competitiveness of these energy options depends so strongly on coal costs, it is important to make reasonably accurate estimates of mining costs. This is particularly true for surface coal mines which currently supply approximately one-half of U.S. coal production and are expected to supply even more of the U.S. coal demand in the future.

The macromodels can be used to develop first-order costs for coal conversion process evaluation. The detailed micromodels can be used for more precise cost determination for specific plants.

	DETAILED MICROMODELS		MACROMODELS		
	DRAGLINE MINING	SHOVEL/TRUCK MINING	DRAGLINE MINING		SHOVEL /TRUCK MINING
OVERBURDEN REMOVAL	BASIC STRIPPING METHOD OR EXTENDED BENCH METHOD OR CONTOUR STRIPPING METHOD (VOL. 14)	SHOVEL/TRUCK STRIPPING OR MULTIPLE DIPPING SEAMS OR MOUNTAIN TOP REMOVAL (VOL. 15)	 AREA DRAGLINE (VOL. 10) 	 CONTOUR DRAGLINE (VOL. 11) 	 AREA SHOVEL /TRUCK (VOL. 12) 
COAL LOAD AND HAUL	HAUL UNIT SIMULATION AND COAL LOAD AND HAUL (VOL. 16)				
OVERBURDEN DRILLING AND BLASTING	DRILLING AND BLASTING SIMULATION (VOL. 16)				
COAL DRILLING AND BLASTING	DRILLING AND BLASTING SIMULATION (VOL.16)				
LAND RECLAMATION	LAND RECLAMATION SIMULATION (VOL. 16)				
COAL HANDING AND PREPARATION	COAL PREP. FACTORING (VOL. 16)				
PRE-MINING, FACILITIES, & ADMINISTRATIVE	GENERAL AND ADMINISTRATIVE FACTORING (VOL. 16)				
ECONOMIC ANALYSIS	CASH FLOW ANALYSIS (VOL. 13)				

Plate 3.
Simulation Models for Surface Coal Mine Planning

1.5.2 MINE EVALUATION

Mine evaluation typically progresses through a series of steps from initial order-of-magnitude estimates through final engineering and start-up as follows:

- Order-of-Magnitude Estimate
- Preliminary Estimate
- Basic Engineering
- Detailed Engineering
- Procurement
- Construction
- Start-up.

The broad macromodels can be used to inexpensively obtain order-of-magnitude estimates for initial reserve evaluation. As more field data is collected, preliminary estimates can be made using: 1) the macromodels for analyzing the overall mining complex, and 2) the detailed micromodels for analyzing critical mining functions.

In the basic engineering stage, the computer models can be used to examine a wide range of alternatives for both mining and processing prior to committing large expenditures for the preparation of detailed engineering drawings, specifications, calculations, and estimates. Using the results of field investigation and testing to replace model default values with actual data, a great many cases can be run rapidly and inexpensively to examine many alternative mining methods, mining plans, processing methods, equipment types, and equipment sizes.

The detailed micromodels can be used as an aid in preparing year-by-year mine plans.

The cash flow analysis model can be used to update profitability projections as construction and purchase commitments are made.

1.5.3 EVALUATION OF GOVERNMENT POLICY

Government policies affecting coal mining costs that could be evaluated include: leasing of federal lands, alternative land reclamation requirements, various depreciation methods, increased labor and equipment costs due to safety requirements, state severance taxes, royalty costs, price subsidies, and construction grants.

The models can also be valuable in estimating long-term coal price projections. Curves representing the cost of coal as a function of the cumulative amount of coal mined

(coal supply curves) could be constructed for coal resource regions. Curves based on prices estimated by the models using detailed geologic and resource data, from sources such as the U.S. Geological Survey and the U.S. Bureau of Mines, could be used to augment the coal supply curves developed under the sponsorship of the Federal Energy Administration.

1.5.4 ENVIRONMENTAL IMPACT ASSESSMENT AND EVALUATION

The infrastructure report printed by the Cash Flow Analysis model presents information in four categories:

- Physical Effects
- Economic Impact
- Utility Requirements
- Manpower Requirements

This type of information can be used to assess environmental and socioeconomic impact.

1.6 PUBLIC ACCESS TO THE SIMULATION MODELS

The simulation models are online on a Xerox Sigma 7 computer as of the completion of the project. They can be run either in time share (remote terminal) or batch mode. The ultimate method of continued public access to the models has not been decided. Those desiring an up-to-date status of the availability of the models should contact one or more of the following as appropriate:

1. The Fossil Energy Office of the Energy Research and Development Administration in Washington, D.C., which sponsored the project, should be contacted for questions regarding government participation and government agency use.
2. Fluor Utah, Inc., San Mateo, California, which supplied the mining and process engineering expertise for the project should be contacted for questions regarding the formulation of mining problems, equipment selection logic, and interpretation of simulation results.
3. Bonner & Moore Associates, Inc. of Houston, Texas, which supplied the simulation modeling and computing expertise for the project, should be contacted for questions regarding mathematical modeling techniques and details of time-sharing or batch use of the models.

1.7 DESCRIPTION OF SIMULATION MODELS

The mining functions simulated by the models described in this report are illustrated in Plate 4. The following paragraphs discuss the functions as simulated by the models. There is not a one-to-one correspondence between the User's Manuals, the models and the mining functions. Combinations and separations were made during development as deemed appropriate to the model logic and intended use.

1.7.1 LOADING AND HAULING

Three models simulate loading and hauling operations where the material may be either coal or overburden as specified by the user. Part 3 contains the User's manual for the Haul Unit Simulation (HUS) model and Part 4 the manual for the two Load and Haul (LAH) models. The two LAH models differ in terms of the loading equipment; CLH uses loading shovels and FLH uses front-end loaders. Two steps are involved in load and haul evaluations. First, the HUS model is used to develop cycle times for one or more trucks over one or more user-defined haul roads. Second, one of the LAH models is used to evaluate combinations of loaders and trucks. The LAH models determine the numbers of loaders and trucks required to meet a specified production rate, estimate ownership and operating costs, and determine the least-cost combination. Specification information for the trucks, shovels and front-end loaders is taken from the equipment data files.

1.7.2 DRILLING AND BLASTING

Part 2 contains the User's Manual for the Drilling and Blasting (DAB) model which simulates operation in either overburden or coal as specified by the user. The model determines the required number of drills and estimates ownership and operating costs. It also estimates costs of blasting materials and explosives. The drill specifications are taken from the equipment data file.

1.7.3 LAND RECLAMATION

Part 5 contains the User's Manual for the Land Reclamation Simulation (LRS) model. The model simulates six reclamation functions; topsoil removal, spoil pile regrading, topsoil spreading, revegetation, and land management. The model estimates equipment requirements and ownership and operating costs.

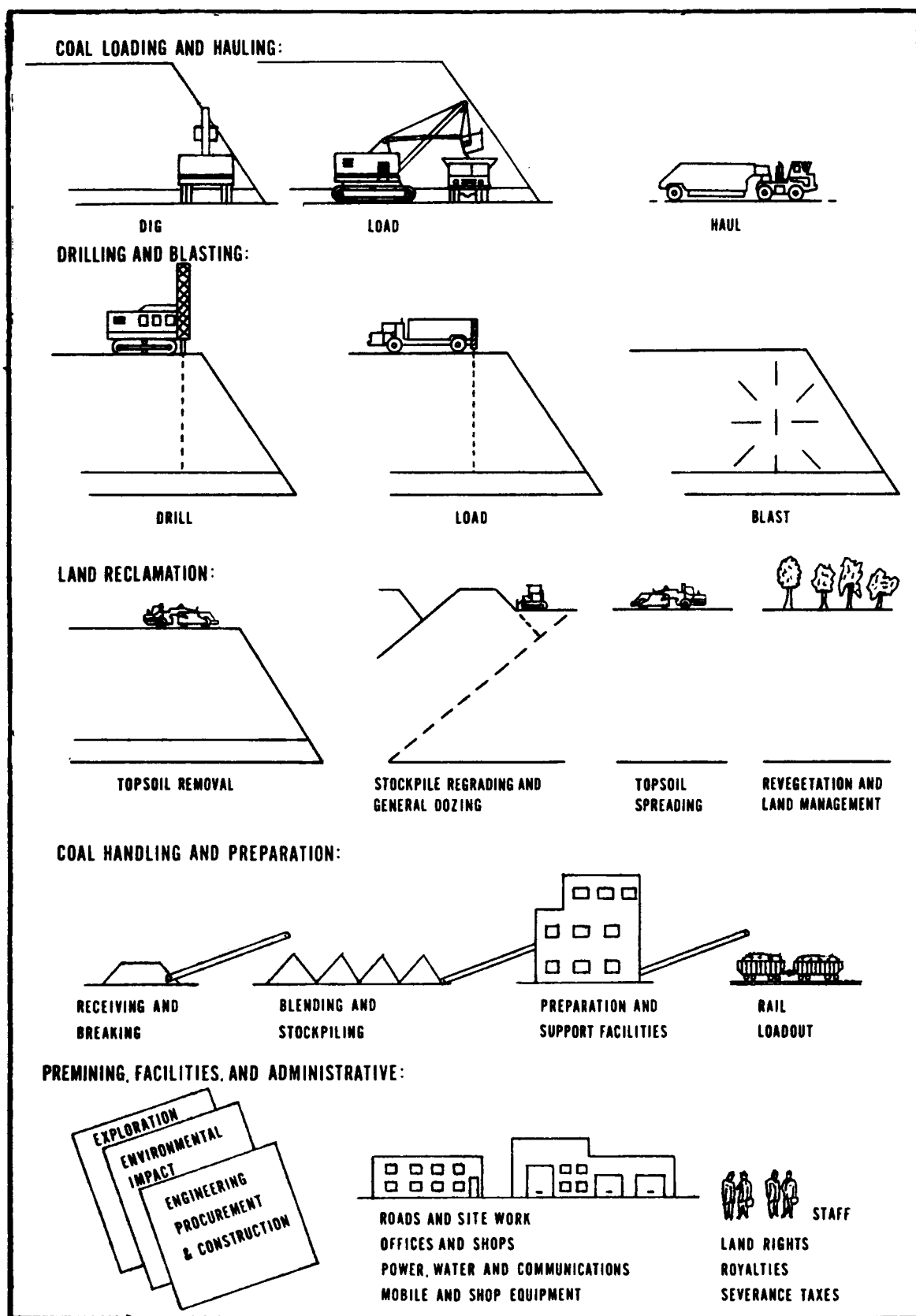


Plate 4.
Micromodels for Nonstripping Functions

1.7.4 COAL HANDLING AND PREPARATION

Part 6 contains the User's Manual for the Coal Preparation Factoring (CPF) model. This model uses extrapolation from a baseline case rather than simulation. The model estimates ownership and operating costs for a complete coal handling and preparation facility including receiving and breaking, stockpiling and blending, preparation, support facilities, and coal loadout. One of three preparation plants may be selected by the user; Crushing and Screening, Baum Jig or Heavy Media. The baseline values for extrapolation were derived from a detailed study of hypothetical large-scale preconversion facilities as described in Part 9. The user may redefine the baseline values to describe other handling and preparation facilities.

1.7.5 PREMINING, FACILITIES AND ADMINISTRATIVE

Part 6 also contains the User's Manual for the General and Administrative (GAA) model. This model also uses extrapolation from a baseline case rather than simulation. The model estimates ownership and operating costs associated with premining activities, central facilities, operating staff, and taxes and royalties. The baseline values were derived from a study of the GAA costs for a large-scale surface mine. The user may redefine the baseline values to describe other general and administrative approaches.

1.7.6 EQUIPMENT DATA FILE PROGRAMS

The programs used to create the equipment data files are described in the User's Manuals for the Truck Data File (TDF) and the Mining Equipment Data File (MEDF) contained in Parts 7 and 8, respectively. To support the planning system models, data files for the following equipment classes were developed and maintained:

- Bulldozers
- Motor Graders
- Rotary Drills
- Scrapers
- Loading Shovels
- Front-end Loaders
- Haul Trucks

The MEDF programs are used to create the files from manufacturer's specification data and print the files in data-book format. Special programs are used to calculate ownership and operating costs. The TDF program, typical of these special programs, is included to illustrate the methods. Copies of all data files are available from the contractors.

APPENDIX A
PHASE II FINAL REPORTS

Economics of Large-Scale Surface Coal Mining
Using Simulation Models

Volume
No.

SUMMARY

- 1 Executive Summary (FE-1520-101)

REGIONAL TEST CASES

- 2 Area Stripping with Draglines Using Illinois Basin Region Test Case (FE-1520-102)
- 3 Area Stripping with Draglines Using Four Corners Region Test Case (FE-1520-103)
- 4 Area Stripping with Draglines Using Fort Union Region Test Case (FE-1520-104)
- 5 Area Stripping with Draglines Using Texas Gulf Region Test Case (FE-1520-105)
- 6 Contour Stripping with Draglines Using Appalachia-Ohio Region Test Case (FE-1520-106)
- 7 Area Stripping with Shovels and Trucks Using Power River Region Test Case (FE-1520-107)
- 8 Mountain Top Removal Mining Using Appalachia-West Virginia Region Test Case (FE-1520-108)
- 9 Multiple Dipping Seam Mining Using Green River Region Test Case (FE-1520-109)

USER'S MANUALS FOR COMPUTER MODELS

- 10 User's Manual for Area Dragline Macromodel (FE-1520-110)
- 11 User's Manual for Area Shovel Truck Macromodel (FE-1520-111)
- 12 User's Manual for Contour Stripping with Draglines Macromodel (FE-1520-112)
- 13 User's Manual for Cash Flow Analysis Model (FE-1520-113)
- 14 User's Manual for Dragline Stripping Micromodels (FE-1520-114)
- 15 User's Manual for Shovel Truck Mining Micromodels (FE-1520-115)
- 16 User's Manual for Nonstripping Mining Function Micromodels (FE-1520-116)

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APPENDIX B
PHASE I REPORTS

Volume
No.

- 1 Introduction, Summary, Conclusions, and Recommendations
 for Research.

 Summary of Phase I Results
 (31 pages, FE-1520-1)
- 2 Characterization of Coal Deposits for Large-Scale Surface Mining.

 Delineates strippable coal resource regions
 of the U.S. and describes their physiography,
 surficial deposits, soils, structural geology,
 general stratigraphy, and coal stratigraphy
 (346 pages, FE-1520-2)
- 3 Surface Coal Mining Methods and Equipment.

 Describes mining methods and equipment used
 in large-scale surface coal mining
 (109 pages, FE-1520-3)
- 4 Large-Scale Coal Processing for Coal Conversion.

 Discusses coal preparation plant design
 related to producing feedstocks for coal
 conversion and describes hypothetical
 plants for three types of coal preparation
 (80 pages, FE-1520-4)
- 5 Survey of Socioeconomics, Financial Statistics, and Legal Aspects.

 Provides an overview of the socioeconomic,
 financial, and legal factors which affect
 surface coal mining
 (121 pages, FE-1520-5)
- 6 Computer Systems to Support Mine Planning.

 Describes the status of the simulation models
 and supporting data files at the end of
 Phase I
 (307 pages, FE-1520-6)

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PART 2

DRILLING AND BLASTING (DAB) MODEL
USER'S MANUAL

17 September 1976

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DAB MODEL USER'S MODEL
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SECTION 1
INTRODUCTION

1.1 PURPOSE AND SCOPE

This manual describes the function and use of the Drilling and Blasting (DAB) model. The DAB model is designed to assist the mining engineer in planning drilling and blasting operations for a surface coal mine. The model simulates the operation for either coal or overburden, and calculates the number of rotary drills necessary to drill the material and the amount of explosives required for blasting. It also calculates ownership and operating costs for the equipment and explosives.

1.2 ORGANIZATION OF THE MANUAL

Following this Introduction, Section 2 of this manual details the definition of the drilling and blasting problems for solutions by the DAB model. Included are descriptions of the various parameters which must be defined by the user. Section 3 consists of a step-by-step description of the sequence of operations in the DAB model. Section 4 describes the DAB model output, and provides a sample print-out from the model.

1.3 USING THIS MANUAL

This manual assumes that the user of the DAB model understands mining operations. Such operations are discussed in this manual only to the extent necessary to explain the operation of the DAB model.

The model simulates drilling and blasting for coal or overburden. Specific reference to the drilling medium is made when necessary; otherwise, the model operation is the same for both coal and overburden.

The terms "explosives" and "powder" are used in the model and this manual to refer to blasting agents.

The data file processed by the model is the Rotary Drill Data File. The file contains information on both rotary and coal auger drills. The term "rotary drill", as used in this manual, refers to auger drills when the model is used for coal drilling and blasting.

SECTION 2

MODEL DESCRIPTION

2.1 GENERAL OVERVIEW

The DAB model is designed to simulate blasting of a single layer of material, such as a 40-foot coal seam or 60 feet of overburden, or a series of coal or overburden benches.

If the user specifies more than one set of input data, the model assumes each set describes a bench to be drilled and blasted. The model will select equipment and estimate costs for each bench, and accumulate costs and number of drills required for all benches. Summary information about all benches is printed in report format at the end of the model run. A detailed description of the model output is presented in Section 4.

To control the DAB model, the user may specify a particular hole diameter size and spacing and burden, only the drill hole diameter, or neither of these. The user sets parameter ICASE to indicate to the model what input data to expect. If ICASE = 1, the DAB model examines all drills in the Drill Data File and calculates the proper spacing and burden to match each drill diameter. If ICASE = 2, the user specifies the drill diameter and the model calculates the associated spacing and burden. If ICASE = 3, the model assumes the user has specified both the drill diameter and the spacing and burden to be used in the simulation. (In the second and third cases, only drills having the specified diameter are considered by the model.)

The ICASE setting controls the order in which the model must consider the requirements for drilling and blasting. If ICASE = 1, the model considers each drill in the Data File (one at a time), using its specified drill diameter to calculate a matching spacing and burden. Next, the model calculates the possible production for the drill, given a drilling rate supplied by the user or found in the Data File. By comparing the possible production rate and the user's demand production rate, the model determines the number of drills required to meet the production demand. The powder requirements are considered next. For each drill and its associated spacing and burden, the powder necessary to blast the material is calculated. Finally, the ownership and operating cost of the drill, and the cost of the explosives are calculated and printed out by the model. After all the drills in the Data File have been costed and the powder requirements for each determined, a least-cost solution is indicated to the user.

If ICASE = 2, the simulation calculates the proper spacing and burden to match the user's specified drill diameter. If ICASE = 3, the spacing and burden are specified as input by the user. The calculations described above for drill production, required number of drills, amount of explosives, ownership and operating cost for the drill, and explosives costs are made for each drill having the specified drill diameter.

The model determines if the user has specified input concerning additional benches to be included in the current model run. If more input data exists, the model repeats the evaluation of the user's data for each additional bench. When all input data has been processed, a final report is printed which summarizes the requirements by bench and in total for the area to be drilled and blasted.

2.2 INPUT PARAMETERS

The input parameters for the DAB model are categorized into three groups:

- 1) Parameters which describe the area to be drilled and blasted.
- 2) Parameters concerning the explosives to be used.
- 3) Parameters specifying the rate at which the area must be drilled and blasted, based on specific coal or overburden data.

The following subsections describe the parameters, the mechanics of the input format, and the building of an input file.

The DAB model is a computer program written in the FORTRAN programming language. Every parameter described in this section is a "variable" in the FORTRAN program. When the program is written, the programmer assigns a value to each variable for testing. This programmer-assigned value becomes the initial value of the variable whenever the model is run.

The first model action is to read the user's input data file. This action resets the parameter values as specified in the input file. Any parameter not specifically set in the user's input data file continues to have the programmer's assigned value. Thus, the user must set all parameters when building the input file.

The user's file may call for several solutions, i.e., for drilling and blasting on several benches. The parameters

whose values are to remain the same for all benches need be set only for the first bench. Once the value has been set, it continues until reset by the user's input data file.

2.2.1 Area Description Parameters

The following parameters supply the model with information regarding the schedule for drilling and blasting, the drilling medium, the drill diameter, and the spacing and burden. The parameters are:

- 1) KMED - indicates to the model whether the user wants to simulate coal or overburden drilling and blasting. If KMED = 0, the drilling medium is coal; if KMED = 1, the drilling medium is overburden.
- 2) ICASE - controls the model actions concerning drill diameter, spacing, and burden. If ICASE = 1, spacing and burden are determined by the model for each drill diameter. If ICASE = 2, the user must specify the drill hole diameter; spacing and burden are calculated by the model. If ICASE = 3, the user must specify the drill hole diameter and spacing and burden.
- 3) OSRHY - is the number of hours/year the drilling and blasting operation is scheduled to work.
- 4) OPRHY - is the number of hours/year of productive drilling and blasting.

- 5) EDO - is the expected efficiency of the drilling and blasting operation. This parameter is used to determine the effective minutes/hour the operation takes place ($60 \times \text{EDO}$).
- 6) PTF - is a factor used by the model to adjust the effective drilling rate to account for time lost when the drill is moved from one area to another. A factor of 0.9 would indicate 10 percent lost time.
- 7) P - is the width of the working panel for drilling and blasting, in feet. P is used to calculate yearly rate of linear advance of the drilling operation.
- 8) HBMF - is the hole bottom margin, in feet. The length of the hole to be drilled is calculated by subtracting the hole bottom margin from the height of the layer to be drilled. HBMF controls sub-drilling. If $\text{HBMF} = 0$, the hole will be drilled to the bottom of the layer. If HBMF is positive, the drilling will stop HBMF feet from the bottom of the layer. If HBMF is negative, the hole length will be longer than the height of the layer, indicating sub-drilling will take place.
- 9) PLY - is the life of the project, in years.
- 10) DRSMFH - is the drilling rate expected in soft material, in feet/hour. The drilling rates found in the Drill Data File are calculated based on the

drill downpressure when drilling hard rock. Since coal and coal overburden are relatively soft materials, DRSMFH overrides the drilling rate found in the Data File. If DRSMFH is not 0, its value is used as the drilling rate. If DRSMFH = 0, the Data File value for drilling rate is used.

- 11) SDDI - is the user-specified drill diameter to be used by the model, in inches. It must be specified when ICASE = 2 or 3.
- 12) S - is the spacing, in feet, required by the user. Spacing is the distance from one drill hole to the next, in a line parallel to the blasting face. It must be specified when ICASE = 3.
- 13) B - is the burden, in feet, specified by the user. Burden is the distance from one hole to the next in a line perpendicular to the blasting face. It must be specified when ICASE = 3.
- 14) LOGPA - controls the printing of the input data. LOGPA is a "0/1" variable. When LOGPA = 0, this printing does not occur. If LOGPA = 1, the model prints the name, value, and description of each of the input parameters.
- 15) LOGIV - controls the printing of the intermediate calculated variables. If LOGIV = 0, the intermediate variables calculated by the model are not printed. If LOGIV = 1, a listing of the intermediate variables appears in the model output.

2.2.2 Explosive Parameters

Several assumptions have been made about the explosives used in the model:

- 1) Prilled ammonium nitrate sensitized with fuel oil (commonly called ANFO) is used to blast dry holes.
- 2) Slurry is used to blast wet holes.
- 3) Two types of detonators can be used: either electric blasting caps and primer explosive, or detonating cord and cast boosters.

These assumptions were made to allow the model to estimate the cost of explosives with relative accuracy, using a representative type of explosive. It was not intended that the model examine all possible explosive combinations.

The following is a list of the input parameters used to describe the types and costs of the explosives:

- 1) PRPY - is the amount of explosive to be used for each cubic yard of material to be blasted, in pounds/cubic yard.
- 2) PDH - is the percentage of the holes to be drilled and blasted which are dry, expressed as a decimal fraction.
- 3) PWH - is the percentage of the holes which the user expects to be wet, expressed as a decimal fraction.

- 4) DAGCC - is the density of the ANFO, in grams/
cubic centimeter.
- 5) DSGCC - is the density of the slurry, in grams/
cubic centimeter.
- 6) DPGCC - is the density of the primer, if it
is to be used, in grams/cubic centimeter.
- 7) HPF - is the height of the primer or the
length of the hole which will be filled with primer,
in feet.
- 8) CADP - is the cost of the ANFO, in dollars/
pound.
- 9) CSDP - is the cost of slurry, in dollars/
pound.
- 10) CPDP - is the cost of the primer, in dollars/
pound.
- 11) CPCDMF - is the cost of detonating cord, in
dollars/thousands of feet. If CPCDMF is not equal
to zero, the model assumes the user wants to use
detonating cord and cast boosters as detonators. If
 $CPCDMF = 0$, the model assumes the detonator will be
electric blasting caps and primer.
- 12) CBCDC - is the cost of electric blasting caps
or cast boosters, in dollars/100.

13) PEBC - is the percentage of additional blasting caps or cast boosters that will be required in excess of one per hole, expressed as a fraction.

2.2.3 Demand Rate Parameters

These user-set parameters are divided into two groups depending on whether the drilling medium is coal or overburden. If the user intends the model to simulate drilling and blasting of coal, (i.e., KMED = 0), the following data must be input:

- 1) CDRTY - the coal demand rate, in recoverable tons of coal/year.
- 2) CDBYY - the coal demand rate, in bank cubic yards/year.
- 3) HC - the height of the coal seam or coal bench, in feet.

When the user intends the model to simulate the drilling and blasting of overburden, (i.e., KMED = 1) the following two parameters are required:

- 1) BDBYY - the overburden demand rate, in bank cubic yards/year.
- 2) HB - the height of the overburden or bench to be drilled, in feet.

2.2.4 Rotary Drill Input Data

In addition to the parameters specified by the user, the DAB model uses the Drill Data File as input. The following items about each drill are used:

- 1) Drill Bit Diameter - inches.
- 2) Drilling Rate for Hard Rock - feet/hour.
- 3) Hourly Ownership Cost - dollars/hour.
- 4) Hourly Operating Cost - dollars/hour.

2.2.5 Input Data Forms

Figures 2-1 through 2-6 are input data forms for the DAB model. A separate form is shown for each of the possible combinations of settings for parameters ICASE and KMED.

1	7	8	9	19
ICASE	=	1		Drill Diameter, Spacing, and Burden NOT Specified.
KMED	=	0		Drilling Medium is Coal.
OSRHY	=			Operating Scheduled Hours (hours/year).
OPRHY	=			Operating Productive Hours (hours/year).
EDO	=			Efficiency of Drilling and Blasting (fraction).
PTF	=			Propel Time Factor (fraction)
P	=			Panel Width (feet).
DRSMFH	=			Drilling Rate in Soft Material (feet/hour).
HBMF	=			Hole Bottom Margin (feet).
CDBYY	=			Coal Demand (bank cubic yards/year).
CDRTY	=			Coal Demand in Recoverable Tons (tons/year).
HC	=			Height of Coal (feet).
DPGCC	=			Density of Primer (grams/cc).
DAGCC	=			Density of ANFO (grams/cc).
DSGCC	=			Density of Slurry (grams/cc).
PRPY	=			Powder Ratio (pounds/yard).
PDH	=			Percent Dry Holes (fraction).
PWH	=			Percent Wet Holes (fraction).
HPF	=			Height of Primer (feet).
#CPCDMF	=			Cost of Primer Cord (\$/1000 feet).
PEBC	=			Percent of Extra Blasting Caps (fraction).
CBCDC	=			Cost of Blasting Caps (\$/100)
#CPDP	=			Cost of Primer (\$/pound).
CADP	=			Cost of ANFO (\$/pound).
CSDP	=			Cost of Slurry (\$/pound).
PLY	=			Project Life (years).
LOGPA	=			Log Parameters (0,1).
LOGIV	=			Log Intermediate Variables (0,1).
*	=			Indicates End of Data for this Case.

#Note: One of these should be zero.

Figure 2-1. Input Data Sheet for ICASE = 1 and KMED = 0

1	7	8	9	19
ICASE	=	2		Drill Diameter Specified, Spacing and Burden NOT Specified.
KMED	=	0		Drilling Medium is Coal.
OSRHY	=			Operating Scheduled Hours (hours/year).
OPRHY	=			Operating Productive Hours (hours/year).
EDO	=			Efficiency of Drilling and Blasting (fraction).
PTF	=			Propel Time Factor (fraction).
P	=			Panel Width (feet).
HBMF	=			Hole Bottom Margin (feet).
CDBYY	=			Coal Demand (bank cubic yards /year).
CDRTY	=			Coal Demand in Recoverable Tons (tons/year).
HC	=			Height of Coal (feet).
SDDI	=			Specified Drill Diameter (inches).
DPGCC	=			Density of Primer (grams/cc).
DAGCC	=			Density of ANFO (grams/cc).
DSGCC	=			Density of Slurry (grams/cc).
PRPY	=			Powder Ratio (pounds/yard).
PDH	=			Percent Dry Holes (fraction).
PWH	=			Percent Wet Holes (fraction).
HPE	=			Height of Primer (feet).
#CPCDMF	=			Cost of Primer Cord (\$/1000 feet).
PEBC	=			Percent Extra Blasting Caps (fraction).
CBCDC	=			Cost of Blasting Caps (\$/100).
#CPDP	=			Cost of Primer (\$/pound).
CADP	=			Cost of ANFO (\$/pound).
CSDP	=			Cost of Slurry (\$/pound).
PLY	=			Project Life (years).
LOGPA	=			Log Parameters (0.1).
LOGIV	=			Log Intermediate Variables (0,1).
*	=			Indicates End of Data for this Case.

#Note: One of these should be zero.

Figure 2-2. Input Data Sheet for ICASE = 2 and KMED =0

1	7	8	9	19
ICASE	=	3		Drill Diameter, Spacing, and Burden Specified.
KMED	=	0		Drilling Medium is Coal.
SDDI	=			Specified Drill Diameter (inches).
S	=			Spacing (feet).
B	=			Burden (feet).
OSRHY	=			Operating Scheduled Hours (hours/year).
OPRHY	=			Operating Productive Hours (hours/year).
EDO	=			Efficiency of Drilling and Blasting (fraction).
PTF	=			Propel Time Factor (fraction).
P	=			Panel Width (feet).
DRSMFH	=			Drilling Rate in Soft Material (feet/hour).
HBMF	=			Hole Bottom Margin (feet).
CDBYY	=			Coal Demand (bank cubic yards/year).
CDRTY	=			Coal Demand in Recoverable Tons (tons/year).
HC	=			Height of Coal (feet).
DPGCC	=			Density of Primer (grams/cc).
DAGCC	=			Density of ANFO (grams/cc).
DSGCC	=			Density of Slurry (grams/cc).
PRPY	=			Powder Ratio (pounds/yard).
PDH	=			Percent Dry Holes (fraction).
PWH	=			Percent Wet Holes (fraction).
HPF	=			Height of Primer (feet).
PEBC	=			Percent Extra Blasting Caps (fraction).
#CPCDMF	=			Cost of Primer Cord (\$/100 feet).
CBCDC	=			Cost of Blasting Caps (\$/100).
#CPDP	=			Cost of Primer (\$/pound).
CADP	=			Cost of ANFO (\$/pound).
CSDP	=			Cost of Slurry (\$/pound).
PLY	=			Project Life (years).
LOGPA	=			Log Parameters (0,1).
LOGIV	=			Log Intermediate Variables (0,1).
*	=			Indicates End of Data for this Case.

#Note: One of these should be zero.

Figure 2-3. Input Data Sheet for ICASE = 3 and KMED = 0

1	7	8	9	19
ICASE	=	1		Drill Diameter, Spacing, and Burden NOT Specified.
KMED	=	1		Drilling Medium is Overburden.
OSRHY	=			Operating Scheduled Hours (hours/year).
OPRHY	=			Operating Productive Hours (hours/year).
EDO	=			Efficiency of Drilling and Blasting (fraction).
PTF	=			Propel Time Factor (fraction).
P	=			Panel Width (feet).
DRSMFH	=			Drilling Rate in Soft Material (feet/hour).
HBMF	=			Hole Bottom Margin (feet).
BDBYY	=			Overburden Demand (bank cubic yards/year).
HB	=			Height of Burden (feet).
DPGCC	=			Density of Primer (grams/cc).
DAGCC	=			Density of ANFO (grams/cc).
DSGCC	=			Density of Slurry (grams/cc).
PRPY	=			Powder Ratio (pounds/yard).
PDH	=			Percent Dry Holes (fraction).
PWH	=			Percent Wet Holes (fraction).
HPF	=			Height of Primer (feet).
PEBC	=			Percent Extra Blasting Caps (fraction).
#CPCDMF	=			Cost of Primer Cord (\$/1000 feet).
CBCDC	=			Cost of Blasting Caps (\$/100).
#CPDP	=			Cost of Primer (\$/pound).
CADP	=			Cost of ANFO (\$/pound).
CSDP	=			Cost of Slurry (\$/pound).
PLY	=			Project Life (years).
LOGPA	=			Log Parameters (0,1).
LOGIV	=			Log Intermediate Variables (0,1).
*	=			Indicates End of Data for this Case.

#Note: One of these should be zero.

Figure 2-4. Input Data Sheet for ICASE = 1 and KMED = 1

1	7	8	9	19
ICASE	=	2		Drill Diameter Specified, Spacing and Burden NOT Specified.
KMED	=	1		Drilling Medium is Overburden.
SDDI	=			Specified Drill Diameter (inches)
OSRHY	=			Operating Scheduled Hours (hours/year).
OPRHY	=			Operating Productive Hours (hours/year).
EDO	=			Efficiency of Drilling and Blasting (fraction).
PTF	=			Propel Time Factor (fraction).
P	=			Panel Width (feet).
DRSMFH	=			Drilling Rate in Soft Material (feet/hour).
HBMF	=			Hole Bottom Margin (feet).
BDBYY	=			Overburden Demand (bank cubic yards/year).
HB	=			Height of Burden (feet).
DPGCC	=			Density of Primer (grams/cc).
DAGCC	=			Density of ANFO (grams/cc).
DSGCC	=			Density of Slurry (grams/cc).
PRPY	=			Powder Ratio (pounds/yard).
PDH	=			Percent Dry Holes (fraction).
PWH	=			Percent Wet Holes (fraction).
HPF	=			Height of Primer (feet).
PEBC	=			Percent Extra Blasting Caps (fraction).
#CPCDMF	=			Cost of Primer Cord (\$/1000 feet).
CBCDC	=			Cost of Blasting Caps (\$/100).
#CPDP	=			Cost of Primer (\$/pound).
CADP	=			Cost of ANFO (\$/pound).
CSDP	=			Cost of Slurry (\$/pound).
PLY	=			Project Life (years).
LOGPA	=			Log Parameters (0,1).
LOGIV	=			Log Intermediate Variables (0,1).
*	=			Indicates End of Data for this Case.

#Note: One of these should be zero.

Figure 2-5. Input Data Sheet for ICASE = 2 and KMED =1

1	7	8	9	19
ICASE	=	3		Drill Diameter, Spacing, and Burden Specified.
KMED	=	1		Drilling Medium is Overburden.
SDDI	=			Specified Drill Diameter.
S	=			Spacing (feet).
B	=			Burden (feet).
OSRHY	=			Operating Scheduled Hours (hours/year).
OPRHY	=			Operating Productive Hours (hours/year).
EDO	=			Efficiency of Drilling and Blasting (fraction).
PTF	=			Propel Time Factor (fraction).
P	=			Panel Width (feet).
DRSMFH	=			Drilling Rate in Soft Material (feet/hour).
HBMF	=			Hole Bottom Margin (feet).
BDBYY	=			Overburden Demand (bank cubic yards/year).
HB	=			Height of Burden (feet).
DPGCC	=			Density of Primer (grams/cc).
DAGCC	=			Density of ANFO (grams/cc).
DSGCC	=			Density of Slurry (grams/cc).
PRPY	=			Powder Ratio (pounds/yard).
PDH	=			Percent Dry Holes (fraction).
PWH	=			Percent Wet Holes (fraction).
HPF	=			Height of Primer (feet).
PEBC	=			Percent Extra Blasting Caps (fraction).
#CPCDMF	=			Cost of Primer Cord (\$/1000 feet).
CBCDC	=			Cost of Blasting Caps (\$/100).
#CPDP	=			Cost of Primer (\$/100).
CADP	=			Cost of ANFO (\$/pound).
CSDP	=			Cost of Slurry (\$/pound).
PLY	=			Project Life (years).
LOGPA	=			Log Parameters (0,1).
LOGIV	=			Log Intermediate Variables (0,1).
*	=			Indicates End of Data for this Case.

#Note: One of these should be zero.

Figure 2-6. Input Data Sheet for ICASE = 3 and KMED = 1

2.2.6 Setting up the Input Data File

The first record in the input file is read by the model as the "run title" card. This record is followed by one or more sets of case-definition records. The model reads the first record in each case-definition set as the "case title" card. The case title record is followed by one or more records setting input parameters. The final record in a set of case-definition records must contain a "*", which the model reads as the termination of parameter setting.

Figures 2-7 and 2-8 list the input data files used to develop the example runs included in this manual.

Figure 2-7 contains 13 records, or cards. Record 1 is the run title card. Records 2, 10, and 13 are case title cards. Thus, the run simulates the operation on three benches. Records 3-9 set the parameters for the first bench. Any number of parameters can be set on a single record in any desired order, subject only to the restriction that a card contains 80 columns. Note that the parameter name is followed with a "=" which is followed with the desired numeric value. Each value except the last one on the card is followed with a ",". For the second and third benches, only two parameters are specified; all other parameters retain the values set for the first bench.

Figure 2-8 contains 11 records: record 1 is the run title card, and records 2 and 10 are case title cards. This input simulates two coal benches. Record 11 contains only a "*", indicating that all settings for the first bench apply to the second bench.

```

1 - 0502 (PDAB0502) POWDER RIVER BASIN
2 -      1 DRILLING AND BLASTING OVERBURDEN - LAYER 1
3 - LOGIV=1,LOGPA=1,KMED=1,ICASE=2
4 - OSRHY=3625,OPRHY=3263,EDO=1,P=300
5 - PRPY=.5,HBMF=0,PTF=1.,DRSMFH=100
6 - DPGCC=1.5,DAGCC=.8,DSGCC=1.5,PDH=.9,PWH=.1
7 - HPF=.5,CPDP=.00,CADP=.08,CSDP=.32,CDCDMF=125
8 - CBCDC=130.,PEBC=.05,SDDI=9.875,PLY=30
9 - BDBYY=4.3332E6,HB=50,*
10 -      2 DRILLING AND BLASTING OVERBURDEN - LAYER 2
11 - BDBYY=4.6059E6,HB=50,*
12 -      3 DRILLING AND BLASTING OVERBURDEN - LAYER 3
13 - BDBYY=2.2593E6,HB=23.2,*

```

Figure 2-7. Input Data File for ICASE =2 and KMED =1


```

1 - 0502 (PDBC0502) POWDER RIVER BASIN
2 -      1          DRILLING AND BLASTING COAL - LAYER 1
3 - KMED=0, ICASE=3, LOGPA=1, LOGIV=1
4 - OSRHY=3625, OPRHY=3263
5 - EDO=1, P=300, PRPY=.25, HBMF=0, PTF=1., CDRTY=3988930
6 - DRSMFH=360, DPGCC=1.5, DAGCC=.8, DSGCC=1.5, PDH=.90, PWH=.10
7 - HPF=.5, CPDP=.00, CADP=.08, CSDP=.32, CBCDC=130., CDCDMF=125.
8 - PEBC=.05, CDBYY=2035584, HC=25, SDDI=6, S=20, B=20, PLY=30
9 - *
10 -      2          DRILLING AND BLASTING COAL - LAYER 2
11 - *

```

Figure 2-8. Input Data File for ICASE = 3 and KMED = 0

SECTION 3
MODEL LOGIC

3.1 MODEL OPERATIONS

Table 1 at the end of this section provides a detailed outline of the model calculations. A general description of operations for the DAB model is as follows:

- 1) The model reads the first record in the input data file as the run title card.
- 2) The model reads the next record, in sequence, as the case title card.
- 3) The model reads all records following the case title card until it encounters a "*", i.e., until it encounters the end of parameter settings for this case. This group of records resets parameter values, as specified.
- 4) Parameter LOGPA is examined to see if the user wants the model to print out a listing of his input data values. If LOGPA = 1, the model prints the input data.
- 5) The model calculates rate of advance of the stripping operation, the required hole length, the total coal or overburden to be drilled and blasted, and the coal or overburden acres.

6) If ICASE = 1, the model proceeds as follows:

- a) The model reads a drill from the Drill Data File, and obtains its drill rate and drill diameter along with pertinent cost data.
- b) Using the drill bit diameter, the model calculates the drill hole spacing and burden. If the drilling medium is coal:

$$\text{SPACING} = \text{BURDEN} = \frac{35 \times \text{DRILL DIAMETER}}{12}$$

If the drilling medium is overburden:

$$\text{SPACING} = \text{BURDEN} = \frac{30 \times \text{DRILL DIAMETER}}{12}$$

- c) The model calculates the powder requirements and associated costs of explosives for blasting the area with the given hole diameter size.
- d) The model calculates drill requirements and ownership and operating costs, using the user's demand rate for drilling of the coal or overburden and the drill costs from the Drill Data File.
- e) After all costs associated with drilling and blasting have been calculated, the model prints the calculated data in report format.
- f) The model returns to Step a) to evaluate the next drill in the Drill Data File. Steps a) through e) are repeated for each drill in the Data File until all drills have been evaluated.

- 7) If ICASE = 2, the model operation is the same as described before, except that only those drills with the specified drill bit diameter are evaluated by the model.
- 8) If ICASE = 3, the model operates in the same manner as described in Step 6, except spacing and burden are specified by the user. Again, only drills having the specified diameter are evaluated.
- 9) The model prints a single-page summary listing of the information about each drill and its associated requirements. The combination of drill and powder requirements with the least cost is indicated by the model at the bottom of the summary page.
- 10) After the summary listing has been prepared, the model returns to Step 2 to see if the user has specified additional input data sets indicating the use of the model in a benching situation. If there are more data cards, the model repeats the operations described in Steps 1 through 9 for each set of input data.
- 11) After all input data have been processed, the model prepares a final listing of each of the least-cost solutions for each model case run. This final listing includes totals for drilling and blasting costs for all benches.

TABLE 1
DRILLING AND BLASTING SIMULATION MODEL CALCULATIONS
 (Sheet 1 of 9)

No.	Variable Name	Description	Unit	Programmed Calculations
1	RLADFY	Rate of Linear Advance of the Stripping Operation	feet/year	<i>NOTE</i> <i>The following calculations are made if the drill diameter and spacing and burden are specified by the user (ICASE = 3). The additional calculations, if these variables are not specified (ICASE = 1 or 2), are discussed following these equations.</i> If the blasting medium is coal (KMED = 0): $RLADFY = \frac{CDBYY \times 27}{HC \times P}$ If the drilling medium is overburden (KMED=1): $RLADFY = \frac{BDBYY \times 27}{HB \times P}$
				I
				I
				I
				I
				I
2	RHLF	Required Hole Length	feet	If the drilling medium is coal (KMED = 0): $RHLF = HC - HBMF$ If the drilling medium is overburden (KMED=1): $RHLF = HB - HBMF$
				I
3	ACBY	Area Coal	bank yards	If the drilling medium is coal (KMED = 0): $ACBY = CDBYY \times PLY$ If the drilling medium is overburden, this calculation is not made.

TABLE 1
DRILLING AND BLASTING SIMULATION MODEL CALCULATIONS
 (Sheet 2 of 9)

No.	Variable Name	Description	Unit	Programmed Calculations
3	PLY	Project Life	years	I
4	ABBY	Area Overburden	bank yards	If the drilling medium is coal (KMED = 0), the calculation is not made. If the drilling medium is overburden (KMED =1): ABBY = BDBYY x PLY
5	CAF	Coal Acres	acres	If the drilling medium is coal (KMED = 0): $CAF = \frac{ACBY \times 27}{HC \times 43560}$
6	BAF	Overburden Acres	acres	If the drilling medium is overburden (KMED = 1), this calculation is not made. If the drilling medium is coal (KMED = 0), this calculation is not made. If the drilling medium is overburden (KMED =1): $BAF = \frac{ABBY \times 27}{HB \times 43560}$
7	VCYFH	Volume Effected	cubic yards/ foot of hole	VCYFH = S x B / 27
	S	Drill Hole Spacing	feet	I
	B	Drill Hole Burden	feet	I
8	PEH	Explosive per Hole	pounds/hole	If the drilling medium is coal (KMED = 0): PEH = int (PRPY x HC x VCYFH + 0.9)
	PRPY	Powder Ratio	pounds/cubic yard	If the drilling medium is overburden (KMED = 1): PEH = int (PRPY x HB x VCYFH + 0.9) I

TABLE 1
DRILLING AND BLASTING SIMULATION MODEL CALCULATIONS
 (Sheet 3 of 9)

No.	Variable Name	Description	Unit	Programmed Calculations
9	VECYH	Volume Effected	cubic yards/ hole	If the drilling medium is coal (KMED = 0): VECYH = VCYFH x HC If the drilling medium is overburden (KMED = 1): VECYH = VCYFH x HB
10	NHY	Number of Holes	holes/year	If the drilling medium is coal (KMED = 0), NHY = CDBYY / VECYH If the drilling medium is overburden (KMED = 1): NHY = BDBYY / VECYH
11	WAPFH	Weight of ANFO	pounds/foot of hole	$WAPFH = \frac{\pi \times SDDI^2}{4} \times \frac{1}{144} \times DAGCC \times 62.43$
	SDDI	Specified Drill Diameter	inches	I
	DAGCC	Density of ANFO	grams/cc	I
12	WSPFH	Weight of Slurry	pounds/foot of hole	$WSPFH = \frac{\pi \times SDDI^2}{4} \times \frac{1}{144} \times DSGCC \times 62.43$
	DSGCC	Density of Slurry	grams / cc	I
13	WPPFH	Weight of Primer	pounds/foot of hole	$DPPFH = \frac{\pi \times SDDI^2}{4} \times \frac{1}{144} \times DPGCC \times 62.43$
	DPGCC	Density of Primer	grams/cc	I
14	HAF	Height of ANFO in the Hole	feet	If there are dry holes: HAF = PEH - (HPF x WPPFH) / WAPFH If no dry holes exist: HAF = 0
	HPF	Height of Primer	feet	I

TABLE 1
DRILLING AND BLASTING SIMULATION MODEL CALCULATIONS
 (Sheet 4 of 9)

No.	Variable Name	Description	Unit	Programmed Calculations
15	HSF	Height of Slurry in Hole	feet	If wet holes exist: $HSF = PEH - (HPF \times WPPFH) / WSPFH$ If there are no wet holes: $HSF = 0$
16	SHDF	Stemming Height for Dry Holes	feet	$SHDF = RHLE - HAF - HPF$
17	SHWF	Stemming Height for Wet Holes	feet	$SHWF = RHLE - HSF - HPF$
<i>Note:</i> If the user specifies a cost for detonating cord, the model assumes he intends for cast boosters and detonating cord to be used as detonators. The following calculations for detonator cost are then made.				
18	RLPCFY	Required Length of Detonating Cord	feet/year	$RLPCHY = 1.15 \times (S + RHLE) \times NHY$
19	CPCDY	Cost of Detonating Cord	\$/year	$CPCDY = CPCMDY \times (RLPCFY / 1000)$
	CPCMDY	Cost of Detonating Cord	\$/1000 feet	I
20	NBCY	Number of Cast Boosters	number/year	$NBCY = NHY \times (1 + PEBC)$
	PEBC	Percent Extra Cast Boosters	fraction	I
21	CBCDY	Cost of Cast Boosters	\$/year	$CBCDY = (NBCY / 100) \times CBCDC$
	CBCDC	Cost of Cast Boosters	\$/100	I

TABLE 1
DRILLING AND BLASTING SIMULATION MODEL CALCULATIONS
 (Sheet 5 of 9)

No.	Variable Name	Description	Unit	Programmed Calculations
<i>NOTE:</i> If the user wants the model to use electric blasting caps and primers, CPCDMF should be "0" and the following calculations are made. Otherwise, the program skips to Calculation 26..				
22	NBCY	Number of Blasting Caps	number/year	$NBCY = NHY \times (1 + PEBC)$
	PEBC	Percent Extra Blasting Caps	fraction	I
23	CBCDY	Cost of Blasting Caps	\$/year	$CBCDY = (NBCY / 100) \times CBCDC$
	CBCDC	Cost of Blasting Caps	\$/100	I
24	WPPY	Weight of Primer	pounds/year	$WPPY = NHY \times WPPFH \times HPF$
25	CPDY	Cost of Primer	\$/year	$CPDY = WPPY \times CPDP$
	CPDP	Cost of Primer	\$/pound	I
26	WAPY	Weight of ANFO	pound/year	$WAPY = PDH \times NHY \times (PEH - (HPF \times WPPFH))$
	PDH	Percent of Dry Holes	fraction	I
27	CADY	Cost of ANFO	\$/year	$CADY = WAPY \times CADP$
	CADP	Cost of ANFO	\$/pound	I
28	WSPY	Weight of Slurry	pounds/year	$WSPY = PWH \times NHY \times (PEH - (HPF \times WPPFH))$
	PWH	Percent Wet Holes	fraction	I
29	CSDY	Cost of Slurry	\$/year	$CSDY = WSPY \times CSDP$
	CSDP	Cost of Slurry	\$/pound	I

TABLE 1
DRILLING AND BLASTING SIMULATION MODEL CALCULATIONS
 (Sheet 6 of 9)

No.	Variable Name	Description	Unit	Programmed Calculations
30	APRPY	Actual Powder Ratio	pounds/cubic yard	If the drilling medium is coal (KMED = 0): $\text{APRPY} = \frac{\text{WPPY} \times \text{WAPY} \times \text{WSPY}}{\text{CDBYY}}$ If the drilling medium is overburden (KMED = 1): $\text{APRPY} = \frac{\text{WPPY} \times \text{WAPY} \times \text{WSPY}}{\text{BDBYY}}$
31	CEDY	Cost of Explosives	\$/year	If detonating cord is used: $\text{CEDY} = \text{CBCDY} + \text{CPDY} + \text{CADY} + \text{CSDY} + \text{CPCDY}$ If detonating cord is not used: $\text{CEDY} = \text{CBCDY} + \text{CPDY} + \text{CADY} + \text{CSDY}$
32	CEFH	Cost of Explosives	\$/foot of hole	$\text{CDFH} = \text{CEDY} / \text{NHY} \times \text{RHLF}$
33	CEUB	Cost of Explosives	\$/unit blasted	If the drilling medium is coal (KMED = 0): $\text{CEUB} = \text{CEDY} / \text{CDRTY}$ If the drilling medium is overburden (KMED = 1): $\text{CEUB} = \text{CEDY} / \text{BDBYY}$
	CDRTY	Coal Demand	Recovered tons/year	I
34	DRFY	Drilling Rate	feet/year	If no drilling rate in soft material is specified (DRSMFH = 0): $\text{DRFY} = \text{RDSI} \times \text{EDO} \times \text{OPRHY} \times \text{PTF}$ If DRSMFH is not equal to 0: $\text{DRFY} = \text{DRSMFH} \times \text{EDO} \times \text{OPRHY} \times \text{PTF}$
	DRSMFH	Drilling Rate in Soft Material	feet/hour	I
	RDSI	Drilling Rate	feet/hour	Drill Data File

TABLE 1
DRILLING AND BLASTING SIMULATION MODEL CALCULATIONS
 (Sheet 7 of 9)

No.	Variable Name	Description	Unit	Programmed Calculations
34	EDO	Efficiency of Drilling Operations	fraction	I
	OPRHY	Productive Operating Hours	hours/year	I
	PTF	Propel Time Factor	fraction	I
35	PCYY	Production Rate	cubic yards/year	If the drilling medium is coal (KMED = 0): $PCYY = DRFY \times \frac{HC}{RHLF} \times VCYFH$ If the drilling medium is overburden (KMED =1): $PCYY = DRFY \times \frac{HB}{RHLF} \times VCYFH$
36	NDR	Number of Drills Required		If the drilling medium is coal (KMED = 0): $NDR = (CDBYY / PCYY) + 0.9$ If the drilling medium is overburden (KMED =1): $NDR = (BDBYY / PCYY) + 0.9$
37	DLF	Drilling Length	feet	DLF = RDSD x RDSE
	RDSD	Number of Drilling Pipes		Drill Data File
	RDSE	Length of Drill Pipes	feet	Drill Data File
38	OWNDY	Ownership Cost	\$/year	OWNDY = NDR x OSRHY x RDCP
	OSRHY	Scheduled Operating Hours	hours/year	I
	RDCP	Ownership Cost	\$/hour	Drill Data File
39	OPNDY	Operating Cost	\$/year	OPNDY = NDR x OPRHY x RDCN
	RDCN	Operating Cost	\$/hour	DRILL DATA FILE

TABLE 1

DRILLING AND BLASTING SIMULATION MODEL CALCULATIONS

(Sheet 8 of 9)

No.	Variable Name	Description	Unit	Programmed Calculations
40	OAODY	Ownership and Operating Cost	\$/year	$OAODY = OWNDY + OPNDY$
41	CDFH	Cost of Drilling	\$/foot of hole	$CDFH = OAODY / (NHY \times RHLF)$
42	CDUD	Cost of Drilling	\$/unit drilled	If drilling medium is coal (KMED = 0): $CDUD = OAODY / CDRTY$ If drilling medium is overburden (KMED = 1): $CDUD = OAODY / BDBYY$
43	CDY	Cost of Drilling and Blasting	\$/year	$CDY = CEDY + OAODY$
44	CCDFH	Cost of Drilling and Blasting	\$/foot of hole	$CCDFH = CDFH + CEFH$
45	CCDUB	Cost of Drilling and Blasting	\$/unit drilled and blasted	$CCDUB = CDUB + CDUD$
NOTE When the drill diameter is specified by the user (ICASE = 2 or 3), only the drills with the specified drill diameter in the drill Data File are considered. If ICASE = 2, the spacing and burden are not specified. They are calculated in the following manner:				
	S	Spacing	feet	If the drilling medium is coal (KMED = 0): $S = (35 \times SDDI) / 12$ If the drilling medium is overburden (KMED = 1): $S = (30 \times SDDI) / 12$
	B	Burden	feet	$B = S$

TABLE 1

DRILLING AND BLASTING SIMULATION MODEL CALCULATIONS

(Sheet 9 of 9)

No.	Variable Name	Description	Unit	Programmed Calculations
		<i>NOTE:</i> <i>This method of calculating spacing and burden is taken from "The Design of Blasting Rounds", Section 7.3 of SURFACE MINING, by Richard L. Ashl.</i> <i>If ICASE = 1, neither the drill diameter nor spacing and burden are specified by the user. The simulation examines the Drill Data File, using the given drill diameter in the files as SDDI, and calculates the spacing and burden as discussed above.</i> <i>After establishing the drill diameter and spacing and burden for ICASE = 1 or 2, the previous calculations are made for each rotary drill applicable.</i>		

SECTION 4
MODEL OUTPUT

4.1 SAMPLE OUTPUT

Figures 4-1 and 4-2 are sample output from the DAB model. Figure 4-1 is the output from a DAB run where the drilling medium was overburden (KMED = 1). In this example, ICASE = 2 and the drill diameter was specified by the user. Also, the area to be drilled and blasted consisted of three benches: two with 50 feet of overburden, and one with 23.2 feet. The following paragraphs describe the sample run.

Page 1 of Figure 4-1 is a listing of the user input data. This page of output is controlled by variable LOGPA. If LOGPA = 0, this page would not appear in the simulation output. Note that the page begins with the user's run title and case number. This appears at the top of each page of the printout. For each input variable, the variable name, value, and description appears. If ICASE = 1, input variable SDDI would not be printed on this page. If ICASE = 3, parameters S and B would appear in addition to those in the sample.

Page 2 of the Figure 4-1 lists all intermediate variables calculated by the simulation. This page of output is controlled by parameter LOGIV. If LOGIV = 0, this page would not be printed by the model. If ICASE = 1, all variables about powder requirements would be recalculated for each drill diameter. The variables on Page 2 would consist of only those which could be calculated for all drill diameters. If ICASE = 3, there would be no change in the appearance of Page 2 except that parameters S and B would appear in the input listing instead of the intermediate variable listing. Table 2 is a

detail description of the output on Page 3. The circled numbers correspond to the line numbers in the Table.

Page 4 of Figure 4-1 is a summary listing of each drill appearing on Page 3/line 3, preceded by the Drill Data File sequence number and model number. The least-cost solution is indicated after the drill listing.

Pages 5-8 of Figure 4-1 are the output from the DAB model for the second overburden bench. Page 5 corresponds to Page 1, and so on. Pages 9-12 are the results for the third overburden bench.

Page 13 of Figure 4-1 is the summary listing of the selected drill and powder requirements for the total area (all three benches). Totals of each of the cost columns are provided.

Figure 4-2 is a sample run where $KMED = 0$, i.e., drilling and blasting of coal. In this sample, two coal benches were input to the model. The output is similar to the overburden run, except that coal-related data appear in place of overburden data. The pages of the sample runs correspond to each other. The input data listing is printed first, followed by the intermediate variable listing, the drill evaluation, and the summary listing of the evaluated drills. The final page of Figure 4-2 is the summary of the selected drills and powder requirements, and the cost totals for all benches.

DRILLING AND BLASTING SIMULATION
INPUT PARAMETERS

06/22/76

0502 (PDAB0502) POWDER RIVER BASIN

1 DRILLING AND BLASTING OVERBURDEN - LAYER 1

KMED	1.	MEDIUM FOR DRILLING, 0=COAL 1=0.B.
ICASE	2.	ICASE = 1, NO S,B,SDDI SPECIFIED
		ICASE = 2, SDDI SPECIFIED
		ICASE = 3, S,B, AND SDDI SPECIFIED
BSRHY	3625.00	SCHEDULED OPERATING HOURS PER YEAR
BPRHY	3263.00	PRODUCTIVE OPERATING HOURS PER YEAR
ED0	1.000	EFFICIENCY OF DRILLING OPERATIONS - FRACTION
PTF	1.00	PROPEL TIME FACTOR - FRACTION
P	300.00	PANEL WIDTH - FEET
HBMF	.00	HOLE BOTTOM MARGIN - FEET
DPGCC	.00	DENSITY OF PRIMER - GRAM / CC
DAGCC	.80	DENSITY OF ANFO - GRAM / CC
DSGCC	1.50	DENSITY OF SLURRY - GRAM / CC
PRPY	.50	POWDER RATIO - LBS. / YARD
PDH	.90	PERCENTAGE DRY HOLES
PWH	.10	PERCENTAGE WET HOLES
HPF	.00	HEIGHT OF PRIMER - FEET
PEBC	.05	% EX. BLASTING CAPS/CAST BOOSTERS
CBCDC	130.00	COST OF BLASTING CAPS/CAST BOOSTERS - \$/100
CPCDMF	125.00	COST OF PRIMER CORD - \$ / M FT
CPDP	.00	COST OF PRIMER - \$ / LB.
CADP	.08	COST OF ANFO - \$ / LB.
CSDP	.32	COST OF SLURRY - \$ / LB.
PLY	30.00	PROJECT LIFE - YEARS
DRSMFH	100.	DRILLING RATE IN SOFT MAT'L - FT./HR.
BDBYY	.4333E 07	BURDEN DEMAND - BANK YDS/YR
HB	50.00	HEIGHT OF BURDEN - FEET
SDDI	9.875	SPECIFIED DRILL DIAMETER - INCHES

Figure 4-1. Sample DAB Model Output for Overburden Drilling and Blasting
(Sheet 1 of 13)

DRILLING AND BLASTING SIMULATION
INTERMEDIATE VARIABLES

06/22/76

0502 (PDAB0502) POWDER RIVER BASIN
1 DRILLING AND BLASTING OVERBURDEN - LAYER 1

S	25.00	SPACING - FT.
B	25.00	BURDEN - FT.
BAF	1611.52	BURDEN ACRE FEET
ABBY	•13000E 09	AREA BURDEN - BANK YDS
RLADFY	7799.76	RATE OF LINEAR ADVANCE - FT. / YR.
RHLF	50.00	REQUIRED HOLE LENGTH - FT.
VCIFYH	23.15	VOLUME EFFECTED - CU. YD. / FOOT OF HOLE
PEH	579.00	POUNDS OF EXPLOSIVE PER HOLE
VECYH	1157.41	VOLUME EFFECTED - CU. YD. / HOLE
NHY	3743.00	NUMBER OF HOLES PER YEAR
WAPFH	26.56	WEIGHT OF ANFO - LBS. / FT. OF HOLE
WSPFH	49.81	WEIGHT OF SLURRY - LBS. / FT. OF HOLE
WPPFH	.00	WEIGHT OF PRIMER - LBS. / FT. OF HOLE
HAF	21.80	HEIGHT OF ANFO IN HOLE - FT.
HSF	11.62	HEIGHT OF SLURRY IN HOLE - FT.
SHDF	28.20	STEMMING HEIGHT FOR DRY HOLES - FT.
SHWF	38.38	STEMMING HEIGHT FOR WET HOLES - FT.
RLPCFY	322833.62	REQUIRED LENGTH OF PRIMER CORD - FT / YR
CPCDY	40354.18	COST OF PRIMER CORD - \$ / YR.
NBCY	786.00	NO. OF BLASTING CAPS/CAST BOOSTERS / YEAR
CBCDY	1021.80	COST OF BLASTING CAPS/CAST BOOSTERS - \$/YR
WPPY	.00	WEIGHT OF PRIMER - LBS. / YR.
CPDY	.00	COST OF PRIMER - \$ / YR.
WAPY	1950477.00	WEIGHT OF ANFO - LBS. / YR.
CADY	156038.12	COST OF ANFO - \$ / YR.
WSPY	216719.75	WEIGHT OF SLURRY - LBS. / YR.
CSDY	69350.31	COST OF SLURRY - \$ / YR.
APRPY	.50	ACTUAL POWDER RATIO - LBS. / CU. YD.
CEDY	266764.31	COST OF EXPLOSIVES - \$ / YR.
CEFH	1.43	COST OF EXPLOSIVES - \$ / FT. OF HOLE
CEVB	.06	COST OF EXPLOSIVES - \$ / UNIT BLASTED

Figure 4-1. Sample DAB Model Output for Overburden Drilling and Blasting
(Sheet 2 of 13)

DRILLING AND BLASTING SIMULATION
CALCULATED RESULTS

06/22/76

0502 (PDAB0502) POWDER RIVER BASIN
1 DRILLING AND BLASTING OVERBURDEN - LAYER 1

(1)		FT PC	PC\$/YR	BC-NB	BC\$/YR	PRM-LBS	PRM\$/YR	ANFO-LBS	ANFO\$/YR	SLRY-LBS	SLRY\$/YR		
		322834.	40354.	786.	1022.	0.	0.	1950477.	156038.	216720.	69350.		
(2)		ID	DIAMETER	RATE	LENGTH	DRFY	NDR						
B 45R ER8		9.875	100.	165.	326300.	.574							
(3)		M\$BWN	M\$BPN	M\$B&B	\$/FT	\$/UNIT	M\$/YR	\$/FT	\$/UNIT	CM\$/YR	C\$/FT	C\$/UNIT	C\$/AFT
		46.40	75.00	121.40	.65	.028	266.76	1.43	.062	388.17	2.07	.090	7226.14
		ID	DIAMETER	RATE	LENGTH	DRFY	NDR						
B 60R-3ER3		9.875	100.	195.	326300.	.574							
		M\$BWN	M\$BPN	M\$B&B	\$/FT	\$/UNIT	M\$/YR	\$/FT	\$/UNIT	CM\$/YR	C\$/FT	C\$/UNIT	C\$/AFT
		61.85	91.27	153.12	.82	.035	266.76	1.43	.062	419.88	2.24	.097	7816.54

Figure 4-1. Sample DAB Model Output for Overburden Drilling and Blasting
(Sheet 3 of 13)

DRILLING AND BLASTING SIMULATION
CALCULATED RESULTS

06/22/76

0502 (PDAB0502) POWDER RIVER BASIN
1 DRILLING AND BLASTING OVERBURDEN - LAYER 1

	NDR	M\$BWN	M\$BPN	M\$BEO	\$/FT	\$/UNIT	M\$/YR	\$/FT	\$/UNIT	CM\$/YR	C\$/FT	C\$/UNIT	C\$/AFT
9 B 45R ER8	.574	46.40	75.00	121.40	.65	.028	266.76	1.43	.062	388.17	2.07	.090	7226.14
12 B 60R-3ER3	.574	61.85	91.27	153.12	.82	.035	266.76	1.43	.062	419.88	2.24	.097	7816.54

LEAST COST MACHINE - 9

Figure 4-1. Sample DAB Model Output for Overburden Drilling and Blasting
(Sheet 4 of 13)

DRILLING AND BLASTING SIMULATION
INPUT PARAMETERS

06/22/76

0502	(PDAB0502)	POWDER RIVER BASIN
2		DRILLING AND BLASTING OVERBURDEN - LAYER 2
KMED	1.	MEDIUM FOR DRILLING, 0=COAL 1=0.B.
ICASE	2.	ICASE = 1, NO S,B,SDDI SPECIFIED
		ICASE = 2, SDDI SPECIFIED
		ICASE = 3, S,B, AND SDDI SPECIFIED
BSRHY	3625.00	SCHEDULED OPERATING HOURS PER YEAR
OPRHY	3263.00	PRODUCTIVE OPERATING HOURS PER YEAR
EDB	1.000	EFFICIENCY OF DRILLING OPERATIONS - FRACTION
PTF	1.00	PROPUL TIME FACTOR - FRACTION
P	300.00	PANEL WIDTH - FEET
HBMF	.00	HOLE BOTTOM MARGIN - FEET
DPGCC	.00	DENSITY OF PRIMER - GRAM / CC
DAGCC	.80	DENSITY OF ANFO - GRAM / CC
DSGCC	1.50	DENSITY OF SLURRY - GRAM / CC
PRPY	.50	POWDER RATIO - LBS. / YARD
PDH	.90	PERCENTAGE DRY HOLES
PWH	.10	PERCENTAGE WET HOLES
HPF	.00	HEIGHT OF PRIMER - FEET
PEBC	.05	% EX. BLASTING CAPS/CAST BOOSTERS
CBQDC	130.00	COST OF BLASTING CAPS/CAST BOOSTERS - \$/100
CPCDMF	125.00	COST OF PRIMER CORD - \$ / M FT
CPDP	.00	COST OF PRIMER - \$ / LB.
CADP	.08	COST OF ANFO - \$ / LB.
CSDP	.32	COST OF SLURRY - \$ / LB.
PLY	30.00	PROJECT LIFE - YEARS
DRSMFH	100.	DRILLING RATE IN SOFT MAT'L - FT./HR.
BDBYY	.4606E 07	BURDEN DEMAND - BANK YDS/YR
HB	50.00	HEIGHT OF BURDEN - FEET
SDDI	9.875	SPECIFIED DRILL DIAMETER - INCHES

Figure 4-1. Sample DAB Model Output for Overburden Drilling and Blasting
(Sheet 5 of 13)

DRILLING AND BLASTING SIMULATION
INTERMEDIATE VARIABLES

06/22/76

0502	(PDAB0502)	POWDER RIVER BASIN
2		DRILLING AND BLASTING OVERBURDEN - LAYER 2
S	25.00	SPACING - FT.
B	25.00	BURDEN - FT.
BAF	1712.94	BURDEN ACRE FEET
ABBY	•13818E 09	AREA BURDEN - BANK YDS
RLADFY	8290.62	RATE OF LINEAR ADVANCE - FT. / YR.
RHLF	50.00	REQUIRED HOLE LENGTH - FT.
VCIFYH	23.15	VOLUME EFFECTED - CU. YD. / FOOT OF HOLE
PEH	579.00	POUNDS OF EXPLOSIVE PER HOLE
VECYH	1157.41	VOLUME EFFECTED - CU. YD. / HOLE
NHY	3979.00	NUMBER OF HOLES PER YEAR
WAPFH	26.56	WEIGHT OF ANFO - LBS. / FT. OF HOLE
WSPFH	49.81	WEIGHT OF SLURRY - LBS. / FT. OF HOLE
WPPFH	.00	WEIGHT OF PRIMER - LBS. / FT. OF HOLE
HAF	21.80	HEIGHT OF ANFO IN HOLE - FT.
HSF	11.62	HEIGHT OF SLURRY IN HOLE - FT.
SHDF	28.20	STEMMING HEIGHT FOR DRY HOLES - FT.
SHWF	38.38	STEMMING HEIGHT FOR WET HOLES - FT.
RLPCFY	343188.62	REQUIRED LENGTH OF PRIMER CORD - FT / YR
CPCDY	42898.56	COST OF PRIMER CORD - \$ / YR.
NBCY	835.00	NO. OF BLASTING CAPS/CAST BOOSTERS / YEAR
CBCDY	1085.50	COST OF BLASTING CAPS/CAST BOOSTERS - \$/YR
WPPY	.00	WEIGHT OF PRIMER - LBS. / YR.
CPDY	.00	COST OF PRIMER - \$ / YR.
WAPY	2073456.00	WEIGHT OF ANFO - LBS. / YR.
CADY	165876.44	COST OF ANFO - \$ / YR.
WSPY	230384.12	WEIGHT OF SLURRY - LBS. / YR.
CSDY	73722.87	COST OF SLURRY - \$ / YR.
APRPY	.50	ACTUAL POWDER RATIO - LBS. / CU. YD.
CEDY	283583.25	COST OF EXPLOSIVES - \$ / YR.
CEFH	1.43	COST OF EXPLOSIVES - \$ / FT. OF HOLE
CEUB	.06	COST OF EXPLOSIVES - \$ / UNIT BLASTED

Figure 4-1. Sample DAB of Model Output for Overburden Drilling and Blasting
(Sheet 6 of 13)

DRILLING AND BLASTING SIMULATION
CALCULATED RESULTS

06/22/76

0502 (PDAB0502) POWDER RIVER BASIN
2 DRILLING AND BLASTING OVERBURDEN - LAYER 2

		FT PC	PC\$/YR	BC-NB	BC\$/YR	PRM=LBS	PRM\$/YR	ANF0=LBS	ANF0\$/YR	SLRY=LBS	SLRY\$/YR			
		343189.	42899.	835.	1085.	0.	0.	2073456.	165876.	230384.	73723.			
ID	DIAMETER	RATE	LENGTH	DRFY	NDR									
B 45R ER8	9.875	100.	165.	326300.	.610									
	M\$0WN	M\$0PN	M\$000	\$/FT	\$/UNIT	M\$/YR	\$/FT	\$/UNIT	CM\$/YR	C\$/FT	C\$/UNIT	C\$/AFT		
	49.33	79.72	129.05	.65	.028	283.58	1.43	.062	412.63	2.07	.090	7226.68		
ID	DIAMETER	RATE	LENGTH	DRFY	NDR									
B 60R-3ER3	9.875	100.	195.	326300.	.610									
	M\$0WN	M\$0PN	M\$000	\$/FT	\$/UNIT	M\$/YR	\$/FT	\$/UNIT	CM\$/YR	C\$/FT	C\$/UNIT	C\$/AFT		
	65.75	97.01	162.76	.82	.035	283.58	1.43	.062	446.34	2.24	.097	7817.07		

Figure 4-1. Sample DAB Model Output for Overburden Drilling and Blasting
(Sheet 7 of 13)

DRILLING AND BLASTING SIMULATION
CALCULATED RESULTS

06/22/76

0502 (PDAB0502) POWDER RIVER BASIN
2 DRILLING AND BLASTING OVERBURDEN - LAYER 2

	NDR	M\$BWN	M\$BPN	M\$B&B	\$/FT	\$/UNIT	M\$/YR	\$/FT	\$/UNIT	CM\$/YR	C\$/FT	C\$/UNIT	C\$/AFT
9 B 45R ER8	.610	49.33	79.72	129.05	.65	.028	283.58	1.43	.062	412.63	2.07	.090	7226.68
12 B 60R-3ER3	.610	65.75	97.01	162.76	.82	.035	283.58	1.43	.062	446.34	2.24	.097	7817.07

LEAST COST MACHINE = 9

Figure 4-1. Sample DAB Model Output for Overburden Drilling and Blasting
(Sheet 8 of 13)

DRILLING AND BLASTING SIMULATION
INPUT PARAMETERS

06/22/76

0502	(PDAB0502)	POWDER RIVER BASIN
3		DRILLING AND BLASTING OVERBURDEN - LAYER 3
KMED	1.	MEDIUM FOR DRILLING, 0=COAL 1=0.B.
ICASE	2.	ICASE = 1, NO S,B,SDDI SPECIFIED
		ICASE = 2, SDDI SPECIFIED
		ICASE = 3, S,B, AND SDDI SPECIFIED
0SRHY	3625.00	SCHEDULED OPERATING HOURS PER YEAR
0PRHY	3263.00	PRODUCTIVE OPERATING HOURS PER YEAR
ED0	1.000	EFFICIENCY OF DRILLING OPERATIONS - FRACTION
PTF	1.00	PROPEL TIME FACTOR - FRACTION
P	300.00	PANEL WIDTH - FEET
HBMF	.00	HOLE BOTTOM MARGIN - FEET
DPGCC	.00	DENSITY OF PRIMER - GRAM / CC
DAGCC	.80	DENSITY OF ANFO - GRAM / CC
DSGCC	1.50	DENSITY OF SLURRY - GRAM / CC
PRPY	.50	POWDER RATIO - LBS. / YARD
PDH	.90	PERCENTAGE DRY HOLES
PWH	.10	PERCENTAGE WET HOLES
HPF	.00	HEIGHT OF PRIMER - FEET
PEBC	.05	% EX. BLASTING CAPS/CAST BOOSTERS
CBDC	130.00	COST OF BLASTING CAPS/CAST BOOSTERS - \$/100
CPCDMF	125.00	COST OF PRIMER CORD - \$ / M FT
CPDP	.00	COST OF PRIMER - \$ / LB.
CADP	.08	COST OF ANFO - \$ / LB.
CSDP	.32	COST OF SLURRY - \$ / LB.
PLY	30.00	PROJECT LIFE - YEARS
DRSMFH	100.	DRILLING RATE IN SOFT MAT'L - FT./HR.
BDBY	.2259E 07	BURDEN DEMAND - BANK YDS/YR
HB	23.20	HEIGHT OF BURDEN - FEET
SDDI	9.875	SPECIFIED DRILL DIAMETER - INCHES

Figure 4-1. Sample DAB Model Output for Overburden Drilling and Blasting
(Sheet 9 of 13)

DRILLING AND BLASTING SIMULATION
INTERMEDIATE VARIABLES

06/22/76

0502 (PDAB0502) POWDER RIVER BASIN
3 DRILLING AND BLASTING OVERBURDEN - LAYER 3

S	25.00	SPACING - FT.
B	25.00	BURDEN - FT.
BAF	1810.85	BURDEN ACRE FEET
ABBY	.67779E 08	AREA BURDEN - BANK YDS
RLADFY	8764.53	RATE OF LINEAR ADVANCE - FT. / YR.
RHLF	23.20	REQUIRED HOLE LENGTH - FT.
VCFYH	23.15	VOLUME EFFECTED - CU. YD. / FOOT OF HOLE
PEH	269.00	POUNDS OF EXPLOSIVE PER HOLE
VECYH	537.04	VOLUME EFFECTED - CU. YD. / HOLE
NHY	4206.00	NUMBER OF HOLES PER YEAR
WAPFH	26.56	WEIGHT OF ANFO - LBS. / FT. OF HOLE
WSPFH	49.81	WEIGHT OF SLURRY - LBS. / FT. OF HOLE
WPPFH	.00	WEIGHT OF PRIMER - LBS. / FT. OF HOLE
HAF	10.13	HEIGHT OF ANFO IN HOLE - FT.
HSF	5.40	HEIGHT OF SLURRY IN HOLE - FT.
SHDF	13.07	STEMMING HEIGHT FOR DRY HOLES - FT.
SHWF	17.80	STEMMING HEIGHT FOR WET HOLES - FT.
RLPCFY	233138.37	REQUIRED LENGTH OF PRIMER CORD - FT / YR
CPCDY	29142.29	COST OF PRIMER CORD - \$ / YR.
NBCY	883.00	NO. OF BLASTING CAPS/CAST BOOSTERS / YEAR
CBCDY	1147.90	COST OF BLASTING CAPS/CAST BOOSTERS - \$/YR
WPPY	.00	WEIGHT OF PRIMER - LBS. / YR.
CPDY	.00	COST OF PRIMER - \$ / YR.
WAPY	1018272.56	WEIGHT OF ANFO - LBS. / YR.
CADY	81461.75	COST OF ANFO - \$ / YR.
WSPY	113141.37	WEIGHT OF SLURRY - LBS. / YR.
CSDY	36205.24	COST OF SLURRY - \$ / YR.
APRPY	.50	ACTUAL POWDER RATIO - LBS. / CU. YD.
CEDY	147957.06	COST OF EXPLOSIVES - \$ / YR.
CEFH	1.52	COST OF EXPLOSIVES - \$ / FT. OF HOLE
CEUB	.07	COST OF EXPLOSIVES - \$ / UNIT BLASTED

Figure 4-1. Sample DAB Model Output for Overburden Drilling and Blasting
(Sheet 10 of 13)

DRILLING AND BLASTING SIMULATION
CALCULATED RESULTS

06/22/76

0502 (PDAB0502) POWDER RIVER BASIN

3

DRILLING AND BLASTING OVERBURDEN - LAYER 3

		FT PC	PC\$/YR	BC-NB	BC\$/YR	PRM-LBS	PRM\$/YR	ANF0-LBS	ANF0\$/YR	SLRY-LBS	SLRY\$/YR			
		233138.	29142.	883.	1148.	0.	0.	1018273.	81462.	113141.	36205.			
ID		DIAMETER		RATE	LENGTH	DRFY	NDR							
B 45R	ER8	9.875		100.	165.	326300.	.299							
		M\$0WN	M\$9PN	M\$000	\$/FT	\$/UNIT	M\$/YR	\$/FT	\$/UNIT	CM\$/YR	C\$/FT	C\$/UNIT	C\$/AFT	
		24.20	39.10	63.30	.65	.028	147.96	1.52	.065	211.26	2.16	.094	3499.84	
ID		DIAMETER		RATE	LENGTH	DRFY	NDR							
B 60R-3ER3		9.875		100.	195.	326300.	.299							
		M\$0WN	M\$0PN	M\$000	\$/FT	\$/UNIT	M\$/YR	\$/FT	\$/UNIT	CM\$/YR	C\$/FT	C\$/UNIT	C\$/AFT	
		32.25	47.59	79.84	.82	.035	147.96	1.52	.065	227.79	2.33	.101	3773.79	

Figure 4-1. Sample DAB Model Output for Overburden Drilling and Blasting
(Sheet 11 of 13)

DRILLING AND BLASTING SIMULATION
CALCULATED RESULTS

06/22/76

0502 (PDAB0502) POWDER RIVER BASIN
3 DRILLING AND BLASTING OVERBURDEN - LAYER 3

	NDR	M\$BWN	M\$BPN	M\$BDB	\$/FT	\$/UNIT	M\$/YR	\$/FT	\$/UNIT	CM\$/YR	C\$/FT	C\$/UNIT	C\$/AFT
9 B 45R ER8	.299	24.20	39.10	63.30	.65	.028	147.96	1.52	.065	211.26	2.16	.094	3499.84
12 B 60R-3ER3	.299	32.25	47.59	79.84	.82	.035	147.96	1.52	.065	227.79	2.33	.101	3773.79

LEAST COST MACHINE • 9

Figure 4-1. Sample DAB Model Output for Overburden Drilling and Blasting
(Sheet 12 of 13)

DRILLING AND BLASTING SIMULATION
SUMMARY OF SELECTED MACHINES

06/22/76

0502 (PDAB0502) POWDER RIVER BASIN
DRILLING AND BLASTING OVERBURDEN - LAYER 3

	NDR	M*BN	M*BN	M*BA	\$/FT	\$/UNIT	M\$/YR	\$/FT	\$/UNIT	CM\$/YR	C\$/FT	C\$/UNIT	C\$/AFT
9 B 45R ER8	.574	46.40	75.00	121.40	.65	.028	266.76	1.43	.062	388.17	2.07	.090	7226.14
9 B 45R ER8	.610	49.33	79.72	129.05	.65	.028	283.50	1.43	.062	412.63	2.07	.090	7226.68
9 B 45R ER8	.299	24.20	39.10	63.30	.65	.028	147.96	1.52	.065	211.26	2.16	.094	3499.84
	1.483	119.93	193.82	313.75	1.95	.084	698.30	4.38	.189	1012.06	6.30	.274	17952.66

STOP 0

Figure 4-1. Sample DAB Model Output for Overburden Drilling and Blasting
(Sheet 13 of 13)

DRILLING AND BLASTING SIMULATION
INPUT PARAMETERS

06/22/76

0502 (PDBC0502) POWDER RIVER BASIN
1 DRILLING AND BLASTING COAL - LAYER 1

KMED	0.	MEDIUM FOR DRILLING, 0=COAL 1=0.B.
ICASE	3.	ICASE = 1, NO S,B,SDDI SPECIFIED ICASE = 2, SDDI SPECIFIED ICASE = 3, S,B, AND SDDI SPECIFIED
0SRHY	3625.00	SCHEDULED OPERATING HOURS PER YEAR
0PRHY	3263.00	PRODUCTIVE OPERATING HOURS PER YEAR
ED0	1.000	EFFICIENCY OF DRILLING OPERATIONS - FRACTION
PTF	1.00	PROPEL TIME FACTOR - FRACTION
P	300.00	PANEL WIDTH - FEET
HBMF	.00	HOLE BOTTOM MARGIN - FEET
DPGCC	.00	DENSITY OF PRIMER - GRAM / CC
DAGCC	.80	DENSITY OF ANFO - GRAM / CC
DSGCC	1.50	DENSITY OF SLURRY - GRAM / CC
PRPY	.25	POWDER RATIO - LBS. / YARD
PDH	.90	PERCENTAGE DRY HOLES
PWH	.10	PERCENTAGE WET HOLES
HPF	.00	HEIGHT OF PRIMER - FEET
PEBC	.05	% EX. BLASTING CAPS/CAST BOOSTERS
CBCDC	130.00	COST OF BLASTING CAPS/CAST BOOSTERS - \$/100
CPDMF	125.00	COST OF PRIMER CORD - \$ / M FT
CPDP	.00	COST OF PRIMER - \$ / LB.
CADP	.08	COST OF ANFO - \$ / LB.
CSDP	.32	COST OF SLURRY - \$ / LB.
PLY	30.00	PROJECT LIFE - YEARS
DRSMFH	360.	DRILLING RATE IN SOFT MAT'L - FT./HR.
CORTY	3988930.	COAL DEMAND - TONS/YEAR
CDBYY	.2036E 07	COAL DEMAND - BANK YDS/YR
HC	25.00	HEIGHT OF COAL - FEET
SDDI	6.000	SPECIFIED DRILL DIAMETER - INCHES
S	20.00	SPACING - FEET
B	20.00	BURDEN - FEET

Figure 4-2. Sample DAB Model Output for Coal Drilling and Blasting
(Sheet 1 of 9)

DRILLING AND BLASTING SIMULATION
INTERMEDIATE VARIABLES

06/22/76

0502 (PDBC0502) POWDER RIVER BASIN
1 DRILLING AND BLASTING COAL - LAYER 1

CAF	1514.07	COAL ACRE FEET
ACBY	•61068E 08	AREA COAL - BANK YDS
RLADFY	7328.10	RATE OF LINEAR ADVANCE - FT. / YR.
RHLF	25.00	REQUIRED HOLE LENGTH - FT.
VCFYH	14.81	VOLUME EFFECTED - CU. YD. / FOOT OF HOLE
PEH	93.00	POUNDS OF EXPLOSIVE PER HOLE
VECYH	370.37	VOLUME EFFECTED - CU. YD. / HOLE
NHY	5496.00	NUMBER OF HOLES PER YEAR
WAPFH	9.81	WEIGHT OF ANFO - LBS. / FT. OF HOLE
WSPFH	18.39	WEIGHT OF SLURRY - LBS. / FT. OF HOLE
WPPFH	.00	WEIGHT OF PRIMER - LBS. / FT. OF HOLE
HAF	9.48	HEIGHT OF ANFO IN HOLE - FT.
HSF	5.06	HEIGHT OF SLURRY IN HOLE - FT.
SHDF	15.52	STEMMING HEIGHT FOR DRY HOLES - FT.
SHWF	19.94	STEMMING HEIGHT FOR WET HOLES - FT.
RLPCFY	284417.87	REQUIRED LENGTH OF PRIMER CORD - FT / YR
CPCDY	35552.21	COST OF PRIMER CORD - \$ / YR.
NBCY	1154.00	NO. OF BLASTING CAPS/CAST BOOSTERS / YEAR
CBCDY	1500.20	COST OF BLASTING CAPS/CAST BOOSTERS - \$/YR
WPPY	.00	WEIGHT OF PRIMER - LBS. / YR.
CPDY	.00	COST OF PRIMER - \$ / YR.
WAPY	460015.19	WEIGHT OF ANFO - LBS. / YR.
CADY	36801.21	COST OF ANFO - \$ / YR.
WSPY	51112.81	WEIGHT OF SLURRY - LBS. / YR.
CSDY	16356.10	COST OF SLURRY - \$ / YR.
APRPY	.25	ACTUAL POWDER RATIO - LBS. / CU. YD.
CEDY	90209.69	COST OF EXPLOSIVES - \$ / YR.
CEFH	.66	COST OF EXPLOSIVES - \$ / FT. OF HOLE
CEUB	.02	COST OF EXPLOSIVES - \$ / UNIT BLASTED

Figuer 4-2. Sample DAB Model Output for Coal Drilling and Blasting
(Sheet 2 of 9)

DRILLING AND BLASTING SIMULATION
CALCULATED RESULTS

06/22/76

0502 (PDBCO502) POWDER RIVER BASIN
1 DRILLING AND BLASTING COAL - LAYER 1

FT PC	PC\$/YR	BC-NB	BC\$/YR	PRM-LBS	PRM\$/YR	ANF0-LBS	ANF0\$/YR	SLRY-LBS	SLRY\$/YR		
284418.	35552.	1154.	1500.	0.	0.	460015.	36801.	51113.	16356.		
ID	DIAMETER	RATE	LENGTH	DRFY	NDR						
CD 6-35	6.000	360.	35.	1174680.	.117						
M\$OWN	M\$OPN	M\$O&O	\$/FT	\$/UNIT	M\$/YR	\$/FT	\$/UNIT	CM\$/YR	C\$/FT	C\$/UNIT	C\$/AFT
2.38	6.91	9.29	.07	.002	90.21	.66	.023	99.50	.72	.025	1971.59

Figure 4-2. Sample DAB Model Output for Coal Drilling and Blasting
(Sheet 3 of 9)

DRILLING AND BLASTING SIMULATION
CALCULATED RESULTS

06/22/76

0502 (PD8C0502) POWDER RIVER BASIN
1 DRILLING AND BLASTING COAL - LAYER 1

24 CD 6-35	NDR •117	M\$CWN 2•38	M\$OPN 6•91	M\$OEO 9•29	\$/FT •07	\$/UNIT •002	M\$/YR 90•21	\$/FT •66	\$/UNIT •023	CM\$/YR 99•50	C\$/FT •72	C\$/UNIT •025	C\$/AFT 1971•59

LEAST COST MACHINE • 24

Figure 4-2. Sample DAB Model Output for Coal Drilling and Blasting
(Sheet 4 of 9)

DRILLING AND BLASTING SIMULATION
INPUT PARAMETERS

06/22/76

0502 (PCBC0502) POWDER RIVER BASIN
2 DRILLING AND BLASTING COAL - LAYER 2

KMED	0.	MEDIUM FOR DRILLING, 0=COAL 1=O.B.
ICASE	3.	ICASE = 1, NO S,B,SDDI SPECIFIED ICASE = 2, SDDI SPECIFIED ICASE = 3, S,B, AND SDDI SPECIFIED
BSRHY	3625.00	SCHEDULED OPERATING HOURS PER YEAR
BPRHY	3263.00	PRODUCTIVE OPERATING HOURS PER YEAR
EDB	1.000	EFFICIENCY OF DRILLING OPERATIONS - FRACTION
PTF	1.00	PROPEL TIME FACTOR - FRACTION
P	300.00	PANEL WIDTH - FEET
HBMF	.00	HOLE BOTTOM MARGIN - FEET
DPGCC	.00	DENSITY OF PRIMER - GRAM / CC
DAGCC	.80	DENSITY OF ANFO - GRAM / CC
DSGCC	1.50	DENSITY OF SLURRY - GRAM / CC
PRPY	.25	POWDER RATIO - LBS. / YARD
PDH	.90	PERCENTAGE DRY HOLES
PWH	.10	PERCENTAGE WET HOLES
HPF	.00	HEIGHT OF PRIMER - FEET
PEBC	.05	% EX. BLASTING CAPS/CAST BOOSTERS
CBCDC	130.00	COST OF BLASTING CAPS/CAST BOOSTERS - \$/100
CPCDMF	125.00	COST OF PRIMER CORD - \$ / M FT
CPDP	.00	COST OF PRIMER - \$ / LB.
CADP	.08	COST OF ANFO - \$ / LB.
CSDP	.32	COST OF SLURRY - \$ / LB.
PLY	30.00	PROJECT LIFE - YEARS
DRSMFH	360.	DRILLING RATE IN SOFT MATIL - FT./HR.
CDRTY	3988930.	COAL DEMAND - TONS/YEAR
CDBYY	.2036E 07	COAL DEMAND - BANK YDS/YR
HC	25.00	HEIGHT OF COAL - FEET
SDDI	6.000	SPECIFIED DRILL DIAMETER - INCHES
S	20.00	SPACING - FEET
B	20.00	BURDEN - FEET

Figure 4-2. Sample DAB Model Output for Coal Drilling and Blasting
(Sheet 5 of 9)

DRILLING AND BLASTING SIMULATION
INTERMEDIATE VARIABLES

06/22/76

0502 (PDBC0502) POWDER RIVER BASIN
2 DRILLING AND BLASTING COAL - LAYER 2

CAF	1514.07	COAL ACRE FEET
ACBY	.61068E 08	AREA COAL - BANK YDS
RLADFY	7328.10	RATE OF LINEAR ADVANCE - FT. / YR.
RHLF	25.00	REQUIRED HOLE LENGTH - FT.
VCIFYH	14.81	VOLUME EFFECTED - CU. YD. / FOOT OF HOLE
PEH	93.00	POUNDS OF EXPLOSIVE PER HOLE
VECYH	370.37	VOLUME EFFECTED - CU. YD. / HOLE
NHY	5496.00	NUMBER OF HOLES PER YEAR
WAPFH	9.81	WEIGHT OF ANFO - LBS. / FT. OF HOLE
WSPFH	18.39	WEIGHT OF SLURRY - LBS. / FT. OF HOLE
WPPFH	.00	WEIGHT OF PRIMER - LBS. / FT. OF HOLE
HAF	9.48	HEIGHT OF ANFO IN HOLE - FT.
HSF	5.06	HEIGHT OF SLURRY IN HOLE - FT.
SHDF	15.52	STEMMING HEIGHT FOR DRY HOLES - FT.
SHWF	19.94	STEMMING HEIGHT FOR WET HOLES - FT.
RLPCFY	284417.87	REQUIRED LENGTH OF PRIMER CORD - FT / YR
CPCDY	35552.21	COST OF PRIMER CORD - \$ / YR.
NBCY	1154.00	NO. OF BLASTING CAPS/CAST BOOSTERS / YEAR
CBCDY	1500.20	COST OF BLASTING CAPS/CAST BOOSTERS - \$/YR
WPPY	.00	WEIGHT OF PRIMER - LBS. / YR.
CPDY	.00	COST OF PRIMER - \$ / YR.
WAPY	460015.19	WEIGHT OF ANFO - LBS. / YR.
CADY	36801.21	COST OF ANFO - \$ / YR.
WSPY	51112.81	WEIGHT OF SLURRY - LBS. / YR.
CSDY	16356.10	COST OF SLURRY - \$ / YR.
APRPY	.25	ACTUAL POWDER RATIO - LBS. / CU. YD.
CEDY	90209.69	COST OF EXPLOSIVES - \$ / YR.
CEFH	.66	COST OF EXPLOSIVES - \$ / FT. OF HOLE
CEUB	.02	COST OF EXPLOSIVES - \$ / UNIT BLASTED

Figure 4-2. Sample DAB Model Output for Coal Drilling and Blasting
(Sheet 6 of 9)

DRILLING AND BLASTING SIMULATION
CALCULATED RESULTS

06/22/76

G502 (PDBC0502) POWDER RIVER BASIN
2 DRILLING AND BLASTING COAL - LAYER 2

FT PC	PC\$/YR	BC-NB	BC\$/YR	PRM-LBS	PRM\$/YR	ANFB-LBS	ANFB\$/YR	SLRY-LBS	SLRY\$/YR		
284418.	35552.	1154.	1500.	0.	0.	460015.	36801.	51113.	16356.		
ID	DIAMETER	RATE	LENGTH	DRFY	NDR						
CD 6.35	6.000	360.	35.	1174680.	.117						
M\$OWN	M\$BPN	M\$S&B	\$/FT	\$/UNIT	M\$/YR	\$/FT	\$/UNIT	CM\$/YR	C\$/FT	C\$/UNIT	C\$/AFT
2.38	6.91	9.29	.07	.002	90.21	.66	.023	99.50	.72	.025	1971.59

Figure 4-2. Sample DAB Model Output for Coal Drilling and Blasting
(Sheet 7 of 9)

DRILLING AND BLASTING SIMULATION
CALCULATED RESULTS

06/22/76

0502 (PDBC0502) POWDER RIVER BASIN
2 DRILLING AND BLASTING COAL - LAYER 2

	NDR	M\$OWN	M\$OPN	M\$B&B	\$/FT	\$/UNIT	M\$/YR	\$/FT	\$/UNIT	CM\$/YR	C\$/FT	C\$/UNIT	C\$/AFT
24 CD 6.35	.117	2.38	6.91	9.29	.07	.002	90.21	.66	.023	99.50	.72	.025	1971.59

LEAST COST MACHINE • 24

Figure 4-2. Sample DAB Model Output for Coal Drilling and Blasting
(Sheet 8 of 9)

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DRILLING AND BLASTING SIMULATION
SUMMARY OF SELECTED MACHINES

06/22/76

0502 (POBC0502) POWDER RIVER BASIN
2 DRILLING AND BLASTING COAL - LAYER 2

	NDR	M\$BWN	M\$BPN	M\$BAG	\$/FT	\$/UNIT	M\$/YR	\$/FT	\$/UNIT	CM\$/YR	C\$/FT	C\$/UNIT	C\$/AFT
24 CD 6-35	.117	2.38	6.91	9.29	.07	.002	90.21	.66	.023	99.50	.72	.025	1971.59
24 CD 6-35	.117	2.38	6.91	9.29	.07	.002	90.21	.66	.023	99.50	.72	.025	1971.59
	.234	4.76	13.82	18.58	.14	.004	180.42	1.32	.046	199.00	1.44	.050	3943.18
STOP 0													

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Figure 4-2. Sample DAB Model Output for Coal Drilling and Blasting
(Sheet 9 of 9)

TABLE 2

DRILLING AND BLASTING SIMULATION MODEL

SAMPLE MODEL OUTPUT - ICASE = 2

(Sheet 1 of 2)

LINE NO.	HEADING	DATA ENTRY	DESCRIPTION
1	FTPC	322834.	Feet of Detonating Cord Required (feet/year)
	PC\$/YR	40354.	Detonating Cord Cost (\$/year)
	BC-NO	786.	Number of Cast Boosters Required (number/year)
	BC\$/YR	1022.	Cost of Cast Boosters (\$/year)
NOTE			
<i>If electric blasting caps and primer were used for detonators, BC-NO and BC\$/YR would refer to blasting cap requirements and cost.</i>			
2	PRM-LBS	0.	Pounds of Primer Required (pounds/year)
	PRM\$/YR	0.	Cost of Primer (\$/year)
	ANFO-LBS	1950477.	Pounds of ANFO Required (pounds/year)
	ANFO\$/YR	156038.	Cost of ANFO (\$/year)
	SLRY-LBS	216720	Pounds of Slurry Required (pounds/year)
	SLRY\$/YR	69350.	Cost of Slurry (\$/year)
	ID	B 45R ER8	Rotary Drill Model Number
	DIAMETER	9.875	Drill Diameter (inches)
	RATE	100.	Drilling Rate (feet/hour)
	LENGTH	165.	Drilling Length (feet)
	DRFY	326300.	Possible Drilling Rate (feet/year)
	NDR	.574	Number of Drills Required

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TABLE 2

DRILLING AND BLASTING SIMULATION MODEL

SAMPLE MODEL OUTPUT - ICASE = 2

(Sheet 1 of 2)

LINE NO.	HEADING	DATA ENTRY	DESCRIPTION
3	M\$OWN	46.60	Drill Ownership Cost (M\$/year)
	M\$OPN	75.00	Drill Operating Cost (M\$/year)
	M\$OAO	121.40	Drill Ownership and Operating Cost (M\$/year)
	\$/FT	.65	Drilling Cost (\$/foot of hole)
	\$/UNIT	.028	Drilling Cost (\$/unit of material drilled) - for coal, unit = recoverable tons of coal - for overburden, unit = bank cubic yards
	M\$/YR	266.76	Blasting Cost (M\$/year)
	\$/FT	1.43	Blasting Cost (\$/foot of hole)
	\$/UNIT	.062	Blasting Cost (\$/unit of material blasted)
	CM\$/YR	388.17	Combined Drilling and Blasting Cost (M\$/year)
	C\$/FT	2.07	Combined Drilling and Blasting Cost (\$/foot of hole)
	C\$/UNIT	.090	Combined Drilling and Blasting Cost (\$/unit of material)
	C\$/TON		Combined Drilling and Blasting Cost (\$/recoverable ton of coal)

NOTE

All costs except C\$/TON and \$/FT are yearly costs. C\$/TON is total dollars divided by total coal recovered.

Lines 2 and 3 are repeated for each drill with the correct drill diameter. If ICASE = 1, lines 2 and 3 are printed for each drill in the Data File. In addition, the information printed on line 1 prints for each drill.

PART 3

HAUL UNIT SIMULATION (HUS) MODEL
USER'S MANUAL

17 September 1976

PART 3
HUS MODEL USER'S MANUAL
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Manual
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SECTION 1
INTRODUCTION

1.1 GENERAL

The combination of loading shovels or front-end loaders with off-highway trucks may be used in surface mines for overburden removal and coal recovery. Three models have been developed to simulate these operations:

1) Haul Unit Simulation (HUS).

The HUS model is described in this manual. This model evaluates the operation of trucks over haul roads specified by the user. It assumes the availability of a loading unit (loading shovel or front-end loader) correctly matched to the truck. A new truck data file created by this model contains the haul road performance data to be processed with one of the following two models.

2) Load and Haul with Shovels (CLH).

The CLH model is described in Document No. FLU-039. It evaluates the performance of loading shovels in combination with trucks processed by the HUS model.

3) Load and Haul with Front-end Loaders (FLH).

The FLH model is also described in Document No. FLU-039. It evaluates the performance of front-end loaders in combination with trucks that have been processed by the HUS model.

1.2 ORGANIZATION OF THIS MANUAL

This manual is organized into four sections. Following this introduction, Section 2 provides an overview of the HUS model, including details of its structure and operation. Section 3 identifies and discusses the input to the model, as prepared by the user. Section 4 describes, and illustrates examples of, the output of the HUS model.

SECTION 2
MODEL OVERVIEW

2.1 GENERAL

Using data contained in the truck data file, the HUS model simulates the performance of off-highway trucks over haul road(s) specified by the user. User-set parameters specify whether the operation being simulated is coal or overburden removal, and control the type of trucks evaluated. The user can evaluate all trucks in the truck data file, or only specified types such as rock rear dump or coal bottom dump. The user can also evaluate each truck over a single haul road or several haul roads.

The model evaluates the ability of a truck in the following ways:

- ▣ Possible truck speed and time to travel the haul road.
- ▣ Possible production that could be sustained by one truck.
- ▣ Size of the fleet required to maintain a given production rate.
- ▣ Cost of ownership and operation of each truck in the fleet.
- ▣ Cost of haulage, in dollars/unit of material handled by each truck.

The Truck Data File contains all the parameters needed by the HUS model. The following parameters are used for each truck to be studied:

- ▣ Weight capacity.
- ▣ Performance data.
- ▣ Braking data.
- ▣ Ownership and operating cost data.
- ▣ Number and size of tires.
- ▣ Engine characteristics.

2.2 FUNCTIONAL STRUCTURE

The HUS model is designed to examine coal or overburden hauling. The model begins with a specification of the mine and the haul road, from pit to dump site. The user describes the haul road in segments, with distance, grade, speed limits, stops, etc., defined for each segment.

The Truck Data File contains all needed truck specification data. Using these data, and the user-supplied parameters, the model simulates the hauling operation, determines vehicle performance (by segment and overall), and calculates operating statistics and operating and investment costs.

As designed, the model makes no selections. It simply calculates and prints the results, with selection made subsequently by the load and haul simulation models (CLH, FLH).

2.3 OPERATIONS

The HUS model performs five major steps for each truck to be considered:

- 1) Determines the loading time.
- 2) Determines the truck cycle time over a specified haul road configuration.
- 3) Determines the production level for the truck.
- 4) Determines the number of units needed to sustain production.
- 5) Determines the ownership and operating costs.

2.3.1 Loading Time

The model assumes the loader capacity to be one-sixth of the truck's rated payload. The loading time is a function of the loader cycle time, and is assumed by the model to be 30 seconds times six cycles to load. The loading time is adjusted to account for expected loader efficiency.

2.3.2 Truck Cycle Time

The truck cycle time is the sum of six separate operation times:

1) Wait Time at the Loader

The time the truck is expected to wait before the previously loaded truck moves away from the loader.

2) Spot Time

The time needed to place the truck in the proper position in the loading area.

3) Load Time

The time required to load the truck.

4) Haul Time

The time required to drive the truck to the unloading area.

5) Turn and Dump Time

The time needed for the unloading operation.

6) Return Time

The time required to drive the truck back to the loading area.

Cycle times depend upon vehicle speed (versus distance), and speed depends upon vehicle performance and road conditions. In computing cycle times, performance and braking curves are used to obtain maximum vehicle speed. Using industry average factors, the maximum speeds are reduced to average speeds. The average speeds are used to compute the cycle times.

Compared to other simulation models, the HUS model simplifies the cycle time determination with respect to the performance and braking curves and the speed calculations.

The curves show many discontinuities at the many gearshift points. Generally, the curves are defined by 20-30 sets of coordinates and the models interpolate between the points. The HUS model uses equations to represent the curves. Thus, the Truck Data File needs only three items for each curve, which reduces the file size.

Some other models integrate the speed over the segment to closely approximate the manner in which a vehicle reaches its effective speed. The HUS model determines speed over the entire segment, and uses factors to reduce the determined speed to the effective speed. Tests with the HUS model compared to two other simulation models indicate acceptable accuracy with these two simplifications.

The wait time at the loader and spot time depend on the maneuverability of the vehicle. This time is based on the input parameter, index for job conditions, and the truck body type. Generally, the spot time is less for a rear dump truck than for a trailer type. The model does not consider possible queueing problems.

The haul time depends upon many factors. The several functions that must be resolved to determine the total driving time are as follows:

- ▣ The driving time is a function of vehicle speed and distance to be traveled.
- ▣ The vehicle speed is a function of vehicle engine performance, vehicle weight, and road conditions.
- ▣ The maximum attainable speed for a vehicle can be determined from the performance charts supplied by the manufacturer. These charts relate rimpull to speed. Thus, speed is a function of required rimpull.
- ▣ The rimpull is the force available between the truck tires and the ground to move the vehicle. The required rimpull is a function of gross vehicle weight and road resistance. In other words, the engine must provide a sufficient force (rimpull) to overcome the resistance offered by the weight of the vehicle and the road.
- ▣ The empty vehicle weight is supplied by the manufacturer. The gross vehicle weight is the empty weight plus the weight of the load. (On the return trip, gross vehicle weight is "empty" weight.)

- ▣ The rolling resistance is a function of tire penetration, which depends upon vehicle weight and road surface material.
- ▣ The grade resistance represents vertical distance relative to horizontal distance. If the grade is positive (uphill); in effect, the engine must lift the vehicle the vertical distance. If the grade is negative (downhill); in effect, the engine and braking system must maintain a safe speed down the vertical distance.
- ▣ The total road resistance consists of the algebraic sum of the rolling resistance and the grade resistance.
- ▣ For downhill grades (negative total resistance), the braking performance charts supplied by the manufacturer must be used to determine maximum vehicle speed.

All of these relationships are expressed mathematically in the HUS model. They are solved by the model to obtain the driving speed. Actually, these relationships result in maximum attainable speed, which is adjusted by the model to reflect the fact that the vehicle will travel at a maximum speed only a portion of the time. A series of factors are used to reduce maximum speed to an expected average speed, based on the length of the segment and whether the truck is moving or not at the start of the segment.

The turn and dump time is determined in the same manner as spot time.

The return time calculation is the same as the haul time calculation, except that the gross vehicle weight is now the empty weight.

2.3.3 Production Level

After completing the cycle-time calculation, the HUS model determines the production rate that could be expected from the truck. The production rate can be calculated from the cycle time and payload. The following relationships are resolved to make this determination:

- ▣ Production rate is figured as tons/hour for coal or bank cubic yards/hour for overburden.
- ▣ The rate is a function of the number of trips which a vehicle can make in an hour, and the load carried on each trip.
- ▣ The number of trips/hour is calculated from the cycle time, and is adjusted to account for the expected efficiency of the operation.
- ▣ The payload (load carried on each trip) is assumed to be equal to the rated payload of the vehicle.

2.3.4 Fleet Size

The HUS model determines the fleet size, i.e., the number of vehicles that would be required to sustain a specified hourly production level. The following relationships are resolved for this determination:

- The minimum number of vehicles is calculated from the specified production level and the expected hourly production rate.
- The minimum number of vehicles is adjusted by the user-set parameter defining expected truck availability.

2.3.5 Ownership and Operating (O & O) Costs

In the next step, the HUS model calculates the O & O costs. Ownership costs are essentially the investment (or capitalized) costs required to own a vehicle; these costs depend on the initial purchase investment, the amortization or depreciation period, and the cost of capital.

The investment cost is the purchase price of the vehicle minus the replacement cost of tires. Tires are generally treated as an operating cost. The investment cost is spread over the amortization period. Since straight-line depreciation is normally used for haul vehicles, the investment is evenly spread over vehicle life.

The cost of capital usually includes the cost of insurance, taxes, and interest. It is determined as a specified percentage of the average annual investment.

Ownership cost is computed on a per-hour basis, and then converted to a per-ton or per-cubic-yard basis using the expected hourly production rate. Operating costs involve the following items (calculated on a per-hour basis):

- ▣ Fuel - fuel costs are the product of expected fuel consumption multiplied by fuel price. Fuel consumption is based on engine horsepower and operating conditions, and fuel price is an input parameter.
- ▣ Tires - tire costs are based on the replacement cost of tires and an expected average tire life. The model calculates the average ton miles/hour (TMPH) for the operation, and compares this value to the TMPH rating of the tires. If the rating is not exceeded, tire replacement cost is spread over the expected average life. If the rating is exceeded, the tire cost is increased on the assumption that more-expensive tires would be needed to make the truck usable for the haul road.
- ▣ Maintenance - maintenance costs are a percentage of investment costs.
- ▣ Labor - labor cost is the wage of the driver (an input parameter).

SECTION 3
MODEL INPUT

3.1 GENERAL

Three types of input are necessary to define the haul problem:

- 1) General information regarding the haul road site, density and general properties of the material to be hauled, and the desired production.
- 2) Manufacturer-supplied information concerning the trucks (contained in the Truck Data File).
- 3) A definition of the haul road.

The site description input parameters and haul road configuration specifications are described in this section.

3.2 DEFINING THE HAUL ROAD

Because the haul road is not usually a single straight stretch of highway between the loading and unloading areas, the engineer must design and specify the haul road layout in order to run the HUS model.

Figure 3-1 illustrates a haul road divided into segments. Each segment differs from the previous one in grade, rolling resistance, and/or some speed requirement. For example, segment 1 leading from the pit is 500 feet long, with a 5 percent grade. The second segment is 1000 feet long with no grade. All segments are specified from the pit to the dumping site and then returning.

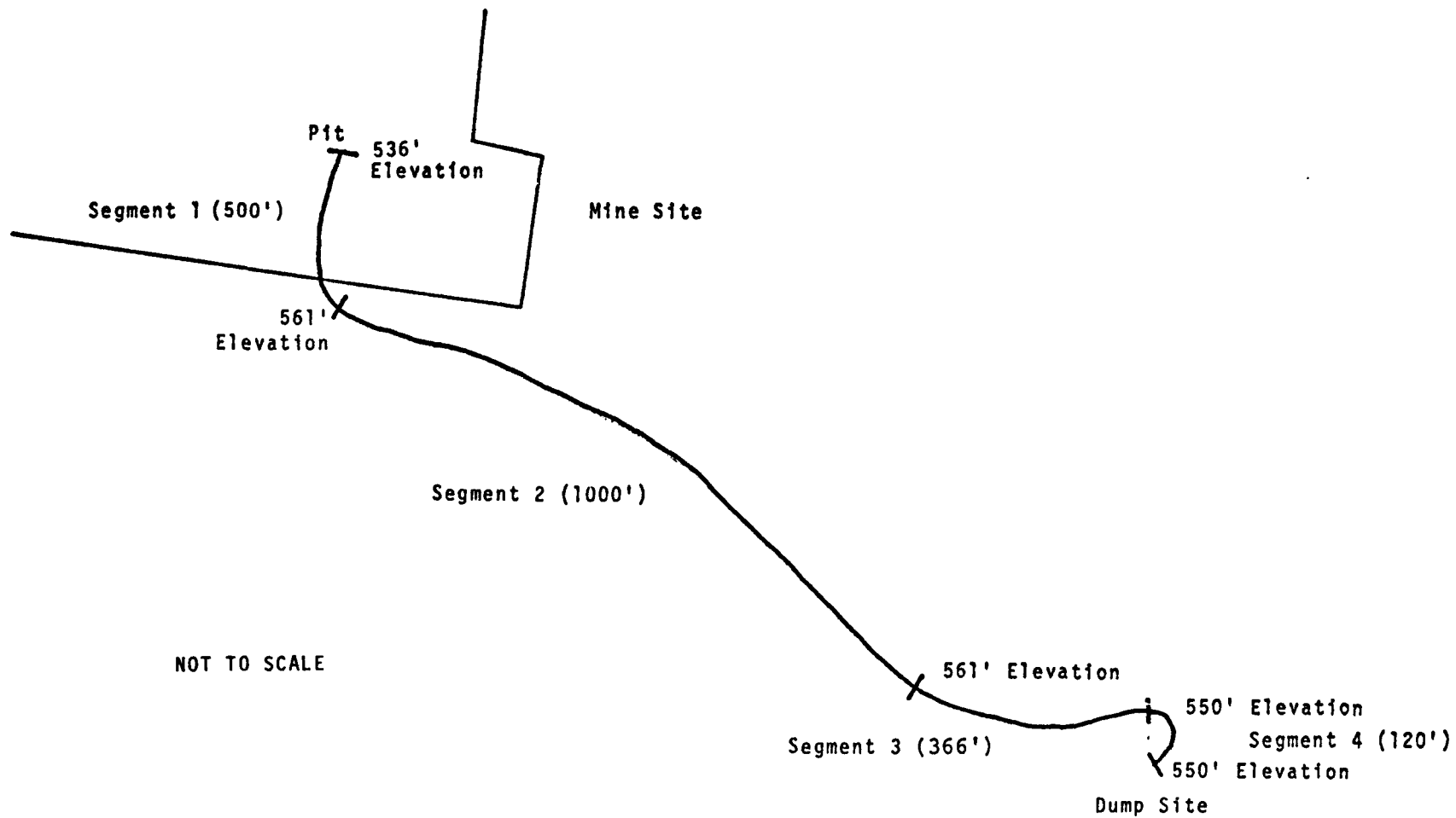


Figure 3-1. Haul Road Layout in Segments

The number of segments in a complete haul road depends on the number of variations in basic road parameters. The HUS model permits the user to describe the road in as many as 20 segments.

The user may average segments, and the results will be averaged by the program. For example, assume an exit segment consisting of 1000 feet at 7 percent, followed by 1500 feet at 3 percent. These segments could be averaged to a single segment of 2500 feet at 4.6 percent. Keeping all other factors constant, the program would compute a travel time of 78.2 seconds for the two-segment exit and 72.5 seconds for the averaged segment. The variation in time is about 8 percent. Such a variation may or may not be considered significant by the user.

A complete haul road is the sum of all described segments. The road must be traversed in both directions. If the vehicle travels different routes hauling and returning, the user must describe both routes. If the vehicle returns over the haul route, however, the user need only describe the haul route; the model will traverse the reverse route on the return trip.

The model requires a completed input form (see Figure 3-2) which provides the following eight data items for each segment of the hauling route:

- 1) Segment Number

The user numbers the segments sequentially to indicate to the model the correct sequence of traverse. If a separate return route is not described, the model reverses the sequence numbers for the return trip.

HAUL ROAD LAYOUT INPUT FORM

Segment Number	Direction	Segment Length	Segment Grade	Rolling Resistance	Speed Limit	Start fr Stop	Stop at End
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
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Figure 3-2. Haul Road Layout Form

2) Direction

This indicator permits the user to designate a segment as part of the haul route, the return route, or both. The value may be "L", "E", or blank. If the user specifies "L", the segment is used on the loaded haul. If the user specifies "E", the segment is used on the empty return. If the user leaves this value blank, the model assumes the segment is used first for the loaded haul and then for the empty return. This feature allows the user to specify the haul road in only one direction if the road is used for both hauls. The model automatically reverses all necessary grades, etc., if the segment is used in both directions.

3) Segment Length

This value is the segment length, in feet.

4) Segment Grade

The grade is the vertical distance over the horizontal distances, expressed as a percent. An uphill grade is indicated by a positive grade percent; a downhill grade is indicated by a negative grade percent. If this parameter is omitted, the program assumes a zero percent grade (i.e., a level road segment). If the user describes the haul route only, the program reverses the sign of the grade for the return trip. For example, a value of "6" would indicate an uphill 6 percent grade for the loaded haul, and a downhill (-)6 percent grade for the return haul.

5) Rolling Resistance

The segment rolling resistance is the amount of drawbar pull or tractive effort required to overcome the retarding effect between the tires and the ground or road surface. This is expressed as a percent of vehicle weight, such as 2 percent or "2.0", for use in the model.

6) Speed Limit

The user can impose a speed limit, in MPH, on the particular segment. He may impose a limit in the pit area, for example, where it is common to restrict the truck's speed, or on curved segments where high speeds are prohibited.

7) Start from Stop

The model uses this indicator to retard the acceleration of the truck when the vehicle must start from a stop at the beginning of the segment. Common use of this indicator is in the pit area after the truck has been loaded and is beginning a haul. If the user wishes the acceleration to start from a stop, he should set this value to "1"; otherwise, it should be set to "0".

8) Stop at End

If the truck must come to a stop at the end of a segment, the user should set this indicator to "1". This is used in the case of a stop sign on the haul road, an intersection where the driver must look for other haulage traffic, or at the dump site where the truck must stop.

3.3 DEFINING THE MINE SITE

Certain information concerning the mine site is needed to run the HUS model. Figure 3-3 illustrates the input form used. The information items required are:

- KMED - Haulage Medium (overburden, coal) Indicator. KMED tells the model what the haul units will be hauling. If KMED is set to "0", the haul units will be hauling coal. If KMED is set to "1", the haul units will be hauling overburden.
- KTT - Truck Type Indicator. KTT tells the model the type of trucks the user wishes the model to consider for haulage. If KTT is set to "1", only rear-dump trucks will be evaluated by the model. If KTT is set to "2", only bottom-dump trucks will be used by the model. If KTT is set to "3", the model will use both rear-dump and bottom-dump trucks.
- KSWT - Spot Time Indicator. KSWT indicates to the model whether or not the user wishes to include spot time at the loader as part of the truck's cycle time. If KSWT is set to "0", spot time is not included. If KSWT is set to "1", spot time is included.
- AST - Average Site Temperature. AST is used to decrease engine performance in extremely hot climates. It is specified in degrees Fahrenheit.

cc	1	89	<table border="1"><tr><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td></tr></table>	10	11	12	13	14	15	16	17	18	
10	11	12	13	14	15	16	17	18					
	KMED	=	<table border="1"><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>										Haulage Medium Indicator (0=Coal, 1=Overburden)
	KTT	=	<table border="1"><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>										Truck Type Indicator (1=rear-dumps, 2=bottom-dumps, 3=both)
	KSWT	=	<table border="1"><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>										Spot Time Indicator (0=spot time not included, 1=included)
	AST	=	<table border="1"><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>										Average Site Temperature (degrees)
	ATF	=	<table border="1"><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>										Altitude (feet)
	EQO	=	<table border="1"><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>										Efficiency of Loader Operation (fraction)
	ETO	=	<table border="1"><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>										Efficiency of Truck Operation (fraction)
	FF	=	<table border="1"><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>										Fill Factor (fraction)
	RSFLH	=	<table border="1"><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>										Speed Factor - Empty Long Haul (fraction)
	RSFSH	=	<table border="1"><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>										Speed Factor - Empty Short Haul (fraction)
	CF	=	<table border="1"><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>										Cost of Fuel (dollars/gallon)
	TA	=	<table border="1"><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>										Truck Availability (fraction)
	OLF	=	<table border="1"><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>										Oil and Lube Factor (fraction)
	OSTHD	=	<table border="1"><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>										Scheduled Operating Hours/Day
	OPTHD	=	<table border="1"><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>										Productive Operating Hours/Day
	IJC	=	<table border="1"><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>										Index for Job Conditions (1=excellent, 2=average, 3=poor)
	PLT	=	<table border="1"><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>										Payload Tolerance Factor (fraction)
If KMED = 0,													
	CDRTH	=	<table border="1"><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>										Coal Demand (tons/hour)
	DCBPY	=	<table border="1"><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>										Density of Coal (bank pounds/cubic yard)
	SFC	=	<table border="1"><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>										Swell Factor of Coal (fraction)
If KMED = 1,													
	BDBYH	=	<table border="1"><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>										Overburden Demand (bank cubic yards/hour)
	DBBPY	=	<table border="1"><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>										Density of Overburden (bank pounds/cubic yard)
	SFB	=	<table border="1"><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>										Swell Factor of the Overburden (fraction)
	LOGPA	=	<table border="1"><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>										Log Parameters (1 or 0)
	LOGHD	=	<table border="1"><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>										Log Haul Data (1 or 0)
	LOGSP	=	<table border="1"><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>										Log Summary Page (1 or 0)

Figure 3-3. Haul Unit Simulation Input Form

- ▣ ATF - Altitude. ATF is used to make corrections for engine efficiency, depending on the actual altitude in which the truck is working. It is specified in feet.
- ▣ EQO - Efficiency of Loader Operation. EQO is the fraction representing the efficiency of the loader operation during its productive time. If the efficiency of the loader operation is 83 percent, $EQO = 0.83$.
- ▣ ETO - Efficiency of Truck Operation. ETO is the fraction representing the efficiency of the truck operation during its productive time. If the efficiency of the truck operation is 83 percent, $ETO = 0.83$.
- ▣ FF - Fill Factor. FF is the fraction of the loader bucket or dipper that the loader will be able to fill successfully. For coal loading, the fill factor is generally 1.00.
- ▣ RSFLH - Speed Factor Empty Long Haul. RSFLH is the fraction of the truck's maximum speed that the user thinks could be attained on an empty long haul (over 500 feet). The value is specified as a fraction.
- ▣ RSFSH - Speed Factor Empty Short Haul. RSFSH is the fraction of the truck's maximum speed that the user thinks could be attained on an empty short haul (500 feet or less). This value is specified as a fraction.

- ▣ CF - Cost of Fuel. CF is the cost of fuel, in dollars/gallon.
- ▣ TA - Truck Availability. TA is used to size the truck fleet by allotting enough spare trucks to compensate for the loss in productive time due to maintenance. It is specified as an expected fraction of availability.
- ▣ OLF - Oil and Lube Factor. OLF is the cost of oil and lubes for the truck, as a fraction of the cost of fuel. For example, if the cost of oil and lubes is 30 percent of the cost of fuel, $OLF = 0.30$.
- ▣ OSTHD - Scheduled Hours/Day. OSTHD is the number of hours/day that the loading operation is scheduled to work. For coal loading in one shift/day $OSTHD = 8.00$.
- ▣ OPTHD - Productive Hours/Day. OPTHD is the number of actual productive hours/day the loading operation will work. It excludes the start-up time, time for breaks, etc., during which the operator will not be productive. For a one-shift operation, the productive hours/day might be 7.25.
- ▣ IJC - Index for Job Conditions. IJC is used to set spot time and turn and dump times for unfavorable, average, or excellent conditions. If the loading operation takes place in excellent conditions, IJC should be set to "1". If the average loading situation exists, IJC should be set to "2". If the loading is unfavorable, the value of IJC should be set to "3".

- ▣ PLT - Payload Tolerance Factor. Because the truck manufacturers have suggested that trucks hauling coal can be overloaded approximately 10 percent of their rated payload, the user can take advantage of this overload by setting $PLT = 0.10$. A zero value would result in no overload.

Several parameters regarding the characteristics of the material being hauled are needed by the model. If the model is simulating coal hauling, the following data are required:

- ▣ CDRTH - Coal Demand. CDRTH is the tons of recovered coal per hour the user wishes to be produced.
- ▣ DCBPY - Density of the Coal. DCBPY is the density of the coal to be hauled, in bank pounds/cubic yard.
- ▣ SFC - Swell Factor of the Coal. SFC is the fraction of swell of the coal from the bank condition to the loose condition. If the density of the bank coal is 2160 pounds/cubic yard, and its loose density is 1600 pounds/cubic yard, the swell factor is 35 percent (specified as 0.35 for the model).

If the model is simulating hauling overburden, a similar set of information is required:

- ▣ BDBYH - Overburden Demand. BDBYH is the bank cubic yards of overburden/hour the user wishes to be hauled.

- ▣ DBBPY - Density of the Overburden. DBBPY is the density of the overburden to be hauled, in bank pounds/cubic yard.
- ▣ SFB - Swell Factor of the Overburden. SFB is the fraction of swell of the overburden from the bank condition to the loose condition. SFB is specified as a fraction (35 percent would be 0.35 for the model).

Other input parameters, referred to as LOG parameters, can be input to the model to control its output. The LOG parameters are 0/1 variables; that is, their values are set to "1" or "0". If the LOG value is set to "1", the variable is "on" and the controlled printing occurs. If the LOG value is set to "0", the variable is "off" and the controlled printing does not occur. The LOG parameters are:

- ▣ LOGPA - Log Parameters. LOGPA controls the printing of the user's input values.
- ▣ LOGHD - Log Haul Data. LOGHD controls the printing of the complete haul data, including the user's input and the calculated speeds and times for each segment.
- ▣ LOGSP - Log Summary Page. LOGSP controls the printing of the summary page of information calculated for each truck, including all production and cost data.

Examples of the output controlled by each of the LOG parameters are described in Section 4.

SECTION 4
MODEL OUTPUT

Figures 4-1 through 4-5 illustrate samples of the HUS model output for coal handling.

Figure 4-1 is a listing of the user-specified input resulting when LOGPA = 1. The variable names to the right of the numeric values have been explained in Section 3. Further description appears at the left of the page.

Figures 4-2 and 4-3 are printed for each truck/haul road combination. Figure 4-2 is a listing of the input and calculated haul data. Note that the truck model number is printed at the top of the page to identify the truck being tested. The first section of data printed pertains to the loaded haul. The segments are listed as they were input, with the addition of the calculated speed and time. After all the loaded segments are printed, the totals of the segment lengths and time to travel the loaded segments appear.

The second section of data consists of the empty segments. Immediately following the list of empty segments, the total distance traveled empty and the time on the empty segments are printed. Finally, the total distance traveled and the total time to travel both the loaded and empty segments are calculated. The printing of this page is controlled by LOG variable LOGHD. This page will not be printed if LOGHD = 0.

Figure 4-3 is the summary page containing all production and cost data pertaining to the truck evaluation. This page will be printed when LOGSP = 1. Note that the truck model number is repeated at the top of the figure.

The first section of Figure 4-3 is a recap of the cycle time. In addition to the loaded time and empty time, the load time, wait time, spot time, and turn and dump time are listed. The second section is the production data consisting of the effective minutes/hour for the truck, the number of trips the truck can make in one hour (effective), the truck payload in tons, the number of tons the truck can haul in one hour, and the number of trucks needed in the fleet to maintain the required coal production rate. The remaining items are the cost data and the intermediate variables used to calculate the costs.

Figures 4-4 and 4-5 correspond to Figures 4-2 and 4-3, but refer to another truck.

INPUT FACTORS USED IN HAUL UNIT CALCULATIONS

HAULING MEDIUM - 0=COAL,1=D.B.	0, KMED
TRUCK TYPE - 1=REAR,2=TRAILER,3=BOTH	2, KTT
TRUCK SPOT AND WAIT - 0=NO,1=YES	0, KSWT
AVERAGE SITE TEMPERATURE	75.00 AST
ALTITUDE	700.00 ATF
COAL PRODUCTION DEMAND	556.99 CDRTN
DENSITY OF BANK COAL	2160.00 DCBPY
SWELL FACTOR OF COAL	.35 SFC
EFFICIENCY OF LOADER OPERATION	.833 EQO
EFFICIENCY OF TRUCK OPERATION	.833 ETQ
FILL FACTOR	.95 FF
EMPTY SPEED FACTOR-LONG HAUL	.95 RSFLH
EMPTY SPEED FACTOR-SHORT HAUL	.80 RSFSH
COST OF FUEL PER GAL.	.30 CF
TRUCK AVAILABILITY FACTOR	1.00 TA
OIL AND LUBE FACTOR	.30 OLF
SCHEDULED OPERATING HOURS PER DAY	14.50 OSTHD
PRODUCTIVE OPERATING HOURS PER DAY	13.05 OPTHD
INDEX FOR JOB CONDITIONS	2.00 IJC
TOLERANCE FOR PAYLOAD OVERLOAD	.10 PLT

Figure 4-1. Example Output with LOGPA = 1

-----HAUL DATA-----

TRUCK 050 D050RM--* (DHUS0503) OHIO HAUL UNIT SIMULATION

----- LOADED -----

SEG NO	LENGTH (FT.)	GRADE (%)	ROLLING RES. (%)	SPEED LIMIT	SAS IND	SAE IND	ACTUAL SPEED (MIN)	TIME (MIN)
1.	2000.0	.0	7.5	12.0	1.	0.	8.3	2.7
2.	4600.0	.0	5.0	30.0	0.	0.	14.8	3.5
3.	27720.0	-.2	3.0	30.0	0.	1.	26.9	11.7
34320.0								18.0

----- EMPTY -----

SEG NO	LENGTH (FT.)	GRADE (%)	ROLLING RES. (%)	SPEED LIMIT	SAS IND	SAE IND	ACTUAL SPEED (MIN)	TIME (MIN)
3.	27720.0	.2	3.0	30.0	1.	0.	30.0	10.5
2.	4600.0	.0	5.0	30.0	0.	0.	30.0	1.7
1.	2000.0	.0	7.5	12.0	0.	1.	12.0	1.9
34320.0								14.1
68640.0								TOTAL MOVING TIME & LENGTH 32.1

Figure 4-2. Listing of Input and Calculated Haul Data (Example 1)

TRUCK 050 D050RM--* (OHUS0503) OHIO HAUL UNIT SIMULATION

-----CYCLE TIME-----

LOADED TIME	17.96	
EMPTY TIME	14.14	
LOADING TIME	7.20	
WAIT TIME AT LOADER	3.60	
TIME TO SPOT AT LOADER	.00	
TURN AND DUMP TIME	1.30	

-----TOTAL CYCLE TIME----- 44.20

-----PRODUCTION DATA-----

EFFECTIVE MINUTES / HOUR	50.0	
NO. OF TRIPS / HOUR	1.1	
ACTUAL - CAPACITY PAYLOAD IN TONS	50.0	29.6
NO. OF TONS / HOUR	56.5	
NO. OF HAUL UNITS NEEDED	10.0	

-----COST DATA-----

APPLICATION - RATED TON MILES PER HOUR	138.07	150.00
EFFECTIVE TIRE LIFE-HRS	5000.0	
FUEL CONSUMPTION-GAL/HR	12.7	
OWNERSHIP COST - \$/HR	13.68	

-----OPERATING COST-----

MAINTENANCE - MAT'L	7.00
LABOR	4.66
FUEL COST	4.95
LABOR	11.26
TIRE COST	4.11
OPERATING COST - \$/HR	31.98

TOTAL OWNERSHIP & OPERATING COST	45.66
D & D DOLLARS PER TON	.81

Figure 4-3. Summary Page of Production and Cost Data
(Example 1)

-----HAUL DATA-----

TRUCK 050 C050RM--* (DHUS0503) OHIO HAUL UNIT SIMULATION

----- LOADED -----

SEG NO	LENGTH (FT.)	GRADE (%)	ROLLING RES.(%)	SPEED LIMIT	SAS IND	SAE IND	ACTUAL SPEED	TIME (MIN)
1.	2000.0	.0	7.5	12.0	1.	0.	9.3	2.4
2.	4600.0	.0	5.0	30.0	0.	0.	16.7	3.1
3.	27720.0	-.2	3.0	30.0	0.	1.	30.0	10.5
34320.0								16.1

----- EMPTY -----

SEG NO	LENGTH (FT.)	GRADE (%)	ROLLING RES.(%)	SPEED LIMIT	SAS IND	SAE IND	ACTUAL SPEED	TIME (MIN)
3.	27720.0	.2	3.0	30.0	1.	0.	30.0	10.5
2.	4600.0	.0	5.0	30.0	0.	0.	30.0	1.7
1.	2000.0	.0	7.5	12.0	0.	1.	12.0	1.9
34320.0								14.1
68640.0								TOTAL MOVING TIME & LENGTH 30.2

Figure 4-4. Listing of Input and Calculated Haul Data
(Example 2)

TRUCK 050 C050RM--* (OHUS0503) OHIO HAUL UNIT SIMULATION

-----CYCLE TIME-----

LOADED TIME	16.07
EMPTY TIME	14.14
LOADING TIME	7.20
WAIT TIME AT LOADER	3.60
TIME TO SPOT AT LOADER	.00
TURN AND DUMP TIME	1.30

-----TOTAL CYCLE TIME----- 42.31

-----PRODUCTION DATA-----

EFFECTIVE MINUTES / HOUR	50.0	
NO. OF TRIPS / HOUR	1.2	
ACTUAL - CAPACITY PAYLOAD IN TONS	50.0	29.6
NO. OF TONS / HOUR	59.1	
NO. OF HAUL UNITS NEEDED	9.0	

-----COST DATA-----

APPLICATION - RATED TON MILES PER HOUR	144.24	150.00
EFFECTIVE TIRE LIFE-HRS	5000.0	
FUEL CONSUMPTION=GAL/HR	12.7	
OWNERSHIP COST - \$/HR	13.68	

-----OPERATING COST-----

MAINTENANCE - MAT'L	7.00
LABOR	4.66
FUEL COST	4.95
LABOR	11.26
TIRE COST	4.11
OPERATING COST - \$/HR	31.98

TOTAL OWNERSHIP & OPERATING COST	45.66
O & O DOLLARS PER TON	.77

Figure 4-5. Summary Page of Production and Haul Data
(Example 2)

PART 4

LOAD AND HAUL SIMULATION

(FLH, CLH) MODELS

USER'S MANUAL

20 August 1976

PART 4
FLH, CLH MODELS USER'S MODEL
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SECTION 1

INTRODUCTION

1.1 GENERAL

The combination of shovels or front-end loaders loading off-highway trucks may be used in surface mines for overburden removal and coal recovery. Three models were developed to simulate these operations:

1) Haul Unit Simulation (HUS).

The HUS model is described in FLU-036. It evaluates the operation of trucks over haul roads specified by the user. It assumes the availability of a loading unit (loading shovel or front-end loader), correctly matched to the truck. A new Truck Data File created by this model contains the haul road performance data to be processed with one of the following two models.

2) Coal Load and Haul with Shovels (CLH).

The CLH model is described in this manual. It evaluates the performance of loading shovels in combination with trucks processed by the HUS model.

3) Coal Load and Haul with Front-end Loaders (FLH).

The FLH model is also described in this manual. It evaluates the performance of front-end loaders in combination with trucks processed by the HUS model.

1.2 ORGANIZATION OF THIS MANUAL

This manual is organized into four sections. Following this Introduction, Section 2 provides an overview of the CLH and FLH models, including details of structure and operation. Section 3 identifies and discusses the input to the models, as prepared by the user. Section 4 describes, and illustrates examples of, the output of the models.

Note

For ease of reference, the abbreviation "LAH" is used to refer to the CLH and FLH models, except in instances where a specific reference is required. Also, the term "loaders" is used to refer to either a loading shovel or front-end loader. The specific terms "shovel" and "front-end loader" are used when specific reference is intended.

SECTION 2
MODEL OVERVIEW

2.1 GENERAL

The LAH models simulate loading and hauling in a surface coal mine. They permit the user to evaluate the combined operation of loaders and trucks.

The models can be used for either overburden or coal loading and hauling; user-set parameters define which type of operation is being simulated. Other user-set parameters permit the evaluation of loaders to include all loaders in the data file or only those used for rock or for coal.

The number of trucks evaluated in combination with the loaders depends upon the number of trucks included in the HUS model evaluation which must have preceeded the LAH evaluation to create the proper Truck Data File.

Both LAH models process loader and truck files to evaluate the ability of the loader and truck, in combination, to meet the requirements of physical dimensions and production during the loading operation. Production and cost information are calculated and printed for the user.

The models operate the loader and truck separately, each at its full capacities, to determine production capabilities. Then the combination is evaluated, taking into account the necessary losses in possible production due to waiting time for the truck to spot at the loader.

For each combination, the user is provided with the following information on which to base his selection:

- ▣ The possible production the truck and loader can accomplish.
- ▣ The years to handle all material at the maximum production rate for the combination.
- ▣ The cost associated with moving the material at the maximum production rate for the loader and the truck.
- ▣ The number of trucks necessary to sustain the maximum loader production.
- ▣ The years to move the material at the production rate specified by the user.
- ▣ The cost associated with the user's production rate.
- ▣ The fleet size necessary for sustaining production at the rate specified by the user.

2.2 MODEL LOGIC

Figures 2-1 through 2-4 illustrate the methods of operation simulated by the model. Each of these cases differs in the method of loading the truck. In Figure 2-1, the truck is loaded on a berm above the loader base. Figures 2-2 and 2-3 show the truck being loaded on the pit floor, first by positioning itself at the side of the loader and then by being loaded behind the loader. Figure 2-4 is similar to Figure 2-2, except the loader is loading two trucks beside it, one on each side. These four methods are referred to as Cases 1-4 by the model. The user specifies which loading method the model is to use by setting parameter ICASE to 1, 2, 3, or 4.

2.2.1 Production Capacity Calculation

To determine the production capacity of the loader-truck combination, information about the truck's ability on the haul road must be known. [As discussed in FLU-036, the Haul Unit Simulation (HUS) model has been developed to simulate the haulage cycle for trucks.] The haul cycle is broken down into six major parts:

- 1) Loading Time
- 2) Loaded Haul Time
- 3) Turn and Dump Time
- 4) Empty Return Time
- 5) Spot Time
- 6) Wait Time at the Loader

Of these six parts, four are significant to the coal loading model. The loaded and empty haul times are calculated by the HUS model, based on the ability of the truck to perform over a haul road specified by the user.

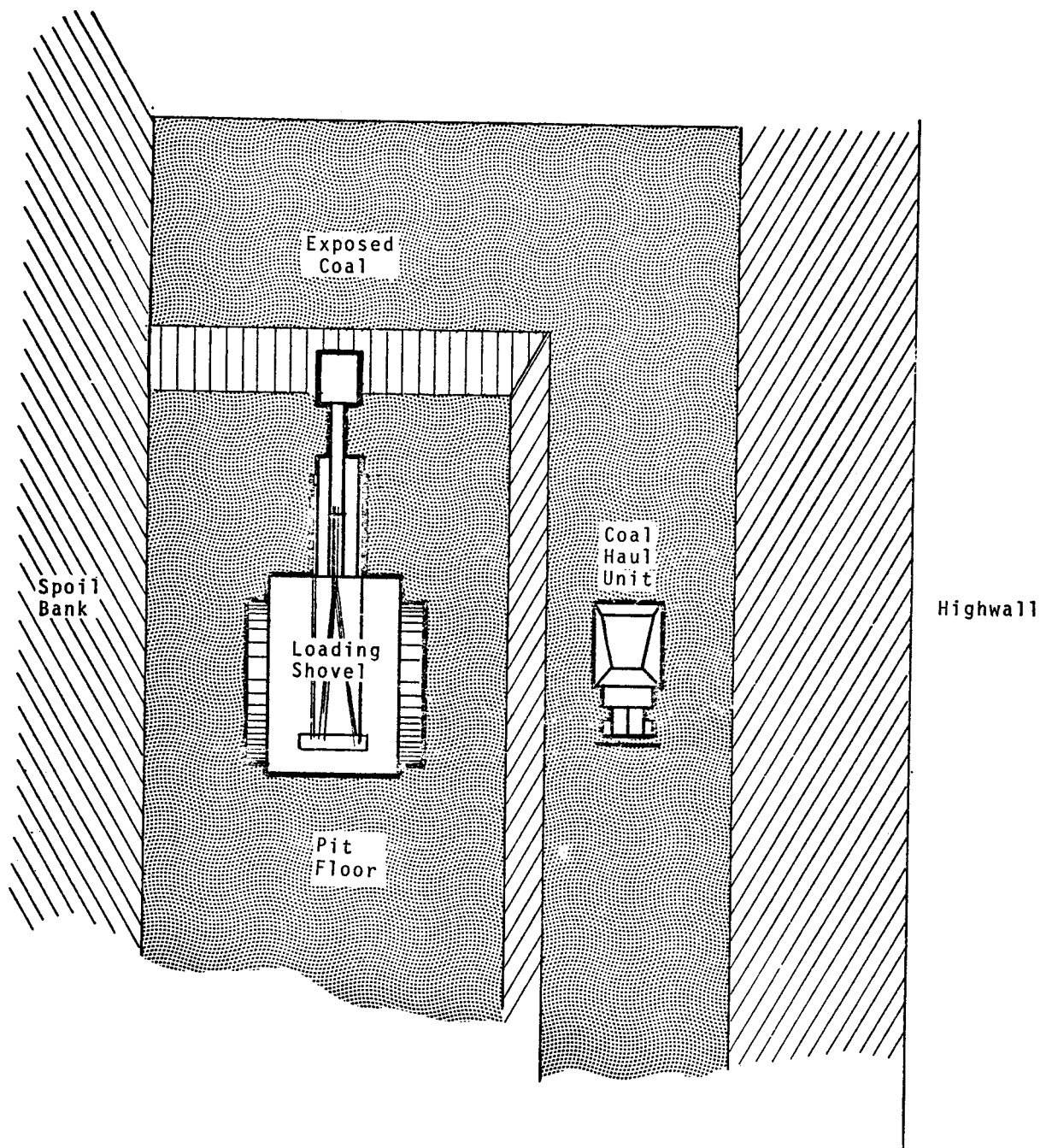


Figure 2-1. Case 1: Coal Loading with One Truck on a Berm

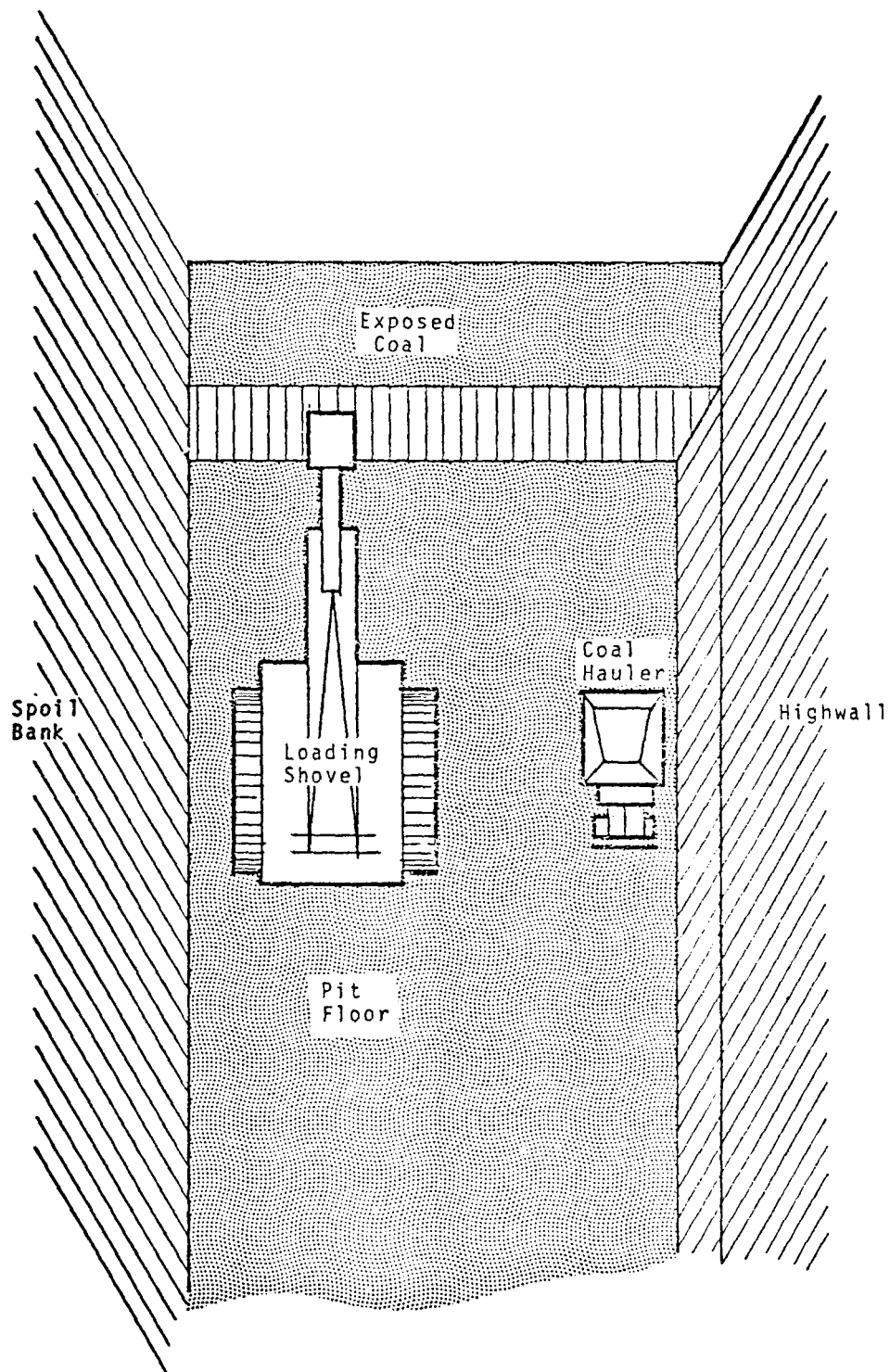


Figure 2-2. Case 2: Coal Loading with One Truck on the Pit Floor

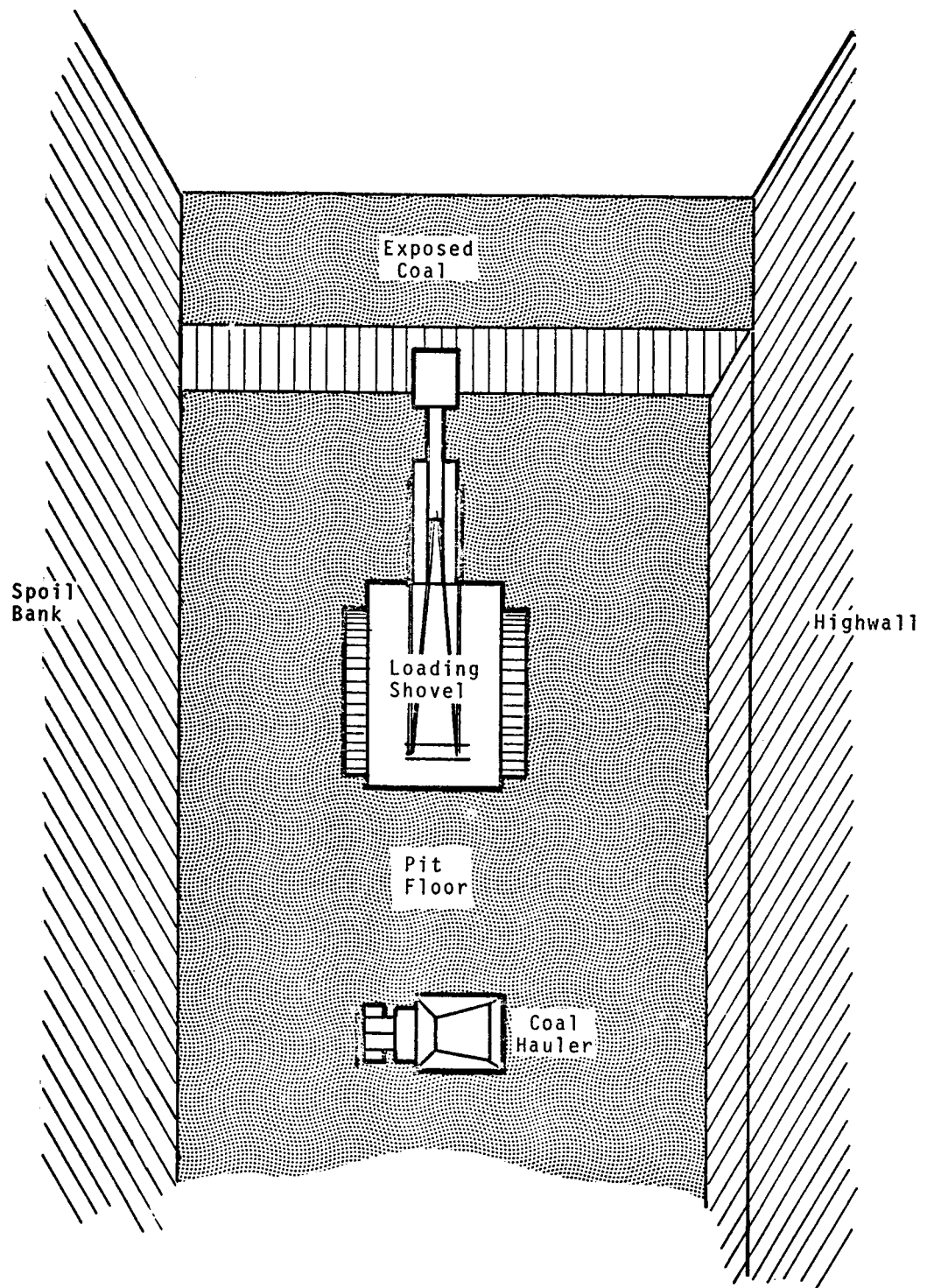


Figure 2-3. Case 3: Coal Loading with One Truck Behind Loader

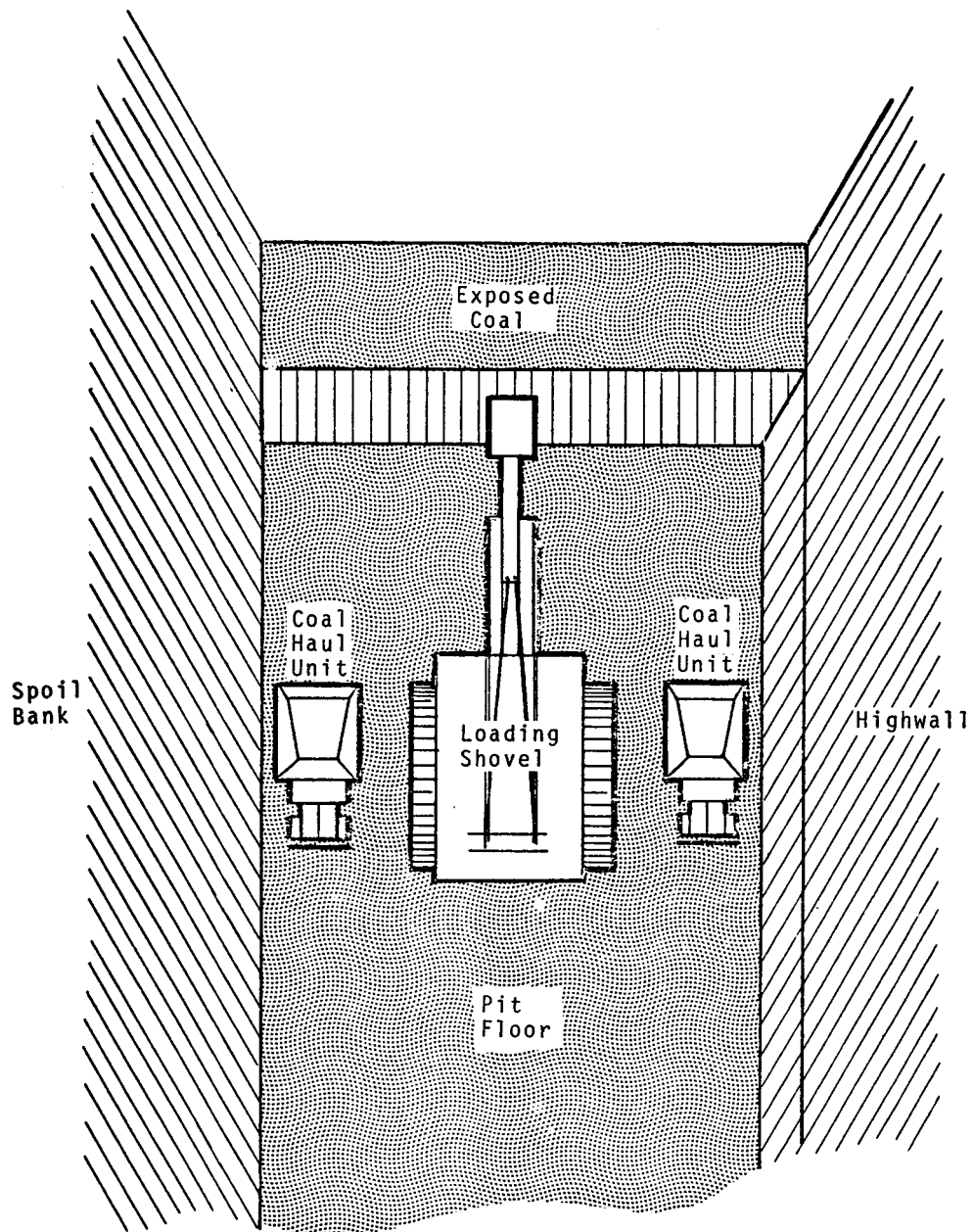


Figure 2-4. Case 4: Coal Loading with Two Trucks per Loader

The turn and dump and spot times depend on the physical characteristics of the truck. If the truck is a rear dump model, its maneuverability is greater than a trailer-type model, resulting in faster spotting times. The assignment of turn and dump and spot times is based on body type.

The HUS model is run by the user, before the loading operation is simulated, to define the times identified above. This simulation produces an input file for the loading simulation as a by-product of its normal run, which includes the loaded haul time, the empty return time, the spot time, and the turn and dump time, in addition to the manufacturer's specifications. When the loading simulation is run, the actual load time for each specific loader is calculated and added to the four other times to obtain a complete haul cycle time for the truck.

The model logic depends largely on the value of the ICASE parameter set by the user. As input to the model, the user specifies what he expects as the average cycle time of the loader. This is normally in the neighborhood of 30 seconds, based on an average angle of swing of 90 degrees. In Case 3, the angle of swing becomes 180 degrees; therefore, the average swing time is increased by the model. By knowing the efficiency of the loader operation and the time it takes for the loader to make one swing, the number of swings/hour is determined.

For each loader, the model examines the bucket capacity to determine the actual weight the bucket can hold, considering the density of the material to be loaded. The loader's yearly production is calculated from the number of swings/hour the loader is capable of making, the actual weight each bucket holds, and the number of productive hours/year. This capacity does not take into consideration any lost time which may occur as the truck spots at the loader.

The model then studies a loader in combination with a truck. The load time must now be determined. The number of swings the loader must make to load the truck is calculated from the effective bucket load of the loader and the truck's rated payload capacity.

As in the HUS model, the user may wish to specify some percentage of overload for the truck. An input parameter has been provided for this purpose.

The final consideration for truck cycle time is the spotting time. In Case 4, where the loader is loading two trucks, one on each side, there is no spotting time at the loader. In all other cases, the spotting time from the HUS model is used. Thus, the truck haulage cycle time is complete.

2.2.2 Production Rate Calculation

In the next step, the model calculates the possible production rate for the loader-truck combination. This is determined from the number of trips/hour the truck can make, and its productive operating hours/year. As an input, the user specifies either a coal demand rate in tons of coal/year or an overburden demand rate in bank yards of overburden/year which he expects the combination to maintain. Corresponding to the demand rate and the maximum production rate, the years to remove the material are calculated. If the demand rate is larger than the possible production for one loader-truck fleet combination, the model uses more than one combination.

The model tries to size a fleet for each production rate. Since, at the maximum production rate, it is assumed that no lost time occurs between loading trucks, the fleet size for that production rate is a ratio of the haulage cycle time and the time to load a truck.

For example, if the truck's haulage cycle time is 25 minutes, including five minutes to load a truck, then five trucks are needed to keep the loader at maximum production.

Similarly, the demand-rate fleet size is based on the ratio of the demand rate to the maximum production. If the maximum production rate for five trucks is 500,000 tons, and the demand rate is 250,000 tons, the fleet size at the demand rate is 2.5 trucks. These fleet sizes do not take into account fleet availability. Therefore, the fleet size for the demand production is adjusted, using the truck fleet availability factor, and is rounded up to the next higher integer.

2.2.3 Ownership and Operating Cost Calculation

Once the production capacity of the combination is established, the next task is to calculate the ownership and operating (O&O) costs in dollars/hour and in dollars/ton of coal or cubic yard of overburden.

The data files contain O&O cost figures in terms of dollars/hour for each loader and truck. To calculate the total O&O cost of the equipment for the life of the mine, the total hours of operation in the mine are calculated to be the product of the productive hours/year the loading operation will take place and the mine life (years). The total cost of ownership of each loader or truck can be determined in one of the following ways:

- 1) If the mine life is longer than the depreciation life of the equipment, the total ownership cost is the hourly ownership cost multiplied by the length of the project (in hours).

- 2) If the mine life is shorter than the depreciation life of the equipment, two options exist for calculating total ownership: in the first option, the user may elect to "force" the model to pay the full investment cost of the equipment and assume no salvage value at the end of the mine operation; in the second option, he may choose that the model only pay for the part of the equipment investment cost required for operating it for the mine life. In the latter case, the equipment would not be fully depreciated at the end of the mine life, and would retain a salvage value at the end of the operation. The user sets input parameter IDEP to indicate to the model how he wishes the total ownership cost to be handled.

The total operating cost for the loaders or trucks is the hourly operating cost multiplied by the total number of hours the mine operates. The total cost of the operation is the sum of the total ownership and total operating costs for each item, multiplied by the number of the items in the combination. The total cost is divided by the appropriate units of material removed by the combination to obtain the final dollars/unit figure.

The final operation of the model is to determine if the loader-truck combination will physically fit within the dimensions and constraints of the pit area. This is totally dependent on the user's input parameter ICASE. (These range requirements are discussed in detail under "Range Calculations".) Briefly, these constraints are:

- It must take a reasonable number of swings to load the truck.

- ▣ The truck must be able to turn within the panel width.
- ▣ The loader must have adequate dumping height to load the truck.
- ▣ The combination must physically fit within the panel dimension.

2.3 RANGE CALCULATIONS

The number of swings the loader must make to load the truck is restricted by two input parameters: MINNC and MAXNC, the minimum number and maximum number of swings, respectively. These two parameters are specified by the user to restrict the load time to a reasonable range. If the loader cannot load the truck within the user's range, the capacities of the loader and the truck have not been suitably matched and the model rejects this combination.

In the manufacturer's specifications for each truck, the turning circle is provided. This dimension is the distance in feet it takes to turn the truck 180° . In Figure 2-5 this dimension is defined as D. Dimension P is the panel width, as specified by the user. If the turning circle plus a clearance is not less than the panel width, the truck cannot turn within the panel and the model rejects this truck.

For each loader, the manufacturer specifies its maximum dumping height. This height allows the bucket or dipper of the loading equipment to reach above the truck body to load the truck. The truck manufacturer also specifies a required loading height for the loader. Obviously, the dumping height of the loader must be greater than the required loading height of the truck.

If the engineer specifies parameter ICASE = 1, the truck is being loaded on a berm. The height of the berm increases the height which the loader must be able to reach to load the truck. Therefore, for Case 1, the loader's dumping height must be greater than the height of the berm above the loader's base plus the required loading height of the truck.

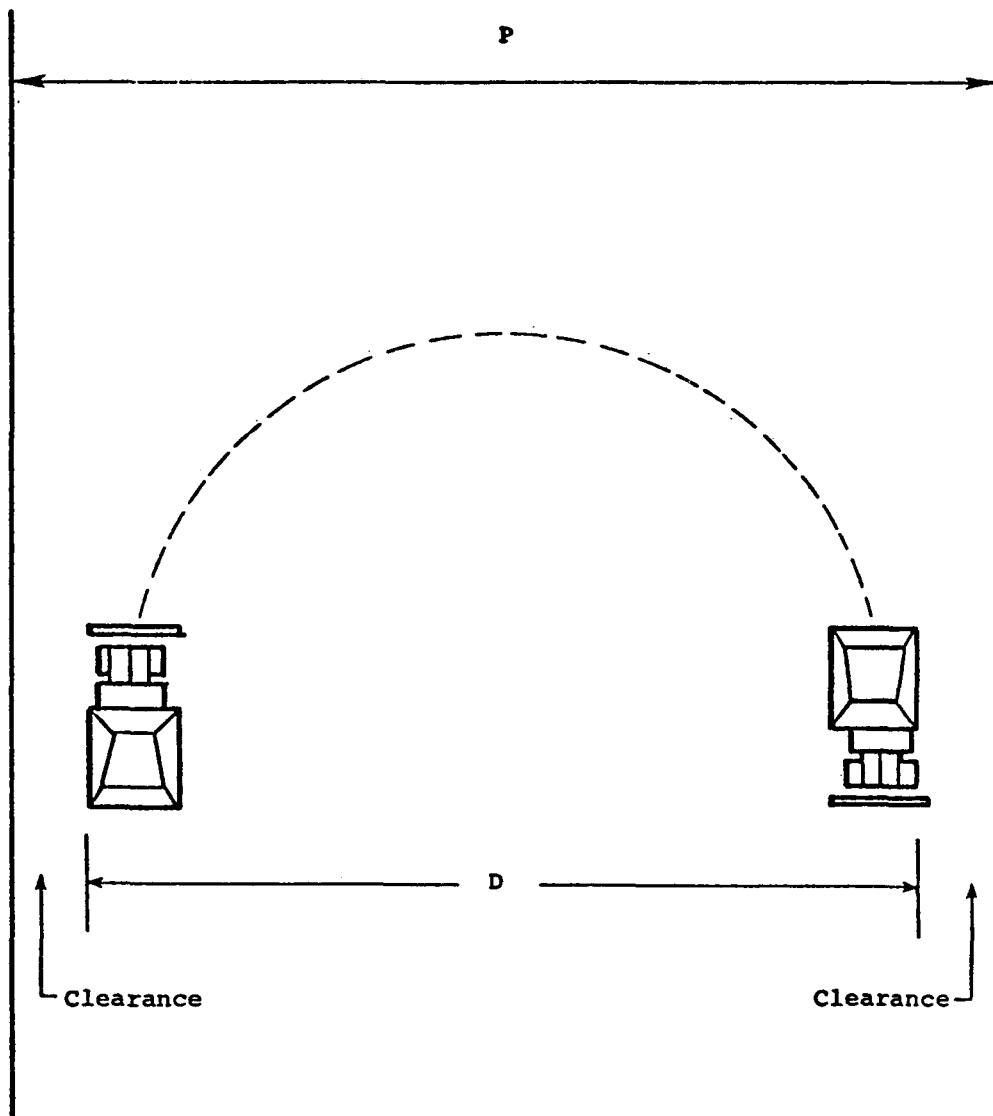


Figure 2-5. Truck Turning Circle

The final requirement placed on the loading equipment is that its physical dimensions must fit within the panel width. This requirement is governed by two parameters: the ICASE value assigned by the user, and the actual piece of loading equipment being used (either a shovel or front-end loader). The following equations apply to shovels and trucks:

- ▣ ICASE = 1 or 2 (see Figure 2-6)
MINP = (2 x CLO) + (TW/2) + SDR + SRC
- ▣ ICASE = 3 (see Figure 2-7)
MINP = SDR + SRC + (2 x CLO)
- ▣ ICASE = 4 (see Figure 2-8)
MINP = (2 x SDR) + TW + (2 x CLO)

In these equations, SDR represents the shovel dump radius, SRC is the shovel rear-end clearance, CLO is the clearance for operation, and TW is the truck width.

The following equations describe the same minimum dimensions required by the front-end loader and truck combination:

- ▣ ICASE = 1 or 2 (see Figure 2-9)
MINP = (2 x CLO) + (TW/2) + FCC
- ▣ ICASE = 3 (see Figure 2-10)
MINP = CLO + FCC
- ▣ ICASE = 4 (see Figure 2-11)
MINP = (2 x CLO) + TW + FCC

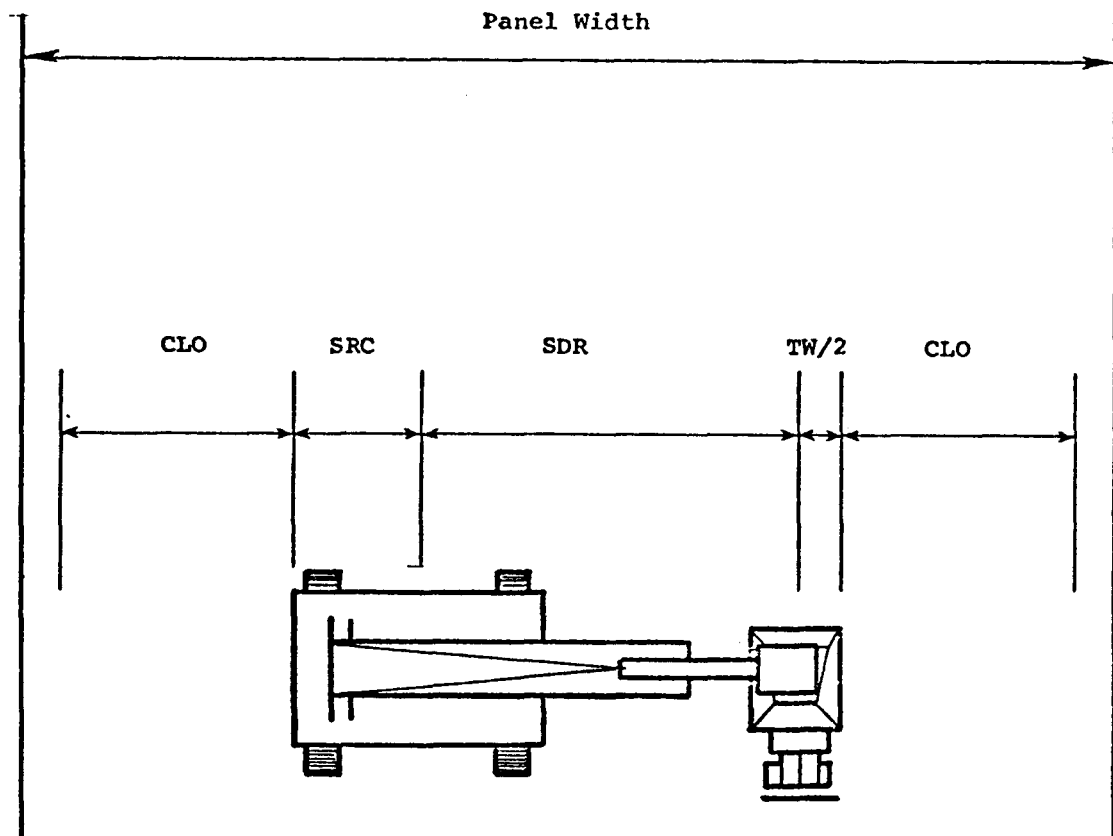


Figure 2-6. Shovel and Truck Dimensions
ICASE = 1 or 2

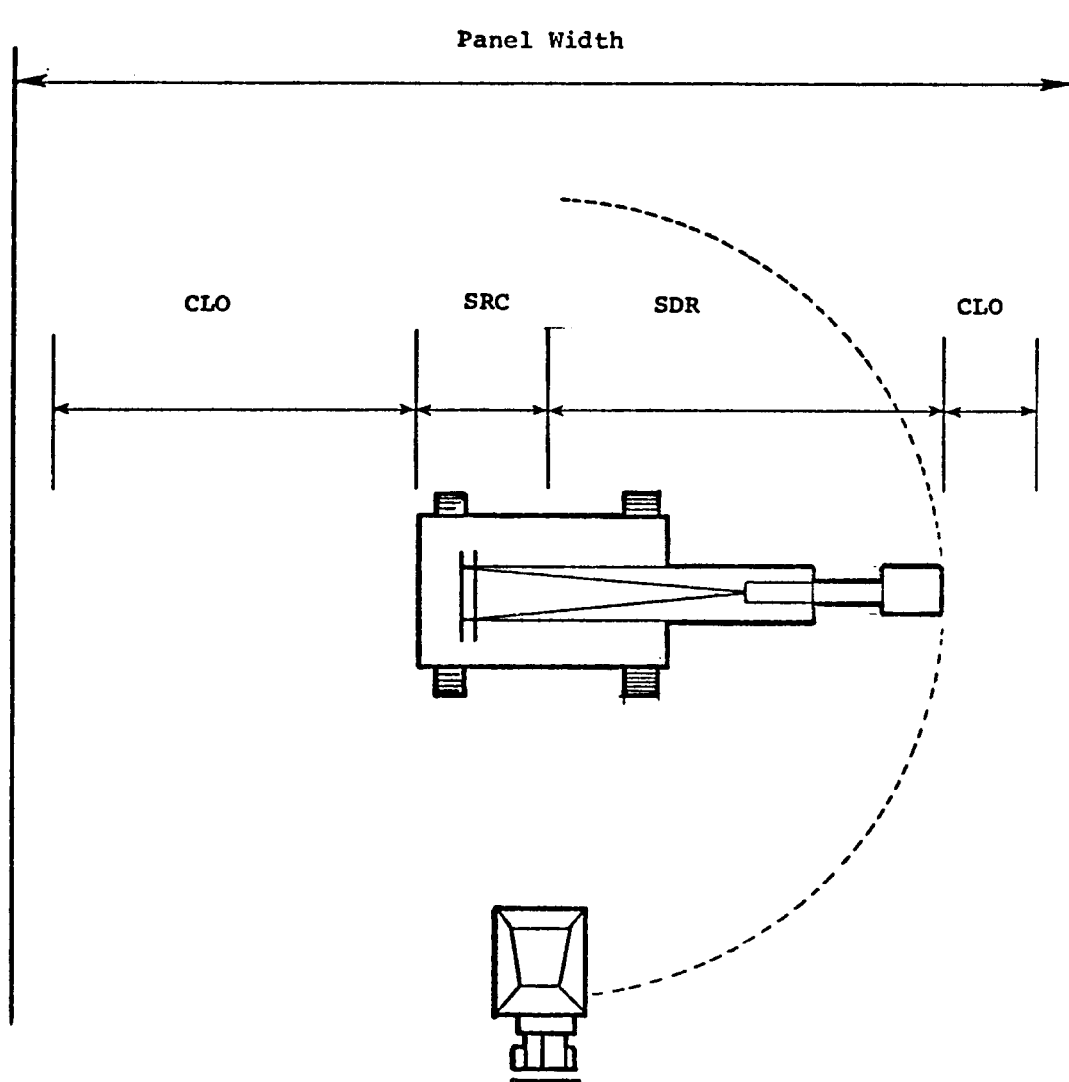


Figure 2-7. Shovel and Truck Dimensions
ICASE = 3

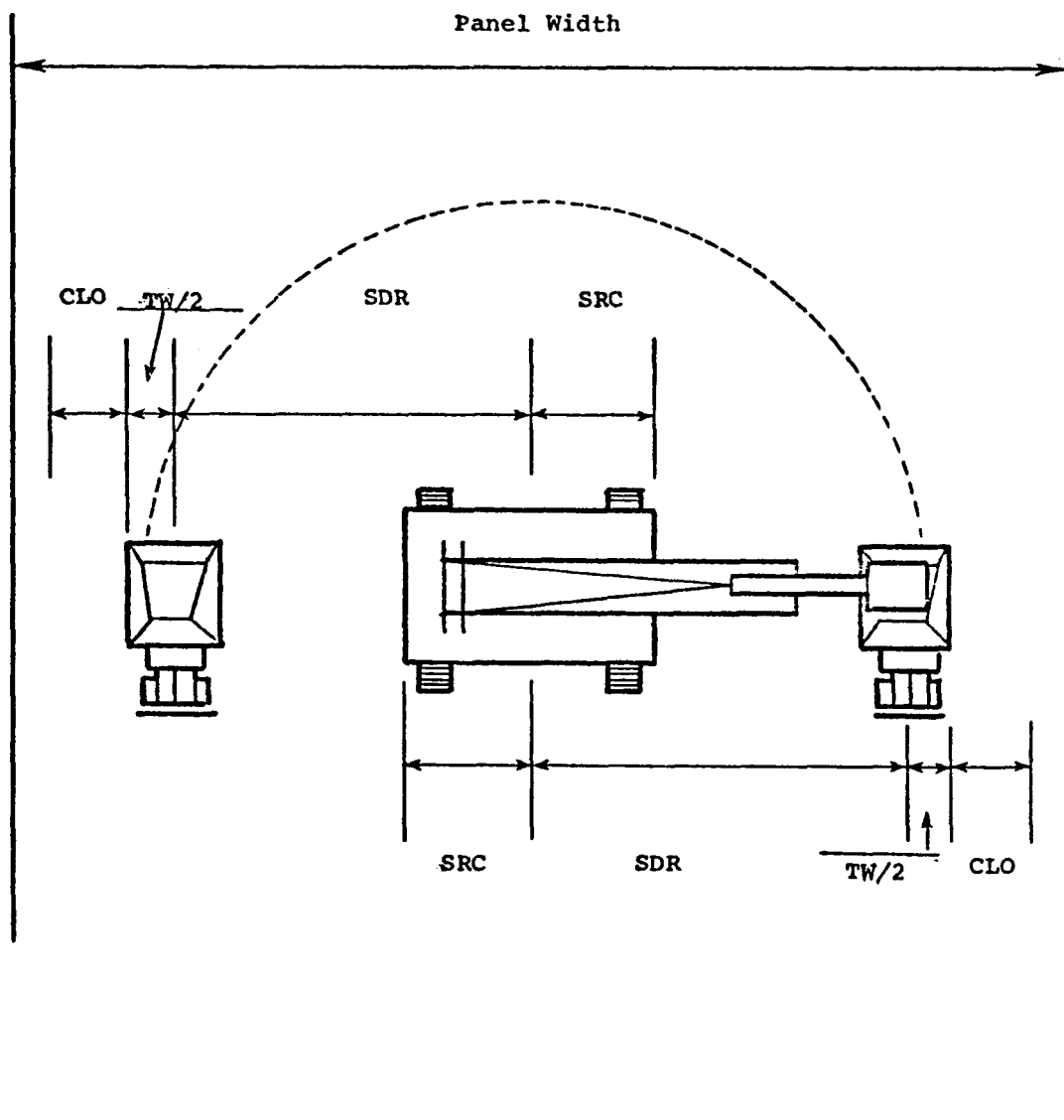


Figure 2-8. Shovel and Truck Dimensions
ICASE = 4.

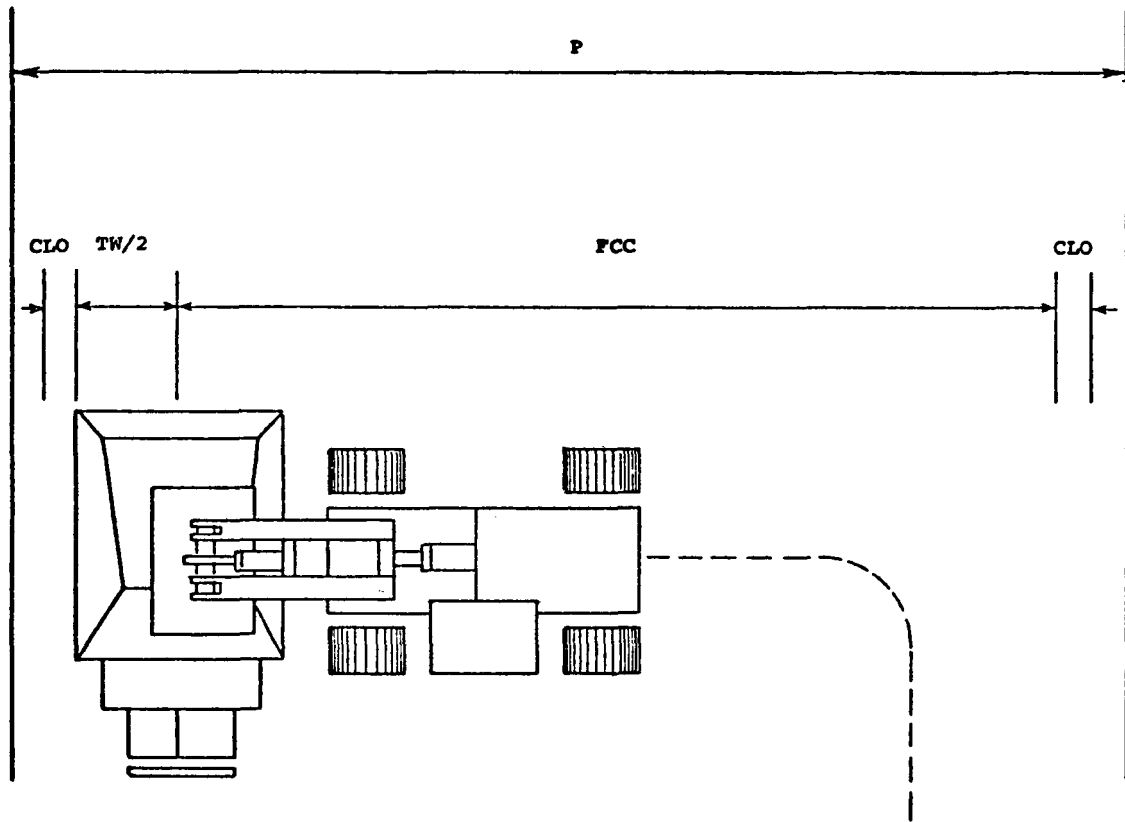


Figure 2-9. Front-end Loader - Truck Dimensions
ICASE = 1 or 2

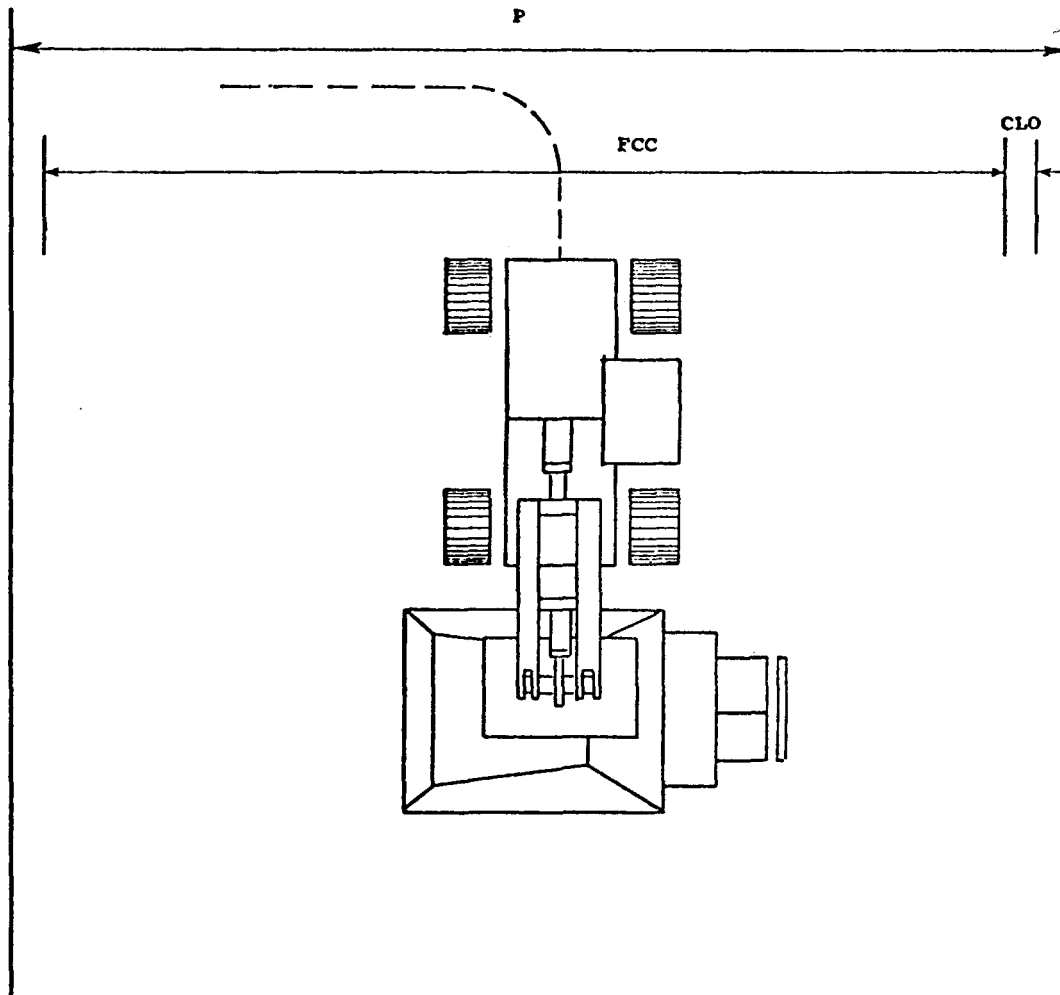


Figure 2-10 Front-end Loader - Truck Dimensions
ICASE = 3

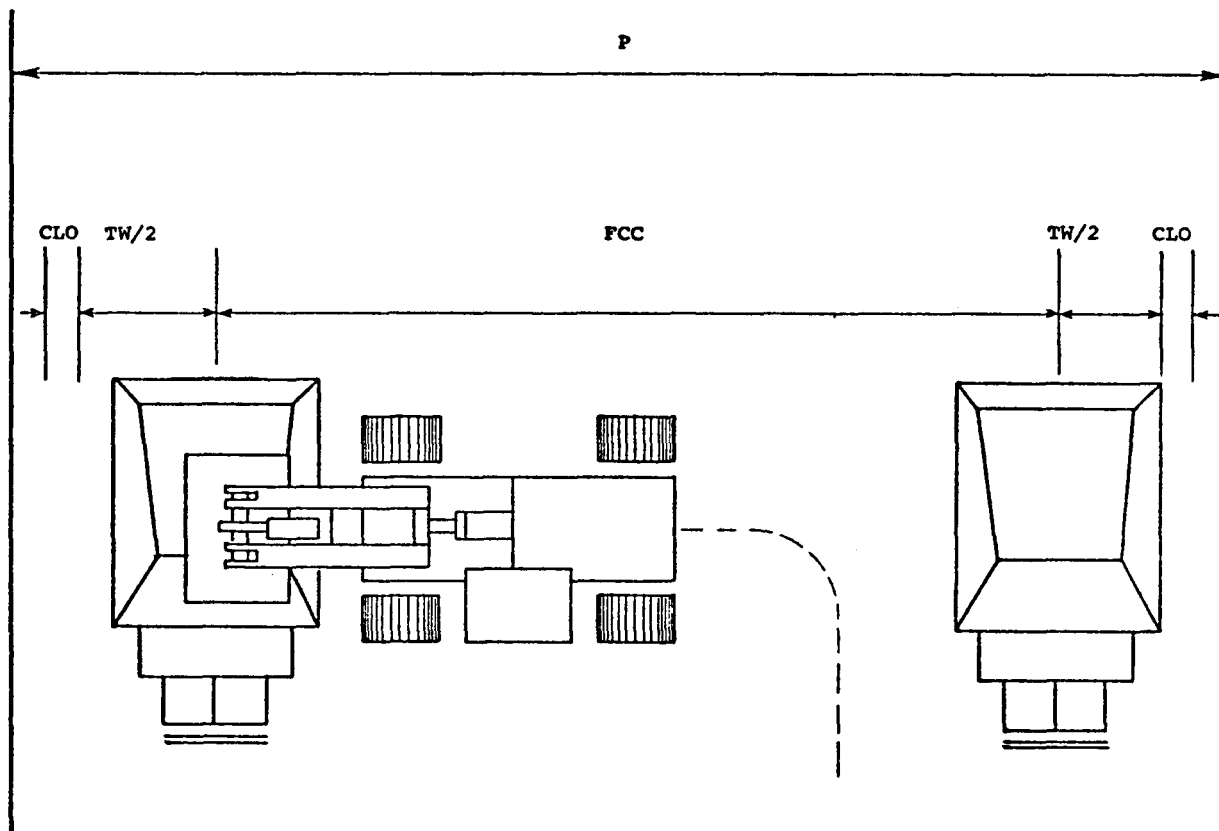


Figure 2-11. Front-end Loader - Truck Dimensions
ICASE = 4.

In these equations, FCC is the front-end loader clearance circle, and CLO and TW represent the same dimensions as in the shovel-truck equations.

If the loader-truck combination fails to meet any of the previously discussed requirements, the combination is not acceptable to the model. The model output indicates which of the above requirements were met by the combination and which were not. This output is discussed in Section 4.

The model assumes the loader-truck combination is acceptable if it meets these four requirements. If the combination does not meet these requirements, the model considers the combination physically unsuitable and drops it from further consideration.

There are certain qualitative factors which influence an engineer in his selection of the loading equipment, and these may or may not be handled to his satisfaction in the model. To permit the engineer to exercise judgment based on factors not modeled, the model provides a complete log of its actions. (This log is explained in Section 4).

SECTION 3
MODEL INPUT

The model input form is shown in Figure 3-1. The models are designed to run one or more cases in a series, at one time. The user repeats the set of input definition forms for the cases desired. For the first case of all series, all parameters must be set. For all subsequent cases, only the parameters whose values are to be changed must be set. That is, the model remembers all parameters from one case to the next, and the values remain the same unless reset by the user.

The variable names used in the model are explained in Table 1.

The LOG variables control printing by the models. They are "0/1" variables. The user sets them to 0 (meaning "off" or "no") or 1 (meaning "on" or "yes"). If the parameter is on, control printing occurs; if it is off, printing does not occur.

As previously noted, parameter ICASE controls the method of operation the model will use for coal loading:

- If ICASE = 1, the loader loads the truck on a berm at the side of the loader.
- If ICASE = 2, the loader loads the truck beside the loader, but not on a berm.
- If ICASE = 3, the loader loads the truck behind the loader.
- If ICASE = 4, the loader loads two trucks, one on each side of the loader.

cc	1	9	10	12	22
	ICASE	=			Method of Operation (1, 2, 3, or 4)
	KMED	=			Loading Medium (0 or 1)
	OSQHY	=			Loader Scheduled Hours/Year
	OPQHY	=			Loader Productive Hours/Year
	QCTM	=			Loader Cycle Time (minutes)
	EQO	=			Efficiency of Loader Operation (fraction)
	FF	=			Fill Factor (fraction)
	MINNC	=			Minimum Number of Swings
	MAXNC	=			Maximum Number of Swings
	CLO	=			Clearance of Operation (feet)
	ETO	=			Efficiency of Truck Operation (fraction)
	TA	=			Truck Availability (fraction)
	OSTHY	=			Truck Scheduled Hours/Year
	OPTHY	=			Truck Productive Hours/Year
	PLT	=			Payload Tolerance (fraction)
	NCS	=			Number of Cuts to Remove Material (ICASE=1)
	IDEP	=			Depreciation Switch (0 or 1)
If KMED = 0:					
	HC	=			Height of Coal (feet)
	ECR	=			Expected Coal Recovery (fraction)
	ACRT	=			Available Coal in Recoverable Tons (M tons)
	CDRTY	=			Coal Demand (recoverable tons/year)
	DCBPY	=			Density of Coal (bank pounds/yard)
	SFC	=			Swell Factor of Coal (fraction)
If KMED = 1:					
	HB	=			Height of Overburden (feet)
	ABBY	=			Area Overburden (bank cubic yards)
	BDBYY	=			Overburden Demand (cubic yards/year)
	DBBPY	=			Density of Overburden (bank pounds/ cubic yard)
	SFB	=			Swell Factor of Overburden (fraction)

Figure 3-1. Coal Loading Simulation Input Parameter Form

TABLE 1
LAH PARAMETER AND VARIABLE NAMES

(Sheet 1 of 4)

Name	Input/ Calculation	Description	Units	Definition
AANGS	c	Actual Angle of Swing	degrees	Angle of swing of the loader in the actual coal loading method operation.
ABBY	i	Area Overburden	cubic yards	Area overburden, in bank cubic yards.
ACRT	i	Area Coal in Recoverable Tons	million tons	Total weight of coal expected to be recovered.
BDBYY	i	Overburden Demand	cubic yards/ year	Overburden demand, in bank cubic yards/year.
CDRTY	i	Coal Demand	tons/year	Coal demand, in recovered tons/year.
CLH	c	Clearance Height	feet	Height of coal berm above pit floor.
CLO	i	Clearance of Operation	feet	Operational clearance at highwall and spoil sides of the coal loading equipment.
DBBPY	i	Density of Overburden	pounds/yard	Density of bank overburden, in pounds/yard.
DCBPY	i	Density of Coal	pounds/yard	Density of bank coal, in pounds/yard.
ECR	i	Expected Coal Recovery	fraction	Fraction of in-place coal that can be recovered (1 minus pit losses).
EQO	i	Efficiency of Loader Operation	fraction	Fraction of efficiency loader is expected to maintain in one hour (number of loading minutes/hour is 60 x EQO).
ETO	i	Efficiency of Truck Operation	fraction	Fraction of efficiency truck is expected to maintain in one hour (the number of hauling minutes/hour x ETO).

TABLE 1
LAH PARAMETER AND VARIABLE NAMES

(Sheet 2 of 4)

Name	Input/ Calculation	Description	Units	Definition
FF	i	Fill Factor	fraction	Loader bucket or dipper fill factor.
HB	i	Height of Overburden	feet	Height of overburden.
HC	i	Height of Coal	feet	Height of coal.
ICASE	i	Method of Operation		Method of operation the model is to simulate for coal loading and hauling (1, 2, 3, or 4).
IDEP	i	Depreciation Switch		Controls total ownership cost of equipment for mine life. If "1", model pays entire investment cost of equipment even if mine life is shorter than depreciation life of equipment. If "0", model does not pay.
KMED	i	Loading Medium		Loading medium (0 = coal, 1 = overburden).
LOGIV	i	Log Intermediate Variables		Controls printing of intermediate variable values (0 = No; 1 = Yes).
LOGPA	i	Log Parameters		Controls printing of input parameter values (0 = No; 1 = Yes).
LOGRJ	i	Log Rejects		Controls printing of combinations rejected by the model (0 = No; 1 = Yes).
LOGSM	i	Log Selected Combination		Controls printing of selected combinations (0 = No; 1 = Yes). Does not affect summary listing which is always printed.
MAXNC	i	Maximum Number of Loader Swings to Load		Maximum number of allowed swings the loader may take to load the truck.
MINNC	i	Minimum Number of Loader Swings to Load		Minimum number of swings required for the loader to load the truck.

TABLE 1
LAH PARAMETER AND VARIABLE NAMES
 (Sheet 3 of 4)

Name	Input/ Calculation	Description	Units	Definition
NCS	i	Number of Cuts to Remove		Number of cuts or passes the coal loading equipment will make to remove the coal. (Only used when ICASE = 1 and height of coal is obviously too large to expected the loading equipment to reach the top of the truck on a berm.)
OPQHY	i	Loader Productive Hours	hours/year	Number of hours the loader is actually expected to operate, taking into account maintenance, weather, and so on. Used to convert hourly production to annual.
OPTHY	i	Truck Productive Hours	hours/year	Number of hours the truck is actually expected to operate, taking into account maintenance, weather, and so on. Used to convert hourly production to annual.
OSQHY	i	Loader Scheduled Hours	hours/year	Scheduled hours/year the loader is to work. Used to convert hourly O&O costs from the loader file to annual cost to determine the cost of coal loading.
OSTHY	i	Truck Scheduled Hours	hours/year	Scheduled hours/year the truck is to work. Used to convert hourly O&O costs from the truck file to annual cost to determine the cost of haulage.
P	i	Panel Width	feet	Width of the panel.

TABLE 1
LAH PARAMETER AND VARIABLE NAMES
 (Sheet 4 of 4)

Name	Input/ Calculation	Description	Units	Definition
PLT	i	Payload	fraction	Fraction of overload above rated payload allowed by the user.
QCTM	i	Loader Cycle Time	minutes	Estimated average swing time for the loader, based on a 90° swing.
QCTMA	c	Actual Loader Cycle Time	minutes	Actual swing time for the loader adjusted by the actual angle of swing.
QEMH	c	Loader Effective Minutes	minutes	Number of minutes/hour the loader will actually work, taking into account the loader efficiency factor (EQO).
QNSH	c	Loader Number of Swings		Number of swings the loader can make in one hour, taking into account the loader effective minutes/hour and the actual loader cycle time as adjusted by angle of swing.
SFB	i	Swell Factor of Overburden	fraction	Fraction of expected swell or increase in volume of the overburden from the bank to the loose condition.
SFC	i	Swell Factor of Coal	fraction	Fraction of expected swell or increase in volume of the coal from the bank to loose condition.
TA	i	Truck Availability	fraction	Fraction of availability of the truck in the fleet expected. Used to size truck fleet to compensate for in-shop maintenance on trucks.

SECTION 4
MODEL OUTPUT

Figure 4-1 is a copy of a run of the CLH model for a single case. To reduce the volume of paper in this example output, the full data files for the shovels and trucks were reduced.

The following paragraphs discuss the model output by referring to sheets in Figure 4-1. Note that each sheet of the output is headed with a standard line giving:

- ▣ The date of the run.
- ▣ The run number.
- ▣ The title of the output to be printed.

The engineer can solve any number of cases with a single model run by defining the appropriate sets of input parameters.

If switch LOGPA is "on" (value of 1), the first sheet of the output will be a listing of the values of all input parameters. Sheet 1 of Figure 4-1 of the model output shows this listing. If switch LOGIV is "on", Sheet 2 will be a listing of all values of the intermediate variables. The meanings of these parameters and variable names are explained in Table 1.

Sheets 3 through 10 of the model output result from setting switches LOGRJ and LOGSM "on"; that is, both acceptable machines and rejects are logged. The abbreviations used on these pages are explained in Table 2.

The information provided on Sheets 3 through 10 is explained below by referring specifically to Sheet 6. The circled numbers on this page correspond to the following:

- 1) This line is the "base line data". It displays specification and production data for the shovel. The first two items on the line identify the shovel and give its model number. The abbreviations on the preceding print line label the values. The item labeled CUYD is the cubic yard capacity of the shovel. The item labeled TONS is the tons/bucket load that the shovel bucket will hold. The item labeled MIN/OP is the minutes/operation it takes the shovel to load a truck; in this case, 4.0. The item labeled OP/HR is the trucks/hour the shovel can load. The next two items labeled UNT/HR and MUNT/YR are the production figures for the shovel, in tons/hour and thousands of tons/year. The production figures listed for the shovel are theoretical production figures, assuming no wait time for spotting the truck.
- 2) This line presents the application information for the truck. The model number of the truck is listed under the title ID. The truck's rated payload capacity appears under TONS. MIN/OP reflects the minutes/operation for the truck, or the haulage cycle time. The number of trips the truck can make in one hour is indicated under OP/HR. The next two items are the theoretical production in tons/hour and thousands of tons/year the truck can maintain. These production figures were obtained using the actual loading time for the shovel printed in the previous line.

- 3) The possible line presents the results when the loader and truck were taken in combination at their maximum production rate. The information on the left-hand side of the fifth line preceding the heading C\$/UNT are the ownership and operating cost and the dollars/ton for the shovel at the maximum production rate. The information to the right of the heading C\$/UNT reflects the ownership and operating cost of the fleet of trucks the model recommends to maintain maximum production. Consider the left half of the line first. Since the model is examining the maximum capacity of one shovel with a fleet of trucks, the columns headed I MM\$ and O MM\$ are the investment and operating costs for the shovel. The column headed \$/UNT is the dollars/ton obtained by spreading the investment and operating costs of the shovel over the area of coal to be recovered.

On the right-hand side of the line is the information which pertains to the truck fleet as designed by the model. The two figures under the number signs (14.14 and 15) are the fleet sizes calculated by the model. The 14.14 is the number of trucks needed without truck availability having been taken into account. When the truck availability is considered, the model increases the number of trucks in the fleet to 15. With 15 trucks in the fleet, the investment cost is \$8.146 million and the operating cost is \$19.399 million over the life of the mining complex, resulting in \$0.505/ton for the truck operation. At maximum capacity, one shovel and 15 trucks can load and haul 4,461,300 tons of coal/year, resulting in the entire area being loaded and hauled in 12.2 years.

- 4) The required line represents ownership and operating cost (in dollars/ton) of the shovel and truck fleet as assigned by the model at the user's specified production rate. In this case, the user's demand rate is 1,817,179 tons of coal/year. Since the demand rate is less than the maximum production rate for one shovel, only one shovel is needed to maintain the demand rate. At the user's rate, only six trucks are recommended by the model to sustain production.

Note the differences in the investment and operating cost. This results from an increased amount of operating hours needed to remove the coal at the slower rate. The years to recover coal becomes 30 years rather than 12.2 years, thus increasing ownership and operating costs for all pieces of equipment. Likewise, the combined dollars/ton increases from \$0.586 to \$0.700.

Letters may appear at the right-hand side of this line. These letters indicate non-acceptance of the shovel-truck combination:

- P - The physical dimensions of the shovel truck combination do not fit within the panel width.
- D - The dumping height of the shovel is not sufficient to reach the top of the truck.
- T - The turning circle of the truck does not fit within the panel dimension.

- S - The number of swings it takes to load the truck using this shovel does not fall within the range specified by the user as the minimum maximum number of swings allowed for the shovel.

The absence of the letter indicates the shovel-truck combination meets that requirement, while the presence of the letter indicates that the requirement has not been met.

By examining the remainder of Figure 4-1, it should be noted that all of the shovel-truck combinations in this particular case were acceptable. The method of operation selected by the user in this run was ICASE = 1, i.e., the truck is being loaded on a berm.

INPUT FACTORS USED IN COAL LOAD AND HAUL SIMULATION 07/20/76 RUN NO. = 1

0501 (ICLH0501) ILLINOIS BASIN
1 COAL LOAD AND HAUL SIMULATION

LOAD AND HAUL MEDIUM - 0=COAL, 1=0.8,	0, KMED
SHOVEL-SCHEDULED HOURS PER YEAR	3625,00 QSQHY
SHOVEL-PRODUCTIVE HOURS PER YEAR	3262,50 UPQHY
SHOVEL CYCLE TIME IN MINUTES	,50 QCTH
EFFICIENCY OF SHOVEL OPERATIONS	,83 EQD
SHOVEL DIPPER FILL FACTOR	,95 FF
MINIMUM NUMBER OF SHOVEL SWINGS TO LOAD	4,0 MINNC
MAXIMUM NUMBER OF SHOVEL SWINGS TO LOAD	20,0 MAXNC
PANEL WIDTH	100,00 P
HEIGHT OF COAL	4,00 HC
EXPECTED COAL RECOVERY	,92 ECR
AREA COAL IN RECOVERABLE MILLION TONS	54,52 ACRT
COAL DEMAND	1817179, CORTY
DENSITY OF COAL - BANK	2160,00 UCBPY
SWELL FACTOR OF COAL	,35 SFC
CLEARANCE OF OPERATION	2,00 CLD
EFFICIENCY OF TRUCK OPERATION	,83 ETD
TRUCK AVAILABILITY	1,00 TA
TRUCK-SCHEDULED HOURS PER YEAR	3625,00 DSTHY
TRUCK-PRODUCTIVE HOURS PER YEAR	3262,50 DPTHY
PAYLOAD TOLERANCE	,10 PLT
METHOD OF OPERATION	1,00 ICASE
NUMBER OF CUTS TO REMOVE MATERIAL	1,0 NCS
DEPRECIATION SWITCH	,0 IDEP

CASE = 1 ---TRUCK LOADED ON BERM BY SHOVEL

Figure 4-1. Sample Model Run (Sheet 1 of 12)

INTERMEDIATE VARIABLES CALCULATED BY SIMULATION 07/20/76 RUN NO. = 1

0501 (ICLH0501) ILLINOIS BASIN
1 COAL LOAD AND HAUL SIMULATION

ACTUAL ANGLE OF SWING	90.0 AANGS
ACTUAL SHUVEL CYCLE TIME	,50 QCTMA
SHUVEL EFFECTIVE MINUTES PER HOUR	50.0 SEMH
NUMBER OF SHUVEL SWINGS PER HOUR	100.0 SNSH
HEIGHT OF BERM ABOVE FLOOR - CASE 1	4.0 CLH
COAL ACRES	8502,76 CAF

Figure 4-1. Sample Model Run (Sheet 2 of 12)

SHUVEL - TRUCK BASIC DATA

07/20/76 RUN NO. = 1

0501 (ICLH0501) ILLINOIS BASIN

1 COAL LOAD AND HAUL SIMULATION

ID	CUYD	TONS	MIN/UP	OP/HR	UNT/HR	MUNT/YR									
SHVL B155 4537C	15	11.4	4.5	11.1	1139.5	3717.8									
TRK A350PHC100TM		102.6	57.4	.9	89.3	291.3									
#	I MM\$	Q MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	I MM\$	Q MM\$	#	#	MUNT/YR	YRTC			
POSS 1	1.725	2.389	.075	.617	3955,	.541	8.493	21.022	12.76	13	3717.8	14.7			
REQ 1.00	3.529	4.888	.154	.712	4563,	.557	9.357	21.022	6.24	7		30.0			
SHVL B155 4537C	15	11.4	4.5	11.1	1139.5	3717.8									
TRK A350PHC100TM		102.6	57.3	.9	89.4	291.8									
#	I MM\$	Q MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	I MM\$	Q MM\$	#	#	MUNT/YR	YRTC			
POSS 1	1.725	2.389	.075	.615	3946,	.540	8.472	20.966	12.74	13	3717.8	14.7			
REQ 1.00	3.529	4.888	.154	.710	4553,	.556	9.333	20.966	6.23	7		30.0			
SHVL B155 4537C	15	11.4	4.5	11.1	1139.5	3717.8									
TRK E100CHC100TM		102.6	49.8	1.0	102.9	335.7									
#	I MM\$	Q MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	I MM\$	Q MM\$	#	#	MUNT/YR	YRTC			
POSS 1	1.725	2.389	.075	.769	4934,	.694	13.634	24.204	11.07	12	3717.8	14.7			
REQ 1.00	3.529	4.888	.154	.854	5477,	.700	13.946	24.204	5.41	6		30.0			
SHVL B155 4537C	15	11.4	5.5	9.1	1139.5	3717.8									
TRK E120CHC120TM		125.4	53.7	.9	116.7	380.7									
#	I MM\$	Q MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	I MM\$	Q MM\$	#	#	MUNT/YR	YRTC			
POSS 1	1.725	2.389	.075	.693	4441,	.617	11.554	22.092	9.76	10	3717.8	14.7			
REQ 1.00	3.529	4.888	.154	.776	4978,	.622	11.819	22.092	4.77	5		30.0			
SHVL B155 4537C	15	11.4	8.5	5.9	1139.5	3717.8									
TRK U8D180U180TE		193.8	52.7	.9	183.7	599.2									
#	I MM\$	Q MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	I MM\$	Q MM\$	#	#	MUNT/YR	YRTC			
POSS 1	1.725	2.389	.075	.518	3321,	.443	7.639	16.488	6.20	7	3717.8	14.7			
REQ 1.00	3.529	4.888	.154	.621	3979,	.466	8.931	16.488	3.03	4		30.0			

Figure 4-1. Sample Model Run (Sheet 3 of 12)

ID	CUYD	TONS	MIN/UP	DP/HR	UNT/HR	MUNT/YR								
SHVL B155 4537C	15	11.4	4.5	11.1	1139.5	3717.8								
TRK W050T C100TM		102.6	47.5	1.1	108.0	352.4								
	#	I MM\$	O MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	I MM\$	O MM\$	#	#	MUNT/YR	YRTC	
POSS 1	1	1,725	2,389	.075	.643	4124,	.568	10,200	20,752	10.55	11	3717.8	14.7	
REQ 1.00	3,529	4,888	.154	.744	4769,	.589	11.382	20,752	5.16	6			30.0	

ID	CUYD	TONS	MIN/UP	DP/HR	UNT/HR	MUNT/YR								
SHVL B155 4537C	15	11.4	4.5	11.1	1139.5	3717.8								
TRK W050T D100TM		102.6	47.5	1.1	108.0	352.4								
	#	I MM\$	O MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	I MM\$	O MM\$	#	#	MUNT/YR	YRTC	
POSS 1	1	1,725	2,389	.075	.643	4124,	.568	10,200	20,752	10.55	11	3717.8	14.7	
REQ 1.00	3,529	4,888	.154	.744	4769,	.589	11.382	20,752	5.16	6			30.0	

Figure 4-1. Sample Model Run (Sheet 3 of 12) (Cont'd)

SHVEL - TRUCK BASIC DATA

07/20/76 RUN NO, = 1

0501 (ICLH0501) ILLINOIS BASIN

1 COAL LOAD AND HAUL SIMULATION

ID	CUYD	TONS	MIN/OP	OP/HR	UNT/HR	MUNT/YR								
SHVL B155 4537C	15	11.4	5.5	9.1	1139.5	3717.8								
TRK W075B C120TM		125.4	52.2	1.0	120.1	391.9								
#	I MM\$	Q MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	I MM\$	Q MM\$	#	#	MUNT/YR	YRTC		
POSS 1	1.725	2.389	.075	.614	3937,	.539	8.845	20,520	9.49	10	3717.8	14.7		
REQ 1.00	3.529	4.888	.154	.697	4467,	.542	9.048	20,520	4.64	5		30.0		
ID	CUYD	TONS	MIN/OP	OP/HR	UNT/HR	MUNT/YR								
SHVL B155 4537C	15	11.4	5.5	9.1	1139.5	3717.8								
TRK W075B D120TM		125.4	52.2	1.0	120.1	391.9								
#	I MM\$	Q MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	I MM\$	Q MM\$	#	#	MUNT/YR	YRTC		
POSS 1	1.725	2.389	.075	.614	3937,	.539	8.845	20,520	9.49	10	3717.8	14.7		
REQ 1.00	3.529	4.888	.154	.697	4467,	.542	9.048	20,520	4.64	5		30.0		
ID	CUYD	TONS	MIN/OP	OP/HR	UNT/HR	MUNT/YR								
SHVL B155 4537C	15	11.4	7.0	7.1	1139.5	3717.8								
TRK W150CTC150TM		159.6	50.8	1.0	156.9	512.0								
#	I MM\$	Q MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	I MM\$	Q MM\$	#	#	MUNT/YR	YRTC		
POSS 1	1.725	2.389	.075	.580	3719,	.505	8.396	19,112	7.26	8	3717.8	14.7		
REQ 1.00	3.529	4.888	.154	.662	4248,	.508	8.588	19,112	3.55	4		30.0		
ID	CUYD	TONS	MIN/OP	OP/HR	UNT/HR	MUNT/YR								
SHVL B195 4756C	16	12.2	4.5	11.1	1215.5	3965.6								
TRK A350PHC100TM		109.4	57.4	.9	95.2	310.7								
#	I MM\$	Q MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	I MM\$	Q MM\$	#	#	MUNT/YR	YRTC		
POSS 1	2.299	2.723	.092	.600	3845,	.508	7.963	19,708	12.76	13	3965.6	13.7		
REQ 1.00	5.018	5.942	.201	.710	4550,	.509	8.020	19,708	5.85	6		30.0		
ID	CUYD	TONS	MIN/OP	OP/HR	UNT/HR	MUNT/YR								
SHVL B195 4756C	16	12.2	4.5	11.1	1215.5	3965.6								
TRK A350PHU100TM		109.4	57.3	.9	95.4	311.3								
#	I MM\$	Q MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	I MM\$	Q MM\$	#	#	MUNT/YR	YRTC		
POSS 1	2.299	2.723	.092	.598	3836,	.506	7.942	19,656	12.74	13	3965.6	13.7		
REQ 1.00	5.018	5.942	.201	.708	4541,	.507	7.999	19,656	5.84	6		30.0		

Figure 4-1. Sample Model Run (Sheet 4 of 12)

		IO	CUYD	TONS	MIN/OP	OP/HR	UNT/HR	MUNT/YR								
SHVL	B195	4756C	16	12.2	4.5	11.1	1215.5	3965.6								
TRK	E100CHC100TM			109.4	49.8	1.0	109.8	358.1								
		#	I MM\$	O MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	I MM\$	O MM\$	#	#	MUNT/YR	YRTC		
	POSS	1	2,299	2,723	.092	.743	4763,	.651	12,781	22,691	11.07	12	3965.6	13.7		
	REQ	1.00	5,018	5,942	.201	.873	5598,	.672	13,946	22,691	5.07	6		30.0		
SHVL	B195	4756C	16	12.2	5.0	10.0	1215.5	3965.6								
TRK	E120CHC120TM			121.6	53.0	.9	114.8	374.4								
		#	I MM\$	O MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	I MM\$	O MM\$	#	#	MUNT/YR	YRTC		
	POSS	1	2,299	2,723	.092	.723	4634,	.631	11,915	22,464	10.59	11	3965.6	13.7		
	REQ	1.00	5,018	5,942	.201	.830	5321,	.629	11,819	22,464	4.85	5		30.0		

Figure 4-1. Sample Model Run (Sheet 4 of 12) (Con'td)

SHOVEL - TRUCK BASIC DATA

07/20/76 RUN NO. = 1

0501 (ICLH0501) ILLINOIS BASIN
1 COAL LOAD AND HAUL SIMULATION

ID	CUYD	TONS	MIN/OP	OP/HR	UNT/HR	MUNT/YR							
SHVL B195 4756C	16	12.2	8.0	6.2	1215.5	3965.6							
TRK URD180U180TE		194.6	52.0	1.0	187.0	610.2							
#	I MM\$	Q MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	I MM\$	Q MM\$	#	#	MUNT/YR	YRTC	
POSS 1	2,299	2,723	.092	.520	3337,	.428	7,162	16,190	6.50	7	3965.6	13.7	
REQ 1.00	5,018	5,942	.201	.621	3981,	.420	6,698	16,190	2.98	3		30.0	
ID	CUYD	TONS	MIN/OP	OP/HR	UNT/HR	MUNT/YR							
SHVL B195 4756C	16	12.2	4.5	11.1	1215.5	3965.6							
TRK W050T C100TM		109.4	47.5	1.1	115.2	375.9							
#	I MM\$	Q MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	I MM\$	Q MM\$	#	#	MUNT/YR	YRTC	
POSS 1	2,299	2,723	.092	.624	4003,	.532	9,562	19,455	10.55	11	3965.6	13.7	
REQ 1.00	5,018	5,942	.201	.732	4693,	.531	9,485	19,455	4.83	5		30.0	
ID	CUYD	TONS	MIN/OP	OP/HR	UNT/HR	MUNT/YR							
SHVL B195 4756C	16	12.2	4.5	11.1	1215.5	3965.6							
TRK W050T D100TM		109.4	47.5	1.1	115.2	375.9							
#	I MM\$	Q MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	I MM\$	Q MM\$	#	#	MUNT/YR	YRTC	
POSS 1	2,299	2,723	.092	.624	4003,	.532	9,562	19,455	10.55	11	3965.6	13.7	
REQ 1.00	5,018	5,942	.201	.732	4693,	.531	9,485	19,455	4.83	5		30.0	
ID	CUYD	TONS	MIN/OP	OP/HR	UNT/HR	MUNT/YR							
SHVL B195 4756C	16	12.2	5.0	10.0	1215.5	3965.6							
TRK W075B C120TM		121.6	51.4	1.0	118.2	385.6							
#	I MM\$	Q MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	I MM\$	Q MM\$	#	#	MUNT/YR	YRTC	
POSS 1	2,299	2,723	.092	.642	4116,	.550	9,121	20,857	10.29	11	3965.6	13.7	
REQ 1.00	5,018	5,942	.201	.750	4806,	.549	9,048	20,857	4.71	5		30.0	
ID	CUYD	TONS	MIN/OP	OP/HR	UNT/HR	MUNT/YR							
SHVL B195 4756C	16	12.2	5.0	10.0	1215.5	3965.6							
TRK W075B D120TM		121.6	51.4	1.0	118.2	385.6							
#	I MM\$	Q MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	I MM\$	Q MM\$	#	#	MUNT/YR	YRTC	
POSS 1	2,299	2,723	.092	.642	4116,	.550	9,121	20,857	10.29	11	3965.6	13.7	
REQ 1.00	5,018	5,942	.201	.750	4806,	.549	9,048	20,857	4.71	5		30.0	

Figure 4-1. Sample Model Run (Sheet 5 of 12)

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SHVL	B195	4756C	CUYD	16	TONS	12.2	MIN/OP	6.5	OP/HR	7.7	UNT/HR	1215.5	MUNT/YR	3965.6					
TKK	W150CTC150TM					159.1		50.1		1.0		157.8		514.7					
		#	1	MM\$	Q	MM\$	\$/UNT	C\$/UNT	C\$/AFT		\$/UNT	I	MM\$	Q	MM\$	#	#	MUNT/YR	YRTC
	POSS	1	2,299	2,723		.092	.585	3752,		.493	7,871	19,011	7.71	8	3965.6	13.7			
	REQ	1.00	5,018	5,942		.201	.707	4535,		.506	8,588	19,011	3.53	4		30.0			
SHVL	B195	WT5056C	CUYD	18	TONS	13.7	MIN/OP	4.0	OP/HR	12.5	UNT/HR	1367.5	MUNT/YR	4461.3					
TKK	A350PHC100TM					109.4		56.7		.9		96.5		314.8					
		#	1	MM\$	Q	MM\$	\$/UNT	C\$/UNT	C\$/AFT		\$/UNT	I	MM\$	Q	MM\$	#	#	MUNT/YR	YRTC
	POSS	1	2,001	2,388		.081	.587	3764,		.507	8,167	19,451	14.17	15	4461.3	12.2			
	REQ	1.00	4,913	5,862		.198	.702	4498,		.504	8,020	19,451	5.77	6		30.0			

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Figure 4-1. Sample Model Run (Sheet 5 of 12) (Cont'd)

SHUVEL - TRUCK BASIC DATA

07/20/76 RUN NO, = 1

0501 (ICLH0501) ILLINOIS BASIN

1

COAL LOAD AND HAUL SIMULATION

ID	CUYD	TONS	MIN/OP	OP/HR	UNT/HR	MUNT/YR							
① SHVL B195 WT5056C	18	13.7	4.0	12.5	1367.5	4461.3							
② TRK A350PHU100TM		109.4	56.6	.9	96.7	315.4							
#	1 MM\$	0 MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	1 MM\$	0 MM\$	#	#	MUNT/YR	YRTC	
③ POSS 1	2,001	2,388	.081	.586	3756,	.505	8,146	19,399	14.14	15	4461.3	12.2	
④ REQ 1.00	4,913	5,862	.198	.700	4490,	.503	7,999	19,399	5.76	6		30.0	
ID	CUYD	TONS	MIN/OP	OP/HR	UNT/HR	MUNT/YR							
SHVL B195 WT5056C	18	13.7	4.0	12.5	1367.5	4461.3							
TRK E100CHC100TM		109.4	49.1	1.0	111.4	363.6							
#	1 MM\$	0 MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	1 MM\$	0 MM\$	#	#	MUNT/YR	YRTC	
POSS 1	2,001	2,388	.081	.716	4592,	.636	12,308	22,350	12.27	13	4461.3	12.2	
REQ 1.00	4,913	5,862	.198	.821	5263,	.623	11,622	22,350	5.00	5		30.0	
ID	CUYD	TONS	MIN/OP	OP/HR	UNT/HR	MUNT/YR							
SHVL B195 WT5056C	18	13.7	4.5	11.1	1367.5	4461.3							
TRK E120CHC120TM		123.1	52.2	1.0	117.9	384.5							
#	1 MM\$	0 MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	1 MM\$	0 MM\$	#	#	MUNT/YR	YRTC	
POSS 1	2,001	2,388	.081	.694	4447,	.613	11,554	21,872	11.60	12	4461.3	12.2	
REQ 1.00	4,913	5,862	.198	.816	5230,	.618	11,819	21,872	4.73	5		30.0	
ID	CUYD	TONS	MIN/OP	OP/HR	UNT/HR	MUNT/YR							
SHVL B195 WT5056C	18	13.7	7.0	7.1	1367.5	4461.3							
TRK UBD180U180TE		191.5	50.5	1.0	189.6	618.6							
#	1 MM\$	0 MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	1 MM\$	0 MM\$	#	#	MUNT/YR	YRTC	
POSS 1	2,001	2,388	.081	.507	3250,	.426	7,276	15,973	7.21	8	4461.3	12.2	
REQ 1.00	4,913	5,862	.198	.613	3934,	.416	6,698	15,973	2.94	3		30.0	
ID	CUYD	TONS	MIN/OP	OP/HR	UNT/HR	MUNT/YR							
SHVL B195 WT5056C	18	13.7	4.0	12.5	1367.5	4461.3							
TRK W050T C100TM		109.4	46.7	1.1	117.1	381.9							
#	1 MM\$	0 MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	1 MM\$	0 MM\$	#	#	MUNT/YR	YRTC	
POSS 1	2,001	2,388	.081	.602	3859,	.521	9,272	19,148	11.68	12	4461.3	12.2	
REQ 1.00	4,913	5,862	.198	.723	4635,	.525	9,485	19,148	4.76	5		30.0	

Figure 4-1. Sample Model Run (Sheet 6 of 12)

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ID	CUYD	TONS	MIN/UP	OP/HR	UNT/HR	MUNT/YR							
SHVL B195 W15056C	18	13.7	4.0	12.5	1367.5	4461.3							
TRK W050T 0100TM		109.4	46.7	1.1	117.1	381.9							
	#	I MM\$	O MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	I MM\$	O MM\$	#	#	MUNT/YR	YRTC
POSS 1		2,001	2,388	.081	.602	3859,	.521	9,272	19,148	11.68	12	4461.3	12.2
REQ 1.00		4,913	5,862	.198	.723	4635,	.525	9,485	19,148	4.76	5		30.0

ID	CUYD	TONS	MIN/UP	OP/HR	UNT/HR	MUNT/YR							
SHVL B195 W15056C	18	13.7	4.5	11.1	1367.5	4461.3							
TRK W075B C120TM		123.1	50.7	1.0	121.4	396.2							
	#	I MM\$	O MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	I MM\$	O MM\$	#	#	MUNT/YR	YRTC
POSS 1		2,001	2,388	.081	.615	3944,	.535	8,845	20,299	11.26	12	4461.3	12.2
REQ 1.00		4,913	5,862	.198	.736	4719,	.538	9,048	20,299	4.59	5		30.0

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Figure 4-1. Sample Model Run (Sheet 6 of 12) (Cont'd)

SHUVEL - TRUCK BASIC DATA

07/20/76 RUN NO. = 1

0501 (ICLH0501) ILLINOIS BASIN

1 COAL LOAD AND HAUL SIMULATION

ID	CUYD	TONS	MIN/OP	OP/HR	UNT/HR	MUNT/YR									
SHVL B195 WT5056C	18	13.7	4.5	11.1	1367.5	4461.3									
TRK W075B D120TH		123.1	50.7	1.0	121.4	396.2									
#	1 MM\$	0 MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	1 MM\$	0 MM\$	#	#	MUNT/YR	YRTC			
POSS 1	2,001	2,388	.081	.615	3944,	.535	8,845	20,299	11.26	12	4461.3	12.2			
REQ 1.00	4,913	5,862	.198	.736	4719,	.538	9,048	20,299	4.59	5		30.0			
ID	CUYD	TONS	MIN/OP	OP/HR	UNT/HR	MUNT/YR									
SHVL B195 WT5056C	18	13.7	6.0	8.3	1367.5	4461.3									
TRK W150CTC150TH		164.2	49.3	1.0	166.3	542.6									
#	1 MM\$	0 MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	1 MM\$	0 MM\$	#	#	MUNT/YR	YRTC			
POSS 1	2,001	2,388	.081	.556	3563,	.475	7,871	18,033	8.22	9	4461.3	12.2			
REQ 1.00	4,913	5,862	.198	.686	4398,	.488	8,588	18,033	3.35	4		30.0			
ID	CUYD	TONS	MIN/OP	OP/HR	UNT/HR	MUNT/YR									
SHVL H1600 4535C	12	9.1	6.0	8.3	911.6	2974.2									
TRK A350PHC100TH		109.4	59.7	.8	91.6	299.0									
#	1 MM\$	0 MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	1 MM\$	0 MM\$	#	#	MUNT/YR	YRTC			
POSS 1	1,242	2,798	.074	.600	3844,	.525	8,167	20,480	9.95	10	2974.2	18.3			
REQ 1.00	2,033	4,580	.121	.669	4287,	.547	9,357	20,480	6.08	7		30.0			
ID	CUYD	TONS	MIN/OP	OP/HR	UNT/HR	MUNT/YR									
SHVL H1600 4535C	12	9.1	6.0	8.3	911.6	2974.2									
TRK A350PHD100TH		109.4	59.6	.8	91.8	299.5									
#	1 MM\$	0 MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	1 MM\$	0 MM\$	#	#	MUNT/YR	YRTC			
POSS 1	1,242	2,798	.074	.598	3836,	.524	8,146	20,427	9.93	10	2974.2	18.3			
REQ 1.00	2,033	4,580	.121	.667	4278,	.546	9,333	20,427	6.07	7		30.0			
ID	CUYD	TONS	MIN/OP	OP/HR	UNT/HR	MUNT/YR									
SHVL H1600 4535C	12	9.1	6.0	8.3	911.6	2974.2									
TRK E100CHC100TH		109.4	52.1	1.0	105.0	342.7									
#	1 MM\$	0 MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	1 MM\$	0 MM\$	#	#	MUNT/YR	YRTC			
POSS 1	1,242	2,798	.074	.744	4768,	.669	12,781	23,716	8.68	9	2974.2	18.3			
REQ 1.00	2,033	4,580	.121	.812	5207,	.691	13,946	23,716	5.30	6		30.0			

Figure 4-1. Sample Model Run (Sheet 7 of 12)

ID	CUYD	TONS	MIN/UP	OP/HR	UNT/HR	MUNT/YR							
SHVL H1600 4535C	12	9.1	7.0	7.1	911.6	2974.2							
TRK E120CHC120TM		127.7	56.0	.9	114.0	372.1							
#	I MM\$	O MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	I MM\$	O MM\$	#	#	MUNT/YR	YRTC	
PDSS 1	1,242	2,798	.074	.701	4493,	.627	11,554	22,606	7.99	8	2974.2	18.3	
KEW 1.00	2,033	4,580	.121	.753	4827,	.631	11,819	22,606	4.88	5		30.0	
ID	CUYD	TONS	MIN/UP	OP/HR	UNT/HR	MUNT/YR							
SHVL H1600 4535C	12	9.1	6.0	8.3	911.6	2974.2							
TRK W050T C100TM		109.4	49.7	1.0	110.0	358.9							
#	I MM\$	O MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	I MM\$	O MM\$	#	#	MUNT/YR	YRTC	
PDSS 1	1,242	2,798	.074	.639	4099,	.565	10,431	20,377	8.29	9	2974.2	18.3	
KEW 1.00	2,033	4,580	.121	.704	4513,	.583	11,382	20,377	5.06	6		30.0	

Figure 4-1. Sample Model Run (Sheet 7 of 12) (Cont'd)

SHUVEL - TRUCK BASIC DATA

07/20/76 RUN NO. = 1

0501 (ICLH0501) ILLINOIS BASIN

1 CUAL LOAD AND HAUL SIMULATION

ID	CUYD	TONS	MIN/OP	OP/HR	UNT/HR	MUNT/YR							
SHVL H1600 4535C	12	9.1	6.0	8.3	911.6	2974.2							
TRK W050T D100TM		109.4	49.7	1.0	110.0	358.9							
#	I MM\$	Q MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	I MM\$	Q MM\$	#	#	MUNT/YR	YRTC	
POSS 1	1,242	2,798	.074	.639	4099,	.565	10,431	20,377	8.29	9	2974.2	18.3	
REQ 1.00	2,033	4,580	.121	.704	4513,	.583	11,382	20,377	5.06	6		30.0	
ID	CUYD	TONS	MIN/OP	OP/HR	UNT/HR	MUNT/YR							
SHVL H1600 4535C	12	9.1	7.0	7.1	911.6	2974.2							
TRK W075B C120TM		127.7	54.4	.9	117.2	382.5							
#	I MM\$	Q MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	I MM\$	Q MM\$	#	#	MUNT/YR	YRTC	
POSS 1	1,242	2,798	.074	.622	3988,	.548	8,845	21,023	7.78	8	2974.2	18.3	
REQ 1.00	2,033	4,580	.121	.673	4314,	.552	9,048	21,023	4.75	5		30.0	
ID	CUYD	TONS	MIN/OP	OP/HR	UNT/HR	MUNT/YR							
SHVL H1600 4535C	12	9.1	7.0	7.1	911.6	2974.2							
TRK W075B D120TM		127.7	54.4	.9	117.2	382.5							
#	I MM\$	Q MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	I MM\$	Q MM\$	#	#	MUNT/YR	YRTC	
POSS 1	1,242	2,798	.074	.622	3988,	.548	8,845	21,023	7.78	8	2974.2	18.3	
REQ 1.00	2,033	4,580	.121	.673	4314,	.552	9,048	21,023	4.75	5		30.0	
ID	CUYD	TONS	MIN/OP	OP/HR	UNT/HR	MUNT/YR							
SHVL H1600 4535C	12	9.1	9.0	5.6	911.6	2974.2							
TRK W150CTC150TM		164.2	53.8	.9	152.4	497.2							
#	I MM\$	Q MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	I MM\$	Q MM\$	#	#	MUNT/YR	YRTC	
POSS 1	1,242	2,798	.074	.579	3715,	.505	7,871	19,677	5.98	6	2974.2	18.3	
REQ 1.00	2,033	4,580	.121	.640	4102,	.518	8,588	19,677	3.65	4		30.0	
ID	CUYD	TONS	MIN/OP	OP/HR	UNT/HR	MUNT/YR							
SHVL H1900CL5046C	16	12.2	4.5	.11,1	1215.5	3965.6							
TRK A350PHC100TM		109.4	57.4	.9	95.2	310.7							
#	I MM\$	Q MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	I MM\$	Q MM\$	#	#	MUNT/YR	YRTC	
POSS 1	1,838	2,464	.079	.586	3760,	.508	7,963	19,708	12.76	13	3965.6	13.7	
REQ 1.00	4,011	5,377	.172	.681	4365,	.509	8,020	19,708	5.85	6		30.0	

Figure 4-1. Sample Model Run (Sheet 8 of 12)

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ID	CUYD	TONS	MIN/UP	DP/HR	UNT/HR	MUNT/YR								
SHVL H1900CL5046C	16	12.2	4.5	11.1	1215.5	3965.6								
TRK A350PHU100TM		109.4	57.3	.9	95.4	311.3								
	#	1 MM\$	0 MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	1 MM\$	0 MM\$	#	#	MUNT/YR	YRTC	
POSS 1	1	1,838	2,464	.079	.385	3752,	.506	7,942	19,656	12.74	13	3965.6	13.7	
REQ 1.00	4,011	5,377	.172	.679	4357,	.507	7,999	19,656	5.84	6			30.0	

ID	CUYD	TONS	MIN/UP	DP/HR	UNT/HR	MUNT/YR								
SHVL H1900CL5046C	16	12.2	4.5	11.1	1215.5	3965.6								
TRK E100CHC100TM		109.4	49.8	1.0	109.8	358.1								
	#	1 MM\$	0 MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	1 MM\$	0 MM\$	#	#	MUNT/YR	YRTC	
POSS 1	1	1,838	2,464	.079	.730	4678,	.651	12,781	22,691	11.07	12	3965.6	13.7	
REQ 1.00	4,011	5,377	.172	.844	5413,	.672	13,946	22,691	5.07	6			30.0	

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Figure 4-1. Sample Model Run (Sheet 8 of 12) (Cont'd)

SHOVEL - TRUCK BASIC DATA 07/20/76 RUN NO. = 1
 0501 (ICLH0501) ILLINOIS BASIN
 1 COAL LOAD AND HAUL SIMULATION

ID	CUYD	TONS	MIN/OP	OP/HR	UNT/HR	MUNT/YR								
SHVL H1900CL5046C	16	12.2	5.0	10.0	1215.5	3965.6								
TRK E1200CHC120TM		121.6	53.0	.9	114.8	374.4								
#	1 MM\$	0 MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	1 MM\$	0 MM\$	#	#	MUNT/YR	YRTC		
POSS 1	1.838	2.464	.079	.709	4549,	.631	11.915	22.464	10.59	11	3965.6	13.7		
REQ 1.00	4.011	5.377	.172	.801	5136,	.629	11.819	22.464	4.85	5		30.0		
SHVL H1900CL5046C	16	12.2	8.0	6.2	1215.5	3965.6								
TRK URD180D180TE		194.6	52.0	1.0	187.0	610.2								
#	1 MM\$	0 MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	1 MM\$	0 MM\$	#	#	MUNT/YR	YRTC		
POSS 1	1.838	2.464	.079	.507	3252,	.428	7.162	16.190	6.50	7	3965.6	13.7		
REQ 1.00	4.011	5.377	.172	.592	3796,	.420	6.698	16.190	2.98	3		30.0		
SHVL H1900CL5046C	16	12.2	4.5	11.1	1215.5	3965.6								
TRK W050T C100TM		109.4	47.5	1.1	115.2	375.9								
#	1 MM\$	0 MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	1 MM\$	0 MM\$	#	#	MUNT/YR	YRTC		
POSS 1	1.838	2.464	.079	.611	3919,	.532	9.562	19.455	10.55	11	3965.6	13.7		
REQ 1.00	4.011	5.377	.172	.703	4508,	.531	9.485	19.455	4.83	5		30.0		
SHVL H1900CL5046C	16	12.2	4.5	11.1	1215.5	3965.6								
TRK W050T D100TM		109.4	47.5	1.1	115.2	375.9								
#	1 MM\$	0 MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	1 MM\$	0 MM\$	#	#	MUNT/YR	YRTC		
POSS 1	1.838	2.464	.079	.611	3919,	.532	9.562	19.455	10.55	11	3965.6	13.7		
REQ 1.00	4.011	5.377	.172	.703	4508,	.531	9.485	19.455	4.83	5		30.0		
SHVL H1900CL5046C	16	12.2	5.0	10.0	1215.5	3965.6								
TRK W075B C120TM		121.6	51.4	1.0	118.2	385.6								
#	1 MM\$	0 MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	1 MM\$	0 MM\$	#	#	MUNT/YR	YRTC		
POSS 1	1.838	2.464	.079	.629	4032,	.550	9.121	20.857	10.29	11	3965.6	13.7		
REQ 1.00	4.011	5.377	.172	.721	4621,	.549	9.048	20.857	4.71	5		30.0		

Figure 4-1. Sample Model Run (Sheet 9 of 12)

FLU-039

IO	CUYD	TONS	MIN/UP	OP/HR	UNT/HR	MUNT/YR							
SHVL H1900CL5046C	16	12.2	5.0	10.0	1215.5	3965.6							
TRK W075B D120TM		121.6	51.4	1.0	118.2	385.6							
#	I MM\$	Q MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	I MM\$	Q MM\$	#	#	MUNT/YR	YRTC	
POSS 1	1,838	2,464	.079	.629	4032,	.550	9,121	20,857	10.29	11	3965.6	13.7	
REQ 1.00	4,011	5,377	.172	.721	4621,	.549	9,048	20,857	4.71	5		30.0	
IO	CUYD	TONS	MIN/UP	OP/HR	UNT/HR	MUNT/YR							
SHVL H1900CL5046C	16	12.2	6.5	7.7	1215.5	3965.6							
TRK W150CTC150TM		158.1	50.1	1.0	157.8	514.7							
#	I MM\$	Q MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	I MM\$	Q MM\$	#	#	MUNT/YR	YRTC	
POSS 1	1,838	2,464	.079	.572	3667,	.493	7,871	19,011	7.71	8	3965.6	13.7	
REQ 1.00	4,011	5,377	.172	.678	4350,	.506	8,588	19,011	3.53	4		30.0	

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Figure 4-1. Sample Model Run (Sheet 9 of 12) (Cont'd)

SHUVEL - TRUCK BASIC DATA

07/20/76 RUN NO. = 1

0501 (ICLH0501) ILLINOIS BASIN
1 COAL LOAD AND HAUL SIMULATION

ID	CUYD	TONS	MIN/OP	OP/HR	UNT/HR	MUNT/YR								
SHVL H2100BL4544C	24	18.2	3.0	16.7	1823.3	5948.4								
TRK A350PHC100TM		109.4	55.2	9	99.1	323.4								
#	1 MM\$	0 MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	1 MM\$	0 MM\$	#	#	MUNT/YR	YRTC		
POSS 1	1,459	1,829	.060	.550	3526,	.490	7,758	18,936	18.40	19	5948.4	9.2		
REQ 1.00	4,776	5,988	.197	.692	4436,	.494	8,020	18,936	5.62	6		30.0		
SHVL H2100BL4544C	24	18.2	3.0	16.7	1823.3	5948.4								
TRK A350PHD100TM		109.4	55.1	9	99.3	324.0								
#	1 MM\$	0 MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	1 MM\$	0 MM\$	#	#	MUNT/YR	YRTC		
POSS 1	1,459	1,829	.060	.549	3518,	.488	7,738	18,884	18.36	19	5948.4	9.2		
REQ 1.00	4,776	5,988	.197	.691	4428,	.493	7,999	18,884	5.61	6		30.0		
SHVL H2100BL4544C	24	18.2	3.0	16.7	1823.3	5948.4								
TRK E100CHC100TM		109.4	47.6	1.1	115.0	375.1								
#	1 MM\$	0 MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	1 MM\$	0 MM\$	#	#	MUNT/YR	YRTC		
POSS 1	1,459	1,829	.060	.666	4271,	.606	11,361	21,666	15.86	16	5948.4	9.2		
REQ 1.00	4,776	5,988	.197	.808	5181,	.611	11,622	21,666	4.85	5		30.0		
SHVL H2100BL4544C	24	19.2	3.5	14.3	1823.3	5948.4								
TRK E120CHC120TM		127.7	50.7	1.0	125.8	410.6								
#	1 MM\$	0 MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	1 MM\$	0 MM\$	#	#	MUNT/YR	YRTC		
POSS 1	1,459	1,829	.060	.635	4070,	.574	10,832	20,485	14.49	15	5948.4	9.2		
REQ 1.00	4,776	5,988	.197	.790	5065,	.593	11,819	20,485	4.43	5		30.0		
SHVL H2100BL4544C	24	18.2	5.0	10.0	1823.3	5948.4								
TRK UBD180U180TE		182.4	47.5	1.1	192.0	626.3								
#	1 MM\$	0 MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	1 MM\$	0 MM\$	#	#	MUNT/YR	YRTC		
POSS 1	1,459	1,829	.060	.475	3544,	.414	6,821	15,775	9.50	10	5948.4	9.2		
REQ 1.00	4,776	5,988	.197	.610	3909,	.412	6,698	15,775	2.90	3		30.0		

Figure 4-1. Sample Model Run (Sheet 10 of 12)

FLU-039

ID	CUYD	TONS	MIN/OP	OP/HR	UNT/HR	MUNT/YR								
SHVL H2100BL4544C	24	18.2	3.0	16.7	1823.3	5948.4								
TRK W050T C100TM		109.4	45.2	1.1	120.9	394.6								
#	I MM\$	Q MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	I MM\$	Q MM\$	#	#	MUNT/YR	YRTC		
POSS 1	1,459	1,829	.060	.570	3657,	.510	9,272	18,533	15.08	16	5948.4	9.2		
REQ 1.00	4,776	5,988	.197	.711	4561,	.514	9,485	18,533	4.61	5		30.0		

ID	CUYD	TONS	MIN/OP	OP/HR	UNT/HR	MUNT/YR								
SHVL H2100BL4544C	24	18.2	3.0	16.7	1823.3	5948.4								
TRK W050T D100TM		109.4	45.2	1.1	120.9	394.6								
#	I MM\$	Q MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	I MM\$	Q MM\$	#	#	MUNT/YR	YRTC		
POSS 1	1,459	1,829	.060	.570	3657,	.510	9,272	18,533	15.08	16	5948.4	9.2		
REQ 1.00	4,776	5,988	.197	.711	4561,	.514	9,485	18,533	4.61	5		30.0		

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Figure 4-1. Sample Model Run (Sheet 10 of 12) (Cont'd)

SHOVEL - TRUCK BASIC DATA

07/20/76 RUN NO. = 1

0501 (ICLH0501) ILLINOIS BASIN
1 COAL LOAD AND HAUL SIMULATION

ID	CUYD	TONS	MIN/OP	OP/HR	UNT/HR	MUNT/YR									
SHVL H2100BL4544C	24	18.2	3.5	14.3	1823.3	5948.4									
TRK W075B U120TM		127.7	49.2	1.0	129.8	423.4									
#	1 MM\$	0 MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	1 MM\$	0 MM\$	#	#	MUNT/YR	YRTC			
POSS 1	1,459	1,829	.060	.561	3596,	.500	8,292	18,995	14.05	15	5948.4	9.2			
REQ 1.00	4,776	5,988	.197	.712	4564,	.514	9,048	18,995	4.29	5		30.0			
ID	CUYD	TONS	MIN/OP	OP/HR	UNT/HR	MUNT/YR									
SHVL H2100BL4544C	24	18.2	3.5	14.3	1823.3	5948.4									
TRK W075B U120TM		127.7	49.2	1.0	129.8	423.4									
#	1 MM\$	0 MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	1 MM\$	0 MM\$	#	#	MUNT/YR	YRTC			
POSS 1	1,459	1,829	.060	.561	3596,	.500	8,292	18,995	14.05	15	5948.4	9.2			
REQ 1.00	4,776	5,988	.197	.712	4564,	.514	9,048	18,995	4.29	5		30.0			
ID	CUYD	TONS	MIN/OP	OP/HR	UNT/HR	MUNT/YR									
SHVL H2100BL4544C	24	18.2	4.5	11.1	1823.3	5948.4									
TRK W150CTC150TM		164.2	47.1	1.1	174.3	568.5									
#	1 MM\$	0 MM\$	\$/UNT	C\$/UNT	C\$/AFT	\$/UNT	1 MM\$	0 MM\$	#	#	MUNT/YR	YRTC			
POSS 1	1,459	1,829	.060	.508	3259,	.448	7,215	17,210	10.46	11	5948.4	9.2			
REQ 1.00	4,776	5,988	.197	.671	4300,	.473	8,588	17,210	3.20	4		30.0			

Figure 4-1. Sample Model Run (Sheet 11 of 12)

SHUVEL - TRUCK BASIC DATA

07/20/76 RUN NO. = 1

0501 (ICLH0501) ILLINOIS BASIN
1 COAL LOAD AND HAUL SIMULATION

SEQ	ID	#	I MM\$	O MM\$	\$/TON	C\$/TON	C\$/AFT	\$/TON	I MM\$	O MM\$	#	#	SEQ	ID	
23	B155	4537C	1.00	3,529	4,888	.154	.712	4563,	.557	9,357	21,022	6.24	7	1	A350PHC100TM
23	B155	4537C	1.00	3,529	4,888	.154	.710	4553,	.556	9,333	20,966	6.23	7	2	A350PHD100TM
23	B155	4537C	1.00	3,529	4,888	.154	.854	5477,	.700	13,946	24,204	5.41	6	5	E100CHC100TM
23	B155	4537C	1.00	3,529	4,888	.154	.776	4978,	.622	11,819	22,092	4.77	5	6	E120CHC120TM
23	B155	4537C	1.00	3,529	4,888	.154	.621	3979,	.466	8,931	16,488	3.03	4	18	UBD180D180TE
23	B155	4537C	1.00	3,529	4,888	.154	.744	4769,	.589	11,382	20,752	5.16	6	45	W050T C100TM
23	B155	4537C	1.00	3,529	4,888	.154	.744	4769,	.589	11,382	20,752	5.16	6	46	W050T D100TM
23	B155	4537C	1.00	3,529	4,888	.154	.697	4467,	.542	9,048	20,520	4.64	5	51	W075B C120TM
23	B155	4537C	1.00	3,529	4,888	.154	.697	4467,	.542	9,048	20,520	4.64	5	52	W075B D120TM
23	B155	4537C	1.00	3,529	4,888	.154	.662	4248,	.508	8,588	19,112	3.55	4	53	W150CTC150TM
25	B195	4756C	1.00	5,018	5,942	.201	.710	4550,	.509	8,020	19,708	5.85	6	1	A350PHC100TM
25	B195	4756C	1.00	5,018	5,942	.201	.708	4541,	.507	7,999	19,656	5.84	6	2	A350PHD100TM
25	B195	4756C	1.00	5,018	5,942	.201	.873	5598,	.672	13,946	22,691	5.07	6	5	E100CHC100TM
25	B195	4756C	1.00	5,018	5,942	.201	.830	5321,	.629	11,819	22,464	4.85	5	6	E120CHC120TM
25	B195	4756C	1.00	5,018	5,942	.201	.621	3981,	.420	6,698	16,190	2.98	3	18	UBD180D180TE
25	B195	4756C	1.00	5,018	5,942	.201	.732	4693,	.531	9,485	19,455	4.83	5	45	W050T C100TM
25	B195	4756C	1.00	5,018	5,942	.201	.732	4693,	.531	9,485	19,455	4.83	5	46	W050T D100TM
25	B195	4756C	1.00	5,018	5,942	.201	.750	4806,	.549	9,048	20,857	4.71	5	51	W075B C120TM
25	B195	4756C	1.00	5,018	5,942	.201	.750	4806,	.549	9,048	20,857	4.71	5	52	W075B D120TM
25	B195	4756C	1.00	5,018	5,942	.201	.707	4535,	.506	8,588	19,011	3.53	4	53	W150CTC150TM
26	B195	WT5056C	1.00	4,913	5,862	.198	.702	4498,	.504	8,020	19,451	5.77	6	1	A350PHC100TM
26	B195	WT5056C	1.00	4,913	5,862	.198	.700	4490,	.503	7,999	19,399	5.76	6	2	A350PHD100TM
26	B195	WT5056C	1.00	4,913	5,862	.198	.821	5263,	.623	11,622	22,350	5.00	5	5	E100CHC100TM
26	B195	WT5056C	1.00	4,913	5,862	.198	.816	5230,	.618	11,819	21,872	4.73	5	6	E120CHC120TM
26	B195	WT5056C	1.00	4,913	5,862	.198	.613	3934,	.416	6,698	15,973	2.94	3	18	UBD180D180TE
26	B195	WT5056C	1.00	4,913	5,862	.198	.723	4635,	.525	9,485	19,148	4.76	5	45	W050T C100TM
26	B195	WT5056C	1.00	4,913	5,862	.198	.723	4635,	.525	9,485	19,148	4.76	5	46	W050T D100TM
26	B195	WT5056C	1.00	4,913	5,862	.198	.736	4719,	.538	9,048	20,299	4.59	5	51	W075B C120TM
26	B195	WT5056C	1.00	4,913	5,862	.198	.736	4719,	.538	9,048	20,299	4.59	5	52	W075B D120TM
26	B195	WT5056C	1.00	4,913	5,862	.198	.686	4398,	.488	8,588	18,033	3.35	4	53	W150CTC150TM
31	H1600	4535C	1.00	2,033	4,580	.121	.669	4287,	.547	9,357	20,480	6.08	7	1	A350PHC100TM
31	H1600	4535C	1.00	2,033	4,580	.121	.667	4278,	.546	9,333	20,427	6.07	7	2	A350PHD100TM
31	H1600	4535C	1.00	2,033	4,580	.121	.812	5207,	.691	13,946	23,716	5.30	6	5	E100CHC100TM
31	H1600	4535C	1.00	2,033	4,580	.121	.753	4827,	.631	11,819	22,606	4.88	5	6	E120CHC120TM
31	H1600	4535C	1.00	2,033	4,580	.121	.704	4513,	.583	11,382	20,377	5.06	6	45	W050T C100TM
31	H1600	4535C	1.00	2,033	4,580	.121	.704	4513,	.583	11,382	20,377	5.06	6	46	W050T D100TM
31	H1600	4535C	1.00	2,033	4,580	.121	.673	4314,	.552	9,048	21,023	4.75	5	51	W075B C120TM
31	H1600	4535C	1.00	2,033	4,580	.121	.673	4314,	.552	9,048	21,023	4.75	5	52	W075B D120TM
31	H1600	4535C	1.00	2,033	4,580	.121	.640	4102,	.518	8,588	19,677	3.65	4	53	W150CTC150TM

Figure 4-1. Sample Model Run (Sheet 12 of 12)

LEAST COST COMBINATION - 34 18

34	H1900CL5046C	1.00	4.011	5.377	.172	.681	4365*	.509	8.020	19.708	5.85	6	1	A350PHC100TM
34	H1900CL5046C	1.00	4.011	5.377	.172	.679	4357*	.507	7.999	19.656	5.84	6	2	A350PHD100TM
34	H1900CL5046C	1.00	4.011	5.377	.172	.844	5413*	.672	13.946	22.691	5.07	6	5	E100CHC100TM
34	H1900CL5046C	1.00	4.011	5.377	.172	.801	5136*	.629	11.819	22.464	4.85	5	6	E120CHC120TM
34	H1900CL5046C	1.00	4.011	5.377	.172	.592	3796*	.420	6.698	16.190	2.98	3	18	UBD180U180TE
34	H1900CL5046C	1.00	4.011	5.377	.172	.703	4508*	.531	9.485	19.455	4.83	5	45	W050T C100TM
34	H1900CL5046C	1.00	4.011	5.377	.172	.703	4508*	.531	9.485	19.455	4.83	5	46	W050T D100TM
34	H1900CL5046C	1.00	4.011	5.377	.172	.721	4621*	.549	9.048	20.857	4.71	5	51	W0758 C120TM
34	H1900CL5046C	1.00	4.011	5.377	.172	.721	4621*	.549	9.048	20.857	4.71	5	52	W0758 D120TM
34	H1900CL5046C	1.00	4.011	5.377	.172	.678	4350*	.506	8.588	19.011	3.53	4	53	W150CTC150TM
36	H2100BL4544C	1.00	4.776	5.988	.197	.692	4436*	.494	8.020	18.936	5.62	6	1	A350PHC100TM
36	H2100BL4544C	1.00	4.776	5.988	.197	.691	4428*	.493	7.999	18.884	5.61	6	2	A350PHD100TM
36	H2100BL4544C	1.00	4.776	5.988	.197	.808	5181*	.611	11.622	21.666	4.85	5	5	E100CHC100TM
36	H2100BL4544C	1.00	4.776	5.988	.197	.610	3909*	.412	6.698	15.775	2.90	3	18	UBD180U180TE
36	H2100BL4544C	1.00	4.776	5.988	.197	.711	4561*	.514	9.485	18.533	4.61	5	45	W050T C100TM
36	H2100BL4544C	1.00	4.776	5.988	.197	.711	4561*	.514	9.485	18.533	4.61	5	46	W050T D100TM
36	H2100BL4544C	1.00	4.776	5.988	.197	.712	4564*	.514	9.048	18.995	4.29	5	51	W0758 C120TM
36	H2100BL4544C	1.00	4.776	5.988	.197	.712	4564*	.514	9.048	18.995	4.29	5	52	W0758 D120TM
36	H2100BL4544C	1.00	4.776	5.938	.197	.671	4300*	.473	8.588	17.210	3.20	4	53	W150CTC150TM

Figure 4-1. Sample Model Run (Sheet 12 of 12) (Cont'd)

TABLE 2

CLH OUTPUT LISTINGS ABBREVIATIONS*

(Sheet 1 of 2)

Abbreviation	Meaning
ID	Shovel or truck model number
CUYD	Shovel dipper or bucket capacity (cubic yards)
TONS	Shovel - weight the shovel bucket can hold Truck - truck rated payload capacity
MIN/OP	Shovel - minutes to load truck Truck - minutes to make one haul cycle
OP/HR	Shovel - trucks the shovel can load in one hour Truck - trips/hour the truck can make
UNT/HR	Shovel - tons/hour the loader can load Truck - tons of coal or cubic yards of overburden/hour the truck can haul
MUNT/YR	Shovel - thousands of tons/year the loader can load Truck - thousands of tons of coal or cubic yards of overburden/year the truck can haul
#	Number of shovels required to maintain maximum or demand production rates
I MM\$	Investment cost for the shovel, in millions of dollars
O MM\$	Operating cost for the shovel, in millions of dollars
\$/UNT	Dollars/tons of recovered coal for coal loading or dollars/cubic yard of overburden for overburden loading

*Note: For program FLH, substitute "Loader" for "Shovel" in abbreviation definitions.

TABLE 2

CLH OUTPUT LISTINGS ABBREVIATIONS*

(Sheet 2 of 2)

Abbreviation	Meaning
\$/UNT	Dollars/ton of recovered coal for coal loading and hauling or dollars/cubic yard of overburden for overburden loading and hauling
C\$/AFT	Dollars/acre foot for loading and hauling
\$/UNT	Dollars/ton of recovered coal for coal hauling or dollars/cubic yard of overburden for overburden loading and hauling
I MM\$	Investment costs for the truck fleet, in million of dollars
O MM\$	Operating costs for the truck fleet, in million of dollars
#	Number of trucks needed to maintain maximum or demand production rates, not taking into account truck availability
#	Number of trucks needed to maintain maximum or demand production rates, considering truck availability
MUNT/YR	Maximum coal production rate possible for the shovel-truck combination, in thousands of tons of coal or cubic yards of overburden/year
YRTC	Years to recover coal at the maximum and demand coal production rates

*Note: For program FLH, substitute "Loader" for "Shovel" in abbreviation definitions.

PART 5

LAND RECLAMATION SIMULATION

(LRS) MODEL

USER'S MANUAL

17 September 1976

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LRS MODEL USER'S MANUAL
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SECTION 1
INTRODUCTION

1.1 PURPOSE AND SCOPE

This manual describes the function and use of the Land Reclamation Simulation (LRS) model. The LRS model is designed to assist the mining engineer in planning reclamation operations for a surface coal mine. The model determines the equipment necessary for topsoil removal and stockpiling, spoil bank regrading, and topsoil resspreading where these operations are necessary in the mining area. It also calculates ownership and operating costs for the equipment, and estimates the costs for revegetation and land management.

1.2 ORGANIZATION OF THE MANUAL

Following this Introduction, Section 2 of this manual details the definition of land reclamation problems for solution by the LRS model. Included are descriptions of the various parameters which must be defined by the user. Section 3 consists of the step-by-step description of the sequence of operations in the LRS model. Section 4 describes the LRS model output, and presents a sample printout from the model.

1.3 USING THIS MANUAL

This manual assumes that the user of the LRS model understands mining operations. Such operations are discussed in this manual only to the extent necessary in explaining the operation of the LRS model.

SECTION 2
MODEL DESCRIPTION

2.1 OVERVIEW

The Land Reclamation Simulation (LRS) model simulates operations for two types of reclamation methods. The first method is used in areas where the overburden is removed with draglines. The dragline removes overburden in panels and casts the waste into spoil banks across the pit from where coal is being removed. The second method is used in mines where the overburden is removed either with shovels and trucks or with front-end loaders and trucks. This stripping method is often used in areas where no topsoil exists, e.g., on a mountain top; and since the overburden is hauled from the working pit by trucks, there are no spoil banks. The LRS model determines the reclamation method from the user input parameters.

The LRS model is divided into three parts. The first part determines the fleet size of scrapers to be used in topsoil removal and stockpiling, and topsoil spreading if topsoil is present in the mining area. The second part calculates the volume of overburden spoils to be leveled, and the size of the bulldozer fleet to be used in the operation. The third part provides a general estimate of the cost of the equipment necessary for the above operations and the costs related to revegetation and land management.

Figure 2-1 illustrates a plan view and a cross-sectional view of a typical mine operation during steady-state conditions where the overburden is being removed using a dragline. The numbered areas in this illustration correspond to the following operations:

- 1) Preliminary Land Clearing - The land surface is being cleared of trees or structures preparatory to topsoil removal.
- 2) Topsoil Removal - The topsoil is being removed with self-loading scrapers and then hauled to the other side of the mining area. The topsoil will be stockpiled for later spreading or it will be spread directly, depending on the rates of required operations and the distance between the area being cleared and the area being restored. This operation is simulated in the LRS model.
- 3) Dragline Stripping - The dragline is shown near the north end of the panel. It removes overburden directly from its south, and casts the material into the previously excavated panel directly to its east.

Note that the dragline will shortly be covering the pit access road. When the dragline has passed the road, the road will be restored using support equipment. This operation is not simulated in the LRS model.

4) Coal Loading - The coal loading operation is working in the panel to the south of the dragline. The distance between the dragline and the coal loading operation depends on the amount of in-place coal inventory desired. This operation is simulated in the appropriate Load and Haul Simulation model (FLH or CLH).

5) Panel with the Coal Removed - The coal has been recovered from this section of the panel which is not active at this time.

6) Ungraded Spoil Banks - Immediately to the east of the working panel are a number of spoil banks in which no activity is taking place. Although land reclamation usually follows closely behind the other operations, some time is necessary to ensure the stability of the spoils on which the equipment will be working.

7) Spoil Regrading - Bulldozers are working in this area to level the spoils to a final contour. The spoil regrading operation is simulated in the LRS model.

8) Topsoil Stockpile - The topsoil might require stockpiling, and this would be a likely place for such a stockpile. The scrapers removing topsoil would proceed from Area 2 to this stockpile and dump their loads. The scrapers spreading topsoil would then load the soil from the stockpile and proceed to Area 9 to deposit topsoil on top of the regraded spoil banks.

9) Topsoil Spreading - The scrapers coming from the stockpile area spread the topsoil onto the regraded spoils so that the area is now ready for planting. This operation is simulated by the LRS model.

10) Revegetation and Land Management - The area is seeded and planted to reestablish vegetation. To ensure proper restoration of the land, the coal operator will perform some ditching and dam construction to prevent runoff, allow treatment of contaminated water, prevent soil erosion, and ensure land stabilization. The costs are based on user-defined cost factors.

11) Coal Haul Roads - The coal hauling equipment uses these ramps and roads to haul coal from the pit floor. Depending on the size of the property to be mined, there may be several of these main haul roads used by the hauling equipment.

The physical dimensions of a mine where draglines are being used in this manner can be specified by the user, in the required format, and the model can calculate haul distances and volumes. On the other hand, in areas where draglines are not being used, area dimensions are not easily described in the required manner. Therefore, the user must specify the haul distances for topsoil removal and spreading, and the number of acres within the mining property, so the model can estimate fleet sizes and rate of advance for the reclamation operations.

The required input that must be specified by the user to differentiate between the two simulated methods of reclamation is described in detail in Section 3.

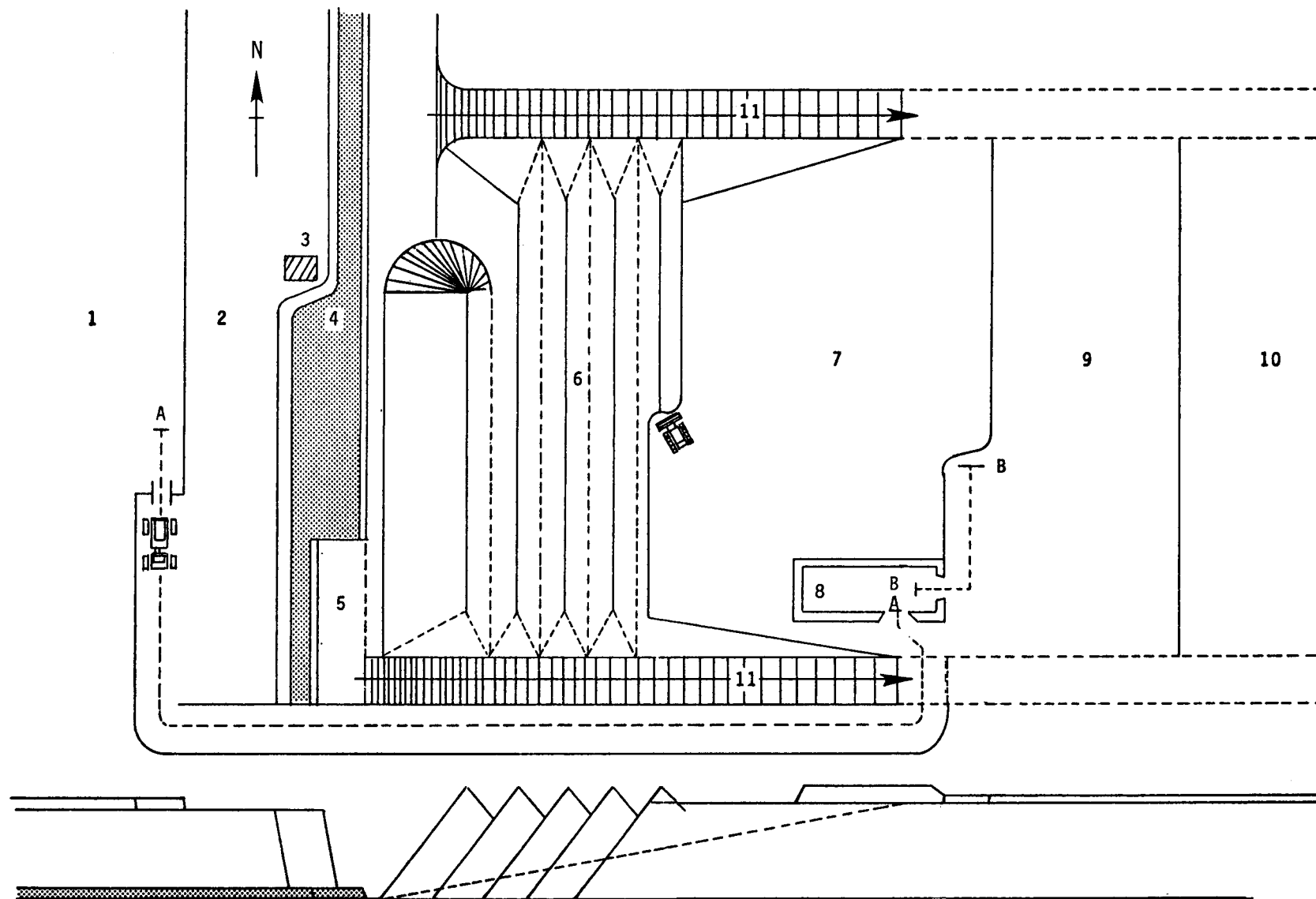


Figure 2-1. Typical Example of Steady-State Mining Operations

2.3 INPUT PARAMETERS

Input parameters for the LRS model are categorized into two groups: equipment description parameters, and area description parameters. The following paragraphs discuss these parameters and describe the mechanics of input format and structure. Table 1 at the end of this section lists the parameters, with pertinent details.

2.3.1 Equipment Description Parameters

The simulated operations--topsoil removal, topsoil spreading, and spoil regrading--use scrapers and bulldozers specified by the user. Each type of equipment is defined by the following specification and cost data from the scraper and bulldozer data files:

- 1) Scraper Availability (SCA) - The expected availability of the scraper. The information is used to calculate the number of fleet spares required.
- 2) Heaped Capacity (SCSA) - The manufacturer-specified heaped capacity, in cubic yards. The scraper load capacity is the heaped capacity (converted to pounds), or the rated payload (Item 4), whichever is smaller.

3) Shipping Weight (SCSC) - The weight of the scraper without its load, in thousands of pounds. The empty weight is used to calculate the speed of the scraper on the empty haul.

4) Payload (SCSD) - The manufacturer-specified payload, in thousands of pounds.

5) Performance Coefficient A (SCPA) - The performance curve for each scraper is supplied by the manufacturer. This curve can be reduced to:

$$\text{SPEED} = A + B/\text{TOTAL RESISTANCE}$$

Performance Coefficient A corresponds to the "A" in the equation.

6) Performance Coefficient B (SCPB) - Performance Coefficient B corresponds to the "B" in the performance curve equation.

7) Maximum Performance Speed (SCPC) - The speed, in miles/hour, shown on the performance curve as the maximum speed feasible for the scraper in the performance mode.

8) Braking Coefficient A (SCPD) - The braking or retarder curve for each scraper is supplied by the manufacturer. This curve can be reduced to:

$$\text{SPEED} = A + B/\text{TOTAL RESISTANCE}$$

Braking Coefficient A corresponds to the "A" in the equation.

9) Braking Coefficient B (SCPE) - Braking Coefficient B corresponds to the "B" in the braking curve equation.

10) Maximum Braking Speed (SCPF) - The speed, in miles/hour, shown on the braking curve as the maximum speed feasible for the scraper in the braking mode.

11) Hourly Ownership Cost (SCCP) - The approximate hourly ownership cost, in dollars/hour, for the scraper, including amortization, interest, taxes, and insurance.

12) Hourly Operating Cost (SCCN) - The approximate hourly operating cost, in dollars/hour, for the scraper, including maintenance materials and labor, fuel, lubes, operating labor, and tires.

Definition of the bulldozer to be used in spoil regrading includes the following items:

1) Availability of Dozer (CDA) - The availability of the bulldozer used to determine the required fleet spares.

2) Minimum Dozing Distance (DMNDF) - The manufacturer supplies a curve relating hourly production to dozing distance. By using this curve as a basis for calculating estimated production, the capabilities of the bulldozer are more easily defined. The minimum distance, in feet, shown on the curve is the minimum dozing distance for which the curve is representative.

3) Maximum Dozing Distance (DMXDF) - The maximum distance, in feet, for which the curve is valid.

4) Production Coefficient A (CDPA) - The production curve can be reduced to:

$$\text{PRODUCTION/HOUR} = A + B/\text{DOZING DISTANCE}$$

Production Coefficient A corresponds to the "A" in the equation.

5) Production Coefficient B (CDPB) - Production Coefficient B corresponds to the "B" in the production curve equation.

6) Hourly Ownership Cost (CDCP) - The approximate hourly ownership cost, in dollars/hour, including amortization, interest, taxes, and insurance.

7) Hourly Operating Cost (CDCN) - The approximate hourly operating cost, in dollars/hour, including maintenance materials and labor, fuel oil, lubes, and operating labor.

8) Efficiency of Dozer (ECDO) - ECDO times 60 is the production minutes/hour the bulldozer works.

2.3.2 Area Description Parameters

The area description parameters describe to the model the physical characteristics of the mining property. Included in this category are several additional parameters which control the action of the model and the printed output.

Each of the area description parameters has a default value. The default value is used by the model unless the user specifies another value. The parameters and their default values are:

- 1) KAC = 1

This variable indicates the way the user intends to describe the property. If the user is evaluating land reclamation operations in a mine where draglines are being used in the stripping operation, KAC should be set to 1, 2, or 3. Corresponding to these settings, the property may be described by giving the area dimensions (KAC = 1), panel dimension (KAC = 2), or the segment dimensions (KAC = 3).

Note

Detailed descriptions of the use of these settings of KAC are provided in Bonner and Moore Document No. FLU-033, Dragline Simulation Models Basic Stripping Method User's Manual. The user should be familiar with the discussion in this manual concerning the implications of each of the KAC settings.

However, if the property is being stripped with equipment other than draglines, the user should set $KAC = 4$. This indicates to the model that the user input specifies topsoil haul distances (if topsoil is present), and the model distance calculations are not performed.

Depending on the setting of KAC , input requirements for area description change. The discussions of the remaining area description parameters indicate when each parameter is used.

2) $LOGPA = 1$ (Required)

$LOGPA$ controls the printing of the user's input data and intermediate calculated variables. When $LOGPA$ is set to "0", no printout of the input data takes place. Setting $LOGPA$ to "1" causes the input data to be printed in list form as a reference for the user.

3) $KSR = 1$ (Required)

KSR indicates to the model whether or not spoil regrading will be simulated. If $KSR = 1$, spoil regrading is simulated; if $KSR = 0$, spoil regrading is not simulated.

4) $ABHD = 63.4349$ (If $KAC = 1, 2, \text{ or } 3$)

The angle of the overburden highwall is set using this parameter.

11) $DTBPY = 3200$. (Required)

This is the density of the topsoil, in bank pounds/cubic yard.

12) $ECR = .92$ (If $KAC = 1, 2, \text{ or } 3$)

This is the expected coal recovery rate, expressed as a fraction.

13) $ERO = .833$ (Required)

This is the efficiency of the reclamation operation. ERO is used to calculate the effective minutes/hour the scrapers and bulldozers are operating.

14) $FPW = 1.5$ (Required if $KSR = 1$)

This is the fraction of the panel width the bulldozed material must be moved by the bulldozer.

15) $FR = .25$ (Required if $KSR = 1$)

This is the fraction of the spoil material which must be rehandled by the bulldozer.

16) $HBT = 1$. (Required if topsoil present)

This is the expected average height of the topsoil, in feet.

17) CDPHY = 1800. (Required)

This is the number of productive hours/year that the bulldozers will be regrading spoil banks or doing general bulldozing.

18) PLRHY = 1800. (Required if topsoil present)

This is the number of productive hours/year the scrapers will be removing or spreading the topsoil.

19) RAP = .04 (If KAC = 1, 2, or 3)

This is the grade of the coal haul road ramp leading from the pit floor to the top of the spoils, expressed as a fraction.

20) SFB = .35 (If KAC = 1, 2, or 3)

This is the expected swell factor of the overburden material, expressed as a fraction.

21) SFT = .12 (Required if topsoil present)

This is the expected swell factor of the topsoil, expressed as a fraction.

22) TMSM = .6 (Required if topsoil present)

This is the time, in minutes, it takes for the scraper to maneuver and spread its load.

23) $TRF = .06$ (Required if topsoil present)

TRF is the total resistance the scraper will encounter on the topsoil haul roads, in fractional form.

24) $TTLM = .6$ (Required if topsoil present)

TTLM is the time, in minutes, it takes the scraper to load to its capacity.

25) $WPLF = 6000$. (If $KAC = 1, 2$, or 3)

WPLF is the distance between the main coal haul roads out of the pit, in feet. This distance is used in calculating the haul distances for topsoil removal and topsoil spreading. The scraper must move approximately one-half the length into the working panel on the topsoil haul.

26) $ALF = 35071$.

The length of the area to be mined, in feet, is specified when $KAC = 1$. If $KAC = 2$, ALF is calculated. If $KAC = 3$, ALF is not used.

27) $AWF = 10560$.

The total width, in feet, of the property to be mined is specified if $KAC = 1$. If $KAC = 2$ or 3 , AWF is calculated.

28) $HBA = 71.$

This is the average height of the overburden, in feet. If $KAC = 1$ or 2 , HBA is input. If $KAC = 3$, HBA is calculated.

29) $HC = 4$

This is the height of the coal or the thickness of the coal seam, in feet. If $KAC = 1$ or 2 , HC is input. If $KAC = 3$, HC is calculated.

30) $PLF = 35071.$

This is the length of the panel, in feet. If $KAC = 1$ or 2 , PLF is input. If $KAC = 3$, PLF is not applicable.

31) $PWF = 100.$ (Required)

This is the expected width of the operating panel, in feet. PWF is input for all settings of KAC .

32) $NP = 0.$

This is the number of panels in the total mining area. For $KAC = 1$ or 3 , this number is calculated by the model. If $KAC = 2$, the number of panels is input.

33) NAP = 3. (Required if KAC = 1, 2, or 3)

NAP is the number of additional panels required, for operational reasons, between the stripping operation and topsoil removal and between topsoil spreading and spoil regrading.

34) ACRES = 0. (Required if KAC = 4)

This is the number of total acres in the mining area. For KAC settings of 1, 2, or 3, this value is calculated.

35) ACRT = 0. (Required if KAC = 4)

This is the total coal in the mining area, in recoverable tons. For KAC = 1, 2, or 3, this number is calculated.

36) BWCF = 0. (Required if KAC = 1, 2, or 3)

This is the width of the berm at the coal face, if one exists, specified in feet.

37) CATC = 1. (Required if KAC = 1, 2, or 3)

This is the operational clearance required at the toe of the coal, specified in feet.

38) CGD = 600. (Required)

This is the estimated cost of general bulldozing, in dollars/acre.

39) $CLM = 100.$ (Required)

This is the estimated cost of land management of the mining area, in dollars/acre.

40) $CRV = 200.$ (Required)

This is the estimated cost of revegetation of the mining area, in dollars/acre.

TABLE 1
LAND RECLAMATION SIMULATION VARIABLES
 (Sheet 1 of 11)

Variable	Input/ Calculation (i/c)	Name	Units	Description
ABBY	c	Area Burden	bank yards	Total volume of in-place burden to be moved.
ABHD	i	Angle of Overburden Highwall	degrees	Expected angle of the overburden highwall.
ABSD	i	Angle of Spoils	degrees	Expected angle of the spoil bank.
ACBT	c	Area Coal	bank tons	Total tons of in-place coal.
ACBY	c	Area Coal	bank yards	Total volume of in-place coal.
ACFD	i	Angle of Coal Face	degrees	Expected angle of the coal face.
ACRES	*	Acres	acres	Total acres in the property.
ACRT	*	Area Coal	recovered tons	Total tons of recoverable coal.
ALF	*	Area Length	feet	Length of the mining area.
AWF	*	Area Width	feet	Width of the mining area.
BWBH	i	Berm Width on Overburden Highwall	feet	Width of operational berm to be left in burden highwall.
*Either input or calculated, depending on KAC setting.				

TABLE 1
LAND RECLAMATION SIMULATION VARIABLES
 (Sheet 2 of 11)

Variable	Input/ Calculation (i/c)	Name	Units	Description
BWCF	i	Berm Width on Coal Face	feet	Width of operational berm to be left on top of coal.
CATC	i	Clearance at Toe of Coal	feet	Operational clearance to be left between the toe of the spoil and the toe of the coal.
CDA	i	Dozer Availability	fraction	Expected availability of the bulldozer.
CDCN	i	Dozer Hourly Operating Cost	\$/hour	Estimated hourly operating cost for the bulldozer.
CDCP	i	Dozer Hourly Ownership Cost	\$/hour	Estimated hourly ownership cost of the bulldozer.
CDPA	i	Dozer Production Coefficient A		Dozer Production Coefficient A.
CDPB	i	Dozer Production Coefficient B		Dozer Production Coefficient B.
CDPHY	i	Dozer Productive Hours/Year	hours/year	Number of productive hours/year the bulldozer is expected to work.
CDRTY	i	Coal Demand in Recoverable Tons/Year	recovered tons/year	Required coal recovery rate, taking into account expected coal recovery.

TABLE 1
LAND RECLAMATION SIMULATION VARIABLES
 (Sheet 3 of 11)

Variable	Input/ Calculation (i/c)	Name	Units	Description
CGD	i	Cost for General Dozing	\$/acre	Estimated cost of general bulldozing.
CGDDR	c	Required Number of Dozers for General Dozing		Number of bulldozers required to do general bulldozing.
CGDDT	c	Cost of General Dozing	\$/ton	Cost of general bulldozing, in dollars/ton of coal.
CGDDY	c	Cost of General Dozing	\$/year	Cost of general bulldozing, in dollars/year.
CLM	i	Cost of Land Management	\$/acre	Estimated cost of land management, in dollars/acre.
CLMDT	c	Cost of Land Management	\$/ton	Cost of land management, in dollars/ ton of coal.
CLMDY	c	Cost of Land Management	\$/year	Cost of land management, in dollars/ year.
COTA	c	Cotangent of Angle of Coal		Cotangent of the angle of the coal.
COTB	c	Cotangent of Angle of Overburden		Cotangent of the angle of the overburden.
COTT	c	Cotangent of Angle of Spoils		Cotangent of the angle of the spoils.

TABLE 1
LAND RECLAMATION SIMULATION VARIABLES
 (Sheet 4 of 11)

Variable	Input/ Calculation (i/c)	Name	Units	Description
CRV	i	Cost of Revegetation	\$/acre	Estimated per-acre cost of revegetation.
CRVDT	c	Cost of Revegetation	\$/ton	Cost of revegetation, in dollars/ton of coal.
CRVDY	c	Cost of Revegetation	\$/year	Cost of revegetation, in dollars/year.
DBBPY	i	Density of Overburden	bank pounds/ cubic yard	Density of in-place overburden material.
DCBPY	i	Density of Coal	bank pounds/ cubic yard	Density of in-place coal.
DCYH	c	Dozer Production Capacity	cubic yards/ hour	Minimum bulldozer production possible, from bulldozer production curve.
DDMF	c	Dozing Distance	feet	Distance spoil material is bulldozed by each pass of the bulldozer.
DIOM	c	Dozer Cost	M\$	Cost of one bulldozer for one year.
DMNDF	i	Minimum Dozing Distance	feet	Minimum distance for which the bulldozer production curves hold true.
DMXDF	i	Maximum Dozing Distance	feet	Maximum distance for which the bulldozer production curves hold true.

TABLE 1
LAND RECLAMATION SIMULATION VARIABLES
 (Sheet 5 of 11)

Variable	Input/ Calculation (i/c)	Name	Units	Description
DTBPY	*	Density of Topsoil	bank pounds/ yard	Density of the in-place topsoil.
ECDO	c	Efficiency of Dozer Operation	fraction	Expected efficiency of the bulldozer operator, etc.
ECR	i	Expected Coal Recovery	fraction	Fraction of the in-place coal that can be recovered (1 minus the pit losses).
EMH	c	Effective Scraper Minutes/Hour	minutes/hour	Number of effective minutes/hour the scraper is working (60 * ERO).
ERO	i	Efficiency of Land Reclamation	fraction	Expected efficiency of the scrapers performing land reclamation.
FPW	i	Fraction of Panel Width	fraction	Fraction of the panel width the bulldozed material is to be moved.
FR	i	Fraction of Rehandle	fraction	Fraction of material on spoil that has to be rehandled by the bulldozer.
HBA	*	Height of the Overburden	feet	Height of the overburden.
HBT	i	Height of Topsoil	feet	Height of the topsoil.
*Input or calculated, depending on KAC				

TABLE 1
LAND RECLAMATION SIMULATION VARIABLES
 (Sheet 6 of 11)

Variable	Input/ Calculation (i/c)	Name	Units	Description
HC	*	Height of the Coal	feet	Height of the coal.
HSA	c	Height of the Overburden Spoils	feet	Height of the overburden spoils.
KAC	i	Method of Input		Variable indicating the method of user input.
KSR	i	Spoil Regrade Switch		Switch indicating whether or not spoil regrading will be simulated.
LOGPA	i	Log Parameters		Switch to control printing of input and calculated parameters.
NAP	i	Number of Additional Panels		Number of additional panels required to separate topsoil removal and spreading from other mining operations.
NP	*	Number of Panels		Number of panels in the area. Values depend on the setting of KAC: KAC = 1, NP = AWF / PWF. KAC = 2, NP must be set by the user. KAC = 3, NP is the count of the number of segments. KAC = 4, NP has no value.
*Input or calculated, depending on KAC				

TABLE 1

LAND RECLAMATION SIMULATION VARIABLES

(Sheet 7 of 11)

Variable	Input/ Calculation (i/c)	Name	Units	Description
PLF	*	Panel Length	feet	Length of the panel, in feet.
PLRHY	i	Scraper Productive Hours/ Year	hours/year	Number of productive hours/year the scrapers are estimated to work.
PWF	i	Panel Width	feet	Width of the working panel.
RAP	i	Ramp Angle	fraction	Grade of the haul road ramp leading from the pit floor to the top of the spoil area.
RAY	c	Reclamation Acres	acres/year	Number of acres/year effected by recla- mation.
SCA	i	Scraper Availability	fraction	Expected availability of the scraper.
SCCN	i	Scraper Hourly Operating Cost	\$/hour	Estimated hourly operating cost for the scraper.
SCCP	i	Scraper Hourly Ownership Cost	\$/hour	Estimated hourly ownership cost for the scraper.
SCPA	i	Scraper Performance Coefficient A		Scraper Performance Coefficient A.
*Input or calculated, depending on KAC				

TABLE 1

LAND RECLAMATION SIMULATION VARIABLES

(Sheet 8 of 11)

Variable	Input/ Calculation (i/c)	Name	Units	Description
SCPB	i	Scraper Performance Coefficient B		Scraper Performance Coefficient B.
SCPC	i	Scraper Performance Maximum Speed	miles/hour	Scraper maximum performance speed.
SCPD	i	Scraper Braking Coefficient A		Scraper Braking Coefficient A.
SCPE	i	Scraper Braking Coefficient B		Scraper Braking Coefficient B.
SCPF	i	Scraper Braking Maximum Speed	miles/hour	Scraper maximum braking speed.
SCSA	i	Scraper Heaped Capacity	cubic yards	Scraper heaped capacity.
SCSC	i	Scraper Shipping Weight	M pounds	Scraper empty weight.
SCSD	i	Scraper Payload	M pounds	Weight of scraper payload.
SFB	i	Swell Factor of Overburden	fraction	Factor defining the expected swell or increase in volume of the overburden.
SFT	i	Swell Factor of Topsoil	fraction	Factor defining the expected swell or increase in volume of the topsoil.

TABLE 1

LAND RECLAMATION SIMULATION VARIABLES

(Sheet 9 of 11)

Variable	Input/ Calculation (i/c)	Name	Units	Description
SRAY	c	Spoil Regrade Acres/Year	acres/year	Acres/year requiring regrading by the dozers.
SRMY	c	Spoil Regrade Cubic Yards/Year	M cubic yards/ year	Number of cubic yards/year to be regraded by the bulldozers.
SRYA	c	Spoil Regrade Yards/Acre	cubic yards/ acre	Number of cubic yards/acre of material to be regraded.
SRYAR	c	Spoil Regrade Yards/Acre including Rehandle	cubic yards/ acre	Number of cubic yards/acre of material to be regraded, including material which requires rehandle.
SRYT	c	Stripping Ratio of Bank Cubic Yards of Overburden to Recoverable Tons of Coal	cubic yards/ tons	Ratio of cubic yards of in-place overburden to tons of recoverable coal.
TANA	c	Tangent of Angle of Coal		Tangent of the angle of the coal.
TANB	c	Tangent of Angle of Overburden		Tangent of the angle of the overburden.
TANT	c	Tangent of Angle of Spoils		Tangent of the angle of the spoils.
TMSM	i	Time to Manuever and Spread with Scraper	minutes	Time it takes to manuever and spread the load of the scraper.

TABLE 1

LAND RECLAMATION SIMULATION VARIABLES

(Sheet 10 of 11)

Variable	Input/ Calculation (i/c)	Name	Units	Description
TMY	c	Total Mining Years	years	Number of years it takes to completely mine the given property.
TRF	i	Total Resistance on Haul Road	fraction	Total rolling resistance and grade resistance on the scraper haul road.
TRMY	c	Topsoil Removal Demand Rate	M cubic yards/ year	Rate at which topsoil must be removed to allow stripping and coal loading to proceed at the rate necessary to obtain coal at the desired coal recovery rate.
TRSA	c	Topsoil Removal and Spreading Acres/Year	acres/year	Number of acres/year for topsoil removal and spreading
TRSLAFY	c	Topsoil Removal and Spread Linear Feet/Year	feet/year	Number of linear feet/year the topsoil removal and spreading advances.
TRSPY	c	Topsoil Removal and Spreading Panels/Year	panels/year	Number of panels/year the topsoil removal and spreading progresses.
TRTDF	*	Topsoil Removal Travel Distance	feet	Topsoil removal haul distance, in feet.
TSMY	c	Topsoil Spreading Demand Rate	M cubic yards/ year	Rate at which topsoil must be spread to recover the regraded spoils at the rate at which stripping, coal loading, and spoil regrading are taking place.

TABLE 1
LAND RECLAMATION SIMULATION VARIABLES
 (Sheet 11 of 11)

Variable	Input/ Calculation (i/c)	Name	Units	Description
TSTDF	*	Topsoil Spreading Travel Distance	feet	Topsoil spreading haul distance.
TTLM	i	Time to Load Scraper	minutes	Scraper loading time.
WPLF	i	Working Panel Length	feet	Length along the panel between the ramped haul roads out of the pit.
XHBA	c	Extension of HBA	feet	Horizontal projection of average overburden.
XHC	c	Extension of HC	feet	Horizontal projection of coal.
XHSA	c	Extension of HSA	feet	Horizontal projection of average spoils.
XRAMP	c	Extension of Haul Ramp	feet	Horizontal projection of the haul road ramp out of the pit.
NP	i/c	Number of Panels		Number of panels in the area. Values depend on the setting of KAC: KAC = 1, NP = AWF / PWF KAC = 2, NP must be set by user KAC = 3, NP is a count of the number of segments
ALF	i/c	Area Length	feet	Area dimension measured along the stripping panel.

SECTION 3
MODEL LOGIC

The sequence of the operations for the LRS model is as follows:

- 1) The model reads the first record in the input data set and extracts the title and case number.
- 2) The model processes the next set of records in the input data set which constitute the user's changes to the default data values required to solve his problem.
- 3) The model examines the setting of parameter KAC to determine the method the user has chosen to input his data. If KAC = 1, 2, or 3, the model determines the area dimensions. If KAC = 4, no area dimensions are calculated.
- 4) If topsoil exists in the user's problem statement, the model calculates the required production rate for topsoil removal and spreading. Each of the operational demands are calculated on a yearly basis, using the expected total mining years and the total volumes to be moved.
- 5) The model calculates the acres disturbed by the reclamation operation.
- 6) If KAC = 4, the model assumes the user has input the topsoil removal and spreading haul distances; otherwise, the haul distances are calculated by the model. Figure 2-1 shows the topsoil removal haul from

A to A. Preceeding from A to A, the travel distance is divided into the following segments:

- NAP x PWF / 2 - The average distance of the number of additional panels required for operational reasons to separate the topsoil removal and stockpiling from the other mining operations.
- PWF - The working stripping panel.
- XHBA - The horizontal extension of the average overburden highwall.
- BWBH - The width of an operational berm on the overburden highwall, if one is required.
- XHC - The horizontal extension of the coal face.
- BWCF - The width of an operational berm on top of the coal seam, if one is required.
- CATC - The clearance at the toe of the coal seam.
- PWF - The width of the panel from which the coal is being removed.
- XRAMP - The horizontal distance of the coal haul road ramp.

- $TRSPY \times PWF / 2$ - The average distance the topsoil removal operation will proceed in a year.
- $WPLF / 2$ - The average distance out of the panel the scraper must travel to reach the topsoil haul road.

7) The model next calculates the travel distance for the topsoil spreading haul. The topsoil haul is indicated in Figure 2-1, from B to B. The following segments comprise the topsoil spreading haul:

- $TRSPY \times PWF / 2$ - The average distance the topsoil spreading operation will proceed in a year.
- $WPLF / 2$ - The average distance into the panel the scraper must travel to spread the topsoil.

8) Once the travel distances have been determined, the model calculates the cycle times for the topsoil removal haul and the topsoil spreading haul. The speed on the haul road is first determined, using the performance and braking curve equations and the weight of the scraper. The cycle time is then a function of the speed loaded, the speed empty, and the fixed times to load and spread the topsoil.

9) The model calculates the possible production for scrapers removing topsoil and scrapers spreading topsoil.

10) The model determines the fleet of scrapers necessary to maintain the desired production rate, based on the possible production rate and the required production rate.

11) The model calculates the costs for topsoil removal and topsoil spreading, using the hourly cost of scraper operation for ownership and operating cost. Costs of topsoil moved per yard, per acre, and per ton of recovered coal are provided.

12) The model examines parameter KSR to determine if spoil regrading is to be simulated. If $KSR = 0$, no spoils are created by the stripping operation and the model skips the calculations for spoil regrading. If $KSR = 1$, the model assumes the user intends to simulate spoil regrading and proceeds to calculate the volume of spoiled material/acre to be regraded.

13) The model calculates the required yearly production rate using the number of acres/year which require regrading.

14) The model determines the bulldozer's capacity by using the production curve equation to arrive at its possible hourly production, in cubic yards. This is based on the expected distance the bulldozed material is to be moved.

15) Based on the specified work schedule of the bulldozer, the model calculates the yearly production of one bulldozer.

- 16) The model calculates the fleet size for bulldozers regrading spoils, using the possible production for one bulldozer and the required production rate.
- 17) The model calculates the cost for the bulldozer fleet, using the hourly cost of owning and operating the bulldozer. Costs of material moved per yard, per acre, and per ton of coal are provided.
- 18) At this point, the model prints out the pertinent information regarding topsoil removal, topsoil spreading, and spoil regrading. If no topsoil is present in the problem description, topsoil removal and spreading information is not printed.
- 19) Next, the model costs all non-simulated operations of land reclamation. Using the estimated cost per acre of general bulldozing, revegetation, and land management; the model calculates dollars/year, dollars/ton of coal, and the number of bulldozers required for the general bulldozing work.
- 20) The model prints out the costs of all non-simulated operations.
- 21) The model accumulates and prints the total dollars/year, dollars/acre, and dollars/ton for all land reclamation operation.
- 22) The model returns to examine the input data set to see if the user has specified additional problems in the current run. If so, the model repeats Steps 2-21 for the next case; otherwise, the model stops.

SECTION 4
MODEL OUTPUT

Figure 4-1 is an example of the LRS model output. The following paragraphs describe the information which appears in the sample output listings.

Pages 1 and 2 of Figure 4-1 are a listing of the user's input data and intermediate calculated variables. This part of the model output is printed only if parameter LOGPA = 1. If LOGPA = 0, these pages are not printed. The following numbered items correspond to the numbers circled in Figure 4-1:

1) Model Title and Case Number

These data are input in the user's input data set. The title and case number appear at the top of each page of the simulation output.

2) Input/Calculation Indicator

If the letter found in this column for each variable is "i", the variable is input by the user. If a "c" is found, the variable is calculated. If an "*" is found, the variable is either input or calculated depending on the setting of KAC.

3) Variable Name

4) Variable Value

5) Description of the Variable and Units

Page 3 of Figure 4-1 shows the results of the simulation run. The first part of the output describes the scraper and bulldozer used in the simulation. On the scraper line, the capacity of the scraper (in cubic yards), the rated payload of the scraper, and the actual weight the scraper will be carrying are printed. The actual weight carried by the scraper is the smaller of the rated payload and the heaped capacity cubic yards converted to pounds. The bulldozer information is the distance the bulldozed material is to be moved (in feet/bulldozer pass) and the bulldozer's possible production (in cubic yards/hour).

The next section of the output consists of the details concerning topsoil removal haul and topsoil spreading haul. For each haul, the following information items are printed:

- 1) Loaded Speed - Miles/Hour
- 2) Empty Speed - Miles/Hour
- 3) Cycle Time - Minutes
- 4) Trips/Hour
- 5) Required Capacity - M Cubic Yards/Year
- 6) Number of Scrapers Required
- 7) Investment Cost - M Dollars/Year
- 8) Operating Cost - M Dollars/ Year
- 9) Total Investment and Operating Cost - M Dollars/Year
- 10) Dollars/Cubic Yard of Material Moved
- 11) Dollars/Acre Disturbed
- 12) Dollars/Ton of Coal

In the case where no topsoil is present in the mining area, the information regarding scrapers, topsoil removal, and topsoil spreading is not printed by the model.

Similar information is printed for spoil regrading. Items 5-12 above are calculated and printed for the bulldozers. For general bulldozing, the required number of bulldozers is back-calculated from the estimated cost of general bulldozing per acre and the ownership and operating cost/year for one bulldozer. If no spoil regrading is required, the spoil regrade line will not appear in the output.

The next two lines of the output are data concerning revegetation and land management. Given the estimated cost of these operations in dollars/acre, the model calculates the total dollars/year and the dollars/ton of recovered coal.

The final line of the output provides totals for total dollars/year for reclamation, dollars/acre, and dollars/ton of recovered coal.

LAND RECLAMATION SIMULATION
LOG PARAMETERS

02/14/77

① 0501 (ILRS0501) ILLINOIS BASIN
1 LAND RECLAMATION SIMULATION

②③	④	⑤
I KAC	1	METHOD OF INPUT - 1, 2, 3, OR 4
I KSP	1	SPOIL REGRADE - 1=YES, 0=NO
I LOGPA	1	PRINT INPUT VARIABLES IF = 1
* ACRES	8502.05	ACRES ON PROPERTY
* ACRT	.545154E 08	AREA COAL IN RECOVERABLE TONS
I CDRTY	.181718E 07	COAL DEMAND - RECOVERED TONS / YEAR
I CGD	600.000	COST FOR GENERAL DOZING - \$/ACRE
I CLM	100.000	COST FOR LAND MANAGEMENT - \$/ACRE
I CRV	200.000	COST FOR REVEGETATION - \$/ACRE
C ENH	43.9800	EFFECTIVE MINUTES PER HOUR
I EPO	.833000	EFFICIENCY OF LAND RECLAMATION - FRACTION
I HBT	1.00000	HEIGHT OF TOPSOIL - FEET
I PLRHY	1800.00	PRODUCTIVE LAND RECLAMATION - HRS / YR
* PWP	100.000	PANEL WIDTH - FEET
C PAY	283.402	RECLAMATION ACRES PER YEAR
C TANT	.666664	TANGENT OF ANGLE OF SPOILS
C TBY	30.0000	TOTAL MINING YEARS
I NAP	3	NUMBER OF ADDITIONAL PANELS
* NP	350	NUMBER OF PANELS
C ABBY	.973882E 09	AREA BURDEN IN BANK YARDS
I ABHD	63.4349	ANGLE OF BURDEN HIGHWALL - DEGREES
C ACBT	.592559E 08	AREA COAL IN BANK TONS
C ACBY	.548666E 08	AREA COAL IN BANK YARDS
I ACPO	75.0000	ANGLE OF COAL FACE - DEGREES
* ALP	10560.0	AREA LENGTH - FEET
* AWP	35071.0	AREA WIDTH - FEET
I BMBH	.000000	BERM WIDTH ON HIGHWALL - FEET
I BWCP	.000000	BERM WIDTH ON COAL FACE - FEET
I CATC	1.00000	CLFAPANCE AT TOE OF COAL - FEET
C COTA	.499999	COTANGENT OF ANGLE OF THE COAL
C COTB	.249326	COTANGENT OF ANGLE OF THE OVERBURDEN
C COTF	1.50006	COTANGENT OF ANGLE OF SPOIL
I DBBPY	3700.00	DENSITY OF BURDEN - BANK LBS / YD
I DCBPY	2160.00	DENSITY OF COAL - BANK LBS / YD
I ECR	.920000	EXPECTED COAL RECOVERY - FRACTION
* HBA	71.0000	AVERAGE HEIGHT OF OVERBURDEN - FEET
* HC	4.00000	HEIGHT OF COAL - FEET
C HSA	112.515	HEIGHT OF SPOIL (AVERAGE) - FEET
* PLP	10560.0	PANEL LENGTH - FEET
I RAP	.400000E-01	RAMP GRADE - FRACTION
C SC	4.01082	SLOPE OF THE COAL
I SPB	.350000	SWELL FACTOR OF OVERBURDEN - FRACTION
C SH	2.00001	SLOPE OF THE HIGHWALL
C SPYT	17.8643	STRIPPING RATIO - BANK YDS / REC. TONS
C SS	1.50006	SLOPE OF THE SPOILS
* SSL	.369600E 07	SUM OF THE SEGMENT LENGTHS
C TANA	2.00001	TANGENT OF ANGLE OF COAL
C TANB	4.01082	TANGENT OF ANGLE OF OVERBURDEN
C TPLAPY	123450.	LINEAR ADV. OF THE STRIPPING OP. - FT/YR
I WPLP	2540.00	WORKING PANEL LENGTH - FEET
C KHBA	35.4999	EXTENSION OF AVERAGE OVERBURDEN - FEET
C XHC	.997303	EXTENSION OF COAL - FEET
C XHSA	158.780	EXTENSION OF AVERAGE SPOIL - FEET

Figure 4-1. Sample of LRS Model Output (Sheet 1 of 3)

C IRAMP	2396.25	EXTENSION OF RAMP - FEET
I DTBPT	2320.00	DENSITY OF TOPSOIL - BANK LBS / YD
I SCA	1.00000	SCRAPER AVAILABILITY - FRACTION
I SCCN	38.2100	SCRAPER HOURLY OPERATING COST - \$/HR
I SCCP	22.2500	SCRAPER HOURLY OWNERSHIP COST - \$/HR
I SCPA	-0.318100	SCRAPER PERF. COEF. A
I SCPB	126.400	SCRAPER PERF. COEF. B
I SCPC	33.5000	SCRAPER MAXIMUM PERF. SPEED - MPH
I SCPD	.225400	SCRAPER BRAKING COEF. A
I SCPE	247.800	SCRAPER BRAKING COEF. B
I SCPF	33.0000	SCRAPER MAXIMUM BRAKING SPEED - MPH
I SCSA	32.0000	SCRAPER HEAPED CAPACITY - CU YDS
I SSCS	91.2000	SCRAPER EMPTY WEIGHT - M LBS
I SCSD	72.0000	SCRAPER PAYLOAD - M LBS
I SPT	.430000	SWELL FACTOR OF TOPSOIL - FRACTION
I TNSH	.700000	TIME TO MANUEVER AND SPREAD - MINUTES
I TPF	.500000*-01	TOTAL RESISTANCE ON HAUL - FRACTION
C TPNY	457.221	TOPSOIL REMOVAL DEMAND M YDS/YR - BANK
C TRSAY	293.401	T.S. REM. & SPRD. ACRES / YR
C TRSPY	46.7612	T.S. REM. & SPRD. NO. OF PANELS / YR
* TPTOP	6141.30	TOPSOIL REMOVAL DISTANCE MOVED - FEET
C TSNYY	653.825	TOPSOIL SPREAD DEMAND M YDS/YR - LOOSE
* TSTOP	3558.06	TOPSOIL SPREAD DISTANCE MOVED - FEET
I TFLN	.900000	TIME TO LOAD SCRAPER - MINUTES
I ABSO	33.6990	ANGLE OF BURDEN SPOILS - DEGREES
I CDA	1.00000	DOZER AVAILABILITY - FRACTION
I CDCN	31.1800	DOZER HOURLY OPERATING COST - \$/HR
I CDCP	21.3000	DOZER HOURLY OWNERSHIP COST - \$/HR
I CDPA	-49.5700	DOZER PRODUCTION COEF. A
I CDPB	158000.	DOZER PRODUCTION COEF. B
I CDPHY	1300.00	DOZER PRODUCTIVE HOURS PER YEAR
C DDMP	150.000	DOZING DISTANCE - FEET
I DNNDP	50.0000	DOZING MINIMUM DISTANCE - FEET
I DNNDP	600.000	DOZING MAXIMUM DISTANCE - FEET
I EDDO	.750000	EFFICIENCY OF DOZER OPERATION
I FFW	1.50000	FRACTION PANEL WIDTH DOZED MAT'L MOVED
I FR	.250000	FRACTION OF DOZED MAT'L REHANDLED
C SRAI	283.402	SPOIL REGRADE ACRES PER YEAR
C SRNYY	2381.27	SPOIL REGRADE DEMAND M YDS / YR
C SRYA	6721.96	SPOIL REGRADE YARDS / ACRE
C SRYAR	8402.45	SPOIL REGRADE YDS / ACRE INCL. R/H

Figure 4-1. Sample of LRS Model Output (Sheet 2 of 3)

LAND RECLAMATION SIMULATION 02/14/77
CALCULATED RESULTS

0501 (ILRS0501) ILLINOIS BASIN
1 LAND RECLAMATION SIMULATION

SCRAPER	CYD	P-YLBS	A-MLBS									
	32.00	72.00	51.92									
DOZER	DMP	CYD/HR										
	150.00	1033.76										
	L-MPH	P-MPH	CTH	TPH	MCY	#	I-M\$/YR	O-M\$/YR	ION\$/YR	\$/CY	\$/A	\$/TON
TS REMOVAL	12.24	22.78	10.79	4.63	186.53	2.45	99.22	168.59	266.81	.584	941.450	.147
TS SPREAD	12.24	22.79	6.82	7.33	422.09	1.55	62.07	106.54	168.60	.258	594.925	.093
						4.00					1536.375	.240
SPOIL REGRADE					1355.08	1.76	67.37	98.63	166.00	.070	585.742	.091
GENERAL DOZING						1.80			170.04		600.000	.094
						3.56					1185.742	.185
REVEGETATION									55.59		200.000	.031
LAND MANAGEMENT									28.34		100.000	.016
TOTAL LAND RECLAMATION									856.47		3022.118	.471
STOP 0												

Figure 4-1. Sample of LRS Model Output (Sheet 3 of 3)

PART 6

COAL PREPARATION AND GENERAL
AND ADMINISTRATIVE (PGA) MODEL
USER'S MANUAL

3 December 1976

PART 6
PGA MODEL USER'S MANUAL
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Manual
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SECTION 1
INTRODUCTION

1.1 PURPOSE AND SCOPE

This manual describes the PGA (coal preparation and general and administrative factoring) model in sufficient detail for a user to correctly formulate a problem statement to solve one or more cases. The PGA model contains two models as submodels:

- 1) CPF - Coal Preparation Factoring
- 2) GAA - General and Administrative Factoring

The CPF model is based on three coal preparation flow sheets developed by Fluor Utah for crushing and screening, baum jig, and heavy media plants. Each flow sheet is designed for a baseline plant size; the user specifies the plant desired, and the model uses factoring equations to scale the baseline plant to the problem statement.

The GAA model is based on a series of baseline surface coal mines developed by Fluor Utah. Each baseline case represents a mine typical of a coal-bearing region. The user sets appropriate model parameters to describe a region, and the model uses factoring equations to scale the baseline solution to the problem statement.

1.2 ORGANIZATION OF THIS MANUAL

This manual contains three sections and three appendices. Following this Introduction, Section 2 describes the model logic and arithmetic and the manner in which user-set parameters are used by the model. Section 3 describes how parameters are set by the user.

Appendix A contains an example problem consisting of five cases. The first three cases illustrate the three preparation plant flow sheets; the remaining two cases illustrate the general and administrative factoring for two regions. Appendix B contains a run with a single case, with all variables at default values. This case illustrates the default values of all model parameters. By studying this example, the user can determine the parameters which must be changed to describe a given problem.

In addition to the reports printed by the PGA model, each appendix includes a listing of the equipment data cards developed for the case. All report pages printed by the model have a page number on the first print line; the single-page listing of the equipment cards does not have a page number on the first line. This single-page listing follows the summary report page for each case. Since both submodels are included in the example in Appendix B, the equipment card listing requires two pages and they follow the summary report page.

Appendix C contains a Cash Flow Analysis run which used the control and equipment data files produced from the six PGA cases contained in Appendices A and B. Only the Financial Summary Reports are presented. These reports demonstrate the effects of a discounted cash flow analysis on the steady-state costs from the PGA model.

1.3 USING THIS MANUAL

The PGA model prepares reports of value for economic analysis; however, the model was designed specifically to develop data files for processing with the Cash Flow Analysis (CFA) model. The PGA model reports are in steady-state or base-year dollars; when a PGA run is followed by a CFA run, the economics include the time-value-of-money effects. The CFA model is described in the CFA User's Manual; only the data files which connect the two models are described in this manual.

The PGA model develops the equipment data cards for the CFA model. These cards are listed in this manual and are discussed only in the context of the PGA model actions. This manual assumes a user understanding of the CFA model and the formats and contents of the equipment data cards.

SECTION 2
MODEL OPERATIONS

2.1 OVERVIEW

The PGA model consists of a main program (the PGA model) and two subroutines (the CPF and GAA submodels). The model begins by reading the default control files for the CFA and the PGA models, and the user's input data file. The default control files set all parameters to default values. The user's input data file resets parameter values as required to define a problem statement, and may describe one or more cases to be solved in the model run. (The parameters and files are explained in Section 3; they are identified here to put the sequence of model actions into context.)

After reading the user's input file, the model calculates the size requirements for the preparation plant and the general and administrative functions. The model then executes one or both of the submodels, as required.

The two submodels operate in similar manner, using factoring equations to scale the baseline solution to the problem statement. They list all submodel parameters under user control, print a cost report, and write CFA equipment data cards to the CFA equipment file.

After the submodels finish their operations, the PGA model writes a set of records for the CFA control file and then prints a summary report.

2.2 PGA SIZING CALCULATIONS

Factoring equations determine the preparation plant size that will supply the user-specified energy demand, considering the energy content of the run-of-mine (ROM) coal. These equations determine the ROM feed requirement and the prepared coal production rate and energy content.

Preparation plant flow sheets were developed for a plant feeding 75,000 tons/day of ROM coal, and producing 0.409×10^{15} equivalent Btus/year from 250 operating days/year. The design factors for the three plants are:

<u>IPPT</u>	<u>PPBHV</u>	<u>PPBSF</u>	<u>PPBHF</u>
1 Crushing & Screening	10990	0.99	1.0036
2 Baum Jig	12760	0.825	1.0373
3 Heavy Media	13084	0.787	1.06

where:

IPPT - is the index to preparation plant type,
PPBHV - are the base heat values,
PPBSF - are the base size factors, and
PPBHF - are the base heat factors.

The user sets IPPT to 1, 2, or 3 to define the desired plant type.

Table 1 presents the equations solved by the PGA model before either submodel is called. The table contains five columns of information: column 1 contains sequence numbers, with each numbered line presenting one equation solved by the model; column 2 contains the model variable name; column 3 contains a description of the variable, followed by the dimensions in column 4; and column 5 contains either an equation or a value, with the

solution value for each calculated variable being presented immediately below the equation. (The solution values were obtained from the input values, as listed in column 5, and all values pertain to Case 2 in the example problem given in Appendix A.)

After making these calculations, the model checks the control parameters to see if the parameter values should be printed and to see which submodel is included in the case.

The majority of the variables described in Table 1 are printed in the parameter list illustrated in Figure 2-1. This list is discussed in Section 3.

TABLE 1
PGA MODEL CALCULATIONS
 (Sheet 1 of 3)

No.	Variable Name	Description and Solution Value	Dimension	Equation or Input Value
1.	PPNS	Plant Feed Rate (ROM Coal)	tons/day	$= \frac{PPNED}{PPBED} * \frac{PPHV}{PPNHV} * PPBT$ = 25317.5
	PPNED	Required Plant Production	Btus/year	0.13E15
	PPBED	Base Plant Production	Btus/year	0.4095E15
	PPHV	Base Heat Content	Btus/pound	= PPBHV (IPPT) = 12760
	PPNHV	Heat Content ROM Coal	Btus/pound	12000
	PPBT	Base Feed Rate (ROM Coal)	tons/day	75000
	IPPT	Index to Plant Type		2
2.	CDRTYX	Annual Feed Rate (ROM Coal)	tons/year	= PPNS * PPODY = 0.632936E7
	PPODY	Plant Operating Schedule	days/year	250
3.	PPFTY	Production Rate (Finished Coal)	tons/year	= CDRTYX * PPSF = 0.522172E7
	PPSF	Base Size Factor		= PPBSF (IPPT) = 0.825
4.	PPFHV	Finished Coal Heat Content	Btus/pound	= PPNHV * PPHF = 12447.6
	PPHF	Base Heat Factor		= PPBHF (IPPT) = 1.0373

TABLE 1
PGA MODEL CALCULATIONS
 (Sheet 2 of 3)

No.	Variable Name	Description and Solution Value	Dimension	Equation or Input Value
5.	PPCRLO	Life of Operation	years	= TMY
				= 30
	TMY	Total Mine Life	years	= 30
6.	XTT	Total Finished Coal Production	tons	= PPFTY * PPCRLO
				= 0.156652E9
7.	XRT	Total ROM Coal Production	tons	= CDRTYX * PPCRLO
				= 0.189881E9
8.	XBT	Total Btu Production	Btus	= PPNEB * PPCRLO
				= .39E16
9.	VCRT	Total Coal Recovered	tons	= CDRTYX * TMY
				= 0.189881E9
10.	VBBY	Total Overburden Volume	bank cubic yard	= VCRT * SRYT
	SRYT	Stripping Ratio Bank Cubic Yards/ROM Ton		= 17.8643

TABLE 1
PGA MODEL CALCULATIONS
 (Sheet 3 of 3)

No.	Variable Name	Description and Solution Value	Dimension	Equation or Input Value
11.	BPBY	Overburden Production	bank cubic yards/year	CDRTYX * SRYT
				= 0.113070E9
12.	GTTY	Total Tons for GAA	tons/year	= CDRTYX + BPBY * $\frac{DBBPY}{2000}$
				= 0.215509E9
	DBBPY	Density of Overburden	pounds/bank cubic yard	3700

Note: GTTY is scaled to millions of tons/year, and printed on the GAA input.

PGA MODEL ECONOMIC SUMMARY

RUN DATE 16:16 NOV 29,'76 PAGE NO. 2.1

CASE NO. 1123 TITLE (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
 ALT. NO. 2 TITLE BAUM JIG PREPARATION PLANT

1975 DOLLARS

I IMOGA	0		INCLUDE GENERAL & ADMINISTRATIVE
I IMOPP	1		INCLUDE PREP PLANT
I IPPT	2		PP - INDEX TO PLANT TYPE
I LOGCF	1		WRITES CFA CONTROL FILE IF 1
I LOGEC	1		WRITES CFA EQUIPMENT FILE IF 1
I LOGPA	1		PRINTS PARAMETERS IF 1
I LOGSD	1		WRITES SPECIFICATION DATA IF 1
I LOGSM	1		WRITES ECONOMIC SUMMARY IF ONE
I NY	3		NO. OF YEARS TO STARTUP
I OBRPY	3700.00		DENSITY OF OVERBURDEN BANK LBS/YARD
I GAMR	50.0000		GAA - MINERAL RIGHTS (\$/ACRE)
I GARA	.250000		GAA - ROYALTY AMOUNT (\$/TON)
I GASR	250.000		GAA - SURFACE RIGHTS (\$/ACRE)
I GAST	.000000		GAA - SEVERANCE TAX (\$/TON)
I GATAO	25505.4		TOTAL ACRES DISTURBED IN COMPLEX
I GATYB	185.614		GAA - TONS/YEAR - BASELINE
I GAUP	.110000		GAA - UNION PAYMENT (\$/TON)
I PPBEJ	.409500E 15		PP - BASE ENERGY BTU/YEAR
I PPBT	75000.0		PP - BASE TONS/DAY
I PPNEO	.130000E 15		PP - COMPLEX ENERGY DEMAND BTU/YEAR
I PPNHV	12000.0		PP - COAL HEAT VALUE BTU/LB
I PPODY	250.000		PP - OPERATING DAYS/YEAR
I SRYT	17.8643		STRIPPING RATIO YARDS/ROM TONS
I TMY	30.0000		TOTAL MINING YEARS
C BPPYY	.113070E 09		COMPLEX OVERBURDEN PROD. YARDS/YEAR
C CORTYX	.632936E 07		COMPLEX COAL DEMAND ROM TONS/YEAR
C PPFHV	12447.6		PP - FINAL HEAT VALUE
C PPFTY	.522172E 07		PP - FINISHED COAL TONS/YEAR
C PPHF	1.03730		PP - HEAT VALUE FACTOR FOR IPPT
C PPHV	12760.0		PP - BASE HEAT VALUE FOR IPPT
C PPNS	25317.5		PP - COMPLEX SIZE TONS/DAY
C PPSF	.825000		PP - SIZE FACTOR FOR IPPT
C VBRV	.379209E 10		VOL. OVERBURDEN BANK YARDS
C VCRT	.189881E 09		VOL. COAL ROM TONS

Figure 2-1. Parameter List

2.3 CPF SUBMODEL

2.3.1 General

The model develops one of three preparation plants. Each of these plants consists of five operations:

- 1) Receiving and Breaking
- 2) Stockpiling and Blending
- 3) Preparation
- 4) Support
- 5) Coal Loadout

The preparation and support operations are selected by user-set parameter IPPT. The value of IPPT may be one of the following:

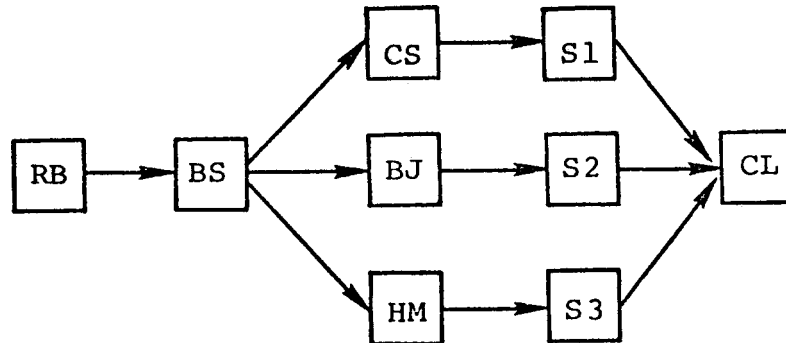
- 1) Crushing and Screening Preparation and Support
- 2) Baum Jig Preparation and Support
- 3) Heavy Media Preparation and Support

Each preparation plant block is identified, in the model, with a two-character code which is the last two characters of the unit identifier placed in the CFA equipment data cards. The model keeps the blocks in a preset order, as follows:

- 1) RB - Receiving and Breaking
- 2) BS - Blending and Stockpiling
- 3) CL - Coal Loadout
- 4) CS - Crush and Screen
- 5) S1 - Crush and Screen Support

- 6) BJ - Baum Jig
- 7) S2 - Baum Jig Support
- 8) HM - Heavy Media
- 9) S3 - Heavy Media Support

The following diagram illustrates the flow through these nine blocks:



The CPF factoring equation is of the form:

$$Y = A + R^X$$

where:

Y - is the value being calculated by the model,
 A - is a constant term set by model parameters,
 R - is a size ratio (explained below), and
 X - is an exponent set by model parameters.

The value of R is determined with the following equation:

$$R = \frac{PPNS}{PPEQTY(I) * 75000} = \frac{25317.5}{1 * 75000} = 0.3376$$

where:

PPNS - is the calculated plant size from the PGA model, and
 PPEQTY - is the quantity of units making up each block (a model parameter).

Parameter PPEQTY is subscripted in the preceding equation, indicating that the parameter has one value for each of the nine plant blocks. In other words, the parameter is dimensioned in the model.

Many model parameters are dimensioned. Figure 2-2 reproduces the listing of input parameters from the example problem. Note that PPEQTY is followed by nine values. Some parameters (e.g., PPMC) are followed by 8 lines, each containing nine values. Considering Figure 2-2 as a table containing nine columns of data for most parameters, the first column applies to the first block, the second column to the second block, and so forth. (The mechanics of setting values for dimensioned parameters are illustrated in Section 3.)

The first three parameters on the Figure 2-2 are followed by three values. These parameters are used in the main program, as explained previously. The subscript for these parameters is IPPT.

Some variables are followed by only one value. These parameters are not subscripted, and apply to all nine blocks.

The following paragraphs describe how the parameters are used by the model. In this discussion, subscripts are used in the factoring equation. The user should understand that each subscripted equation is performed for each block to be included in the plant. The subscript will take on appropriate values and be solved five times. For example, if IPPT = 2, the subscript would take on values of 1, 2, 3, 6, and 7.

PGA MODEL ECONOMIC SUMMARY

RUN DATE 16:16 NOV 29, '76 PAGE NO. 2.3

CASE NO. 1123 TITLE (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
 ALT. NO. 2 TITLE BAUM JIG PREPARATION PLANT

1975 DOLLARS

PPBHV	BASE HEAT VALUES	10990.	12760.	13084.						
PPBSF	BASE SIZE FACTORS	.9900	.8250	.7870						
PPBHF	BASE HEAT FACTORS	1.0036	1.0373	1.0600						
PPCCF	CAP. COST FACTORS	17700.	67400.	3600.	9500.	8100.	52100.	8100.	70200.	8100.
PPCCX	CAP. COST EXP.	.80	.80	1.00	.80	.50	.75	.50	.70	.50
PPPSF	OPER. PER. FRACTIONS	2.00	8.50	2.00	2.00	9.60	6.00	9.60	6.00	9.60
		2.00	2.00	2.00	2.00	4.80	2.00	7.20	6.00	9.60
		3.00	.00	1.00	3.00	.00	3.00	.00	3.00	.00
		.00	.00	.00	1.00	.00	3.00	.00	5.00	.00
		.00	.00	.00	.00	.00	2.00	.00	2.00	.00
		.00	.00	.00	.00	.00	.00	.00	2.00	.00
		.00	.00	.00	.00	.00	.00	.00	.00	.00
		.00	.00	.00	.00	.00	.00	.00	.00	.00
PPPSX	OPER. PER. EXP.	.35	.35	.35	.35	.35	.35	.35	.35	.35
PPCS	OPER. SCHED. CODES	5.	9.	12.	9.	5.	9.	5.	9.	5.
PPCC	OPER. CLASS CODES	13.	13.	13.	13.	11.	13.	11.	13.	11.
		18.	23.	18.	18.	22.	17.	22.	17.	22.
		23.	0.	23.	22.	0.	22.	0.	22.	0.
		0.	0.	0.	23.	0.	23.	0.	5.	0.
		0.	0.	0.	0.	0.	10.	0.	23.	0.
		0.	0.	0.	0.	0.	0.	0.	10.	0.
		0.	0.	0.	0.	0.	0.	0.	0.	0.
		0.	0.	0.	0.	0.	0.	0.	0.	0.
PPMLF	MAINT. LABOR COST F.	71.52	81.39	30.56	54.31	174.02	184.13	215.38	249.38	232.32
PPMLX	MAINT. LABOR EXP.	.35	.35	.35	.35	.35	.35	.35	.35	.35
PPMHF	MAINT. MATL. COST F.	122.07	309.86	10.33	43.67	101.25	287.42	101.25	516.37	101.25
PPMMX	MAINT. MATL. EXP.	.80	.80	.80	.80	.50	.75	.50	.70	.50
PPFCF	FUEL COST FACTORS	.00	.00	.00	12.41	.00	15.45	.00	17.93	.00
PPFCX	FUEL COST EXP.	.00	.00	.00	.80	.00	.75	.00	.70	.00
PPWCF	WATER COST FACTORS	.00	.00	.00	.00	.00	2.40	.00	4.20	.00
PPWCX	WATER COST EXP.	.00	.00	.00	.00	.00	1.00	.00	1.00	.00
PPECF	ELEC. COST FACTORS	45.05	99.87	22.12	19.08	128.12	185.00	128.12	314.65	128.12
PPECX	ELEC. COST EXP.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Figure 2-2. CPF Input Parameters (Sheet 1 of 2)

PGA MODEL ECONOMIC SUMMARY

RUN DATE 16:16 NOV 29, '76 PAGE NO. 2.4

CASE NO. 1123 TITLE (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
 ALT. NO. 2 TITLE BAUM JIG PREPARATION PLANT

1975 DOLLARS										
PPLCF	LABOR COST FACTORS	68.78	105.53	55.83	79.24	143.62	161.06	166.80	220.21	189.99
PPLCX	LABOR COST EXP.	.35	.35	.35	.35	.35	.35	.35	.35	.35
PPOWCF	OWN. COST FACTORS	3625.	5438.	8712.	5438.	2000.	5438.	2000.	5438.	2000.
PPDTF	OPER. HOURS/DAY	14.50	21.75	38.45	21.75	8.00	21.75	8.00	21.75	8.00
PPEQTY	UNIT QUANTITIES	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PPMS	MAINT. SCHED. CODES	5.	5.	5.	5.	5.	5.	5.	5.	5.
PPMC	MAINT. CLASS CODES	4.	4.	4.	4.	4.	4.	4.	4.	4.
		5.	5.	5.	5.	5.	5.	5.	5.	5.
		6.	6.	6.	6.	6.	6.	6.	6.	6.
		14.	14.	14.	14.	12.	14.	12.	14.	12.
		12.	12.	12.	12.	13.	12.	13.	12.	13.
		18.	18.	18.	18.	22.	18.	22.	18.	22.
		23.	23.	23.	23.	0.	23.	0.	23.	0.
		0.	0.	0.	0.	0.	0.	0.	0.	0.
PPMF	MAINT. FRACTIONS	.074	.087	.069	.131	.097	.096	.118	.113	.146
		.074	.044	.069	.064	.195	.096	.157	.099	.146
		.296	.261	.278	.259	.292	.288	.315	.311	.328
		.071	.042	.066	.061	.233	.092	.226	.068	.210
		.212	.125	.199	.187	.093	.128	.075	.122	.070
		.205	.401	.256	.239	.090	.248	.109	.248	.100
		.068	.040	.063	.059	.000	.052	.000	.039	.000
		.000	.000	.000	.000	.000	.000	.000	.000	.000
PPCRSY	START YEAR	7.								
PPCRNY	NO. YEAR STARTUP	3.								
PPCRSE	STARTUP EFF.	1.								
PPCRPL	PURCHASE LEAD TIME	3.								
PPCRLO	LIFE OF OPERN.	30.								
PPD2SF	SALVAGE FRACTION	.00								
PPD2DM	DEPREC. METHOD	3.								
PPD2PC	PURCHASE CODE	5.								
PPD2RA	REGIONAL ADJ.	1.00								
PPD2EF	ESCAL. FACTOR	.00								
PPD2CO	CONSTRUCTION CODE	1.								

Figure 2-2. CPF Input Parameters (Sheet 2 of 2)

2.3.2 CPF Operating Costs

The model calculates six \$/hour operating cost figures, using the factoring equation form explained previously. The following equations are solved (the figures are taken from block 6 in Case 2 of the example problem):

1) Maintenance Labor Cost

$$\begin{aligned} \text{PPML} &= \text{PPMLF}(\text{I}) * \text{R} ** \text{PPMLX}(\text{I}) \\ &= 184.13 * 0.3376 ** 0.35 \\ &= 125.91 \end{aligned}$$

2) Maintenance Materials Cost

$$\begin{aligned} \text{PPMM} &= \text{PPMMF}(\text{I}) * \text{R} ** \text{PPMMX}(\text{I}) \\ &= 287.42 * 0.3376 ** 0.75 \\ &= 127.29 \end{aligned}$$

3) Fuel Cost

$$\begin{aligned} \text{PPFC} &= \text{PPFCF}(\text{I}) * \text{R} ** \text{PPFCX}(\text{I}) \\ &= 15.45 * 0.3376 ** 0.75 \\ &= 6.84 \end{aligned}$$

4) Water Cost

$$\begin{aligned} \text{PPWC} &= \text{PPWCF}(\text{I}) * \text{R} ** \text{PPWCX}(\text{I}) \\ &= 2.40 * 0.3376 ** 1 \\ &= 0.81 \end{aligned}$$

5) Electric Power Cost

$$\begin{aligned} \text{PPEP} &= \text{PPECF}(\text{I}) * \text{R} ** \text{PPECX}(\text{I}) \\ &= 185 * 0.3376 ** 1 \\ &= 62.45 \end{aligned}$$

6) Operating Labor Cost

$$\begin{aligned} \text{PPLC} &= \text{PPLCF}(\text{I}) * \text{R} ** \text{PPLCX}(\text{I}) \\ &= 161.06 * 0.3376 ** 0.35 \\ &= 110.13 \end{aligned}$$

Each operating cost is calculated for each block. The costs are entered directly in the CFA equipment cards developed by the model. Before the model prints the cost report, each cost figure is multiplied by the appropriate value from PPEQTY.

The total hourly operating cost printed in the report is the summation of the six costs after being adjusted for quantity. Thus:

$$\begin{aligned} \text{PPOPC} &= \text{PPML} + \text{PPMM} + \text{PPFC} + \text{PPWC} + \text{PPEP} + \text{PPLC} \\ &= 125.91 + 127.29 + 6.84 + 0.81 + 62.45 + 110.13 \\ &= 433.43 \end{aligned}$$

2.3.3 CPF Unit Investment Costs

The equation used to calculate the unit investment is:

$$\begin{aligned} \text{PPCC} &= \text{PPCCF}(\text{I}) * \text{R} ** \text{PPCCX}(\text{I}) \\ &= 52100 * 0.3376 ** 0.75 \\ &= 23073.2 \end{aligned}$$

The units of PPCC are thousands of dollars, and the calculated values are entered directly in the CFA equipment cards.

After the initial investment (PPCC) is written to the CFA equipment cards, the value is converted to total investment with the following equation:

$$\begin{aligned} \text{PPCC} &= \text{PPCC} * 1000 * \text{PPEQTY}(\text{I}) \\ &= 23073.2 * 1000 * 1 \\ &= .230732\text{E}8 \end{aligned}$$

The hourly ownership cost is calculated with the following equation:

$$\begin{aligned} \text{PPOWC} &= \frac{\text{PPCC} * (1 + 0.07 * (1 + \text{PPDY}))}{\text{PPDY} * \text{PPOWCF}(\text{I})} \\ &\quad + \frac{.230732\text{E}8 * (1 + 0.07 * (1 + 32))}{32 * 5438} \\ &= 448.34 \end{aligned}$$

2.3.4 CPF Report

The information report produced by the CPF model is reproduced below:

PGA MODEL ECONOMIC SUMMARY RUN DATE 16:16 NOV 29,*76 PAGE NO. 2.2

CASE NO. 1123 TITLE (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
ALT. NO. 2 TITLE BAUM JIG PREPARATION PLANT

1975 DOLLARS

PREPARATION PLANT STATISTICS

TYPE	SIZE TONS/DAY	BTU/LB	DELIVERED COAL		BTU/YEAR	O&O \$/TON
			TONS/YEAR			
2	25317.5	12447.6	.522172E 07		.130003E 15	
		UNIT INVESTMENT	LABOR	OWNERSHIP	OPERATING	
			\$/HOUR			
REC & BREAK	PREP. PLANT	.742439E 07	47.03	216.42	162.35	.217
BLEND-STOCK	PREP. PLANT	.282714E 08	72.16	549.35	291.30	.722
COAL LOADOUT	PREP. PLANT	.121524E 07	38.18	14.74	70.87	.130
BAUM JIG	PREP. PLANT	.230732E 08	110.13	448.34	433.43	.758
BJ SUPPORT	PREP. PLANT	.470613E 07	114.06	248.64	363.41	.193
		.646933E 08				2.020

Total ownership plus operating (O&O) cost, in \$/ton ROM coal, is calculated as follows:

$$\begin{aligned}
 \text{PPDT} &= \frac{(\text{PPOWC} + \text{PPOPC}) * \text{PPDTF}(I)}{\text{PNPS}} \\
 &= \frac{(448.34 + 433.43) * 21.75}{25317.5} \\
 &= 0.7575
 \end{aligned}$$

The report includes the total investment and total O&O \$/ton for the plant. It does not include summations of the \$/hour figures, since each figure is based on the operating hours of the block and a total would be meaningless.

2.3.5 Operating and Maintenance Labor Requirements

The model calculates the manpower requirements for entry into the CFA equipment data cards. The operating labor calculation uses the factoring equation; the maintenance labor calculation does not. The different treatment results from the manner in which the labor assignments are handled by the CFA model. (A complete discussion is contained in the CFA User's Manual.)

For this discussion, the operating labor figures are average numbers of employees; and the maintenance labor figures are fractions, i.e., the portion of the maintenance cost to be furnished by a class of maintenance labor.

Four two-dimension arrays are involved:

- 1) PPPSF - operating labor fractions
- 2) PPOC - operating labor class codes
- 3) PPMF - maintenance labor fractions
- 4) PPMC - maintenance labor class codes

Each array has nine rows and eight columns. The rows correspond to the nine blocks in the same sequence as listed in paragraph 2.3.1. The eight columns allow the user to assign up to eight personnel classes. There is a one-to-one correspondence between the columns in PPPSF and PPOC and between PPMF and PPMC.

Note

In the listing of input data in Figure 2-2, the columns and rows are transposed to maintain the table format in which each column pertains to a single block. To illustrate, the first value of PPPSF for block 6 is 6; the second value is 2; the third is 3; the fourth is 3; the fifth is 2; and the remainder are zero. The corresponding class codes from PPOC are 13, 17, 22, 23, and 10.

Three one-dimension arrays are also involved:

- 1) PPPSX - operating labor exponents
- 2) PPCS - operating labor classification codes
- 3) PPMS - maintenance labor schedule codes

The operating labor equation for the sixth block and first class is:

$$\begin{aligned} \text{PPPS} &= \text{PPFS}(6,1) * R ** \text{PPSX}(6) \\ &= 6 * 0.3376 ** 0.35 \\ &= 4.1 \end{aligned}$$

Thus, 4.1 class 13 operators working on schedule 9 are needed. Since there are five non-zero entries for block 6, the equation is repeated for each; and five assignments are made in the CFA equipment cards for the block.

The maintenance labor requirements are taken directly from the PPMF array. Seven assignments are made for block 6 since there are seven non-zero entries for the block. For the CFA model to function as designed, the maintenance labor fractions for any block must sum to 1. The maintenance labor pool is calculated by the CFA model such that the pool will furnish the dollars/hour of maintenance labor defined by the calculated value of PPML. Neither the CPF model nor the CFA model checks to see that the total is 1; thus, the user could enter fractions that do not sum to 1, and the effect would be to have a labor pool which does not provide the correct maintenance dollars/hour.

2.3.6 CPF Equipment Cards

The following is a listing of the equipment data cards for the CFA model, as developed for the second case:

```

38 - *                2 BAUM JIG PREPARATION PLANT
39 - ECRG P 1 PRRB 1 0 3625 5221.72 7 3 .80 3 0 30 3625.
40 - ED1 P 1 PRRB REC & BREAK PREP. PLANT
41 - ED2 P 1 PRRB 7424.39 108750 .000 1 5 0 1.000 .000 1
42 - ED3 P 1 PRRB 48.91 51.20 .00 .00 15.21 .00
43 - EP01 P 1 PRRB 13 5 1.37 18 5 1.37 23 5 2.05
44 - EP41 P 1 PRRB 4 5 .074 5 5 .074 6 5 .296 14 5 .071 12 5 .212
45 - EP42 P 1 PRRB 18 5 .205 23 5 .068
46 - ECRG P 2 PRBS 1 0 5438 5221.72 7 3 .80 3 0 30 5438.
47 - ED1 P 2 PRBS BLEND-STOCK PREP. PLANT
48 - ED2 P 2 PRBS 28271.4 163140 .000 1 5 0 1.000 .000 1
49 - ED3 P 2 PRBS 55.45 129.97 .00 .00 33.71 .00
50 - EP31 P 2 PRBS 13 9 5.81 23 9 1.37
51 - EP41 P 2 PRBS 4 5 .087 5 5 .044 6 5 .261 14 5 .042 12 5 .125
52 - EP42 P 2 PRBS 18 5 .401 23 5 .040
53 - ECRG P 3 PRCL 1 0 8712 5221.72 7 3 .80 3 0 30 8712.
54 - ED1 P 3 PRCL COAL LOADOUT PREP. PLANT
55 - ED2 P 3 PRCL 1215.24 261360 .000 1 5 0 1.000 .000 1
56 - ED3 P 3 PRCL 20.90 4.33 .00 .00 7.47 .00
57 - EP01 P 3 PRCL 13 12 1.37 18 12 1.37 23 12 .68
58 - EP41 P 3 PRCL 4 5 .069 5 5 .069 6 5 .278 14 5 .066 12 5 .199
59 - EP42 P 3 PRCL 18 5 .256 23 5 .063
60 - ECRG P 6 PRBJ 1 0 5438 5221.72 7 3 .80 3 0 30 5438.
61 - ED1 P 6 PRBJ BAUM JIG PREP. PLANT
62 - ED2 P 6 PRBJ 23073.2 163140 .000 1 5 0 1.000 .000 1
63 - ED3 P 6 PRBJ 125.91 127.29 6.84 .00 62.45 .81
64 - EP01 P 6 PRBJ 13 9 4.10 17 9 1.37 22 9 2.05 23 9 2.05 10 9 1.37
65 - EP41 P 6 PRBJ 4 5 .096 5 5 .096 6 5 .288 14 5 .092 12 5 .128
66 - EP42 P 6 PRBJ 18 5 .248 23 5 .052
67 - ECRG P 7 PRS2 1 0 2000 5221.72 7 3 .80 3 0 30 2000.
68 - ED1 P 7 PRS2 BJ SUPPORT PREP. PLANT
69 - ED2 P 7 PRS2 4706.13 60000 .000 1 5 0 1.000 .000 1
70 - ED3 P 7 PRS2 147.28 58.83 .00 .00 43.25 .00
71 - EP01 P 7 PRS2 11 5 6.56 22 5 4.92
72 - EP41 P 7 PRS2 4 5 .118 5 5 .157 6 5 .315 12 5 .226 13 5 .075
73 - EP42 P 7 PRS2 22 5 .109
74 - ??????????????

```

2.3.7 CPF Summary Report

After the required submodels have been run, the PGA model prints a summary report which is reproduced below:

PGA MODEL ECONOMIC SUMMARY RUN DATE 16:16 NOV 29,'76 PAGE NO. 2.5

CASE NO. 1123 TITLE (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
ALT. NO. 2 TITLE BAUM JIG PREPARATION PLANT

1975 DOLLARS

QT.		INITIAL INVESTMENT	ANNUAL OWNERSHIP	ANNUAL OPERATING	PROJECT TOTAL ROM	\$/ TON	\$/ DEL TON
1	PR. PLANT TYPE 2	.646903E 08	.683560E 07	.587382E 07	.381282E 09	2.008	2.434
	PROJECT TOTALS	.646903E 08	.683560E 07	.587382E 07	.381282E 09		
TONS DELIVERED = .156652E 09 COST = 2.43395 \$/TON							
BTUS DELIVERED = .390000E 16 COST = .977646E-01 \$/MM BTU							

When both models are included in a case, this summary will contain two lines; and the totals will apply to the combined operations. In this case, however, only the preparation plant is included in the summary.

The INITIAL INVESTMENT is the summation of the investments in the blocks included in the plant. The ANNUAL OWNERSHIP figure is recalculated, including 14 percent of the average annual capital as the cost of insurance and taxes. The ANNUAL OPERATING cost is the summation of the hourly operating costs, each multiplied by the appropriate operating hours/year. The PROJECT TOTAL is the sum of the two annual costs multiplied by the life of the operation. Note that one plant of type 2 is included in the summary.

The PROJECT TOTALS line is the same as the detail line, since only the CPF model is included in the case. The TONS DELIVERED = .156652E09 COST = 2.43395 \$/TON line prints the value of XTT and the PROJECT TOTAL divided by XTT. The BTUS DELIVERED = .390000E16 COST = .9977646E-01 \$/MM BTU line prints the values of both XBT and PROJECT TOTAL divided by XBT.

2.4 GAA SUBMODEL

2.4.1 General

This model keeps the 13 functions which make up the general and administrative (GAA) costs in a preset order:

- 1) SITE - Roads and Site Work
- 2) BLDG - Buildings
- 3) PWR - Electric Power System
- 4) H2O - Water System
- 5) COM - Communications System
- 6) MBEQ - Mobile Support Equipment
- 7) SHEQ - Equipment Shop
- 8) LAND - Land Rights
- 9) XDRL - Exploration Drilling
- 10) ENG - Construction Engineering
- 11) EIS - Environmental Impact Statement
- 12) STF - Supervisory Personnel
- 13) RLTX - Royalties and Severance Taxes

The three or four-character name of each function is the equipment identifier for the CFA equipment data cards.

The calculations detailed in Table 1 are made by the PGA model before the GAA submodel is called. Figure 2-3 illustrates the parameter listing for the GAA example (Case 4 of the example problem), and this listing contains the parameter values used in the GAA equations discussed below.

PGA MODEL ECONOMIC SUMMARY

RUN DATE 16:16 NOV 29,'76 PAGE NO. 4.1

CASE NO. 1123 TITLE (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
 ALT. NO. 4 TITLE POWDER RIVER BASIN GENERAL & ADMINISTRATIVE

1975 DOLLARS

I IMOGA	1	INCLUDE GENERAL & ADMINISTRATIVE
I IMOPP	0	INCLUDE PREP PLANT
I IPPT	3	PP - INDEX TO PLANT TYPE
I LOGCF	1	WRITES CFA CONTROL FILE IF 1
I LOGEC	1	WRITES CFA EQUIPMENT FILE IF 1
I LOGPA	1	PRINTS PARAMETERS IF 1
I LOGSD	1	WRITES SPECIFICATION DATA IF 1
I LOGSM	1	WRITES ECONOMIC SUMMARY IF ONE
I NY	2	NO. OF YEARS TO STARTUP
I DBBPY	4190.00	DENSITY OF OVERBURDEN BANK LBS/YARD
I GAMR	50.0000	GAA - MINERAL RIGHTS (\$/ACRE)
I GARA	.250000	GAA - ROYALTY AMOUNT (\$/TON)
I GASR	250.000	GAA - SURFACE RIGHTS (\$/ACRE)
I GAST	.000000	GAA - SEVERANCE TAX (\$/TON)
I GATAD	3583.00	TOTAL ACRES DISTURBED IN COMPLEX
I GATYB	58.6920	GAA - TONS/YEAR - BASELINE
I GAJP	.110000	GAA - UNION PAYMENT (\$/TON)
I PPRED	.409500E 15	PP - BASE ENERGY BTU/YEAR
I PPBT	75000.0	PP - BASE TONS/DAY
I PPNEO	.130000E 15	PP - COMPLEX ENERGY DEMAND BTU/YEAR
I PPNHV	8200.00	PP - COAL HEAT VALUE BTU/LB
I PPODY	250.000	PP - OPERATING DAYS/YEAR
I SRYT	3.33440	STRIPPING RATIO YARDS/RCM TONS
I TMY	30.0000	TOTAL MINING YEARS
C BPBY	.288197E 08	COMPLEX OVERBURDEN PROD. YARDS/YEAR
C CORTYX	.949767E 07	COMPLEX COAL DEMAND RCM TONS/YEAR
C PPFHV	8692.00	PP - FINAL HEAT VALUE
C PPFTY	.747466E 07	PP - FINISHED COAL TONS/YEAR
C PPHF	1.06000	PP - HEAT VALUE FACTOR FOR IPPT
C PPHV	13084.0	PP - BASE HEAT VALUE FOR IPPT
C PPNS	37990.7	PP - COMPLEX SIZE TONS/DAY
C PPSF	.787000	PP - SIZE FACTOR FOR IPPT
C VARY	.864592E 09	VOL. OVERBURDEN BANK YARDS
C VCRT	.284930E 09	VOL. COAL RCM TONS

Figure 2-3. GAA Parameter List

The GAA factoring equation is of the form:

$$Y = A + R^X$$

where:

- Y - is the value being calculated,
- A - is a constant term set by model parameters,
- R - is a size ratio (explained below), and
- X - is an exponent set by model parameters.

The value of R is determined with the following equation:

$$R = \frac{GTTY}{GATYB} = \frac{69.8749}{58.692} = 1.1905$$

where:

- GTTY - is the total tons/year of material moved, as calculated by PGA; and
- GATYB - is the baseline tons/year of material moved.

Figure 2-4 is a listing of GAA parameters for Case 4 of the example problem. Note that most of these parameters are followed by a single value, five parameters are followed by 13 values, and seven parameters are followed by 11 values. The values for the dimensioned variables apply to the functions in the order of the preceding listing. Most of the single-value parameters have the function number as a part of the variable name. For example, G2SQF, G2DSQF, G2MSFF, and G2MSFW all apply to the second function (Buildings).

CASE NO. 1123 TITLE (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
ALT. NO. 4 TITLE POWDER RIVER BASIN GENERAL & ADMINISTRATIVE

1975 DOLLARS

[illegible]

Figure 2-4. GAA Input Parameters

Some single-value parameters are set as PGA model variables and, due to FORTRAN conventions, must undergo a name change between the main PGA model and the GAA submodel. The following list gives the corresponding names:

<u>PGA</u>	<u>GAA</u>
GASR	G8SR
GAMR	G8MR
GARA	G15ROY
GAST	G15STX
GAUP	G15UNI
TMY	G8YRS

There are two other model-naming anomalies. The G13 variables apply to Function 12 (STF); and the G15 variables apply to Function 13 (RLTX).

The parameters having only 11 values apply to functions having investments. The last two functions do not have investment costs, so these parameters do not have values for Functions 12 and 13.

Parameter GACRNY may be reset by the user, but the model recalculates the 12th value as follows:

$$GACRNY(12) = NY + 6$$

where:

GACRNY - is the number of years to startup for
each function, and
NY - is the number of years to startup for PGA.

The following subsections explain the use of the parameters in calculating costs and personnel assignments for GAA. The values are taken from Case 4 of the example problem. Subscripts are used with dimensioned variables to refer to the appropriate function.

2.4.2 GAA Operating Costs

Hourly operating costs (GTOPRC) are calculated for four of the functions, using the following equations:

1) Buildings - Function 2

$$\begin{aligned} \text{FUEL} &= \text{G2MSFF} * \text{R} ** \text{G2EXP2} \\ &= 105000 * 1.1905 ** 0.9 \\ &= 122841.7 \end{aligned}$$

$$\begin{aligned} \text{WATER} &= \text{G2MSFW} * \text{R} ** \text{G2EXP3} \\ &= 300 * 1.1905 ** 0.75 \\ &= 341.92 \end{aligned}$$

$$\begin{aligned} \text{GTOPRC} &= \frac{\text{FUEL} + \text{WATER}}{\text{GACROH}(2)} \\ &= \frac{122841.7 + 341.92}{2000} \\ &= 61.59 \end{aligned}$$

2) Land - Function 8

$$\begin{aligned} \text{GTOPRC} &= \frac{(1 - \text{G8PERC}) * (\text{G8SR} + \text{G8MR}) * \text{GATAD}}{\text{G8YRS} * \text{GACROH}(8)} \\ &= \frac{(1 - 0.1) * (250 + 50) * 3583}{30 * 2000} \\ &= 16.12 \end{aligned}$$

3) Staff - Function 12

$$\begin{aligned}\text{ISTAFF} &= \text{G13PRC} * \text{G13MPW} * \text{R} * \text{G13EXP} \\ &= 0.22 * 694 * 1.1905 ** 0.9 \\ &= 178 \text{ (ISTAFF value is truncated)}\end{aligned}$$

$$\begin{aligned}\text{XMATL} &= \frac{\text{G13PRC} * \text{G13MPW} * \text{R} * \text{G13EXP} * \text{G13FCT}}{\text{GACROH}(12)} \\ &= \frac{0.22 * 694 * 1.1905 ** 0.9 * 2000}{2000} \\ &= 178.623\end{aligned}$$

$$\begin{aligned}\text{GTOPRC} &= \text{XMATL} + \frac{\text{ISTAFF} * \text{G13AWR}}{\text{GACROH}(12)} \\ &= 178.623 + \frac{178 * 17900}{2000} \\ &= 1771.73\end{aligned}$$

4) Royalty and Severance Tax - Function 13

$$\begin{aligned}\text{GTOPRC} &= \frac{\text{VCRT} * (\text{G15ROY} + \text{G15STX} + \text{G15UNI})}{\text{GACRLO}(13) * \text{GACROH}(13)} \\ &= \frac{0.28493\text{E}9 * (0.25 + 0 + 0.11)}{31 * 2000} \\ &= 1654.43\end{aligned}$$

Note that the values of FUEL, WATER, ISTAFF, and XMATL are calculated separately for use in equipment data cards which are explained later.

2.4.3 GAA Unit Investment Costs

The following equations are used to develop the unit investment or capital costs (GNPCC) for 11 of the functions:

1) Roads and Site Work

$$\begin{aligned}\text{GNPCC} &= \text{G1CCF} * \text{R} ** \text{G1EXP} \\ &= 350000 * 1.1905 ** 0.35 \\ &= 372029\end{aligned}$$

2) Buildings

$$\begin{aligned}\text{GNPCC} &= \text{G2SQF} * \text{G2DSQF} * \text{R} ** \text{G2EXP1} \\ &= 200000 * 36.25 * 1.1905 ** 0.85 \\ &= 0.84085\text{E}7\end{aligned}$$

3) Electric Power System

$$\begin{aligned}\text{GNPCC} &= \text{G3CCF} * \text{R} ** \text{G3EXP} \\ &= 0.5\text{E}7 * 1.1905 ** 0.7 \\ &= 0.564923\text{E}7\end{aligned}$$

4) Water System

The factors for GNPCC depend upon the value of IPPT.

For IPPT = 1:

$$\begin{aligned}\text{GNPCC} &= \text{G4ACCF} * \text{R} ** \text{G4EXP} \\ &= 200000 * 1.1905 ** 0.45 \\ &= 0.216328\text{E}6\end{aligned}$$

For IPPT = 2:

$$\begin{aligned}\text{GNPCC} &= \text{G4BCCF} * \text{R} ** \text{G4EXP} \\ &= 450000 * 1.1905 ** 0.45 \\ &= 0.486738\text{E}6\end{aligned}$$

For IPPT = 3:

$$\begin{aligned}\text{GNPCC} &= \text{G4CCCF} * \text{R} ** \text{G4EXP} \\ &= 550000 * 1.1905 ** 0.45 \\ &= 0.594903\text{E}6\end{aligned}$$

5) Communications System

$$\begin{aligned}\text{GNPCC} &= \text{G5CCF} * \text{R} ** \text{G5EXP} \\ &= 250000 * 1.1905 * 0.4 \\ &= 286063\end{aligned}$$

6) Mobile Equipment

$$\begin{aligned}\text{GNPCC} &= \text{G6CCF} * \text{R} ** \text{G6EXP} \\ &= 0.12\text{E}7 * 1.1905 ** 0.85 \\ &= 0.139175\text{E}7\end{aligned}$$

7) Shop Equipment

$$\begin{aligned}\text{GNPCC} &= \text{G7CCF} * \text{R} ** \text{G7EXP} \\ &= 0.1\text{E}7 * 1.1905 ** 0.45 \\ &= 0.108164\text{E}7\end{aligned}$$

8) Land Rights

$$\begin{aligned}\text{GNPCC} &= \frac{\text{G8PERC} * (\text{G8SR} + \text{G8MR}) * \text{GATAD}}{1000} \\ &= 0.1 * (250 + 50) * 3583 \\ &= 107490\end{aligned}$$

9) Exploration Drilling

$$\begin{aligned}\text{GNPCC} &= \frac{\text{G9CCF} * \text{GATAD}}{\text{G9AHOL}} \\ &= \frac{1000 * 3583}{40} \\ &= 89574.9\end{aligned}$$

10) Construction Engineering

$$\begin{aligned}\text{GNPCC} &= \text{G10CCF} * \text{R} * \text{G10EXP} \\ &= 0.6\text{E}7 * 1.1905 ** 0.55 \\ &= 0.660403\text{E}7\end{aligned}$$

11) Environmental Impact Statement

$$\begin{aligned}\text{GNPCC} &= \text{G11CCF} * \text{R} * \text{G11EXP} \\ &= 0.1\text{E}7 * 1.1905 ** 0.25 \\ &= 0.104456\text{E}7\end{aligned}$$

The unit investment in the equipment data cards is in thousands of dollars; therefore, each value of GNPCC is divided by 1000 before being written in the appropriate equipment cards.

Each unit investment is converted to an hourly ownership cost (GTOWNC) with the following equation (values for Function 1):

$$\begin{aligned}
 \text{GTOWNC} &= \frac{\text{GNPCC} * (1 + 0.07 * (1 + \text{GACRLO}(1)))}{\text{GACRLO}(1) * \text{GACROH}(1)} \\
 &= \frac{372029 * (1 + 0.07 * (1 + 31))}{31 * 2000} \\
 &= 19.44
 \end{aligned}$$

(This equation adds 14 percent of the average annual capital cost as the cost of insurance and property taxes.)

2.4.4 GAA Report

The detail report for the GAA model is reproduced below:

PGA MODEL ECONOMIC SUMMARY RUN DATE 16:16 NOV 29,'76 PAGE NO. 4-2

CASE NO. 1123 TITLE (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
ALT. NO. 4 TITLE POWDER RIVER BASIN GENERAL & ADMINISTRATIVE

1975 DOLLARS

GENERAL & ADMINISTRATIVE COSTS

	UNIT INVESTMENT	OWNERSHIP \$/HOUR	OPERATING \$/HOUR	O&O \$/TON
ROADS & SITE ANC. FAC.	372029.	19.44	.00	.004
BUILDINGS ANC. FAC.	.840850E 07	439.41	61.59	.109
ELECT. SYS. ANC. FAC.	.564923E 07	295.22	.00	.064
WATER SYS. ANC. FAC.	594903.	31.39	.00	.007
COMMUN. SYS. ANC. FAC.	268063.	14.01	.00	.003
MOBILE SUP. ANC. FAC.	.139175E 07	72.73	.00	.016
EQUIP. SHOP ANC. FAC.	.108164E 07	56.52	.00	.012
LAND RIGHTS PREMINE	107490.	5.62	16.12	.005
EXPL. DRILL. PREMINE	89574.9	4.68	.00	.001
CONT. ENG. PREMINE	.660403E 07	345.11	.00	.075
E. I. S. PREMINE	.104456E 07	54.59	.00	.012
SUPERV. PER.	.000000	.00	1771.73	.386
ROY-SEV. TAX	.000000	.00	1654.43	.360
	.256117E 08	1338.42	3503.88	1.054

TOTAL MM TONS/YEAR 69.8749
TOTAL ACRES DISTURBED 3583.00

The O&O \$/TON figures are calculated by summing the two hourly costs, converting to project costs, and dividing the total costs by the total ROM tons of coal (VCRT). The four columns are totaled on the last line. The value printed on the TOTAL MM TONS/YEAR line is the value of parameter GTTY, as calculated by the PGA model. The value on the TOTAL ACRES DISTURBED line is the value of input parameter GATAD.

2.4.5 GAA Summary Report

The summary report printed by the PGA model after the submodels have been run is reproduced below:

```
PGA MODEL ECONOMIC SUMMARY          RUN DATE 16:16 NOV 29,'76 PAGE NO.  4.4
CASE NO. 1123 TITLE  {PGA1123} USER'S MANUAL EXAMPLE PROBLEM
ALT. NO.   4 TITLE  POWDER RIVER BASIN GENERAL & ADMINISTRATIVE
1975 DOLLARS
QT.              INITIAL      ANNUAL      ANNUAL      PROJECT      $/      $/
                  INVESTMENT  OWNERSHIP  OPERATING  TOTAL ROM  TON DEL  TON
GENERAL & ADMIN.  .256117E 08 .267683E 07 .700775E 07 .300222E 09  1.054  1.339
PROJECT TOTALS    .256117E 08 .267683E 07 .700775E 07 .300222E 09
TONS DELIVERED = .224240E 09 COST =  1.33884      $/TON
BTUS DELIVERED = .390000E 16 COST = .769800E-01 $/MM BTU
```

This report is developed in the manner described in paragraph 2.3.7.

2.4.6 GAA Equipment Data Cards

The equipment data cards developed by the GAA model are reproduced below:

```

113 - *          4 POWDER RIVER BASIN GENERAL & ADMINISTRATIVE
114 - ECRG P      PPCP 1 0 3625 7474.66      7 3 .80 3 0 30 3625
115 - ECRG G 1    SITE 1 0 2000 .000 7 1 .00 3 0 31 2000
116 - ED1 G 1     SITE ROADS & SITE ANC. FAC.
117 - ED2 G 1     SITE 372.0 62000 .000 1 5 0 1.000 .000 1
118 - ECRG G 2    BLDG 1 0 2000 .000 7 1 .00 3 0 31 2000
119 - ED1 G 2     BLDG BUILDINGS ANC. FAC.
120 - ED2 G 2     BLDG 8408.5 62000 .000 1 5 0 1.000 .000 1
121 - ED3 G 2     BLDG .00 .00 61.42 .00 .00 .17
122 - ECRG G 3    PWR 1 0 2000 .000 7 1 .00 3 0 31 2000
123 - ED1 G 3     PWR ELECT. SYS. ANC. FAC.
124 - ED2 G 3     PWR 5649.2 62000 .000 1 5 0 1.000 .000 1
125 - ECRG G 4    H2O 1 0 2000 .000 7 1 .00 3 0 31 2000
126 - ED1 G 4     H2O WATER SYS. ANC. FAC.
127 - ED2 G 4     H2O 594.9 62000 .000 1 5 0 1.000 .000 1
128 - ECRG G 5    CCM 1 0 2000 .000 7 1 .00 3 0 31 2000
129 - ED1 G 5     CCM COMMUN. SYS. ANC. FAC.
130 - ED2 G 5     CCM 268.1 62000 .000 1 5 0 1.000 .000 1
131 - ECRG G 6    MBEQ 1 0 2000 .000 7 1 .00 2 0 31 2000
132 - ED1 G 6     MBEQ MOBILE SUP. ANC. FAC.
133 - ED2 G 6     MBEQ 1391.8 62000 .000 1 5 0 1.000 .000 0
134 - ECRG G 7    SHEQ 1 0 2000 .000 7 1 .00 2 0 31 2000
135 - ED1 G 7     SHEQ EQUIP. SHOP ANC. FAC.
136 - ED2 G 7     SHEQ 1081.6 62000 .000 1 5 0 1.000 .000 0
137 - ECRG G 8    LAND 1 0 2000 .000 7 1 .00 5 0 31 2000
138 - ED1 G 8     LAND LAND RIGHTS PREMINE
139 - ED2 G 8     LAND 107.5 62000 .000 1 1 0 1.000 .000 0
140 - ED3 G 8     LAND 0. 0. 0. 0. 0. 0. 16.12
141 - ECRG G 9    XDRL 1 0 2000 .000 7 1 .00 5 0 31 2000
142 - ED1 G 9     XDRL EXPL. DRILL. PREMINE
143 - ED2 G 9     XDRL 89.6 62000 .000 1 1 0 1.000 .000 0
144 - ECRG G10    ENG 1 0 2000 .000 7 1 .00 6 0 31 2000
145 - ED1 G10     ENG CONT. ENG. PREMINE
146 - ED2 G10     ENG 6604.0 62000 .000 1 5 0 1.000 .000 0
147 - ECRG G11    EIS 1 0 2000 .000 7 1 .00 4 0 31 2000
148 - ED1 G11     EIS E. I. S. PREMINE
149 - ED2 G11     EIS 1044.6 62000 .000 1 1 0 1.000 .000 0
150 - ECRG G12    STF 1 0 2000 .000 1 8 .00 0 0 31 2000
151 - ED1 G12     STF SUPERV. PER.
152 - ED3 G12     STF .00 178.63
153 - EP01 G12    STF 24 3 178
154 - ECRG G13    RLTX 1 0 2000 .000 7 1 .00 0 0 31 2000
155 - ED1 G13     RLTX ROY-SEV. TAX
156 - ED3 G13     RLTX 0. 0. 0. 0. 0. 0. 1654.43
157 - ZZZZZZZZZZZZZZZZ

```


Several aspects about this set of cards deserve particular attention:

- The first ECRG card (record 114) refers to the preparation plant. This card is developed by the PGA model whenever the CPF submodel is not included in a case. The CFA model takes the coal production figures from the preparation plant equipment cards whenever the preparation plant is included. When it is not included, this first card provides the required production figure to the CFA model.
- Only one personnel assignment record (record 153) is developed. This record assigns the supervisory staff for GAA; the personnel class code is contained in parameter G13OCL; the schedule code is taken from parameter G13OSC; and the quantity is variable ISTAFF, as calculated previously.
- Operating cost ED3 cards are produced only for the four functions for which operating costs have been calculated. They are records 121, 140, 152, and 156.

SECTION 3
MODEL INPUT

3.1 GENERAL

The input to the PGA model comes from two files: a default control file which is actually a part of the model, and the user's prepared parameter-setting file. The model creates (under user control) two output files: the control file for the CFA model, and the equipment file for the CFA model. This section describes these files and the manner in which the user controls them.

3.2 CONTROL PARAMETERS

The model is controlled by parameters or model variables. The user sets the value of a parameter by referring to the variable name. The parameters fall into two categories:

- 1) Primary Default Parameters
- 2) Secondary Default Parameters

Before discussing the two parameter categories, the term "default" requires expansion. When a program is written, the programmer uses FORTRAN statements to set up testing values for all model variables. When the model is run, the system uses all programmer values as the default values. These default values are used for all cases in a run, unless reset by either the default control file or the user's input file. The default values make sense for program testing; however, they may not represent any particular mining problem. The user should carefully review all parameter values to be sure his particular problem is correctly stated.

The primary default parameter values are set, at the start of each run, from the default control file. The secondary default values are set from the FORTRAN program. The mechanism for resetting parameters makes no distinction between primary and secondary variables; all parameter values are set in the same manner.

3.2.1 Primary Default Parameters

The following is a listing of the primary default parameters:

<u>Default Value</u>	<u>Name</u>	<u>Description</u>
1.	IMOGA	INCLUDE GENERAL & ADMINISTRATIVE
1.	IMOPF	INCLUDE PREP PLANT
1	IPPT	PP - INDEX TO PLANT TYPE
1	LOGCF	WRITES CFA CONTROL FILE IF 1
1	LOGEC	WRITES CFA EQUIPMENT FILE IF 1
1.	LOGPA	PRINTS PARAMETERS IF 1
1	LOGSD	WRITES SPECIFICATION DATA IF 1
1	LOGSM	WRITES ECONOMIC SUMMARY IF ONE
3	NY	NO. OF YEARS TO STARTUP
3700.	DEBPY	DENSITY OF OVERBURDEN BANK LBS/YARD
50.	GAMR	GAA - MINERAL RIGHTS (\$/ACRE)
.25	GARA	GAA - ROYALTY AMOUNT (\$/TON)
250.	GASR	GAA - SURFACE RIGHTS (\$/ACRE)
0	GAST	GAA - SEVERANCE TAX (\$/TON)
25505.4	GATAD	TOTAL ACRES DISTURBED IN COMPLEX
185.614	GATYB	GAA - TONS/YEAR - BASELINE
.11	GAUP	GAA - UNION PAYMENT (\$/TON)
4.095E14	PPBED	PP - BASE ENERGY BTU/YEAR
75E3	PPBT	PP - BASE TONS/DAY
1.3E14	PPMED	PP - COMPLEX ENERGY DEMAND BTU/YEAR
12000.	PPMHU	PP - COAL HEAT VALUE BTU/LB
250.	PPODY	PP - OPERATING DAYS/YEAR
17.8643	SRYT	STRIPPING RATIO YARDS/ROM TONS
30.	TMV	TOTAL MINING YEARS

Parameters which have not been covered in Section 2 include the following:

- 1) IMOGA - when set to 1, includes the GAA sub-model in the case; excludes GAA when set to 0.
- 2) IMOPP - when set to 1, includes the CPF sub-model in the case; excludes CPF when set to 0.
- 3) LOGCF - when set to 1, allows the CFA control file records for the case to be written; otherwise, the records are not written.
- 4) LOGEC - when set to 1, allows the CFA equipment data cards for the case to be written to the equipment file; otherwise, the cards are not written.
- 5) LOGPA - when set to 1, allows the parameter listing (e.g., Figure 2-1) to be printed; otherwise, the listing is not printed.
- 6) LOGSD - when set to 1, allows the submodel reports to be printed; otherwise, these reports are not printed.
- 7) LOGSM - when set to 1, allows the summary report data to be calculated and printed; otherwise, these data are not calculated or printed.
- 8) NY - number of years to startup for CPF and for Function 12 in GAA.

3.2.2 Secondary Default Parameters

The secondary default parameters are described in Section 2 under the two submodel descriptions. The complete set of parameters is listed in Figures 2-2 and 2-4.

A discussion of entering values for dimensioned variables is pertinent here. As an example variable PPEQTY is dimensioned for nine values. In the example problem, these nine values are 1 since one preparation plant is desired. Should the user wish to have three preparation plants rather than one, he could enter the following string in the input file:

```
PPEQTY = 3, 3, 3, 3, 3, 3, 3, 3, 3
```

In contrast, assume one each of the first three blocks, and three each of the remaining nine, were desired. The following string could then be used:

```
PPEQTY = 1, 1, 1, 3, 3, 3, 3, 3, 3
```

The input file can also contain subscripted entries. For example, if only the first and second blocks are to have two of each unit, with one unit for all other blocks, the following string could be used:

```
PPEQTY(1) = 2, PPEQTY(2) = 2
```

Since items 3-9 are not referenced, they would continue at the default values of 1.

It is not practical to attempt to set all values to two-dimensioned parameters in a single string of numbers. For example, the parameters with nine rows and eight columns would require 72 values written in correct sequence, i.e., the nine for the first column, followed by the nine entries for the second column, and so on. In such instances, the subscripted form:

```
NAME(I,J) = Value
```

where I is the block number and J is the desired column number, is more useful.

3.3 DEFAULT FILES

The model parameters are initialized, at the beginning of each run, to the default values contained in the default control file. At the start of each case, the model reads the user-prepared input file which resets parameter values. The input file may reset any parameter, and any parameter not named in the input file continues to have its default value. A parameter may be set for one case, and then reset or not for the next case; if not reset, it continues to have the value from the preceding case.

There is one default file each for the PGA and CFA models. Since the PGA model is designed to be a precursor to the CFA model, it reads both default files at the start of a run. The user's input file may reset any CFA parameter, as well as any PGA parameter. Subject to user control, the PGA model creates the control input file for the CFA model for each case.

Some variables appear in both default files; however, FORTRAN does not permit the same name in both files. Therefore, the variables which are common to the two models have different names. The following list gives the corresponding names:

<u>PGA Name</u>	<u>CFA Name</u>
IPPT	IPPT\$
CDRTYX	CDRTYX\$
GAMR	GAMR\$
GARA	GARA\$
GASR	GASR\$
GAST	GAST\$
SRYT	SRYT\$
HBT	HBT\$
HC	HC\$
PPFTY	PPFTY\$
PPNED	PPNED\$
PPNHV	PPNHV\$
ROC	ROC\$
PPFHV	VCBP

Of these common variables, only VCBP is used by the CFA model; the other parameters are carried through the model and printed as memo items. It can be seen that these are the key control variables for the PGA model, i.e., they define the mining situation solved by the PGA model. Parameter VCBP contains the heat content of the prepared coal, in Btus/pound. It is calculated by the PGA model, and is used in the CFA model to convert tons to Btus.

3.4 BUILDING THE INPUT CONTROL FILE

Each record in the input control file is an 80-column card image, and the terms "record" and "card" are used throughout this manual.

The first record in the file must be a Run Title card. Columns 1-4 contain the run number (any four-digit number), and columns 5-80 contain the run title (any desired description).

The Run Title card is followed by sets of case cards; one set for each case to be included in the run. The first record of a case set must be a Case Title card, where columns 1-4 contain the case number (any four-digit number) and columns 5-80 contain the case title (any desired description). The Case Title card is followed by one or more parameter-setting records. The last record of the set must contain a "*" to indicate the end of the case definition.

Parameters are set by entering a string in the form:

NAME = VALUE

where:

NAME - is the name of a model variable, and
VALUE - is a numeric value, including a decimal point for fractional values.

NAME may refer to any model parameter. NAME and VALUE in parameter-setting records can not contain imbedded blanks; however, blanks can appear anywhere else in the record.

Any number of parameters may be set on a record, subject only to the 80-column limit of the record. When more than one parameter is set on a record, each VALUE (except the last) on the card must be followed with a ",". If all parameters are to be at

default values, the Case Title card is followed by a record containing only an "*". For example, the following input file was used to develop the default problem contained in Appendix B:

```
1 - 1124 (PGA1124) USER'S MANUAL DEFAULT EXAMPLE
2 - 1 ALL PARAMETERS AT DEFAULT VALUES
3 - *
```

This file contains only three records (the sequence number at the left is not a part of the record):

- 1) Run Title Card
- 2) Case Title Card
- 3) * Record

The following file was used to create the run contained in Appendix A:

```
1 - 1123 (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
2 - 1 CRUSH & SCREEN PREPARATION PLANT
3 - IMOGA=0,*
4 - 2 BAUM JIG PREPARATION PLANT
5 - IPPT=2,*
6 - 3 HEAVY MEDIA PREPARATION PLANT
7 - IPPT=3,*
8 - 4 POWDER RIVER BASIN GENERAL & ADMINISTRATIVE
9 - IMOPP=0, IMOGA=1
10 - PPNHU=8200, NY=2
11 - PPEQTY=1,1,1,1,1,1,1,1,1
12 - SRYT=3.0344, DBBPY=4190, GATYB=58.692
13 - G1CCF=350000, G2SCF=200000, G2MSFF=185000, G2MSFW=300
14 - G3CCF=5.0E6, G5CCF=250000, G9CCF=1000, G9AHOL=40
15 - G13PRC=.22, G13MAW=694
16 - HC=50, HBT=0, ROC=300
17 - GATAD=3583.0,*
18 - 5 TEXAS GULF GENERAL & ADMINISTRATIVE
19 - PPNHU=7020, NY=3
20 - PPEQTY=1,1,1,1,1,1,1,1,1
21 - SRYT=3.804, DBBPY=4190, GATYB=83.5821
22 - G1CCF=3E6, G2SCF=135000, G2MSFF=65000, G2MSFW=250
23 - G3CCF=4.5E6, G5CCF=125000, G9CCF=1000, G9AHOL=40
24 - G13PRC=.16, G13MAW=580
25 - HC=10, HBT=.83, ROC=900
26 - GATAD=18838,*
```

This file contains 26 records, and defines five cases. Record 1 is the Run Title card; records 2, 4, 6, 8, and 18 are Case Title records. Records 3, 5, 7, 17, and 26 contain an "*" to indicate the end of the case input. Record 3 sets only one parameter, IMOGA = 0, to exclude the GAA submodel from the case; all other parameters continue at their default values. For the second case, IPPT is set to 2; and is then reset to 3 for the third case. Since IPPT is not mentioned after record 7, it continues at 3 for Cases 4 and 5.

The input for Cases 4 and 5 sets the GAA parameters which are expected to vary when different regions are studied with the PGA model. Note that record 9 turns off the CPF submodel and turns on the GAA submodel. Records 10-17 and 19-26 set the same set of parameters, even though some of these parameters have the same values in the two cases.

APPENDIX A
EXAMPLE PROBLEM

PGA MODEL ECONOMIC SUMMARY

RUN DATE 16:16 NOV 29,'76 PAGE NO. 1.1

CASE NO. 1123 TITLE (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
 ALT. NO. 1 TITLE CRUSH & SCREEN PREPARATION PLANT

1975 DOLLARS

I IMOGA	0	INCLUDE GENERAL & ADMINISTRATIVE
I IMOPP	1	INCLUDE PREP PLANT
I IPPT	1	PP - INDEX TO PLANT TYPE
I LOGCF	1	WRITES CFA CONTROL FILE IF 1
I LOGEC	1	WRITES CFA EQUIPMENT FILE IF 1
I LOGPA	1	PRINTS PARAMETERS IF 1
I LOGSD	1	WRITES SPECIFICATION DATA IF 1
I LOGSM	1	WRITES ECONOMIC SUMMARY IF ONE
I NY	3	NO. OF YEARS TO STARTUP
I DRBPY	3700.00	DENSITY OF OVERBURDEN BANK LBS/YARD
I GAMR	50.0000	GAA - MINERAL RIGHTS (\$/ACRE)
I GARA	.250000	GAA - ROYALTY AMOUNT (\$/TON)
I GASR	250.000	GAA - SURFACE RIGHTS (\$/ACRE)
I GAST	.000000	GAA - SEVERANCE TAX (\$/TON)
I GATAD	25505.4	TOTAL ACRES DISTURBED IN COMPLEX
I GATY9	185.614	GAA - TONS/YEAR - BASELINE
I GAUP	.110000	GAA - UNION PAYMENT (\$/TON)
I PPRED	.409500E 15	PP - BASE ENERGY BTU/YEAR
I PPBT	75000.0	PP - BASE TONS/DAY
I PPNEB	.130000E 15	PP - COMPLEX ENERGY DEMAND BTU/YEAR
I PPAHV	12000.0	PP - CCAL HEAT VALUE BTU/LB
I PPDDY	250.000	PP - OPERATING DAYS/YEAR
I SRYT	17.8643	STRIPPING RATIO YARDS/ROM TONS
I THY	30.0000	TOTAL MINING YEARS
C BPRYY	.973852E C8	COMPLEX OVERBURDEN PROD. YARDS/YEAR
C CORTYX	.545139E 07	COMPLEX COAL DEMAND ROM TONS/YEAR
C PPFHV	12043.2	PP - FINAL HEAT VALUE
C PPFTY	.539687E 07	PP - FINISHED COAL TONS/YEAR
C PPHF	1.00360	PP - HEAT VALUE FACTOR FOR IPPT
C PPHV	10990.0	PP - BASE HEAT VALUE FOR IPPT
C PPNS	21805.6	PP - COMPLEX SIZE TONS/DAY
C PPSF	.990000	PP - SIZE FACTOR FOR IPPT
C VBBY	.292156E 10	VOL. OVERBURDEN BANK YARDS
C VCRT	.163542E 09	VOL. CCAL ROM TONS

PGA MODEL ECONOMIC SUMMARY

RUN DATE 16:16 NOV 29, '76 PAGE NO. 1.2

CASE NO. 1123 TITLE (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
ALT. NO. 1 TITLE CRUSH & SCREEN PREPARATION PLANT

1975 DOLLARS

PREPARATION PLANT STATISTICS

TYPE	SIZE	- - - DELIVERED COAL - - -				
	TONS/DAY	BTU/LB	TONS/YEAR	BTU/YEAR		
1	21805.6	12043.2	.539687E 07	.130000E 15		
		UNIT	LABOR OWNERSHIP OPERATING			
		INVESTMENT	- - - - \$/HOUR - - - -			
					O&O	
					\$/TON	
REC & BREAK	PREP. PLANT	.658837E 07	44.64	192.05	149.59	.227
BLEND-STOCK	PREP. PLANT	.250879E 08	68.49	487.49	265.49	.751
COAL LOADCUT	PREP. PLANT	.104667E 07	36.23	12.69	66.34	.139
CRUSH-SCREEN	PREP. PLANT	.353613E 07	51.42	68.71	113.09	.181
CS SUPPORT	PREP. PLANT	.436755E 07	93.21	230.75	297.98	.194
		.406266E 08				1.493

PGA MODEL ECONOMIC SUMMARY

RUN DATE 16:16 NOV 29,'76 PAGE NO. 1.3

CASE NO. 1123 TITLE (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
ALT. NO. 1 TITLE CRUSH & SCREEN PREPARATION PLANT

1975 DOLLARS

[illegible]

PGA MODEL ECONOMIC SUMMARY

RUN DATE 16:16 NOV 29,*76 PAGE NO. 1.5

CASE NO. 1123 TITLE (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
ALT. NO. 1 TITLE CRUSH & SCREEN PREPARATION PLANT

1975 DOLLARS

QT.	INITIAL INVESTMENT	ANNUAL OWNERSHIP	ANNUAL OPERATING	PROJECT TOTAL	\$/ TON	\$/ TON
1 PR. PLANT TYPE 1	.406266E 08	.429287E 07	.377488E 07	.242033E 09	1.480	1.495
PROJECT TOTALS	.406266E 08	.429287E 07	.377488E 07	.242033E 09		

TONS DELIVERED = .161906E 09 COST = 1.49489 \$/TON
BTUS DELIVERED = .390000E 16 COST = .620597E-01 \$/MM BTU


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1 - *          1 CRUSH & SCREEN PREPARATION PLANT
2 - ECRG P 1 PRKH 1 0 3625 5396.87 7 3 .80 3 0 30 3625.
3 - ED1 P 1 PRRB REC & BREAK PREP. PLANT
4 - ED2 P 1 PRRB 6588.37 138750 .000 1 5 0 1.000 .000 1
5 - ED3 P 1 PRRB 46.41 45.44 .00 .00 13.10 .00
6 - EPD1 P 1 PRRB 13 5 1.33 18 5 1.33 23 5 1.95
7 - EPM1 P 1 PRRB 4 5 .074 5 5 .074 6 5 .296 14 5 .071 12 5 .212
8 - EPM2 P 1 PRRB 18 5 .205 23 5 .068
9 - ECRG P 2 PRBS 1 0 5438 5396.87 7 3 .80 3 0 30 5438.
10 - ED1 P 2 PRBS BLEND-STOCK PREP. PLANT
11 - ED2 P 2 PRBS 25087.9 163140 .000 1 5 0 1.000 .000 1
12 - ED3 P 2 PRBS 52.63 115.34 .00 .00 29.04 .00
13 - EPD1 P 2 PRBS 13 9 5.52 23 9 1.30
14 - EPM1 P 2 PRBS 4 5 .087 5 5 .044 6 5 .261 14 5 .042 12 5 .125
15 - EPM2 P 2 PRBS 18 5 .401 23 5 .040
16 - ECRG P 3 PRCL 1 0 8712 5396.87 7 3 .80 3 0 30 8712.
17 - ED1 P 3 PRCL COAL LOADOUT PREP. PLANT
18 - ED2 P 3 PRCL 1046.67 261360 .000 1 5 0 1.000 .000 1
19 - ED3 P 3 PRCL 19.83 3.85 .00 .00 6.43 .00
20 - EPD1 P 3 PRCL 13 12 1.30 18 12 1.30 23 12 .65
21 - EPM1 P 3 PRCL 4 5 .069 5 5 .069 6 5 .278 14 5 .066 12 5 .199
22 - EPM2 P 3 PRCL 18 5 .256 23 5 .063
23 - ECRG P 4 PRCS 1 0 5438 5396.87 7 3 .80 3 0 30 5438.
24 - ED1 P 4 PRCS CRUSH-SCREEN PREP. PLANT
25 - ED2 P 4 PRCS 3536.13 163140 .000 1 5 0 1.000 .000 1
26 - ED3 P 4 PRCS 35.25 16.26 4.62 .00 5.55 .00
27 - EPD1 P 4 PRCS 13 9 1.30 18 9 1.30 22 9 1.95 23 9 .65
28 - EPM1 P 4 PRCS 4 5 .131 5 5 .064 6 5 .259 14 5 .061 12 5 .187
29 - EPM2 P 4 PRCS 18 5 .239 23 5 .059
30 - ECRG P 5 PRS1 1 0 2000 5396.87 7 3 .80 3 0 30 2000.
31 - ED1 P 5 PRS1 CS SUPPORT PREP. PLANT
32 - ED2 P 5 PRS1 4367.55 60000 .000 1 5 0 1.000 .000 1
33 - ED3 P 5 PRS1 112.93 54.59 .00 .00 37.25 .00
34 - EPD1 P 5 PRS1 11 5 6.23 22 5 3.12
35 - EPM1 P 5 PRS1 4 5 .097 5 5 .195 6 5 .292 12 5 .233 13 5 .093
36 - EPM2 P 5 PRS1 22 5 .090
37 - ZZZZZZZZZZZZZZ

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PGA MODEL ECONOMIC SUMMARY

RUN DATE 16:16 NOV 29, '76 PAGE NO. 2.1

CASE NO. 1123 TITLE (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
 ALT. NO. 2 TITLE BAUM JIG PREPARATION PLANT

1975 DOLLARS

I IMOGA	0	INCLUDE GENERAL & ADMINISTRATIVE
I IMOPP	1	INCLUDE PREP PLANT
I IPPT	2	PP - INDEX TO PLANT TYPE
I LOGCF	1	WRITES CFA CONTROL FILE IF 1
I LOGEC	1	WRITES CFA EQUIPMENT FILE IF 1
I LOGPA	1	PRINTS PARAMETERS IF 1
I LOGSD	1	WRITES SPECIFICATION DATA IF 1
I LOGSM	1	WRITES ECONOMIC SUMMARY IF ONE
I NY	3	NO. OF YEARS TO STARTUP
I DRBPY	3700.00	DENSITY OF OVERBURDEN BANK LBS/YARD
I GAMR	50.0000	GAA - MINERAL RIGHTS (\$/ACRE)
I GARA	.250000	GAA - ROYALTY AMOUNT (\$/TON)
I GASR	250.000	GAA - SURFACE RIGHTS (\$/ACRE)
I GAST	.000000	GAA - SEVERANCE TAX (\$/TON)
I GATAD	25505.4	TOTAL ACRES DISTURBED IN COMPLEX
I GATYB	185.614	GAA - TONS/YEAR - BASELINE
I GAUP	.110000	GAA - UNION PAYMENT (\$/TON)
I PPBED	.409500E 15	PP - BASE ENERGY BTU/YEAR
I PPBT	75000.0	PP - BASE TONS/DAY
I PPNEO	.130000E 15	PP - COMPLEX ENERGY DEMAND BTU/YEAR
I PPNHV	12000.0	PP - COAL HEAT VALUE BTU/LB
I PPODY	250.000	PP - OPERATING DAYS/YEAR
I SRYT	17.8643	STRIPPING RATIO YARDS/ROM TONS
I TMY	30.0000	TOTAL MINING YEARS
C BPBY	.113070E 09	COMPLEX OVERBURDEN PROD. YARDS/YEAR
C CRTYX	.632936E 07	COMPLEX COAL DEMAND ROM TONS/YEAR
C PPFHV	12447.6	PP - FINAL HEAT VALUE
C PPFTY	.522172E 07	PP - FINISHED COAL TONS/YEAR
C PPHF	1.03730	PP - HEAT VALUE FACTOR FOR IPPT
C PPHV	12760.0	PP - BASE HEAT VALUE FOR IPPT
C PPNS	25317.5	PP - COMPLEX SIZE TONS/DAY
C PPSF	.825000	PP - SIZE FACTOR FOR IPPT
C VBBY	.339209E 10	VOL. OVERBURDEN BANK YARDS
C VCRT	.189881E 09	VOL. COAL ROM TONS

PGA MODEL ECONOMIC SUMMARY

RUN DATE 16:16 NOV 29,*76 PAGE NO. 2.2

CASE NO. 1123 TITLE (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
ALT. NO. 2 TITLE BAUM JIG PREPARATION PLANT

1975 DOLLARS

PREPARATION PLANT STATISTICS

TYPE	SIZE	DELIVERED COAL			
	TONS/DAY	BTU/LB	TONS/YEAR	BTU/YEAR	
2	25317.5	12447.6	.522172E 07	.130000E 15	

	UNIT INVESTMENT	LABOR \$/HOUR	OWNERSHIP \$/HOUR	OPERATING \$/HOUR	O&O \$/TON	
REC & BREAK	PREP. PLANT	.742439E 07	47.03	216.42	162.35	.217
BLEND-STOCK	PREP. PLANT	.282714E 08	72.16	549.35	291.30	.722
COAL LOADOUT	PREP. PLANT	.121524E 07	38.18	14.74	70.87	.130
BAUM JIG	PREP. PLANT	.230732E 08	110.13	448.34	433.43	.758
BJ SUPPORT	PREP. PLANT	.470613E 07	114.06	248.64	363.41	.193
		.646933E 08				2.020

CASF NO. 1123 TITLE (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
ALT. NO. 2 TITLE BAUM JIG PREPARATION PLANT

[illegible]

PGA MODEL ECONOMIC SUMMARY

RUN DATE 16:16 NOV 29, '76 PAGE NO. 2.5

CASE NO. 1123 TITLE (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
ALT. NO. 2 TITLE BAUM JIG PREPARATION PLANT

1975 DOLLARS

QT.		INITIAL INVESTMENT	ANNUAL OWNERSHIP	ANNUAL OPERATING	PROJECT TOTAL	\$/ ROM TON	\$/ DEL TON
1	PR. PLANT TYPE 2	.646903E 08	.683560E 07	.587382E 07	.381282E 09	2.008	2.434
	PROJECT TOTALS	.646903E 08	.683560E 07	.587382E 07	.381282E 09		
TONS DELIVERED = .156652E 09 COST = 2.43395 \$/TON							
BTUS DELIVERED = .390000E 16 COST = .977646E-01 \$/MM BTU							

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38 - *                2 BAUM JIG PREPARATION PLANT
39 - ECRG P 1 PRRB 1 0 3625 5221.72 7 3 .80 3 0 30 3625.
40 - ED1 P 1 PRRB REC 6 BKFAK PREP. PLANT
41 - ED2 P 1 PRRB 7424.39 108750 .000 1 5 0 1.000 .000 1
42 - ED3 P 1 PRRB 48.91 51.20 .00 .00 15.21 .00
43 - EP01 P 1 PRRB 13 5 1.37 18 5 1.37 23 5 2.05
44 - EP41 P 1 PRRB 4 5 .074 5 5 .074 6 5 .296 14 5 .071 12 5 .212
45 - EP42 P 1 PRRB 18 5 .205 23 5 .068
46 - ECRG P 2 PRBS 1 0 5438 5221.72 7 3 .80 3 0 30 5438.
47 - ED1 P 2 PRBS BLEND-STOCK PREP. PLANT
48 - ED2 P 2 PRBS 28271.4 163140 .000 1 5 0 1.000 .000 1
49 - ED3 P 2 PRBS 55.45 129.97 .00 .00 33.71 .00
50 - EP01 P 2 PRBS 13 9 5.81 23 9 1.37
51 - EP41 P 2 PRBS 4 5 .087 5 5 .044 6 5 .261 14 5 .042 12 5 .125
52 - EP42 P 2 PRBS 18 5 .401 23 5 .040
53 - ECRG P 3 PRCL 1 0 8712 5221.72 7 3 .80 3 0 30 8712.
54 - ED1 P 3 PRCL COAL LOADOUT PREP. PLANT
55 - ED2 P 3 PRCL 1215.24 261360 .000 1 5 0 1.000 .000 1
56 - ED3 P 3 PRCL 20.90 4.33 .00 .00 7.47 .00
57 - EP01 P 3 PRCL 13 12 1.37 18 12 1.37 23 12 .68
58 - EP41 P 3 PRCL 4 5 .069 5 5 .069 6 5 .278 14 5 .066 12 5 .199
59 - EP42 P 3 PRCL 18 5 .256 23 5 .063
60 - ECRG P 6 PRBJ 1 0 5438 5221.72 7 3 .80 3 0 30 5438.
61 - ED1 P 6 PRBJ BAUM JIG PREP. PLANT
62 - ED2 P 6 PRBJ 23073.2 163140 .000 1 5 0 1.000 .000 1
63 - ED3 P 6 PRBJ 125.91 127.29 6.84 .00 62.45 .81
64 - EP01 P 6 PRBJ 13 9 4.10 17 9 1.37 22 9 2.05 23 9 2.05 10 9 1.37
65 - EP41 P 6 PRBJ 4 5 .096 5 5 .096 6 5 .288 14 5 .092 12 5 .128
66 - EP42 P 6 PRBJ 18 5 .248 23 5 .052
67 - ECRG P 7 PRS2 1 0 2000 5221.72 7 3 .80 3 0 30 2000.
68 - ED1 P 7 PRS2 BJ SUPPORT PREP. PLANT
69 - ED2 P 7 PRS2 4706.13 60000 .000 1 5 0 1.000 .000 1
70 - ED3 P 7 PRS2 147.28 58.83 .00 .00 43.25 .00
71 - EP01 P 7 PRS2 11 5 6.56 22 5 4.92
72 - EP41 P 7 PRS2 4 5 .118 5 5 .157 6 5 .315 12 5 .226 13 5 .075
73 - EP42 P 7 PRS2 22 5 .109
74 - ZZZZZZZZZZZZZZ

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PGA MODEL ECONOMIC SUMMARY

RUN DATE 16:16 NOV 29, '76 PAGE NO. 3.1

CASE NO. 1123 TITLE (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
 ALT. NO. 3 TITLE HEAVY MEDIA PREPARATION PLANT

1975 DOLLARS

I IMOGA	0	INCLUDE GENERAL & ADMINISTRATIVE
I IMOPP	1	INCLUDE PRFP PLANT
I IPPT	3	PP - INDEX TO PLANT TYPE
I LOGCF	1	WRITES CFA CONTROL FILE IF 1
I LOGEC	1	WRITES CFA EQUIPMENT FILE IF 1
I LOGPA	1	PRINTS PARAMETERS IF 1
I LOGSO	1	WRITES SPECIFICATION DATA IF 1
I LOGSM	1	WRITES ECONOMIC SUMMARY IF ONE
I NY	3	NO. OF YEARS TO STARTUP
I DBBPY	3730.00	DENSITY OF OVERBURDEN BANK LBS/YARD
I GAMR	50.0000	GAA - MINERAL RIGHTS (\$/ACRE)
I GARA	.250000	GAA - ROYALTY AMOUNT (\$/TON)
I GASR	250.000	GAA - SURFACE RIGHTS (\$/ACRE)
I GAST	.000000	GAA - SEVERANCE TAX (\$/TON)
I GATAD	25505.4	TOTAL ACRES DISTURBED IN COMPLEX
I GATYR	185.614	GAA - TONS/YEAR - BASELINE
I GAUP	.110000	GAA - UNION PAYMENT (\$/TON)
I PPBED	.409500E 15	PP - BASE ENERGY BTU/YEAR
I PPBT	75000.0	PP - BASE TONS/DAY
I PPNEO	.130000E 15	PP - COMPLEX ENERGY DEMAND BTU/YEAR
I PPNHV	12000.0	PP - CCAL HEAT VALUE BTU/LB
I PPODY	250.000	PP - OPERATING DAYS/YEAR
I SRYT	17.8643	STRIPPING RATIO YARDS/ROM TONS
I TMY	30.0000	TOTAL MINING YEARS
C BPBY	.115941E 09	COMPLEX OVERBURDEN PROD. YARDS/YEAR
C CORTYX	.649007E 07	COMPLEX COAL DEMAND ROM TONS/YEAR
C PPFHV	12720.0	PP - FINAL HEAT VALUE
C PPFTY	.510769E 07	PP - FINISHED COAL TONS/YEAR
C PPHF	1.06000	PP - HEAT VALUE FACTOR FOR IPPT
C PPHV	13084.0	PP - BASE HEAT VALUE FOR IPPT
C PPNS	25960.3	PP - COMPLEX SIZE TONS/DAY
C PPSF	.787000	PP - SIZE FACTOR FOR IPPT
C VBBY	.347822E 10	VOL. OVERBURDEN BANK YARDS
C VCRT	.194702E 09	VOL. CCAL ROM TONS

PGA MODEL ECONOMIC SUMMARY

RUN DATE 16:16 NOV 29,'76 PAGE NO. 3.2

CASE NO. 1123 TITLE (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
 ALT. NO. 3 TITLE HEAVY MEDIA PREPARATION PLANT

1975 DOLLARS

PREPARATION PLANT STATISTICS

TYPE	SIZE	DELIVERED COAL			
	TONS/DAY	BTU/LB	TONS/YEAR	BTU/YEAR	
3	25960.3	12720.0	.510769E 07	.130000E 15	

	UNIT INVESTMENT	LABOR \$/HOUR	OWNERSHIP \$/TON	OPERATING \$/TON	O&D \$/TON
REC & BREAK PREP. PLANT	.757482E 07	47.45	220.80	164.62	.215
BLEND-STOCK PREP. PLANT	.288442E 08	72.80	560.48	295.91	.717
COAL LOADCUT PREP. PLANT	.124609E 07	38.51	15.11	71.67	.129
HEAVY MEDIA PREP. PLANT	.334050E 08	151.91	649.10	688.55	1.121
HM SUPPORT PREP. PLANT	.476551E 07	131.06	251.78	395.23	.199
	.758356E 08				2.381

CASE NO. 1123 TITLE (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
ALT. NO. 3 TITLE HEAVY MEDIA PREPARATION PLANT

[illegible]

PGA MODEL ECONOMIC SUMMARY RUN DATE 16:16 NOV 29, '76 PAGE NO. 3.5

CASE NO. 1123 TITLE (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
ALT. NO. 3 TITLE HEAVY MEDIA PREPARATION PLANT

1975 DOLLARS

QT.	INITIAL INVESTMENT	ANNUAL OWNERSHIP	ANNUAL OPERATING	PROJECT TOTAL ROM	\$/ TON	\$/ DEL TON
1 PR. PLANT TYPE 3	.758356E 08	.801329E 07	.736508E 07	.461351E 09	2.370	3.011
PROJECT TOTALS	.758356E 08	.801329E 07	.736508E 07	.461351E 09		
TONS DELIVERED = .153231E 09 COST = 3.01083 \$/TON						
BTUS DELIVERED = .390000E 16 COST = .118295 \$/MM BTU						

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75 - *          3 HEAVY MEDIA PREPARATION PLANT
76 - ECRG P 1 PRRB 1 0 3625 5107.69 7 3 .80 3 0 30 3625.
77 - ED1 P 1 PRRB REC 6 BREAK PREP. PLANT
78 - ED2 P 1 PRRB 7574.82 108750 .000 1 5 0 1.000 .000 1
79 - ED3 P 1 PRRB 49.34 52.24 .00 .00 15.59 .00
80 - EPO1 P 1 PRRB 13 5 1.38 18 5 1.38 23 5 2.07
81 - EPM1 P 1 PRRB 4 5 .074 5 5 .074 6 5 .296 14 5 .071 12 5 .212
82 - EPM2 P 1 PRRB 18 5 .205 23 5 .068
83 - ECRG P 2 PRBS 1 0 5438 5107.69 7 3 .80 3 0 30 5438.
84 - ED1 P 2 PRBS BLEND-STOCK PREP. PLANT
85 - ED2 P 2 PRBS 28844.2 163140 .000 1 5 0 1.000 .000 1
86 - ED3 P 2 PRBS 55.94 132.61 .00 .00 34.57 .00
87 - EPO1 P 2 PRBS 13 9 5.86 23 9 1.38
88 - EPM1 P 2 PRBS 4 5 .087 5 5 .044 6 5 .261 14 5 .042 12 5 .125
89 - EPM2 P 2 PRBS 18 5 .401 23 5 .040
90 - ECRG P 3 PRCL 1 0 8712 5107.69 7 3 .80 3 0 30 8712.
91 - ED1 P 3 PRCL COAL LOADOUT PREP. PLANT
92 - ED2 P 3 PRCL 1246.09 261360 .000 1 5 0 1.000 .000 1
93 - ED3 P 3 PRCL 21.08 4.42 .00 .00 7.66 .00
94 - EPO1 P 3 PRCL 13 12 1.38 18 12 1.38 23 12 .69
95 - EPM1 P 3 PRCL 4 5 .069 5 5 .069 6 5 .278 14 5 .066 12 5 .199
96 - EPM2 P 3 PRCL 18 5 .256 23 5 .063
97 - ECRG P 8 PRHM 1 0 5438 5107.69 7 3 .80 3 0 30 5438.
98 - ED1 P 8 PRHM HEAVY MEDIA PREP. PLANT
99 - ED2 P 8 PRHM 33405.0 163140 .000 1 5 0 1.000 .000 1
100 - ED3 P 8 PRHM 172.03 245.72 8.53 .00 108.91 1.45
101 - EPO1 P 8 PRHM 13 9 4.14 17 9 4.14 22 9 2.07 5 9 3.45 23 9 1.38
102 - EPO2 P 8 PRHM 10 9 1.38
103 - EPM1 P 8 PRHM 4 5 .113 5 5 .099 6 5 .311 14 5 .068 12 5 .122
104 - EPM2 P 8 PRHM 18 5 .248 23 5 .039
105 - ECRG P 9 PRS3 1 0 2000 5107.69 7 3 .80 3 0 30 2000.
106 - ED1 P 9 PRS3 HM SUPPORT PREP. PLANT
107 - ED2 P 9 PRS3 4765.51 60000 .000 1 5 0 1.000 .000 1
108 - ED3 P 9 PRS3 160.26 59.57 .00 .00 44.35 .00
109 - EPO1 P 9 PRS3 11 5 6.62 22 5 6.62
110 - EPM1 P 9 PRS3 4 5 .146 5 5 .146 6 5 .328 12 5 .210 13 5 .070
111 - EPM2 P 9 PRS3 22 5 .100
112 - ZZZZZZZZZZZZZZ

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PGA MODEL ECONOMIC SUMMARY

RUN DATE 16:16 NOV 29, '76 PAGE NO. 4.1

CASE NO. 1123 TITLE (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
 ALT. NO. 4 TITLE POWDER RIVER BASIN GENERAL & ADMINISTRATIVE

1975 DOLLARS

I IMOGA	1	INCLUDE GENERAL & ADMINISTRATIVE
I IMOPP	0	INCLUDE PREP PLANT
I IPPT	3	PP - INDEX TO PLANT TYPE
I LOGCF	1	WRITES CFA CONTROL FILE IF 1
I LOGEC	1	WRITES CFA EQUIPMENT FILE IF 1
I LOGPA	1	PRINTS PARAMETERS IF 1
I LOGSD	1	WRITES SPECIFICATION DATA IF 1
I LOGSM	1	WRITES ECONOMIC SUMMARY IF ONE
I NY	2	NO. OF YEARS TO STARTUP
I DBBPY	4190.00	DENSITY OF OVERBURDEN BANK LBS/YARD
I GAMR	50.0000	GAA - MINERAL RIGHTS (\$/ACRE)
I GARA	.250000	GAA - ROYALTY AMOUNT (\$/TON)
I GASR	250.000	GAA - SURFACE RIGHTS (\$/ACRE)
I GAST	.000000	GAA - SEVERANCE TAX (\$/TON)
I GATAD	3583.00	TOTAL ACRES DISTURBED IN COMPLEX
I GATYB	58.6920	GAA - TONS/YEAR - BASELINE
I GAUP	.110000	GAA - UNION PAYMENT (\$/TON)
I PPRED	.439500E 15	PP - BASE ENERGY BTU/YEAR
I PPRT	75000.0	PP - BASE TONS/DAY
I PPNEO	.130000E 15	PP - COMPLEX ENERGY DEMAND BTU/YEAR
I PPNHV	8200.00	PP - COAL HEAT VALUE BTU/LB
I PPDDY	250.000	PP - OPERATING DAYS/YEAR
I SRYT	3.33440	STRIPPING RATIO YARDS/ROM TONS
I TMY	30.0000	TOTAL MINING YEARS
C BPBY	.288157E 08	COMPLEX OVERBURDEN PROD. YARDS/YEAR
C CORTYX	.949767E 07	COMPLEX COAL DEMAND ROM TONS/YEAR
C PPFHV	8692.00	PP - FINAL HEAT VALUE
C PPFTY	.747466E 07	PP - FINISHED COAL TONS/YEAR
C PPHF	1.06000	PP - HEAT VALUE FACTOR FOR IPPT
C PPHV	13084.0	PP - BASE HEAT VALUE FOR IPPT
C PPNS	37990.7	PP - COMPLEX SIZE TONS/DAY
C PPSF	.787000	PP - SIZE FACTOR FOR IPPT
C VBSY	.864592E 09	VOL. OVERBURDEN BANK YARDS
C VCRT	.284930E 09	VOL. COAL ROM TONS

PGA MODEL ECONOMIC SUMMARY

RUN DATE 16:16 NOV 29, '76 PAGE NO. 4-2

CASE NO. 1123 TITLE (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
 ALT. NO. 4 TITLE POWDER RIVER BASIN GENERAL & ADMINISTRATIVE

1975 DOLLARS

GENERAL & ADMINISTRATIVE COSTS

	UNIT INVESTMENT	OWNERSHIP \$/HOUR	OPERATING \$/HOUR	O&O \$/TON
ROADS & SITE ANC. FAC.	372029.	19.44	.00	.004
BUILDINGS ANC. FAC.	.843853E 07	439.41	61.59	.109
ELECT. SYS. ANC. FAC.	.564923E 07	295.22	.00	.064
WATER SYS. ANC. FAC.	594903.	31.09	.00	.007
COMMUN. SYS. ANC. FAC.	268063.	14.01	.00	.003
MOBILE SUP. ANC. FAC.	.139175E 07	72.73	.00	.016
EQUIP. SHOP ANC. FAC.	.138164E 07	56.52	.00	.012
LAND RIGHTS PREMINE	107490.	5.62	16.12	.005
EXPL. DRILL. PREMINE	89574.9	4.68	.00	.001
CONT. ENG. PREMINE	.660403E 07	345.11	.00	.075
E. I. S. PREMINE	.104456E 07	54.59	.00	.012
SUPERV. PER.	.000000	.00	1771.73	.386
ROY-SEV. TAX	.000000	.00	1654.43	.360
	.256117E 08	1338.42	3503.88	1.054

TOTAL MM TONS/YEAR 69.8749
 TOTAL ACRES DISTURBED 3583.00

PGA MODEL ECONOMIC SUMMARY

RUN DATE 16:16 NOV 29, '76 PAGE NO. 4.3

CASE NO. 1123 TITLE (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
ALT. NO. 4 TITLE POWDER RIVER BASIN GENERAL & ADMINISTRATIVE

1975 DOLLARS

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PGA MODEL ECONOMIC SUMMARY RUN DATE 16:16 NOV 29, '76 PAGE NO. 4.4

CASE NO. 1123 TITLE (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
 ALT. NO. 4 TITLE POWDER RIVER BASIN GENERAL & ADMINISTRATIVE

1975 DOLLARS

QT.	INITIAL INVESTMENT	ANNUAL OWNERSHIP	ANNUAL OPERATING	PROJECT TOTAL	\$/ TDM	\$/ TON DEL TON
GENERAL & ADMIN.	.256117E 08	.267683E 07	.700775E 07	.300222E 09	1.054	1.339
PROJECT TOTALS	.256117E 08	.267683E 07	.700775E 07	.300222E 09		

TONS DELIVERED = .224240E 09 COST = 1.33884 \$/TON
 BTUS DELIVERED = .390000E 16 COST = .769800E-01 \$/MM BTU

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113 - *          4 POWDER RIVER BASIN GENERAL & ADMINISTRATIVE
114 - ECRG P      PPCP 1 0 3625 7474.66      7 3 .80 3 0 30 3625
115 - ECRG G 1    SITE 1 0 2000 .000 7 1 .00 3 0 31 2000
116 - ED1 G 1     SITE ROADS & SITE ANC. FAC.
117 - ED2 G 1     SITE 372.0 62000 .000 1 5 0 1.000 .000 1
118 - ECRG G 2    BLDG 1 0 2000 .000 7 1 .00 3 0 31 2000
119 - ED1 G 2     BLDG BUILDINGS ANC. FAC.
120 - ED2 G 2     BLDG 8408.5 62000 .000 1 5 0 1.000 .000 1
121 - ED3 G 2     BLDG .00 .00 61.42 .00 .00 .17
122 - ECRG G 3    PWR 1 0 2000 .000 7 1 .00 3 0 31 2000
123 - ED1 G 3     PWR ELECT. SYS. ANC. FAC.
124 - ED2 G 3     PWR 5649.2 62000 .000 1 5 0 1.000 .000 1
125 - ECRG G 4    H2O 1 0 2000 .000 7 1 .00 3 0 31 2000
126 - ED1 G 4     H2O WATER SYS. ANC. FAC.
127 - ED2 G 4     H2O 594.9 62000 .000 1 5 0 1.000 .000 1
128 - ECRG G 5    COM 1 0 2000 .000 7 1 .00 3 0 31 2000
129 - ED1 G 5     COM COMMUN. SYS. ANC. FAC.
130 - ED2 G 5     COM 268.1 62000 .000 1 5 0 1.000 .000 1
131 - ECRG G 6    MBEQ 1 0 2000 .000 7 1 .00 2 0 31 2000
132 - ED1 G 6     MBEQ MOBILE SUP. ANC. FAC.
133 - ED2 G 6     MBEQ 1391.8 62000 .000 1 5 0 1.000 .000 0
134 - ECRG G 7    SHEQ 1 0 2000 .000 7 1 .00 2 0 31 2000
135 - ED1 G 7     SHEQ EQUIP. SHOP ANC. FAC.
136 - ED2 G 7     SHEQ 1081.6 62000 .000 1 5 0 1.000 .000 0
137 - ECRG G 8    LAND 1 0 2000 .000 7 1 .00 5 0 31 2000
138 - ED1 G 8     LAND LAND RIGHTS PREMINE
139 - ED2 G 8     LAND 107.5 62000 .000 1 1 0 1.000 .000 0
140 - ED3 G 8     LAND 0. 0. 0. 0. 0. 0. 16.12
141 - ECRG G 9    XDRL 1 0 2000 .000 7 1 .00 5 0 31 2000
142 - ED1 G 9     XDRL EXPL. DRILL. PREMINE
143 - ED2 G 9     XDRL 89.6 62000 .000 1 1 0 1.000 .000 0
144 - ECRG G10    ENG 1 0 2000 .000 7 1 .00 6 0 31 2000
145 - ED1 G10     ENG CONT. ENG. PREMINE
146 - ED2 G10     ENG 6634.0 62000 .000 1 5 0 1.000 .000 0
147 - ECRG G11    EIS 1 0 2000 .000 7 1 .00 4 0 31 2000
148 - ED1 G11     EIS E. I. S. PREMINE
149 - ED2 G11     EIS 1044.6 62000 .000 1 1 0 1.000 .000 0
150 - ECRG G12    STF 1 0 2000 .000 1 8 .00 0 0 31 2000
151 - ED1 G12     STF SUPERV. PER.
152 - ED3 G12     STF .00 178.63
153 - EPD1 G12    STF 24 3 178
154 - ECRG G13    RLTX 1 0 2000 .000 7 1 .00 0 0 31 2000
155 - ED1 G13     RLTX ROY-SEV. TAX
156 - ED3 G13     RLTX 0. 0. 0. 0. 0. 0. 1654.43
157 - ZZZZZZZZZZZZZZ

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PGA MODEL ECONOMIC SUMMARY

RUN DATE 16:16 NOV 29,'76 PAGE NO. 5.1

CASE NO. 1123 TITLE (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
 ALT. NO. 5 TITLE TEXAS GULF GENERAL & ADMINISTRATIVE

1975 DOLLARS

I IMOGA	1	INCLUDE GENERAL & ADMINISTRATIVE
I IMOPP	0	INCLUDE PREP PLANT
I IPPT	3	PP - INDEX TO PLANT TYPE
I LOGCF	1	WRITES CFA CONTROL FILE IF 1
I LOGEC	1	WRITES CFA EQUIPMENT FILE IF 1
I LOGPA	1	PRINTS PARAMETERS IF 1
I LOGSD	1	WRITES SPECIFICATION DATA IF 1
I LOGSM	1	WRITES ECONOMIC SUMMARY IF ONE
I NY	3	NO. OF YEARS TO STARTUP
I DBRPY	4190.00	DENSITY OF OVERBURDEN BANK LBS/YARD
I GAMR	50.0000	GAA - MINERAL RIGHTS (\$/ACRE)
I GARA	.250000	GAA - ROYALTY AMOUNT (\$/TON)
I GASR	250.000	GAA - SURFACE RIGHTS (\$/ACRE)
I GAST	.000000	GAA - SEVERANCE TAX (\$/TON)
I GATAD	18838.0	TOTAL ACRES DISTURBED IN COMPLEX
I GATY3	83.5821	GAA - TONS/YEAR - BASELINE
I GAJP	.110000	GAA - UNICN PAYMENT (\$/TON)
I PPRED	.409500E 15	PP - BASE ENERGY BTU/YEAR
I PPRT	75000.0	PP - BASE TONS/DAY
I PPNEO	.130000E 15	PP - COMPLEX ENERGY DEMAND BTU/YEAR
I PPQHV	7020.00	PP - COAL HEAT VALUE BTU/LB
I PPQDY	250.000	PP - OPERATING DAYS/YEAR
I SRYT	3.80400	STRIPPING RATIO YARDS/ROM TONS
I TMY	30.0000	TOTAL MINING YEARS
C BPPYY	.422021E 08	COMPLEX OVERBURDEN PROD. YARDS/YEAR
C CDRTYX	.110941E 08	COMPLEX COAL DEMAND ROM TONS/YEAR
C PPFHV	7441.20	PP - FINAL HEAT VALUE
C PPFTY	.873109E 07	PP - FINISHED COAL TONS/YEAR
C PPHF	1.06000	PP - HEAT VALUE FACTOR FOR IPPT
C PPHV	13084.0	PP - BASE HEAT VALUE FOR IPPT
C PPNS	44376.6	PP - COMPLEX SIZE TONS/DAY
C PPSF	.737000	PP - SIZE FACTOR FOR IPPT
C VBBY	.126606E 10	VOL. OVERBURDEN BANK YARDS
C VCRT	.332824E 09	VOL. CCAL ROM TONS

PGA MODEL ECONOMIC SUMMARY

RUN DATE 16:16 NOV 29,'76 PAGE NO. 5.2

CASE NO. 1123 TITLE (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
 ALT. NO. 5 TITLE TEXAS GULF GENERAL & ADMINISTRATIVE

1975 DOLLARS

GENERAL & ADMINISTRATIVE COSTS

	UNIT INVESTMENT	OWNERSHIP \$/HOUR	OPERATING \$/HOUR	O&O \$/TON
ROADS & SITE ANC. FAC.	.318882E 07	164.92	.00	.032
BUILDINGS ANC. FAC.	.567574E 07	293.54	38.17	.064
ELECT. SYS. ANC. FAC.	.508431E 07	262.95	.00	.051
WATER SYS. ANC. FAC.	594903.	30.77	.00	.006
COMMUN. SYS. ANC. FAC.	134031.	6.93	.00	.001
MORILE SUP. ANC. FAC.	.139175E 07	71.98	.00	.014
EQUIP. SHOP ANC. FAC.	.108164E 07	55.94	.00	.011
LAND RIGHTS PREMINE	565140.	29.23	84.77	.022
EXPL. DRILL. PREMINE	470950.	24.36	.00	.005
CONT. ENG. PREMINE	.660403E 07	341.55	.00	.066
E. I. S. PREMINE	.104456E 07	54.02	.00	.010
SUPERV. PER.	.000000	.00	1075.17	.207
ROY-SEV. TAX	.000000	.00	1872.14	.360
	.258358E 08	1336.20	3070.24	.847

TOTAL MM TONS/YEAR 99.5075
 TOTAL ACRES DISTURBED 18838.0

RUN DATE 16:16 NOV 29, '76 PAGE NO. 5.3

CASE NO. 1123 TITLE (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
ALT. NO. 5 TITLE TEXAS GULF GENERAL & ADMINISTRATIVE

1975 DOLLARS

G1CCF	SITE WORK, \$	.300900E	07
G2SQF	BUILDINGS, SQ. FT.	135000.	
G2DSQF	BUILDING COST, \$/SQFT	36.2500	
G2MSFF	ANNUAL FUEL COST, \$	65000.0	
G2MSFW	ANNUAL WATER COST, \$	250.000	
G3CCF	POWER SYSTEM COST, \$	.450000E	07
G4ACCF	H2O SYS. COST, C-S, \$	200000.	
G4BCCF	H2O SYS. COST, R-J, \$	450000.	
G4CCCC	H2O SYS. COST, H-M, \$	550000.	
G5CCF	COMMUNICATION SYS., \$	125000.	
G6CCF	MOBILE EQUIPMENT, \$	.120000E	07
G7CCF	SHOP EQUIPMENT, \$	.100000E	07
G8PERC	LAND, DOWN PYMT FRACTION	.100000	
GASR	LAND, SURFACE RIGHTS, \$/ACRE	250.000	
GAMR	LAND, MINERAL RIGHTS, \$/ACRE	50.0000	
G9CCF	EXPLORN. DRILLING, \$/HOLE	1000.00	
G9AHOL	EXPLORN. DRILLING, ACRES/HOLE	40.0000	
G10CCD	ENGINEERING, \$	.600000E	07
G11CCF	ENVIRONMENTAL IMPACT STAT., \$	.100000E	07
G13PRC	STAFF PERS., PERCENT OF UNION	.160000	
G13MPW	TOTAL UNION MANPOWER ESTIMATE	580.000	
G13FCT	SUPPLIES, \$/YEAR/STAFF PER.	2000.00	
G137CL	WORK CLASS - STAFF	24.0000	
G13JSC	WORK SCHEDULE - STAFF	3.00000	
G13AWR	AVERAGE STAFF WAGE, \$/YEAR	17900.0	
GARA	ROYALTY ON CGAL, \$/TON	.250000	
GAST	SEVERANCE TAX, \$/TCN	.000000	
GAUP	UNION PENSION FUND, \$/TON	.110000	
G1EXP	SITE CAP. COST EXP.	.35	
G2EXP1	BLDG FUEL EXP.	.85	
G2EXP2	BLDG FUEL M&S EXP.	.90	
G2EXP3	BLDG WATER EXP.	.75	
G3EXP	POWER SYS. EXP.	.70	
G4EXP	WATER SYS. EXP.	.45	
G5EXP	COMM. SYS. EXP.	.40	
G6EXP	MOBILE SUP. EXP.	.85	
G7EXP	SHOP EXP.	.45	
G10EXP	CONT. ENG. EXP.	.55	
G11EXP	E.I.S. EXP.	.25	
G13EXP	STAFF EXP.	.90	
GACRLD	LIFE OF OPERATION	32.	32.
GACRNY	NO. YEARS STARTUP	1.	1.
GACROH	OPERATING HCURS/YEAR	2000.	2000.
GACPRL	PURCHASE LEAD TIME	3.	3.
GACRQT	QUANTITY	1.	1.
GACPSY	STARTUP YEAR	7.	7.
GAD2BY	BASE YEAP	0.	0.
GAD2CO	CONSTRUCTION CODE	1.	1.
GAD2DM	DEPRECIATION METHOD	1.	1.
GAD2EF	STARTUP EFF. FACTOR	.00	.00
GAD2PC	PURCHASE CODE	5.	5.
GAD2RA	REGIONAL ADJUSTMENT FACTOR	1.00	1.00
GAD2SF	SALVAGE FRACTION	.00	.00

PGA MODEL ECONOMIC SUMMARY

RUN DATE 16:16 NOV 29, '76 PAGE NO. 5.4

CASE NO. 1123 TITLE (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
ALT. NO. 5 TITLE TEXAS GULF GENERAL & ADMINISTRATIVE

1975 DOLLARS

QT.	INITIAL INVESTMENT	ANNUAL OWNERSHIP	ANNUAL OPERATING	PROJECT TOTAL ROM	\$/ TON	\$/ DEL TON
GENERAL & ADMIN.	.258358E 08	.267239E 07	.614049E 07	.282012E 09	.847	1.077
PROJECT TOTALS	.258358E 08	.267239E 07	.614049E 07	.282012E 09		

TONS DELIVERED = .261933E 09 COST = 1.07666 \$/TON
BTUS DELIVERED = .390000E 16 COST = .723107E-01 \$/MM BTU

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158 - *          5 TEXAS GULF GENERAL & ADMINISTRATIVE
159 - ECRG P      PPCP 1 0 3625 8731.09 7 3 .80 3 0 30 3625
160 - ECRG G 1    SITE 1 0 2000 .000 7 1 .00 3 0 32 2000
161 - ED1 G 1     SITE ROADS & SITE ANC. FAC.
162 - ED2 G 1     SITE 3188.8 64000 .000 1 5 0 1.000 .000 1
163 - ECRG G 2    BLDG 1 0 2000 .000 7 1 .00 3 0 32 2000
164 - ED1 G 2     BLDG BUILDINGS ANC. FAC.
165 - ED2 G 2     BLDG 5675.7 64000 .000 1 5 0 1.000 .000 1
166 - ED3 G 2     BLDG .00 .00 38.02 .00 .00 .14
167 - ECRG G 3    PWR 1 0 2000 .000 7 1 .00 3 0 32 2000
168 - ED1 G 3     PWR ELECT. SYS. ANC. FAC.
169 - ED2 G 3     PWR 5084.3 64000 .000 1 5 0 1.000 .000 1
170 - ECRG G 4    H2O 1 0 2000 .000 7 1 .00 3 0 32 2000
171 - ED1 G 4     H2O WATER SYS. ANC. FAC.
172 - ED2 G 4     H2O 594.9 64000 .000 1 5 0 1.000 .000 1
173 - ECRG G 5    CCM 1 0 2000 .000 7 1 .00 3 0 32 2000
174 - ED1 G 5     CCM COMMUN. SYS. ANC. FAC.
175 - ED2 G 5     CCM 134.0 64000 .000 1 5 0 1.000 .000 1
176 - ECRG G 6    MBEQ 1 0 2000 .000 7 1 .00 2 0 32 2000
177 - ED1 G 6     MBEQ MOBILE SUP. ANC. FAC.
178 - ED2 G 6     MBEQ 1391.8 64000 .000 1 5 0 1.000 .000 0
179 - ECRG G 7    SHEQ 1 0 2000 .000 7 1 .00 2 0 32 2000
180 - ED1 G 7     SHEQ EQUIP. SHOP ANC. FAC.
181 - ED2 G 7     SHEQ 1081.6 64000 .000 1 5 0 1.000 .000 0
182 - ECRG G 8    LAND 1 0 2000 .000 7 1 .00 5 0 32 2000
183 - ED1 G 8     LAND LAND RIGHTS PREMINE
184 - ED2 G 8     LAND 565.1 64000 .000 1 1 0 1.000 .000 0
185 - ED3 G 8     LAND 0. 0. 0. 0. 0. 84.77
186 - ECRG G 9    XDRL 1 0 2000 .000 7 1 .00 5 0 32 2000
187 - ED1 G 9     XDRL EXPL. DRILL. PREMINE
188 - ED2 G 9     XDRL 470.9 64000 .000 1 1 0 1.000 .000 0
189 - ECRG G10    ENG 1 0 2000 .000 7 1 .00 6 0 32 2000
190 - ED1 G10     ENG CONT. ENG. PREMINE
191 - ED2 G10     ENG 6604.0 64000 .000 1 5 0 1.000 .000 0
192 - ECRG G11    EIS 1 0 2000 .000 7 1 .00 4 0 32 2000
193 - ED1 G11     EIS E. I. S. PREMINE
194 - ED2 G11     EIS 1044.6 64000 .000 1 1 0 1.000 .000 0
195 - ECRG G12    STF 1 0 2000 .000 1 9 .00 0 0 32 2000
196 - ED1 G12     STF SUPERV. PER.
197 - ED3 G12     STF .00 108.57
198 - EP01 G12    STF 24 3 108
199 - ECRG G13    RLTX 1 0 2000 .000 7 1 .00 0 0 32 2000
200 - ED1 G13     RLTX ROY-SEV. TAX
201 - ED3 G13     RLTX 0. 0. 0. 0. 0. 1872.14
202 - ZZZZZZZZZZZZZZZZ

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APPENDIX B

MODEL RESULTS WITH ALL PARAMETERS AT DEFAULT

PGA MODEL ECONOMIC SUMMARY

RUN DATE 16:17 NOV 29,'76 PAGE NO. 1.1

CASE NO. 1124 TITLE (PGA1124) USER'S MANUAL DEFAULT EXAMPLE
 ALT. NO. 1 TITLE ALL PARAMETERS AT DEFAULT VALUES

1975 DOLLARS

I IMOGA	1	INCLUDE GENERAL & ADMINISTRATIVE
I IMOPP	1	INCLUDE PREP PLANT
I IPPT	1	PP - INDEX TO PLANT TYPE
I LOGCF	1	WRITES CFA CONTROL FILE IF 1
I LOGEC	1	WRITES CFA EQUIPMENT FILE IF 1
I LOGPA	1	PRINTS PARAMETERS IF 1
I LOGSD	1	WRITES SPECIFICATION DATA IF 1
I LOGSM	1	WRITES ECONOMIC SUMMARY IF ONE
I NY	3	NO. OF YEARS TO STARTUP
I OBRPY	3700.00	DENSITY OF OVERBURDEN BANK LBS/YARD
I GAGR	50.0000	GAA - MINERAL RIGHTS (\$/ACRE)
I GARA	.250000	GAA - ROYALTY AMOUNT (\$/TON)
I GASR	250.000	GAA - SURFACE RIGHTS (\$/ACRE)
I GAST	.000000	GAA - SEVERANCE TAX (\$/TON)
I GATAD	25505.4	TOTAL ACRES DISTURBED IN COMPLEX
I GATYB	185.614	GAA - TONS/YEAR - BASELINE
I GAUP	.110000	GAA - UNION PAYMENT (\$/TON)
I PPRED	.439500E 15	PP - BASE ENERGY BTU/YEAR
I PPBT	75000.0	PP - BASE TONS/DAY
I PPNEO	.130000E 15	PP - COMPLEX ENERGY DEMAND BTU/YEAR
I PPNHV	12000.0	PP - CCAL HEAT VALUE BTU/LB
I PPODY	250.000	PP - OPERATING DAYS/YEAR
I SRYT	17.8643	STRIPPING RATIO YARDS/ROM TONS
I TMY	30.0000	TOTAL MINING YEARS
C RPBYY	.973852E 08	COMPLEX OVERBURDEN PROD. YARDS/YEAR
C CDRTYX	.545139E 07	COMPLEX COAL DEMAND ROM TONS/YEAR
C PPFHV	12043.2	PP - FINAL HEAT VALUE
C PPFY	.539687E 07	PP - FINISHED COAL TONS/YEAR
C PPHF	1.00360	PP - HEAT VALUE FACTOR FOR IPPT
C PPHV	10990.0	PP - BASE HEAT VALUE FOR IPPT
C PPNS	21805.6	PP - COMPLEX SIZE TONS/DAY
C PPSF	.990000	PP - SIZE FACTOR FOR IPPT
C VBBY	.292156E 10	VOL. OVERBURDEN BANK YARDS
C VCRT	.163542E 09	VOL. CCAL ROM TONS

PGA MODEL ECONOMIC SUMMARY

RUN DATE 16:17 NOV 29,'76 PAGE NO. 1.2

CASE NO. 1124 TITLE (PGA1124) USER'S MANUAL DEFAULT EXAMPLE
ALT. NO. 1 TITLE ALL PARAMETERS AT DEFAULT VALUES

1975 DOLLARS

PREPARATION PLANT STATISTICS

TYPE	SIZE	DELIVERED COAL			
	TONS/DAY	BTU/LB	TONS/YEAR	BTU/YEAR	
1	21805.6	12043.2	.539687E 07	.130000E 15	

	UNIT INVESTMENT	LABOR \$/HOUR	OWNERSHIP \$/HOUR	OPERATING \$/HOUR	O&D \$/TON
REC & BREAK PREP. PLANT	.658837E 07	44.64	192.05	149.59	.227
BLEND-STOCK PREP. PLANT	.250879E 08	68.49	487.49	265.49	.751
COAL LOADOUT PREP. PLANT	.104667E 07	36.23	12.69	66.34	.139
CRUSH-SCREEN PREP. PLANT	.353613E 07	51.42	68.71	113.09	.181
CS SUPPORT PREP. PLANT	.436755E 07	93.21	230.75	297.98	.194
	.406266E 08				1.493

RUN DATE 16:17 NOV 29,'76 PAGE NO. 1.3

CASE NO. 1124 TITLE (PGA1124) USER'S MANUAL DEFAULT EXAMPLE
ALT. NO. 1 TITLE ALL PARAMETERS AT DEFAULT VALUES

1975 DOLLARS

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PGA MODEL ECONOMIC SUMMARY

RUN DATE 16:17 NOV 29,*76 PAGE NO. 1.5

CASE NO. 1124 TITLE (PGA1124) USER'S MANUAL DEFAULT EXAMPLE
 ALT. NO. 1 TITLE ALL PARAMETERS AT DEFAULT VALUES

1975 DOLLARS

GENERAL & ADMINISTRATIVE COSTS

	UNIT INVESTMENT	OWNERSHIP \$/HOUR	OPERATING \$/HOUR	O&D \$/TUN
ROADS & SITE ANC. FAC.	.301000E 07	155.16	.00	.061
BUILDINGS ANC. FAC.	.489375E 07	253.10	32.62	.112
ELECT. SYS. ANC. FAC.	.451000E 07	232.73	.00	.091
WATER SYS. ANC. FAC.	200000.	10.34	.00	.004
COMMUN. SYS. ANC. FAC.	125000.	6.46	.00	.003
MOBILE SUP. ANC. FAC.	.120000E 07	62.06	.00	.024
EQUIP. SHOP ANC. FAC.	.100000E 07	51.72	.00	.020
LAND RIGHTS PREMINE	765162.	39.57	114.77	.060
EXPL. DRILL. PREMINE	637634.	32.98	.00	.013
CONT. ENG. PREMINE	.600000E 07	310.31	.00	.121
E. I. S. PREMINE	.101000E 07	51.72	.00	.020
SUPERV. PER.	.000000	.00	916.20	.359
ROY-SEV. TAX	.000000	.00	919.92	.360
	.233215E 08	1206.16	1983.52	1.248

TOTAL MM TONS/YEAR 185.614
 TOTAL ACRES DISTURBED 25505.4

PGA MODEL ECONOMIC SUMMARY

RUN DATE 16:17 NOV 29, '76 PAGE NO. 1.6

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CASE NO. 1124 TITLE (PGA1124) USER'S MANUAL DEFAULT EXAMPLE
ALT. NO. 1 TITLE ALL PARAMETERS AT DEFAULT VALUES

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1975 DOLLARS

G1CCF	SITE WORK, \$	.300000E	07
G2SQF	BUILDINGS, SQ. FT.	135000.	
G2DSQF	BUILDING COST, \$/SQFT	36.2500	
G2MSFF	ANNUAL FUEL COST, \$	65000.0	
G2MSFW	ANNUAL WATER COST, \$	250.000	
G3CCF	POWER SYSTEM COST, \$	.450000E	07
G4ACCF	H2O SYS. COST, C-S, \$	200000.	
G4BCCF	H2O SYS. COST, B-J, \$	450000.	
G4CCCCF	H2O SYS. COST, H-M, \$	550000.	
G5CCF	COMMUNICATION SYS., \$	125000.	
G6CCF	MOBILE EQUIPMENT, \$	.120000E	07
G7CCF	SHOP EQUIPMENT, \$	.100000E	07
G8PERC	LAND, DOWN PYMT FRACTION	.100000	
GASR	LAND, SURFACE RIGHTS, \$/ACRE	250.000	
GAMR	LAND, MINERAL RIGHTS, \$/ACRE	50.0000	
G9CCF	EXPLORN. DRILLING, \$/HOLE	1000.00	
G9AHOL	EXPLORN. DRILLING, ACRES/HOLE	40.0000	
G10CCD	ENGINEERING, \$	.600000E	07
G11CCF	ENVIRONMENTAL IMPACT STAY., \$	.100000E	07
G13PRC	STAFF PERCS., PERCENT OF UNION	.160000	
G13MPW	TOTAL UNICA MANPOWER ESTIMATE	580.000	
G13FCT	SUPPLIES, \$/YEAR/STAFF PER.	2000.00	
G13OCL	WORK CLASS - STAFF	26.0000	
G13NSC	WORK SCHEDULE - STAFF	3.00000	
G134WR	AVERAGE STAFF WAGE, \$/YEAR	17900.0	
GARA	ROYALTY ON COAL, \$/TON	.250000	
GAST	SEVERANCE TAX, \$/TON	.000000	
GAUP	UNION PENSION FUND, \$/TON	.110000	
G1EXP	SITE CAP. COST EXP.		.35
G2EXP1	BLOG FUEL EXP.		.85
G2EXP2	BLOG FUEL M&S EXP.		.90
G2EXP3	BLOG WATER EXP.		.75
G3EXP	POWER SYS. EXP.		.70
G4EXP	WATER SYS. EXP.		.45
G5EXP	COMM. SYS. EXP.		.40
G6EXP	MOBILE SUP. EXP.		.85
G7EXP	SHOP EXP.		.45
G10EXP	CONT. ENG. EXP.		.55
G11EXP	E.I.S. EXP.		.25
G13EXP	STAFF EXP.		.90
GACRLQ	LIFE OF OPERATION	32.	32.
GACRNY	NO. YEARS STARTUP	1.	1.
GACKOH	OPERATING HOURS/YEAR	2000.	2000.
GACRPL	PURCHASE LEAD TIME	3.	3.
GACRQT	QUANTITY	1.	1.
GACRSY	STARTUP YEAR	7.	7.
GAD2BY	BASE YEAR	0.	0.
GAD2CO	CONSTRUCTION CODE	1.	1.
GAD2DM	DEPRECIATION METHOD	1.	1.
GAD2EF	STARTUP EFF. FACTOR	.00	.00
GAD2PC	PURCHASE CODE	5.	5.
GAD2RA	REGIONAL ADJUSTMENT FACTOR	1.00	1.00
GAD2SF	SAVING ADJUSTMENT	.00	.00

PGA MODEL ECONOMIC SUMMARY

RUN DATE 16:17 NOV 29, 1976 PAGE NO. 1.7

CASE NO. 1124 TITLE (PGA1124) USER'S MANUAL DEFAULT EXAMPLE
ALT. NO. 1 TITLE ALL PARAMETERS AT DEFAULT VALUES

1975 DOLLARS

QT.		INITIAL INVESTMENT	ANNUAL OWNERSHIP	ANNUAL OPERATING	PROJECT TOTAL ROM	\$/ TON DEL	\$/ TON
1	PR. PLANT TYPE 1	.406266E 08	.429287E 07	.377488E 07	.242033E 09	1.480	1.495
	GENERAL & ADMIN.	.233215E 08	.241232E 07	.396704E 07	.204139E 09	1.248	1.261
	PROJECT TOTALS	.639481E 08	.670519E 07	.774192E 07	.446172E 09		
TONS DELIVERED = .161906E 09		COST = 2.75574				\$/TON	
BTUS DELIVERED = .390000E 16		COST = .114403				\$/MM BTU	

COPY CODE124 TO LP(K)

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1 - *
2 - ECRG P 1 PRRB 1 0 3625 5396.87 7 3 .80 3 0 30 3625.
3 - ED1 P 1 PRRB REC & BREAK PREP. PLANT
4 - ED2 P 1 PRRB 6588.37 108750 .000 1 5 0 1.000 .000 1
5 - ED3 P 1 PRRB 46.41 45.44 .00 .00 13.10 .00
6 - EPM1 P 1 PRRB 13 5 1.30 18 5 1.30 23 5 1.95
7 - EPM1 P 1 PRRB 4 5 .074 5 5 .074 6 5 .296 14 5 .071 12 5 .212
8 - EPM2 P 1 PRRB 18 5 .205 23 5 .068
9 - ECRG P 2 PRBS 1 0 5438 5396.87 7 3 .80 3 0 30 5438.
10 - ED1 P 2 PRBS BLEND-STOCK PREP. PLANT
11 - ED2 P 2 PRBS 25087.9 163140 .000 1 5 0 1.000 .000 1
12 - ED3 P 2 PRBS 52.63 115.34 .00 .00 29.04 .00
13 - EPM1 P 2 PRBS 13 9 5.52 23 9 1.30
14 - EPM1 P 2 PRBS 4 5 .087 5 5 .044 6 5 .261 14 5 .042 12 5 .125
15 - EPM2 P 2 PRBS 18 5 .401 23 5 .040
16 - ECRG P 3 PRCL 1 0 8712 5396.87 7 3 .80 3 0 30 8712.
17 - ED1 P 3 PRCL COAL LOADOUT PREP. PLANT
18 - ED2 P 3 PRCL 1046.67 261360 .000 1 5 0 1.000 .000 1
19 - ED3 P 3 PRCL 19.83 3.85 .00 .00 6.43 .00
20 - EPM1 P 3 PRCL 13 12 1.30 18 12 1.30 23 12 .65
21 - EPM1 P 3 PRCL 4 5 .069 5 5 .069 6 5 .278 14 5 .066 12 5 .199
22 - EPM2 P 3 PRCL 18 5 .256 23 5 .063
23 - ECRG P 4 PRCS 1 0 5438 5396.87 7 3 .80 3 0 30 5438.
24 - ED1 P 4 PRCS CRUSH-SCREEN PREP. PLANT
25 - ED2 P 4 PRCS 3536.13 163140 .000 1 5 0 1.000 .000 1
26 - ED3 P 4 PRCS 35.25 16.26 4.62 .00 5.55 .00
27 - EPM1 P 4 PRCS 13 9 1.30 18 9 1.30 22 9 1.95 23 9 .65
28 - EPM1 P 4 PRCS 4 5 .131 5 5 .064 6 5 .259 14 5 .061 12 5 .187
29 - EPM2 P 4 PRCS 18 5 .239 23 5 .059
30 - ECRG P 5 PRS1 1 0 2000 5396.87 7 3 .80 3 0 30 2000.
31 - ED1 P 5 PRS1 CS SUPPORT PREP. PLANT
32 - ED2 P 5 PRS1 4367.55 60000 .000 1 5 0 1.000 .000 1
33 - ED3 P 5 PRS1 112.93 54.59 .00 .00 37.25 .00
34 - EPM1 P 5 PRS1 11 5 6.23 22 5 3.12
35 - EPM1 P 5 PRS1 4 5 .097 5 5 .195 6 5 .292 12 5 .233 13 5 .093
36 - EPM2 P 5 PRS1 22 5 .090
37 - ECRG G 1 SITE 1 0 2000 .000 7 1 .00 3 0 32 2000
38 - ED1 G 1 SITE ROADS & SITE ANC. FAC.
39 - ED2 G 1 SITE 3000.0 64000 .000 1 5 0 1.000 .000 1
40 - ECPG G 2 BLDG 1 0 2000 .000 7 1 .00 3 0 32 2000
41 - ED1 G 2 BLDG BUILDINGS ANC. FAC.
42 - ED2 G 2 BLDG 4893.7 64000 .000 1 5 0 1.000 .000 1
43 - ED3 G 2 BLDG .00 .00 32.50 .00 .00 .12
44 - ECRG G 3 PWR 1 0 2000 .000 7 1 .00 3 0 32 2000
45 - ED1 G 3 PWR ELECT. SYS. ANC. FAC.
46 - ED2 G 3 PWR 4500.0 64000 .000 1 5 0 1.000 .000 1
47 - ECRG G 4 H2O 1 0 2000 .000 7 1 .00 3 0 32 2000
48 - ED1 G 4 H2O WATER SYS. ANC. FAC.
49 - ED2 G 4 H2O 2000.0 64000 .000 1 5 0 1.000 .000 1
50 - ECRG G 5 CCM 1 0 2000 .000 7 1 .00 3 0 32 2000
51 - ED1 G 5 CCM COMMUN. SYS. ANC. FAC.
52 - ED2 G 5 CCM 125.0 64000 .000 1 5 0 1.000 .000 1
53 - ECRG G 6 MBEQ 1 0 2000 .000 7 1 .00 2 0 32 2000
54 - ED1 G 6 MBEQ MOBILE SUP. ANC. FAC.
55 - ED2 G 6 MBEQ 1200.0 64000 .000 1 5 0 1.000 .000 0
56 - ECRG G 7 SHEQ 1 0 2000 .000 7 1 .00 2 0 32 2000
57 - ED1 G 7 SHEQ EQUIP. SHOP ANC. FAC.
58 - ED2 G 7 SHEQ 1000.0 64000 .000 1 5 0 1.000 .000 0

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59	-	ECRG	G 8	LAND	1	0	2000	.000	7	1	.00	5	0	32	2000
60	-	ED1	G 8	LAND	LAND RIGHTS			PREMINE							
61	-	ED2	G 8	LAND	765.2	64000	.000	1	1	0	1.000	.000	0		
62	-	ED3	G 8	LAND	0.	0.	0.	0.	0.	0.	0.	114.77			
63	-	ECRG	G 9	XDRL	1	0	2000	.000	7	1	.00	5	0	32	2000
64	-	ED1	G 9	XDRL	EXPL. DRILL.			PREMINE							
65	-	ED2	G 9	XDRL	637.6	64000	.000	1	1	0	1.000	.000	0		
66	-	ECRG	G10	ENG	1	0	2000	.000	7	1	.00	6	0	32	2000
67	-	ED1	G10	ENG	CONT. ENG.			PREMINE							
68	-	ED2	G10	ENG	6000.0	64000	.000	1	5	0	1.000	.000	0		
69	-	ECRG	G11	EIS	1	0	2000	.000	7	1	.00	4	0	32	2000
70	-	ED1	G11	EIS	E. I. S.			PREMINE							
71	-	ED2	G11	EIS	1000.0	64000	.000	1	1	0	1.000	.000	0		
72	-	ECRG	G12	STF	1	0	2000	.000	1	9	.00	0	0	32	2000
73	-	ED1	G12	STF	SUPERV. PER.										
74	-	ED3	G12	STF	.00	92.80									
75	-	ED1	G12	STF	24	3	92								
76	-	ECRG	G13	RLTX	1	0	2000	.000	7	1	.00	0	0	32	2000
77	-	ED1	G13	RLTX	ROY-SEV. TAX										
78	-	ED3	G13	RLTX	0.	0.	0.	0.	0.	0.	0.	919.92			
79	-	ZZZZZZZZZZZZZZZZZZ													

APPENDIX C
CASH FLOW ANALYSIS RUN

CFA MODEL:

1123 (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
1 CRUSH & SCREEN PREPARATION PLANT

DATE: 12:14 NOV 30, '76 PAGE NO. 1.01

FINANCIAL SUMMARY REPORT

SALES PRICE IN BASE DOLLARS	:	\$/PREPARED TON	2.58
	:	\$/MILLION BTU	.11
RETURN ON INVESTMENT	:	PERCENT	10.00
RETURN ON PAID-IN-CAPITAL	:	PERCENT	11.02
CUMULATIVE INVESTMENT TO STEADY STATE	:	M\$	52815.
CUMULATIVE INVESTMENT TOTAL PROJECT	:	M\$	52815.
ANNUAL OPERATING COST AT STEADY STATE	:	M\$	3780.

BASE YEAR IS 1975
STEADY STATE YEAR IS 1985

PRO-FORMA STATEMENT HIGHLIGHTS

		MIN VALUE		MAX VALUE	
		UNIT	YEAR	UNIT	YEAR
LONG-TERM DEBT	: M\$	0.	1976	14084.	1984
PAID-CAPITAL	: M\$	0.	1976	35210.	1984
RETAINED EARNINGS	: M\$	0.	1976	123186.	2013
DEBT/EQUITY	: RATIO	.00	1993	.44	1982
CASH	: M\$	0.	1976	591.	1984
SURPLUS CASH	: M\$	0.	1976	157420.	2013
INVENTORY	: M\$	0.	1976	1761.	1984
SHORT-TERM BORROW	: M\$	0.	1976	1037.	1982
CUR. ASSETS/CUR. LIAB.	: RATIO	1.18	1982	6132.71	2013
SALES PRICE	: \$/TON	2.58	1982	2.58	1982
NET EARNINGS	: M\$/YR	0.	1976	4928.	2011
CASH FLOW	: M\$/YR	0.	1976	6689.	2011

CFA MODEL:

1123 (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
1 CRUSH & SCREEN PREPARATION PLANT

DATE: 12:14 NOV 30,'76 PAGE NO. 1.02

CASE DESCRIPTION

MINING PARAMETERS

I IPPTS	1	INDEX TO PLANT TYPE
C CORTY\$	.545139E 07	COAL DEMAND ROM TONS/YEAR (COMPLEX)
I SRYT\$	17.8643	STRIPPING RATIO YARDS/ROM TONS
I HMT\$	.000000	HEIGHT OF TOPSOIL - FEET
I HC\$	.000000	HEIGHT OF COAL IN FEET
C PPFTY\$	.539687E 07	PREPARED COAL TONS/YEAR
I PPNE\$	.130000E 15	ENERGY DEMAND FOR COMPLEX BTU/YEAR
I PPNHV\$	12000.0	ROM COAL HEAT VALUE BTU/LB
I ROC\$	.000000	RECLAMATION - OTHER COSTS - \$/ACRE
D VCRP	12043.2	VALUE - COAL BTU/POUND

FINANCIAL ASSUMPTIONS

I CDR	2.00000	CAPITAL/DEBT RATIO
I GAMR\$	50.0000	GAA - MINERAL RIGHTS (\$/ACRE)
I GARA\$	.250000	GAA - ROYALTY AMOUNT (\$/TON)
I GASR\$	250.000	GAA - SURFACE RIGHTS (\$/ACRE)
I GAST\$	.000000	GAA - SEVERANCE TAX (\$/TON)
I RCFO	.100000	RATE - CASH FLOW DISCOUNT
I RFIT	.480000	RATE - FEDERAL INCOME TAX
I RLTI	.800000E-01	RATE - LONG TERM INTEREST
I RSTI	.100000	RATE - SHORT TERM INTEREST
I VSPC	.000000	VALUE - REQ. PRICE OF COAL - \$/TON

FINANCIAL CONTROL PARAMETERS

I DM1	.000000	RESET DEP. METHOD 1 TO NONZERO VALUE
I DM2	.000000	RESET DEP. METHOD 2 TO NONZERO VALUE
I DM3	.000000	RESET DEP. METHOD 3 TO NONZERO VALUE
I ERAEI	.000000	ESCAL. RATE - ALL EQUIP. INVEST.
I EREL	.000000	ESCAL. RATE - ELECTRICITY
I ERFU	.000000	ESCAL. RATE - FUELS
I ERM1	.000000	ESCAL. RATE - MAINTENANCE LABOR
I ERM2	.000000	ESCAL. RATE - MAINTENANCE MATERIALS
I EROL	.000000	ESCAL. RATE - OPERATING LABOR
I ERO1	.000000	ESCAL. RATE - OTHER COSTS
I ERSPC	.000000	ESCAL. RATE - SELLING PRICE OF COAL
I ERTI	.000000	ESCAL. RATE - TIRES
I FRWA	.000000	ESCAL. RATE - WATER
I ESPC	.000000	ESC. COAL PRICE PER COST ESC. IF 1
I PC1	.000000	RESETS PUR. CODE 1 TO NONZERO VALUE
I PC2	.000000	RESETS PUR. CODE 2 TO NONZERO VALUE
I PC3	.000000	RESETS PUR. CODE 3 TO NONZERO VALUE
I PC4	.000000	RESETS PUR. CODE 4 TO NONZERO VALUE
I PC5	.000000	RESETS PUR. CODE 5 TO NONZERO VALUE
I PC6	.000000	RESETS PUR. CODE 6 TO NONZERO VALUE
I PC7	.000000	RESETS PUR. CODE 7 TO NONZERO VALUE

\$ IN NAME INDICATES A MEMO ITEM FOR CFA

CFA MODEL:

1123 (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
2 BAUM JIG PREPARATION PLANT

DATE: 12:14 NOV 30, '76

PAGE NO. 4.01

FINANCIAL SUMMARY REPORT

SALES PRICE IN BASE DOLLARS	:	\$/PREPARED TON	4.21
	:	\$/MILLION BTU	.17
RETURN ON INVESTMENT	:	PERCENT	10.00
RETURN ON PAID-IN-CAPITAL	:	PERCENT	11.02
CUMMULATIVE INVESTMENT TO STEADY STATE	:	M\$	84097.
CUMMULATIVE INVESTMENT TOTAL PROJECT	:	M\$	84097.
ANNUAL OPERATING COST AT STEADY STATE	:	M\$	5877.
BASE YEAR IS		1975	
STEADY STATE YEAR IS		1985	

PRO-FORMA STATEMENT HIGHLIGHTS

		MIN VALUE		MAX VALUE	
		UNIT	YEAR	UNIT	YEAR
LONG-TERM DEBT	: M\$	0.	1976	22426.	1984
PAID-CAPITAL	: M\$	0.	1976	56065.	1984
RETAINED EARNINGS	: M\$	0.	1976	196067.	2013
DEBT/EQUITY	: RATIO	.00	2013	.44	1982
CASH	: M\$	0.	1976	842.	1984
SURPLUS CASH	: M\$	0.	1976	250616.	2013
INVENTORY	: M\$	0.	1976	2824.	1984
SHORT-TERM BORROW	: M\$	0.	1976	1603.	1982
CUR. ASSETS/CUR. LIAB.	: RATIO	1.19	1982	5498.07	2013
SALES PRICE	: \$/TON	4.21	1984	4.21	1982
NET EARNINGS	: M\$/YR	0.	1976	7844.	2011
CASH FLOW	: M\$/YR	0.	1976	10647.	2011

CFA MODEL:

1123 (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
2 BAUM JIG PREPARATION PLANT

DATE: 12:14 NOV 30, '76

PAGE NO. 4.02

CASE DESCRIPTION

MINING PARAMETERS

I IPPTS	2	INDEX TO PLANT TYPE
C CDRTYS	.632936E 07	COAL DEMAND ROM TONS/YEAR (COMPLEX)
I SRYTS	17.8643	STRIPPING RATIO YARDS/ROM TONS
I HBT\$	.000000	HEIGHT OF TOPSOIL - FEET
I HC\$	.000000	HEIGHT OF COAL IN FEET
C PPFTYS	.522172E 07	PREPARED COAL TONS/YEAR
I PPNEYS	.130000E 15	ENERGY DEMAND FOR COMPLEX BTU/YEAR
I PPNHVS	12000.0	ROM COAL HEAT VALUE BTU/LB
I ROC\$	.000000	RECLAMATION - OTHER COSTS - \$/ACRE
D VCBP	12447.6	VALUE - COAL BTU/POUND

FINANCIAL ASSUMPTIONS

I CDR	2.00000	CAPITAL/DEBT RATIO
I GAMR\$	50.0000	GAA - MINERAL RIGHTS (\$/ACRE)
I GARAS	.250000	GAA - ROYALTY AMOUNT (\$/TON)
I GASR\$	250.000	GAA - SURFACE RIGHTS (\$/ACRE)
I GAST\$	.000000	GAA - SEVERANCE TAX (\$/TON)
I RCFO	.100000	RATE - CASH FLOW DISCOUNT
I RFIT	.480000	RATE - FEDERAL INCOME TAX
I RLTI	.800000E-01	RATE - LONG TERM INTEREST
I RSTI	.100000	RATE - SHORT TERM INTEREST
I VSPC	.000000	VALUE - REQ. PRICE OF COAL - \$/TON

FINANCIAL CONTROL PARAMETERS

I DM1	.000000	RESET DEP. METHOD 1 TO NONZERO VALUE
I DM2	.000000	RESET DEP. METHOD 2 TO NONZERO VALUE
I DM3	.000000	RESET DEP. METHOD 3 TO NONZERO VALUE
I ERAEI	.000000	ESCAL. RATE - ALL EQUIP. INVEST.
I EREL	.000000	ESCAL. RATE - ELECTRICITY
I ERFU	.000000	ESCAL. RATE - FUELS
I ERM1	.000000	ESCAL. RATE - MAINTENANCE LABOR
I ERM2	.000000	ESCAL. RATE - MAINTENANCE MATERIALS
I EROL	.000000	ESCAL. RATE - OPERATING LABOR
I EROT	.000000	ESCAL. RATE - OTHER COSTS
I ERSPC	.000000	ESCAL. RATE - SELLING PRICE OF COAL
I ERTI	.000000	ESCAL. RATE - TIRES
I ERWA	.000000	ESCAL. RATE - WATER
I ESPC	.000000	ESC. COAL PRICE PER COST ESC. IF 1
I PC1	.000000	RESETS PUR. CODE 1 TO NONZERO VALUE
I PC2	.000000	RESETS PUR. CODE 2 TO NONZERO VALUE
I PC3	.000000	RESETS PUR. CODE 3 TO NONZERO VALUE
I PC4	.000000	RESETS PUR. CODE 4 TO NONZERO VALUE
I PC5	.000000	RESETS PUR. CODE 5 TO NONZERO VALUE
I PC6	.000000	RESETS PUR. CODE 6 TO NONZERO VALUE
I PC7	.000000	RESETS PUR. CODE 7 TO NONZERO VALUE

\$ IN NAME INDICATES A MEMO ITEM FOR CFA

CFA MODEL:

1123 (PG1123) USER'S MANUAL EXAMPLE PROBLEM
3 HEAVY MEDIA PREPARATION PLANT

DATE: 12:14 NOV 30,'76 PAGE NO. 7.01

FINANCIAL SUMMARY REPORT

SALES PRICE IN BASE COLLARS	: \$/PREPARED TON	5.15
	: \$/MILLION BTU	.20
RETURN ON INVESTMENT	: PERCENT	10.00
RETURN ON PAID-IN-CAPITAL	: PERCENT	11.01
CUMULATIVE INVESTMENT TO STEADY STATE	: M\$	98586.
CUMULATIVE INVESTMENT TOTAL PROJECT	: M\$	98586.
ANNUAL OPERATING COST AT STEADY STATE	: M\$	7459.
BASE YEAR IS	1975	
STEADY STATE YEAR IS	1985	

PRC-FORMA STATEMENT HIGHLIGHTS

		MIN VALUE		MAX VALUE	
		UNIT	YEAR	UNIT	YEAR
LONG-TERM DEBT	: M\$	0.	1976	26290.	1984
PAID-CAPITAL	: M\$	0.	1976	65724.	1984
RETAINED EARNINGS	: M\$	0.	1976	229891.	2013
DEBT/EQUITY	: RATIO	.00	2013	.44	1982
CASH	: M\$	0.	1976	1002.	1985
SURPLUS CASH	: M\$	0.	1976	293795.	2013
INVENTORY	: M\$	0.	1976	3382.	1984
SHORT-TERM BORROW	: M\$	0.	1976	1963.	1982
CUR. ASSETS/CUR. LIAB.	: RATIO	1.17	1982	4691.13	2013
SALES PRICE	: \$/TON	5.15	1984	5.15	1982
NET EARNINGS	: M\$/YR	0.	1976	9199.	2011
CASH FLOW	: M\$/YR	0.	1976	12486.	2011

CFA MODEL:

1123 (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
3 HEAVY MEDIA PREPARATION PLANT

DATE: 12:14 NOV 30, '76 PAGE NO. 7.02

CASE DESCRIPTION

MINING PARAMETERS

I IPPT\$	3	INDEX TO PLANT TYPE
C CORTY\$	.649007E 07	COAL DEMAND ROM TONS/YEAR (COMPLEX)
I SRYT\$	17.8643	STRIPPING RATIO YARDS/ROM TONS
I HRT\$	.000000	HEIGHT OF TOPSOIL - FEET
I HCS	.000000	HEIGHT OF COAL IN FEET
C PPFTY\$	.510769E 07	PREPARED COAL TONS/YEAR
I PPNED\$	.130000E 15	ENERGY DEMAND FOR COMPLEX BTU/YEAR
I PPNHV\$	12000.0	ROM COAL HEAT VALUE BTU/LB
I ROC\$	.000000	RECLAMATION - OTHER COSTS - \$/ACRE
D VCBP	12720.0	VALUE - COAL BTU/POUND

FINANCIAL ASSUMPTIONS

I CDR	2.00000	CAPITAL/DEBT RATIO
I GAMR\$	50.0000	GAA - MINERAL RIGHTS (\$/ACRE)
I GARAS	.250000	GAA - ROYALTY AMOUNT (\$/TON)
I GASR\$	250.000	GAA - SURFACE RIGHTS (\$/ACRE)
I GAST\$	.000000	GAA - SEVERANCE TAX (\$/TON)
I RCFD	.100000	RATE - CASH FLOW DISCOUNT
I RFIT	.480000	RATE - FEDERAL INCOME TAX
I RLTI	.800000E-01	RATE - LONG TERM INTEREST
I RSTI	.100000	RATE - SHORT TERM INTEREST
I VSPC	.000000	VALUE - REQ. PRICE OF COAL - \$/TON

FINANCIAL CONTROL PARAMETERS

I DM1	.000000	RESET DEP. METHOD 1 TO NONZERO VALUE
I DM2	.000000	RESET DEP. METHOD 2 TO NONZERO VALUE
I DM3	.000000	RESET DEP. METHOD 3 TO NONZERO VALUE
I ERAEI	.000000	ESCAL. RATE - ALL EQUIP. INVEST.
I EREL	.000000	ESCAL. RATE - ELECTRICITY
I ERFU	.000000	ESCAL. RATE - FUELS
I ERML	.000000	ESCAL. RATE - MAINTENANCE LABOR
I ERMM	.000000	ESCAL. RATE - MAINTENANCE MATERIALS
I EROL	.000000	ESCAL. RATE - OPERATING LABOR
I EROT	.000000	ESCAL. RATE - OTHER COSTS
I ERSPC	.000000	ESCAL. RATE - SELLING PRICE OF COAL
I ERTI	.000000	ESCAL. RATE - TIRES
I ERWA	.000000	ESCAL. RATE - WATER
I ESPC	.000000	ESC. COAL PRICE PER COST ESC. IF 1
I PC1	.000000	RESETS PUR. CODE 1 TO NONZERO VALUE
I PC2	.000000	RESETS PUR. CODE 2 TO NONZERO VALUE
I PC3	.000000	RESETS PUR. CODE 3 TO NONZERO VALUE
I PC4	.000000	RESETS PUR. CODE 4 TO NONZERO VALUE
I PC5	.000000	RESETS PUR. CODE 5 TO NONZERO VALUE
I PC6	.000000	RESETS PUR. CODE 6 TO NONZERO VALUE
I PC7	.000000	RESETS PUR. CODE 7 TO NONZERO VALUE

* IN NAME INDICATES A MEMO ITEM FOR CFA

CFA MODEL:

1123 (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
4 POWDER RIVER BASIN GENERAL & ADMINISTRATIVE

DATE: 12:14 NOV 30, '76 PAGE NO. 10.01

FINANCIAL SUMMARY REPORT

SALES PRICE IN BASE COLLARS	: \$/PREPARED TON	2.51
	: \$/MILLION BTU	.14
RETURN ON INVESTMENT	: PERCENT	10.03
RETURN ON PAID-IN-CAPITAL	: PERCENT	10.80
CUMULATIVE INVESTMENT TO STEADY STATE	: M\$	30200.
CUMULATIVE INVESTMENT TOTAL PROJECT	: M\$	30200.
ANNUAL OPERATING COST AT STEADY STATE	: M\$	0.
BASE YEAR IS	1975	
STEADY STATE YEAR IS	1985	

PRC-FORMA STATEMENT HIGHLIGHTS

		MIN VALUE		MAX VALUE	
		UNIT	YEAR	UNIT	YEAR
LONG-TERM DEBT	: M\$	0.	1991	8145.	1982
PAID-CAPITAL	: M\$	629.	1976	20133.	1982
RETAINED EARNINGS	: M\$	-25601.	1983	153445.	2013
DEBT/EQUITY	: RATIO	-6.41	1984	11.35	1976
CASH	: M\$	0.	1976	0.	1976
SUPPLUS CASH	: M\$	0.	1976	172556.	2013
INVENTORY	: M\$	63.	1976	1600.	1982
SHORT-TERM BORROW	: M\$	0.	1988	27432.	1983
CUR. ASSETS/CUR. LIAB.	: RATIO	.01	1981	70936.25	2013
SALES PRICE	: \$/TON	2.51	1984	2.51	1982
NET EARNINGS	: M\$/YR	-7877.	1982	8353.	1987
CASH FLOW	: M\$/YR	-6903.	1982	9327.	1987

CFA MODEL:

1123 (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
4 POWDER RIVER BASIN GENERAL & ADMINISTRATIVE

DATE: 12:14 NOV 30, '76 PAGE NO. 10.02

CASE DESCRIPTION

MINING PARAMETERS

I IPPT\$	3	INDEX TO PLANT TYPE
C CORTY\$	.949767E 07	COAL DEMAND ROM TONS/YEAR (COMPLEX)
I SRYT\$	3.03440	STRIPPING RATIO YARDS/ROM TONS
I HRT\$	.000000	HEIGHT OF TOPSOIL - FEET
I HCS	50.0000	HEIGHT OF COAL IN FEET
C PPFTY\$	.747466E 07	PREPARED COAL TONS/YEAR
I PPNE\$	.130000E 15	ENERGY DEMAND FOR COMPLEX BTU/YEAR
I PPNHV\$	8200.00	ROM COAL HEAT VALUE BTU/LB
I ROC\$	300.000	RECLAMATION - OTHER COSTS - \$/ACRE
D VCRP	8692.00	VALUE - COAL BTU/POUND

FINANCIAL ASSUMPTIONS

I CDR	2.00000	CAPITAL/DEBT RATIO
I GAMR\$	50.0000	GAA - MINERAL RIGHTS (\$/ACRE)
I GARAS	.250000	GAA - ROYALTY AMOUNT (\$/TON)
I GASR\$	250.000	GAA - SURFACE RIGHTS (\$/ACRE)
I GAST\$	.000000	GAA - SEVERANCE TAX (\$/TON)
I RCFD	.100000	RATE - CASH FLOW DISCOUNT
I RFIT	.480000	RATE - FEDERAL INCOME TAX
I RLTI	.800000E-01	RATE - LONG TERM INTEREST
I RSTI	.100000	RATE - SHORT TERM INTEREST
I VSPC	.000000	VALUE - REQ. PRICE OF COAL - \$/TON

FINANCIAL CONTROL PARAMETERS

I DM1	.000000	RESET DEP. METHOD 1 TO NONZERO VALUE
I DM2	.000000	RESET DEP. METHOD 2 TO NONZERO VALUE
I DM3	.000000	RESET DEP. METHOD 3 TO NONZERO VALUE
I EPAEI	.000000	ESCAL. RATE - ALL EQUIP. INVEST.
I FREL	.000000	ESCAL. RATE - ELECTRICITY
I ERFU	.000000	ESCAL. RATE - FUELS
I ERML	.000000	ESCAL. RATE - MAINTENANCE LABOR
I ERMH	.000000	ESCAL. RATE - MAINTENANCE MATERIALS
I EROL	.000000	ESCAL. RATE - OPERATING LABOR
I EROT	.000000	ESCAL. RATE - OTHER COSTS
I ERSPC	.000000	ESCAL. RATE - SELLING PRICE OF COAL
I ERTI	.000000	ESCAL. RATE - TIRES
I EPWA	.000000	ESCAL. RATE - WATER
I ESPC	.000000	ESC. COAL PRICE PER COST ESC. IF 1
I PC1	.000000	RESETS PUR. CODE 1 TO NONZERO VALUE
I PC2	.000000	RESETS PUR. CODE 2 TO NONZERO VALUE
I PC3	.000000	RESETS PUR. CODE 3 TO NONZERO VALUE
I PC4	.000000	RESETS PUR. CODE 4 TO NONZERO VALUE
I PC5	.000000	RESETS PUR. CODE 5 TO NONZERO VALUE
I PC6	.000000	RESETS PUR. CODE 6 TO NONZERO VALUE
I PC7	.000000	RESETS PUR. CODE 7 TO NONZERO VALUE

\$ IN NAME INDICATES A MEMO ITEM FOR CFA

CFA MODEL:

1123 (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
5 TEXAS GULF GENERAL & ADMINISTRATIVE

DATE: 12:14 NOV 30,'76

PAGE NO. 13.01

FINANCIAL SUMMARY REPORT

SALES PRICE IN BASE DOLLARS	:	\$/PREPARED TON	1.85
	:	\$/MILLION BTU	.12
RETURN ON INVESTMENT	:	PERCENT	10.02
RETURN ON PAID-IN-CAPITAL	:	PERCENT	10.79
CUMMULATIVE INVESTMENT TO STEADY STATE	:	M\$	30239.
CUMMULATIVE INVESTMENT TOTAL PROJECT	:	M\$	30239.
ANNUAL OPERATING COST AT STEADY STATE	:	M\$	0.
BASE YEAR IS		1975	
STEADY STATE YEAR IS		1985	

PRO-FORMA STATEMENT HIGHLIGHTS

		MIN VALUE		MAX VALUE	
		UNIT	YEAR	UNIT	YEAR
LONG-TERM DEBT	: M\$	0.	1991	8017.	1982
PAID-CAPITAL	: M\$	629.	1976	20159.	1982
RETAINED EARNINGS	: M\$	-17198.	1983	127633.	2012
DEBT/EQUITY	: RATIO	-21.33	1979	2.37	1983
CASH	: M\$	0.	1976	0.	1976
SURPLUS CASH	: M\$	0.	1976	146775.	2014
INVENTORY	: M\$	2.	2015	1517.	1982
SHORT-TERM BORROW	: M\$	0.	1987	18973.	1983
CUR. ASSETS/CUR. LIAB.	: RATIO	.01	1981	110817.75	2015
SALES PRICE	: \$/TON	1.85	1982	1.85	1982
NET EARNINGS	: M\$/YR	-6641.	1982	6568.	1986
CASH FLOW	: M\$/YR	-5696.	1982	7513.	1986

CFA MODEL:

1123 (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
5 TEXAS GULF GENERAL & ADMINISTRATIVE

DATE: 12:14 NOV 30, '76

PAGE NO. 13.02

CASE DESCRIPTION

MINING PARAMETERS

I IPPTS	3	INDEX TO PLANT TYPE
C CDRTY\$	.110941E 08	COAL DEMAND ROM TONS/YEAR (COMPLEX)
I SRYT\$	3.83400	STRIPPING RATIO YARDS/ROM TONS
I HST\$	.830000	HEIGHT OF TOPSOIL - FEET
I HCS	10.0000	HEIGHT OF COAL IN FEET
C PPFTY\$	.873109E 07	PREPARED COAL TONS/YEAR
I PPNED\$	.130000E 15	ENERGY DEMAND FOR COMPLEX BTU/YEAR
I PPNHV\$	7023.00	ROM COAL HEAT VALUE BTU/LB
I ROC\$	900.000	RECLAMATION - OTHER COSTS - \$/ACRE
D VCBP	7441.20	VALUE - COAL BTU/POUND

FINANCIAL ASSUMPTIONS

I COR	2.00000	CAPITAL/DEBT RATIO
I GAMR\$	50.0000	GAA - MINERAL RIGHTS (\$/ACRE)
I GARAS	.250000	GAA - ROYALTY AMOUNT (\$/TON)
I GASR\$	250.000	GAA - SURFACE RIGHTS (\$/ACRE)
I GAST\$	.000000	GAA - SEVERANCE TAX (\$/TON)
I RCFD	.100000	RATE - CASH FLOW DISCOUNT
I RFIT	.480000	RATE - FEDERAL INCOME TAX
I RLTI	.800000E-01	RATE - LONG TERM INTEREST
I RSTI	.100000	RATE - SHORT TERM INTEREST
I VSPC	.000000	VALUE - REQ. PRICE OF COAL - \$/TON

FINANCIAL CONTROL PARAMETERS

I DM1	.000000	RESET DEP. METHOD 1 TO NONZERO VALUE
I DM2	.000000	RESET DEP. METHOD 2 TO NONZERO VALUE
I DM3	.000000	RESET DEP. METHOD 3 TO NONZERO VALUE
I ERAET	.000000	ESCAL. RATE - ALL EQUIP. INVEST.
I EREL	.000000	ESCAL. RATE - ELECTRICITY
I ERFU	.000000	ESCAL. RATE - FUELS
I ERML	.000000	ESCAL. RATE - MAINTENANCE LABOR
I ERMH	.000000	ESCAL. RATE - MAINTENANCE MATERIALS
I EROL	.000000	ESCAL. RATE - OPERATING LABOR
I EROT	.000000	ESCAL. RATE - OTHER COSTS
I ERSPC	.000000	ESCAL. RATE - SELLING PRICE OF COAL
I ERTI	.000000	ESCAL. RATE - TIRES
I ERWA	.000000	ESCAL. RATE - WATER
I ESPC	.000000	ESC. COAL PRICE PER COST ESC. IF 1
I PC1	.000000	RESETS PUR. CODE 1 TO NONZERO VALUE
I PC2	.000000	RESETS PUR. CODE 2 TO NONZERO VALUE
I PC3	.000000	RESETS PUR. CODE 3 TO NONZERO VALUE
I PC4	.000000	RESETS PUR. CODE 4 TO NONZERO VALUE
I PC5	.000000	RESETS PUR. CODE 5 TO NONZERO VALUE
I PC6	.000000	RESETS PUR. CODE 6 TO NONZERO VALUE
I PC7	.000000	RESETS PUR. CODE 7 TO NONZERO VALUE

\$ IN NAME INDICATES A MEMO ITEM FOR CFA

CFA MODEL:

1123 (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
1 ALL PARAMETERS AT DEFAULT VALUES

DATE: 12:14 NOV 30,'76

PAGE NO. 16.01

FINANCIAL SUMMARY REPORT

SALES PRICE IN BASE DOLLARS	: \$/PREPARED TON	4.86
	: \$/MILLION BTU	.20
RETURN ON INVESTMENT	: PERCENT	10.00
RETURN ON PAID-IN-CAPITAL	: PERCENT	10.88
CUMULATIVE INVESTMENT TO STEADY STATE	: M\$	79952.
CUMULATIVE INVESTMENT TOTAL PROJECT	: M\$	79952.
ANNUAL OPERATING COST AT STEADY STATE	: M\$	3780.
BASE YEAR IS	1975	
STEADY STATE YEAR IS	1985	

PRO-FORMA STATEMENT HIGHLIGHTS

		MIN VALUE		MAX VALUE	
		UNIT	YEAR	UNIT	YEAR
LONG-TERM DEBT	: M\$	0.	1993	19375.	1984
PAID-CAPITAL	: M\$	571.	1976	53301.	1984
RETAINED EARNINGS	: M\$	-12283.	1982	229966.	2013
DEBT/EQUITY	: RATIO	-3.80	1980	3.46	1979
CASH	: M\$	0.	1976	591.	1984
SURPLUS CASH	: M\$	0.	1976	282794.	2014
INVENTORY	: M\$	2.	2015	2604.	1982
SHORT-TERM BORROW	: M\$	0.	1985	15503.	1982
CUR. ASSETS/CUR. LIAB.	: RATIO	.01	1981	250057.87	2015
SALES PRICE	: \$/TON	4.86	1985	4.86	1982
NET EARNINGS	: M\$/YR	-4415.	1982	9904.	1985
CASH FLOW	: M\$/YR	-2980.	1982	12513.	1985

CFA MODEL:

1123 (PGA1123) USER'S MANUAL EXAMPLE PROBLEM
1 ALL PARAMETERS AT DEFAULT VALUES

DATE: 12:14 NOV 30,'76

PAGE NO. 16.02

CASE DESCRIPTION

MINING PARAMETERS

I IPPT\$	1	INDEX TO PLANT TYPE
C CDRTY\$	.545139E 07	COAL DEMAND ROM TONS/YEAR (COMPLEX)
I SRYT\$	17.8643	STRIPPING RATIO YARDS/ROM TONS
I HRT\$	.033333	HEIGHT OF TOPSOIL - FEET
I HCS	.000000	HEIGHT OF COAL IN FEET
C PPFTY\$	.539687E 07	PREPARED COAL TONS/YEAR
I PPNE\$	.130000E 15	ENERGY DEMAND FOR COMPLEX BTU/YEAR
I PPNHV\$	12000.0	ROM COAL HEAT VALUE BTU/LB
I RDC\$	.300000	RECLAMATION - OTHER COSTS - \$/ACRE
D VCBP	12043.2	VALUE - COAL BTU/POUND

FINANCIAL ASSUMPTIONS

I CDR	2.00000	CAPITAL/DEBT RATIO
I GAMR\$	50.3000	GAA - MINERAL RIGHTS (\$/ACRE)
I GARAS	.250000	GAA - ROYALTY AMOUNT (\$/TON)
I GASRS	250.000	GAA - SURFACE RIGHTS (\$/ACRE)
I GAST\$	.000000	GAA - SEVERANCE TAX (\$/TON)
I RCFO	.100000	RATE - CASH FLOW DISCOUNT
I PFIT	.480000	RATE - FEDERAL INCOME TAX
I RLTI	.800000E-01	RATE - LONG TERM INTEREST
I RSTI	.100000	RATE - SHORT TERM INTEREST
I VSPC	.000000	VALUE - REQ. PRICE OF COAL - \$/TON

FINANCIAL CONTROL PARAMETERS

I DM1	.000000	RESET DEP. METHOD 1 TO NONZERO VALUE
I DM2	.000000	RESET DEP. METHOD 2 TO NONZERO VALUE
I DM3	.000000	RESET DEP. METHOD 3 TO NONZERO VALUE
I ERAEI	.000000	ESCAL. RATE - ALL EQUIP. INVEST.
I EREL	.000000	ESCAL. RATE - ELECTRICITY
I ERFU	.000000	ESCAL. RATE - FUELS
I ERML	.000000	ESCAL. RATE - MAINTENANCE LABOR
I FRMM	.000000	ESCAL. RATE - MAINTENANCE MATERIALS
I EROL	.000000	ESCAL. RATE - OPERATING LABOR
I EROT	.300000	ESCAL. RATE - OTHER COSTS
I ERSPC	.000000	ESCAL. RATE - SELLING PRICE OF COAL
I ERTI	.000000	ESCAL. RATE - TIRES
I ERWA	.000000	ESCAL. RATE - WATER
I ESPC	.000000	ESC. COAL PRICE PER COST ESC. IF 1
I PC1	.000000	RESETS PUR. CODE 1 TO NONZERO VALUE
I PC2	.000000	RESETS PUR. CODE 2 TO NONZERO VALUE
I PC3	.000000	RESETS PUR. CODE 3 TO NONZERO VALUE
I PC4	.000000	RESETS PUR. CODE 4 TO NONZERO VALUE
I PC5	.000000	RESETS PUR. CODE 5 TO NONZERO VALUE
I PC6	.000000	RESETS PUR. CODE 6 TO NONZERO VALUE
I PC7	.000000	RESETS PUR. CODE 7 TO NONZERO VALUE

\$ IN NAME INDICATES A MEMO ITEM FOR CFA

PART 7

TRUCK DATA FILE
USER'S MANUAL

20 August 1976

PART 7
TDF MODEL USER'S MANUAL
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SECTION 1
INTRODUCTION

1.1 GENERAL

The Mining Equipment Data File Creation Programs (MEDFC) are designed to create and print data files for several different classes of mining equipment, e.g., trucks, drills, shovels, bulldozers, and scrapers. The full set of programs consists of the following:

1) Generalized File Creation Program

This program reads data cards prepared by the mining engineer and creates a file containing a single record for each piece of equipment. This single program is designed to handle all classes of equipment. It is controlled by control and data cards prepared by the engineer. By completing these cards, the engineer can define the contents of each file to fit the equipment contained in the file. (This program is described in FLU-030.)

2) Calculation Programs

These programs are designed to calculate ownership and operating costs for each class of equipment. All equipment items except trucks are handled by one program. The calculations for trucks are made in a separate program.

3) Generalized Printing Program

This program reads the completed data files and prints the information in the form of a data book. The format of the data book is the same for all classes, even though the information content in each book is unique. This program can be used to list any number of files in a single job.

1.2 SCOPE

Section 2 of this manual describes the input data forms developed for the Truck Data File. Section 3 and 4 describe two programs developed especially for truck data. A listing of the Truck Data File is included as Appendix A.

SECTION 2

INPUT DATA FOR TRUCK DATA FILE

2.1 LINE ITEM TEXT (LIT) CARDS

The LIT cards, as completed to define the Truck Data File tables, are listed in Figure 2-1. The following paragraphs describe features unique to the Truck Data File.

2.1.1 File Identification

The file identifier for the Truck Data File is "TD". This code appears in columns 3-4 of all cards.

2.1.2 Unit Codes

The units codes recognized in truck data are shown in Table 1.

The ENG code is treated in a special manner by the programs, since eight positions of alphameric data require two words of computer storage as compared to one word for numeric data. When the ENG code is read by the Read program, the program reserves two words in the table for the datum. In effect, the program creates a second line. The second line item is given the same Table-Line ID (TLID) as the first line.

T TD SA	ENGINE-MFG/MODEL	ENG
T TD SC	BRAKING HORSEPOWER	
T TD SD	AT RPM.	
T TD SE	NO. OF CYCLES	
T TD SF	TORQUE CONVERTER	1--0
T TD SG	TURBOCHARGER	1--0
T TD SH	EMPTY VEHICLE WEIGHT	MLBS
T TD SI	STRUCK CAPACITY - SAE	CUYD
T TD SJ	HEAPED CAPACITY	CUYD
T TD SK	SAE RATIO FOR HEAPED CAP.	
T TD SL	RATED PAYLOAD	MLBS
T TD SM	TIRE TYPE 1A - FRONT	INT
T TD SN	TIRE TYPE 1B - FRONT	INT
T TD SO	NUMBER OF TIRES	INT
T TD SP	TIRE TYPE 2A - REAR	INT
T TD SQ	TIRE TYPE 2B - REAR	INT
T TD SR	NUMBER OF TIRES	INT
T TD SS	OVERALL LENGTH	FEET
T TD ST	OVERALL WIDTH	FEET
T TD SU	LOADING HEIGHT	FEET
T TD SV	TURNING CIRCLE	FEET
T TD SW	SPECIFICATION SHEET DATE	MMYR
T TD PA	PERFORMANCE COEFFICIENT A	COEF
T TD PB	PERFORMANCE COEFFICIENT B	COEF
T TD PC	PERFORMANCE MAXIMUM	MPH
T TD PD	BRAKING COEFFICIENT A	COEF
T TD PE	BRAKING COEFFICIENT B	COEF
T TD PF	BRAKING MAXIMUM	MPH
T TD PG	TURN, SPOT, & WAIT TIME	MIN
T TD PH	TURN AND DUMP TIME	MIN
T TD PJ	FUEL CONSUMPTION RATE	G/HR
T TD PK	NO. DRIVERS + LABOR	
T TD PL	ESTIMATED TIRE LIFE	HOOR
T TD PM	AVERAGE TON MPH RATING	
T TD P7	DEPRECIATION LIFE	HRS
T TD P8	AMORTIZATION	HRS
T TD P9	SCHEDULED OPERATING HOURS	H/Y
T TD PN	PRICE DATE	MMYR
T TD CA	PRICE - FOB FACTORY	M\$
T TD CB	TIRE PRICE	M\$
T TD CC	PRICE - LESS TIRES	M\$
T TD CD	OPTIONS	M\$
T TD CE	SALES TAX	M\$
T TD CF	FREIGHT COST	M\$
T TD CG	TOTAL INVESTMENT	M\$
T TD CH	AMORTIZATION	\$PHR
T TD CI	INT., TAXES, & INS.	\$PHR
T TD CP	HOURLY OWNERSHIP COSTS	\$PHR
T TD CJ	OPERATING-MAINTENANCE MAT'L	\$PHR
T TD CR	MAINTENANCE LABOR	\$PHR
T TD CL	LABOR	\$PHR
T TD CK	FUEL, OIL, & LUBES	\$PHR
T TD CM	TIRE COST	\$PHR
T TD CN	TOTAL OPERATING	\$PHR
T TD CO	TOTAL OWNERSHIP & OPERATING	\$PHR

Figure 2-1. Listing of LIT Cards for Truck Data File

TABLE 1UNITS CODES FOR TRUCK DATA

Units Code Abbreviation	Meaning	Read Format	Print Format
ENG	Engine Code	A8	A8
MIN	Minutes	F8	F8.2
G/HR	Gallons/Hour	F8	F8.2
FEET	Feet	F8	F8.2
\$PHR	Dollars/Hour	F8	F8.2
COEF	Coefficient	F8	F8.3
INT	Integer	F8	I8
1--0	Zero or one code	F8	I8
All other		F8	F8.1
Notes: A8 means eight alphameric characters. F8 means up to eight digits, with or without a decimal point. F8.1 means up to eight digits, with one digit after the decimal point. F8.2 means up to eight digits, with two digits after the decimal point. F8.3 means up to eight digits, with three digits after the decimal point. I8 means up to eight digits, with no decimal point.			

2.2 EQUIPMENT MODEL ID (EMID) CARDS

A portion of the EMID cards for the Truck Data File is shown in Figure 2-2. The cards follow the standard format as defined in FLU-030, and require no additional comment.

The model identifiers are written in the form:

mnnnnneppptd

where:

m - is a letter code for the manufacturer.

nnnnn - is the manufacturer's model number (as much of it as fits into five positions).

e - is a letter code for the engine manufacturer.

ppp - is the rated payload, in tons.

t - is a letter code for the body type.

d - drive (E = Electric, M = Mechanical).

2.3 DATA ENTRY (DE) CARDS

A portion of the DE cards for trucks is shown in Figure 2-3. The following comments amplify some aspects of these cards.

The first card enters data for model A350PWD100U. Note here that the first data field contains the TLID of "SA", which enters the engine code. The eight columns of the data portion of the field contain the engine code "16V71N60".

The fifth card in the listing has an "E" in column 2, which makes this an "equivalence" card. Columns 21-32 of this card contain the truck model ID of the four preceding cards. When this card is processed, the system takes all data entered for the preceding model and applies them to this model.

At this point, the records for models A350PWD100U and A350PWC100U are identical. The difference between the two models is the engine, so the user must re-specify the engine data for the second model. This is done on the sixth card, which also references model A350PWC100U. The values for TLIDs "SA", "SC", "SD", "SE", "SF", and "SH" entered on this card replace the data entered for the base model.

Note that decimal points have been punched in the data fields to enter decimal fractions. No decimal point is punched for data not containing fractions.

E TD E100CHC100TM	EUCLID COAL HAUL TRAILER WITH CUMMINS ENGINE - 100T
E TD E120CHC120TM	EUCLID COAL HAUL TRAILER WITH CUMMINS ENGINE - 120T
E TD 1330 I036RM	INT HARVESTER REAR DUMP WITH IH ENGINE - 36T CAP
E TD 1340 I040RM	INT HARVESTER REAR DUMP WITH IH ENGINE - 40T CAP
E TD 1350 C050RM	INT HARVESTER REAR DUMP WITH CUMMINS ENG - 50T CAP
E TD 1350 D050RM	INT HARVESTER REAR DUMP WITH DET DIESEL ENG - 50T CAP
E TD M120BDC110TM	MACK B.D. COAL TRAILER WITH CUMMINS ENG - 110T CAP
E TD U180BDR180TE	UNIT RIG COAL B.D. TRAILER WITH RELIANCE ENG - 180T
E TD U180BDR180UE	UNIT RIG ROCK B.D. TRAILER WITH RELIANCE ENG - 180T
E TD W035C C035RM	WABCO REAR DUMP COAL TRUCK WITH CUMMINS ENG - 35T
E TD W035C D035RM	WABCO REAR DUMP COAL TRUCK WITH DET DIESEL ENG - 35T
E TD W050 C050RM	WABCO REAR DUMP COAL TRUCK WITH CUMMINS ENG - 50T
E TD W050 D050RM	WABCO REAR DUMP COAL TRUCK WITH DET DIESEL ENG - 50T
E TD W075B B065PM	WABCO REAR DUMP ROCK TRUCK WITH CUMMINS ENG - 65T
E TD W075B E065PM	WABCO REAR DUMP ROCK TRUCK WITH DET DIESEL ENG - 65T
E TD W075B C075PM	WABCO REAR DUMP ROCK TRUCK WITH CUMMINS ENG - 75T
E TD W075B D075PM	WABCO REAR DUMP ROCK TRUCK WITH DET DIESEL ENG - 75T
E TD W075B C120TM	WABCO BOT. DUMP COAL TRAIL WITH CUMMINS ENG - 120T
E TD W075B D120TM	WABCO BOT. DUMP COAL TRAIL WITH DET DIESEL ENG - 120T
E TD W075B C120UM	WABCO BOT. DUMP ROCK TRAIL WITH CUMMINS ENG - 120T
E TD W075B G120UM	WABCO BOT. DUMP ROCK TRAIL WITH G.M. ENG - 120T
E TD W085C B085PM	WABCO REAR DUMP ROCK TRUCK WITH CUMMINS ENG - 85T
E TD W085C C085PM	WABCO REAR DUMP ROCK TRUCK WITH CUMMINS ENG - 85T
E TD W085C D085PM	WABCO REAR DUMP ROCK TRUCK WITH DET DIESEL ENG - 85T
E TD W085C E085PM	WABCO REAR DUMP ROCK TRUCK WITH DET DIESEL ENG - 85T
E TD W085C T085PM	WABCO REAR DUMP ROCK TRUCK WITH CATERPILAR ENG - 85T

Figure 2-2. Partial Listing of EMID Cards for Truck Data File

D TD	A350PWD100UM	SA 16V71N60SC	560SD	2100SE	2SF	1	
D TD	A350PWD100UM	SH 12C.85SI	60SJ	67SK	3SL	200	
D TD	A350PWD100UM	SM 180025SN	2413SO	8SP	210049SG	3613SR	4
D TD	A350PWD100UM	SS 62.67ST	16.75SU	12.92SW	1174		
DETD	A350PWC100UM	A350PWD10CU					
D TD	A350PWC100UM	SA VT2720CSC	56CSD	2100SE	4SF	1SH	121.85
D TD	A350PHD100TM	SA16V71N60SC	56CSD	2100SE	2SF	1	
D TD	A350PHD100TM	SH 125.665SI	123SJ	136SK	3SL	200	
D TD	A350PHD100TM	SM 180025SN	2413SO	8SP	210049SG	3613SR	4
D TD	A350PHD100TM	SS 64.5ST	13.5SU	13.C4SW	1174		
DETD	A350PHC100TM	A350PHD100T					
D TD	A350PHC100TM	SA VT1710CSC	560SD	21C0SE	4SF	1SH	126.665
D TD	U180BDR180TE	SAU101W100SC	1200				
D TD	U180BDR180TE	SH 232.351	204SJ	246SK	2SL	360	
D TD	U180BDR180TE	SM 300051SN	4614SO	10			
D TD	U180BDR180TE	SS 78.23ST	20.5SU	16.0SW	1174		
DETD	U180BDR180UE	U1802DR180T					
D TD	U180BDR180UE	SI 12CSJ	150SK	2			
D TD	W035C C035RM	SA NTA855CSC	42CSD	2300SE	4SF	1	
D TD	W035C C035RM	SH 58.36SI	23SJ	27SK	3SL	70	
D TD	W035C C035RM	SM 180033SN	2413SO	6			
D TD	W035C C035RM	SS 25.33ST	12.42SU	11.SV	49.SW	1174	
DETD	W035C D035RM	W035C C035R					
D TD	W035C D035RM	SA 12V71NSC	434SD	2100SE	2SF	1	
D TD	W050 C050RM	SA VT1710CSC	635SD	2100SE	4SF	1	
D TD	W050 C050RM	SH 75.34SI	30.8SJ	37.SK	3SL	100	
D TD	W050 C050RM	SM 210035SN	3213SO	6			
D TD	W050 C050RM	SS 28.92ST	13.42SU	11.83SV	58.SW	1174	
DETD	W050 D050RM	W050 C050R					
D TD	W050 D050RM	SA 16V71NSC	635SD	21C0SE	4SF	1	

Figure 2-3. Partial Listing of DE Cards for Truck Data File

SECTION 3

TRUCK DATA FILE CALCULATION PROGRAM

3.1 CALCULATIONS

The Truck Data File Calculation program processes the file developed by the Generalized Read program and fills in some selected data items in the P and C tables.

The programmed calculations are given in Table 2. The variable names used in this table are the two-character TLIDs as defined in Figure 2-1. The variables with "F" as the first letter refer to factors used by the program. The factor variables explanation, and the values used, are printed in the data book listing when the file is printed. (Refer to Appendix A, page A-2.)

TABLE 2
PROGRAMMED TRUCK DATA CALCULATIONS
(Sheet 1 of 3)

1. PRELIMINARY PARAMETER SETTING

FJ - SERVICE CODE
1 - LIGHT DUTY
2 - AVERAGE DUTY
3 - HEAVY DUTY

FJ IS USED TO SET FR, FM AND FK IF VALUES ARE NOT SPECIFIED FOR THOSE VARIABLES.

IF FJ IS NOT SPECIFIED BY USER, PROGRAM SETS FJ TO 2.

FR* - TIRE SERVICE FACTOR
IF NOT SPECIFIED, FR IS SET AS FOLLOWS:

FJ	CORRESPONDING FR
1	1.05
2	0.08
3	0.60

FM* - FUEL LOADING FACTOR
IF NOT SPECIFIED, FM IS SET AS FOLLOWS:

FJ	CORRESPONDING FM
1	0.35
2	0.40
3	0.60

2. PG* - SPOT & WAIT TIME - MINUTES
DEPENDS ON BODY TYPE
IF BODY IS TRAILER, THEN
 $PG = 0.8 + 0.00185 * SL * 2.$

IF BODY IS NOT TRAILER, THEN
 $PG = 0.6$

3. PH* - TURN & DUMP TIME - MINUTES
DEPENDS ON BODY TYPE
IF BODY IS TRAILER, THEN
 $PH = 0.4 + 0.00111 * SL * 2$

IF BODY IS NOT TRAILER, THEN
 $PH = 0.4 + 0.0005 * SL * 2.$

* CALCULATION IS SKIPPED IF VALUE IS NON ZERO.

TABLE 2

PROGRAMMED TRUCK DATA CALCULATIONS

(Sheet 2 of 3)

4.	PM*	- AVERAGE TON MILES PER HOUR RATING PROGRAM LOOKS FOR TMPH RATING IN TIRE DATA FILE. IF PRESENT, VALUE IS ENTERED INTO DATA BASE. IF NOT GIVEN IN TIRE DATA, PROGRAM SETS TO FV.
5.	PJ*	- FUEL CONSUMPTION - GAL/HOUR $PJ = SC * FL * FM$
6.	PL*	AVERAGE TIRE LIFE - HOURS PROGRAM LOOKS FOR TIRE LIFE IN TIRE DATA FILE. IF PRESENT, VALUE IS ENTERED INTO DATA BASE. IF NOT GIVEN IN TIRE DATA, PROGRAM SETS TO FQ.
7.	CA*	- PURCHASE PRICE FOB FACTORY - M\$ $CA = FA + FB * (SL + SH)$
8.	CB*	- TIRE COST - M\$ TIRE COST IS TAKEN FROM TIRE DATA, AND DISCOUNTED WITH FACTOR, FS, AS FOLLOWS: $CB' = CB * (1. - FS/100)$ TIRE EXCISE TAX IS THEN ADDED TO CB'.
9.	CC*	-PRICE LESS TIRES - M\$ $CC = CA - CB$
10.	CD*	- OPTIONS PRICE - M\$ $CD = CC * (FC / 100)$
11.	CE	- SALES TAX - M\$ $CE = (CA + CD) * (FD/100)$
12.	CF	- FREIGHT COST - M\$ $CF = (SH * 10. * FE * FF/1000.) / 1000.$
13.	CG	- TOTAL INVESTMENT - M\$ $CG = CC + CD + CE + CF$
14.	CH	- AMMORTIZATION - \$/HOUR $CH = (CG / P8) * 1000.$
* CALCULATION IS SKIPPED IF VALUE IS NON ZERO.		

TABLE 2

PROGRAMMED TRUCK DATA CALCULATIONS

(Sheet 3 of 3)

14. CI - INSUR., TAXES & INTEREST - \$/HOUR
BASED ON AVERAGE ANNUAL INVESTMENT, AAI, AND TRUCK
LIFE, TL
 $TL = P8/P9$
 $AAI = CG * ((TL + 1)/(TL*2))$
 $CI = ((AAI * (FI/100))/P9) * 1000$
15. CP - OWNERSHIP COSTS - \$/HOUR
 $CP = CH + CI$
16. CR* MAINTENANCE LABOR - \$/HOUR
 $CR = CA * FK * FW$
17. CJ* MAINTENANCE MAT'L - \$/HOUR
 $CJ = (CA * FK) - CR$
18. CK* -FUEL, OIL & LUBES - \$/HOUR
 $CK = (PJ * FN) * (1. + FU)$
19. CL* -LABOR COST - \$/HOUR
 $CL = PK * FP * FX$
20. CM TIRE COSTS - \$/HOUR
 $CM = (CB / (PL * FR)) * 1000.$
21. CN OPERATING COST - \$/HOUR
 $CN = CJ + CK + CL + CM + CR$
22. CO O & O - \$/HOUR
 $CO = CP + CN$

* CALCULATION IS SKIPPED IF VALUE IS NON ZERO

3.2 CALCULATION PROGRAM OUTPUT

The Calculation program provides the engineer with an output listing to aid in verifying the calculated and input data. Figure 3-1 is an example of this listing.

The TLID's are listed at the top of the analysis report, as they were coded on the LIT cards. The truck model IDs from the EMID cards, and their sequence number within the Truck Data File, are listed at the left of the page.

The intersection of the columns and rows of the analysis indicate the status of the data corresponding to the column's ID and the row's model. A definition of each status can be found in Table 3.

The engineer can also verify that he has input data for each model in the EMID cards. Note on Figure 3-1 that there is no model with the sequence number "5". This indicates that no data was input for the fifth model in the EMID list.

The analysis report should be carefully reviewed by the user to ensure that the model has made the desired calculations. The items marked with "X" or "Z" indicate a need to correct some input data.

1	A350PHC100T
2	A350PWD100T
3	A350PWD100U
4	A350PWD100U
6	E100CHC100T
7	E120CHC120T
8	I330 I036P
9	I340 I040R
10	1350 C050R
11	1350 D050R
12	M120BDC110T
13	UM100 D100P
14	UM30 D130P
15	UM36 D170P
16	UBD180D180T
17	W035C C0350
18	W035C D035P
19	W035C C035R
20	W035C D035R
21	W035CTC035T
22	W035CTD035T
23	W050 C050P
24	W050 C050R
25	W050 D050R
26	W050T C050T
27	W050T D050T
28	W075B B065P
29	W075B E065P
30	W075B C075P
31	W075B D075P
32	W075B A075R
33	W075B C075R
34	W075B D075R
35	W075B E075R
36	W085C B085P

Figure 3-1. Partial Listing of Analysis Report for Trucks

TABLE 3

ANALYSIS REPORT STATUS DEFINITIONS

Status	Definition
Blank	This data item is expected to be input, but has not been input.
I	This data item was input.
Y	The data item was an input value with the unit code of "1--0" on the LIT card. A "Y" indicates this value was coded "1".
N	The data item was an input value with the unit code "1--0" on the LIT card. An "N" indicates this value was coded "0".
C	The data item was calculated by the Calculation program.
Z	The data item was calculated, but one of the values used to calculate it was zero.
X	The data item could not be calculated because the needed data were not available to the program (e.g., the tire was not in the tire data base, so the price was not available).

SECTION 4

DEVELOPING THE PERFORMANCE AND BRAKING COEFFICIENTS

4.1 GENERAL

The performance and braking curves can be approximated with the equation:

$$F = A + B/S$$

where:

F - is the rimpull force, in thousands of pounds.

S - is the speed, in miles/hour

A and B - are coefficients

The values of coefficients A and B are determined by program BFSRIMP. The input to this program consists of a series of force and speed points read from a performance or braking curve. The program uses the least-squares method to fit the points and determine coefficients A and B. After computing the coefficients, the program computes a speed value for each input force value to indicate to the user how well the curve has been fit.

Program BFSRIMP can be used in either of two modes:

- 1) To develop only the coefficients and an output listing.
- 2) To develop the coefficients, an output listing, and DE cards for the Truck Data File. In this mode,

the program can also produce a graphical representation of the curve.

The input card format is shown in Figure 4-1. An example of input for the first mode (i.e., listing only) is shown in Figure 4-2, and an example of input for the second mode is shown in Figure 4-3. Figure 4-4 is an example of the BFSRIMP output listing.

Figures 4-5 and 4-7 are the performance and braking charts from which the example data were taken. Figures 4-6 and 4-8 show the curves developed by the program.

Figure 4-9 shows the DE cards developed by BFSRIMP from the example input of Figure 4-2.

4.2 INPUT CARD CONVENTIONS

The following paragraphs explain the conventions for completing the data form illustrated in Figure 4-1.

4.2.1 Card Input for Listing-Only Mode

The example input cards for the listing-only mode are shown in Figure 4-2. The conventions are as follows:

- 1) Each set of force and speed points must be preceded by a card with an "*" in card column 1. The remaining columns of this card may contain any information desired by the user. The card image is printed at the top of the output listing. Thus, the information in this card is used to title the output listing.

2) The "*" card is followed by as many data cards as the user desires, or feels are needed, to represent the chart. One value each of force and speed must be punched in each card. The force value is first; the speed value is second. The two values may be punched in any card column, as long as there is at least one blank column between the two values.

4.2.2 Card Input for DE Mode

The example input cards for the DE mode are shown in Figure 4-3. The conventions are as follows:

1) Each set of force and speed points must be preceded by a card with an "*" in card column 1. The format for this card is:

<u>Card Column (s)</u>	<u>Information</u>
1	"*"
2-3	Blank
4-15	Truck Data File model ID
16-17	Blank
18-19	"PC" or "PF" (codes for performance and braking, respectively)
20-21	Blank
22-31	Maximum speed, in miles/hour
32-80	Any desired comments.

2) When the coefficients apply to one or more additional models in the Truck Data File, the data set may include one or more cards with "***" in card columns 1-2. These cards may be placed anywhere in the set of data points. The format for the "***" card is:

<u>Card Column(s)</u>	<u>Information</u>
1-2	"**"
3	Blank
4-15	Truck Data File model ID
16-80	Any desired comments

3) The conventions for the data cards containing the force and speed values is as described for the listing-only mode.

```

*  E100CHC100T    PC    35.                VTA1710C
    70.0    2.0
    42.0    4.0
    24.0    7.0
    18.0   11.0
    13.1   14.0
    10.6   17.4
     7.2   24.0
     6.6   28.0
     6.0   35.0

**  E120CHC120T
*  E100CHC100T    PF    37.5                VTA1710C
    44.0    3.5
    24.0    9.0
    18.5   14.5
    14.0   22.0
    10.0   33.0
**  E120CHC120T

```

Figure 4-3. Example of Input to BFSRIMP to Obtain Listing and DE Cards

CA = -.945307
CB = 197.766

INPUT F	INPUT S	CALC S	DEV	% DEV
70.000	2.000	1.880	-.120	-6.004
42.000	4.000	3.763	-.237	-5.915
24.000	7.000	7.295	.295	4.213
18.000	11.000	10.042	-.958	-8.712
13.100	14.000	14.151	.151	1.081
10.600	17.400	17.712	.312	1.792
7.200	24.000	26.522	2.522	10.509
6.600	28.000	29.019	1.019	3.640
6.000	35.000	32.016	-2.984	-8.527

* E100CHC100T PF 37.5 VTA1710C

$$\begin{aligned} CA &= -6.24635 \\ CB &= 390.621 \end{aligned}$$

INPUT F	INPUT S	CALC S	DEV	%DEV
44.000	3.500	2.631	-.869	-24.817
24.000	9.000	10.030	1.030	11.439
18.500	14.500	14.868	.368	2.540
14.000	22.000	21.655	-.345	-1.568
10.000	33.000	32.816	-.184	-.558

Figure 4-4. Example of Output Listing from BFSRIMP

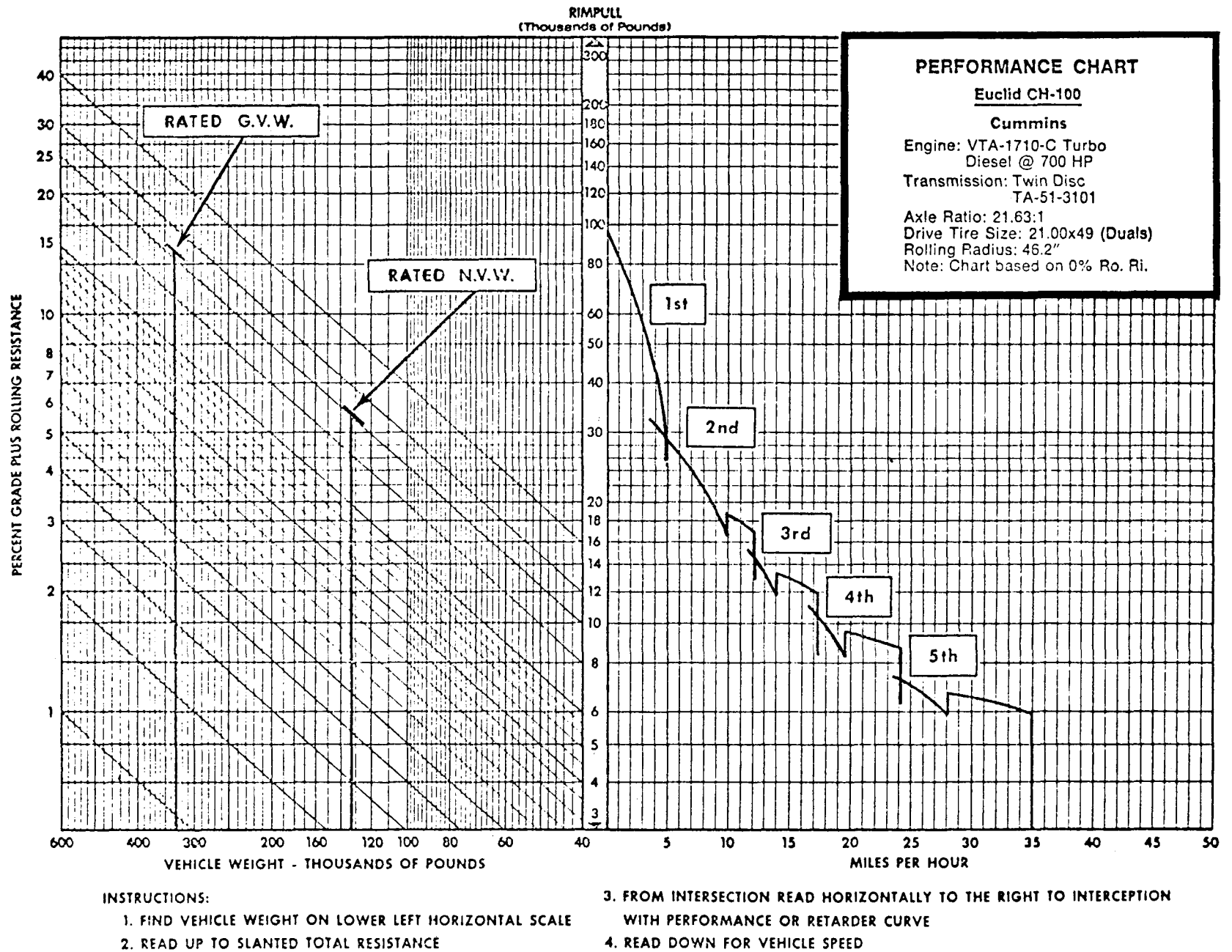


Figure 4-5. Example of Performance Chart

Figure 4-6. Example of Performance Chart Developed by BFSRIMP

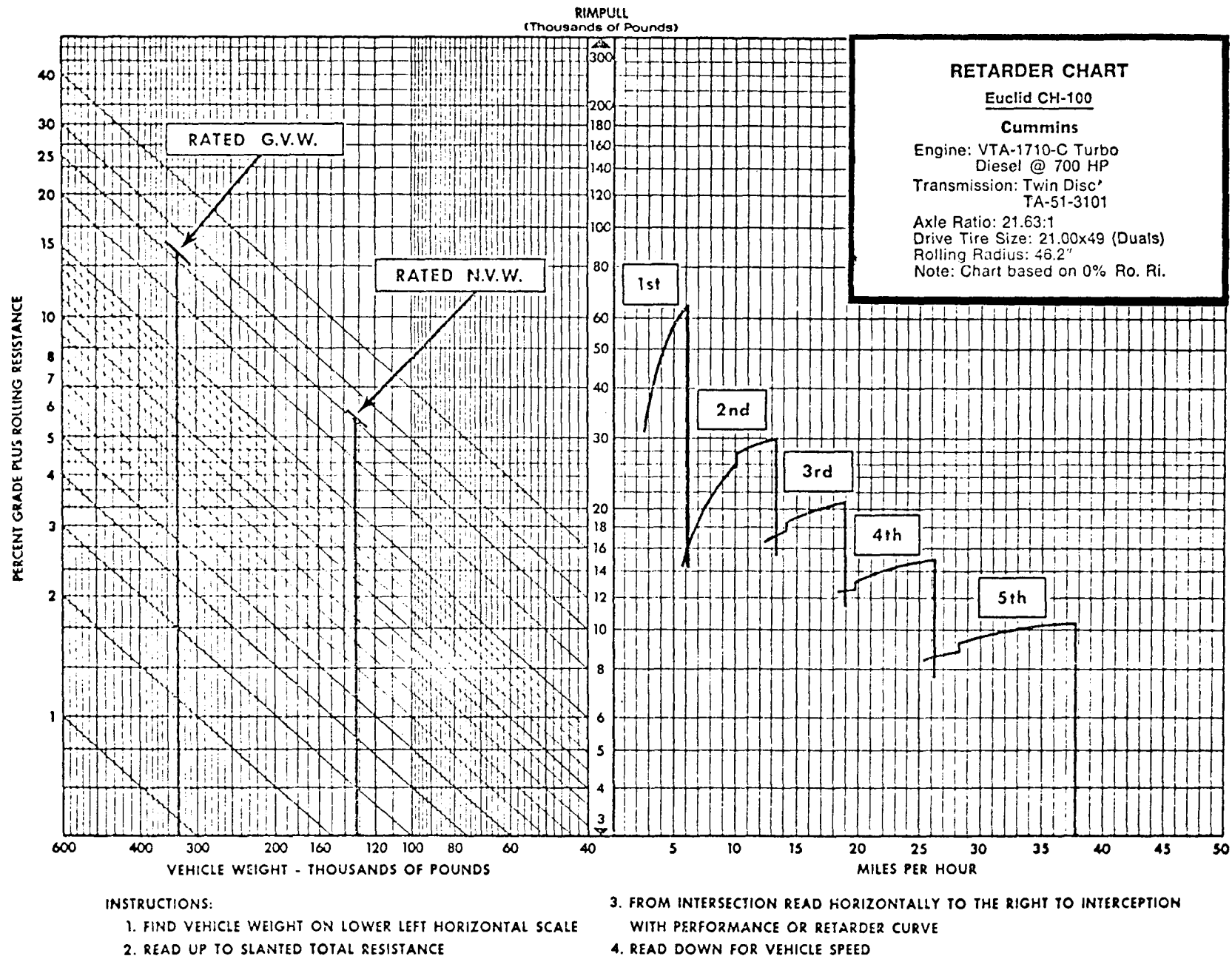


Figure 4-7. Example of Braking Chart

Figure 4-8. Example of Braking Chart Developed by BFSRIMP

D TD E100CHC100T	PA	-.9453PB	197.766PC	35.00
D TD E120CHC120T	PA	-.9453PB	197.766PC	35.00
D TD E100CHC100T	PD	-6.2464PE	390.621PF	37.50
D TD E120CHC120T	PD	-6.2464PE	390.621PF	37.50

Figure 4-9. Example of DE Cards Developed by BFSRIMP

APPENDIX A

LISTING OF TRUCK DATA FILE

FACTOR TABLE VALUES

FA	CONSTANT TERM FOR INVEST. EQN. = M\$	62.0
FB	SLOPE TERM FOR INVEST. EQN. = \$/LB	.380
FC	OPTIONS PERCENT =	5.0
FD	TAX RATE = PERCENT	6.0
FE	FREIGHT RATE \$/CWT/1000MILES	4.500
FF	SHIPPING DISTANCE = MILES	1000
FI	INSUR., INT., & TAXES RATE = PERCENT	14.0
FJ	SERVICE CODE (1, 2 OR 3)	2
FK	MAINTENANCE FACTOR = FRACTION	1.30
FL	DIESEL CONSUMPTION = GALS/HP/HR	.06
FM	DIESEL CONSUMP. LOAD FACTOR	.40
FN	DIESEL COST = \$/GAL	.30
FO	NO. OF LABORERS PER TRUCK	1.0
FPR	ROCK TRUCK DRIVER'S WAGES = \$/HOUR	11.46
FPC	COAL TRUCK DRIVER'S WAGES = \$/HOUR	10.13
FQ	AV. TIRE LIFE = HOURS	5000.
FR	TIRE SERVICE FACTOR	1.000
FS	FLEET DISCOUNT FOR TIRES	.500
FU	LUBE & OIL FRACTION OF DIESEL	.30
FV	DEFAULT TON MPH RATING	211.
FW	MAINT. LABOR = FRACTION OF TOTAL MAINT.	.40
FX	ANNUAL EFFICIENCY FACTOR	.90

FLU-040

FILE ID = TD TRUCK DATA

FILE DATE = 08/19/76

MODEL CODE IS PRINTED AS FOLLOWS:

1. MNNNNN
2. ELLLT

WHERE

M = MANUFACTURER CODE
NNNNN = MODEL NUMBER
E = ENGINE MANUFACTURER
LLL = HAUL LOAD IN TONS
T = TYPE
D = TYPE OF DRIVE

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A-3

FILE ID # TD

TRUCK DATA

FILE DATE = 08/19/76

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SPECIFICATION DATA

		1 A350PH C100TM	2 A350PH D100TM	3 A350PW C100UM	4 A350PW D100UM	5 E100CH C100TM	6 E120CH C120TM	7 I330 I036RM	8 I340 I040RM
SA ENGINE-MFG/MODEL	ENG	VT1710C	16V71N60	VT1710C	16V71N60	VTA1710C	VTA1710C	DT817B	DT817B
SC BRAKING HORSEPOWER		560.0	560.0	560.0	560.0	700.0	700.0	420.0	420.0
SD AT RPM-		2100.0	2100.0	2100.0	2100.0	2100.0	2100.0	2200.0	2200.0
SE NO. OF CYCLES		4.0	2.0	4.0	2.0	4.0	4.0	4.0	4.0
SF TORQUE CONVERTER	1--0	1	1	1	1	0	0	1	1
SG TURBOCHARGER	1--0	0	0	0	0	0	0	1	1
SH EMPTY VEHICLE WEIGHT	MLBS	126.7	125.7	121.9	120.9	131.5	139.4	61.0	62.4
SI STRUCK CAPACITY - SAE	CUYD	123.00	123.00	60.00	60.00	113.00	136.00	24.00	26.60
SJ HEAPED CAPACITY	CUYD	136.00	136.00	67.00	67.00	128.00	151.00	31.00	33.60
SK SAE RATIO FOR HEAPED CAP.		3.0	3.0	3.0	3.0	3.0	3.0	2.0	2.0
SL RATED PAYLOAD	MLBS	200.0	200.0	200.0	200.0	200.0	240.0	72.0	80.0
SM TIRE TYPE 1A - FRONT	INT	180025	180025	180025	180025	180033	210035	180025	180025
SN TIRE TYPE 1B - FRONT	INT	2413	2413	2413	2413	3213	3213	2013	2413
SD NUMBER OF TIRES	INT	8	8	8	8	2	2	8	8
SP TIRE TYPE 2A - REAR	INT	210049	210049	210049	210049	210049	240049	0	0
SQ TIRE TYPE 2B - REAR	INT	3613	3613	3613	3613	3613	3613	0	0
SR NUMBER OF TIRES	INT	4	4	4	4	8	8	0	0
SS OVERALL LENGTH	FEET	64.50	64.50	62.60	62.60	66.25	66.25	26.17	26.17
ST OVERALL WIDTH	FEET	13.50	13.50	16.75	16.75	15.50	16.17	13.25	13.25
SU LOADING HEIGHT	FEET	13.04	13.04	13.25	13.25	14.08	15.71	10.83	11.30
SV TURNING CIRCLE	FEET	61.00	61.00	61.00	61.00	82.67	82.67	59.50	59.50
SW SPECIFICATION SHEET DATE	MMYR	1174	1174	974	974	1174	1174	773	773

PAGE 1 SHEET 1

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A-5

FILE ID = TD

TRUCK DATA

FILE DATE = 08/19/76

		1 A350PH C100TM	2 A350PH D100TM	3 A350PW C100UM	4 A350PW D100UM	5 E100CH C100TM	6 E120CH C120TM	7 I330 I036RM	8 I340 I040RM
PERIPHERAL DATA									
PA PERFORMANCE COEFFICIENT A	CDEF	-.1512	-.1512	-.1512	-.1512	-.5865	-.5339	-1.242	-1.242
PB PERFORMANCE COEFFICIENT B	CDEF	136.2	136.2	136.2	136.2	171.6	181.7	130.2	130.2
PC PERFORMANCE MAXIMUM	MPH	27.0	27.0	27.0	27.0	35.0	36.7	35.5	35.5
PD BRAKING COEFFICIENT A	CDEF	-.4785	-.4785	-.4785	-.4785	-4.346	-2.092	.0000	.0000
PE BRAKING COEFFICIENT B	CDEF	169.5	169.5	169.5	169.5	283.0	228.2	123.2	123.2
PF BRAKING MAXIMUM	MPH	29.6	29.6	29.6	29.6	37.8	39.4	39.0	39.0
PG TURN, SPOT, & WAIT TIME	MIN	1.54	1.54	.60	.60	1.54	1.69	.60	.60
PH TURN AND DUMP TIME	MIN	.84	.84	.60	.60	.84	.93	.47	.48
PJ FUEL CONSUMPTION RATE	G/HR	13.44	13.44	13.44	13.44	16.80	16.80	10.08	10.08
PK NO. DRIVERS + LABOR		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
PL ESTIMATED TIRE LIFE	HOUR	5000.00	5000.00	5000.00	5000.00	5000.00	5000.00	5000.00	5000.00
PM AVERAGE TON MPH RATING		140.0	140.0	140.0	140.0	187.0	209.0	110.0	110.0
P7 DEPRECIATION LIFE	HRS	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0
P8 AMORTIZATION	HRS	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0
P9 OPERATING HOURS	M/Y	3262.5	3262.5	7467.0	7467.0	3262.5	3262.5	3262.5	3262.5
PN PRICE DATE	MMYR	0	0	0	0	1274	1274	1274	1274

OWNERSHIP & OPERATING COST DATA

CA PRICE - FOB FACTORY	M\$	186.1	185.8	184.3	183.9	313.1	322.2	130.9	140.1
CB TIRE PRICE	M\$	29.1	29.1	29.1	29.1	37.6	42.7	11.5	12.7
CC PRICE - LESS TIRES	M\$	157.0	156.6	155.2	154.8	275.5	279.5	119.4	127.4
CD OPTIONS	M\$	7.8	7.8	7.8	7.7	15.7	16.1	5.0	5.1
CE SALES TAX	M\$	11.6	11.6	11.5	11.5	19.7	20.3	8.2	8.7
CF FREIGHT COST	M\$	5.7	5.7	5.5	5.4	5.9	6.3	2.7	2.8
CG TOTAL INVESTMENT	M\$	182.2	181.7	179.9	179.5	316.8	322.2	135.3	144.1
CH AMORTIZATION	\$PHR	9.11	9.09	9.00	8.97	15.84	16.11	6.76	7.20
CI INT., TAXES, & INS.	\$PHR	4.55	4.53	2.32	2.31	7.91	8.04	3.38	3.60
CP HOURLY OWNERSHIP COSTS	\$PHR	13.66	13.62	11.31	11.28	23.75	24.15	10.14	10.80
CJ OPERATING-MAINTENANCE MAT'L	\$PHR	7.26	7.24	7.19	7.17	12.21	12.57	5.11	5.46
CR MAINTENANCE LABOR	\$PHR	4.84	4.83	4.79	4.78	8.14	8.38	3.40	3.64
CL LABOR	\$PHR	11.26	11.26	12.73	12.73	11.26	11.26	11.26	11.26
CK FUEL, OIL, & LUBES	\$PHR	5.24	5.24	5.24	5.24	6.55	6.55	3.93	3.93
CM TIRE COST	\$PHR	5.83	5.83	5.83	5.83	7.53	8.54	2.31	2.53
CN TOTAL OPERATING	\$PHR	34.42	34.40	33.78	33.76	45.69	47.29	26.00	26.83
CO TOTAL OWNERSHIP & OPERATING	\$PHR	48.08	48.02	47.10	47.04	69.43	71.44	36.14	37.62

FILE ID = TD

TRUCK DATA

FILE DATE = 08/19/76

SPECIFICATION DATA

		9	10	11	12	13	14	15	16
		I350	I350	UM85	UM100	UM1205	UM1207	UM30	UM33
		C050RM	D050RM	T085RE	D100RE	D120RE	D120RE	T130RE	D150RE
SPECIFICATION DATA									
SA ENGINE-MFG/MODEL	ENG	VT1710C	16V71N60	D348	12V149T	12V149T	12V149T	D349	16V149T1
SC BRAKING HORSEPOWER		560.0	560.0	850.0	1000.0	1000.0	1000.0	1200.0	1600.0
SD AT RPM-		2100.0	2100.0	2000.0	1900.0	1900.0	1900.0	2000.0	1900.0
SE NO. OF CYCLES		4.0	2.0	4.0	2.0	2.0	2.0	4.0	.0
SF TORQUE CONVERTER	1--0	1	1	1	1	1	1	1	0
SG TURBOCHARGER	1--0	0	0	0	0	0	0	0	0
SH EMPTY VEHICLE WEIGHT	MLBS	73.0	72.0	117.1	131.5	138.9	153.7	156.1	181.9
SI STRUCK CAPACITY - SAE	CUYD	33.30	33.30	101.00	101.00	101.00	120.00	120.00	158.00
SJ HEAPED CAPACITY	CUYD	41.00	41.00	121.00	121.00	121.00	144.00	144.00	193.00
SK SAE RATIO FOR HEAPED CAP.		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
SL RATED PAYLOAD	MLBS	100.0	100.0	170.0	200.0	240.0	240.0	260.0	300.0
SM TIRE TYPE 1A - FRONT	INT	180025	180025	240049	270049	270049	300051	300051	330051
SN TIRE TYPE 1B - FRONT	INT	2413	2413	4214	4214	4814	4614	4614	5014
SO NUMBER OF TIRES	INT	8	8	6	6	6	6	6	6
SP TIRE TYPE 2A - REAR	INT	0	0	0	0	0	0	0	0
SQ TIRE TYPE 2B - REAR	INT	0	0	0	0	0	0	0	0
SR NUMBER OF TIRES	INT	0	0	0	0	0	0	0	0
SS OVERALL LENGTH	FEET	30.30	30.30	32.75	32.75	32.75	34.75	34.75	38.75
ST OVERALL WIDTH	FEET	13.25	13.25	20.00	20.00	20.00	22.00	22.00	23.50
SU LOADING HEIGHT	FEET	11.50	11.50	17.50	17.67	17.67	18.08	18.08	19.75
SV TURNING CIRCLE	FEET	62.75	62.75	60.00	61.00	62.00	75.16	75.16	82.00
SW SPECIFICATION SHEET DATE	MMYR	473	473	874	874	874	874	874	874

FILE ID = TD

TRUCK DATA

FILE DATE = 08/19/76

		9	10	11	12	13	14	15	16
		1350	1350	UM85	UM100	UM1205	UM1207	UM30	UM33
		C050RM	D050RM	T085RE	D100RE	D120RE	D120RE	T130RE	D150RE
PERIPHERAL DATA									
PA PERFORMANCE COEFFICIENT A	COEF	-.6680E-01	-.6680E-01	-.9661	-1.257	-1.257	-1.201	-1.120	-2.344
PB PERFORMANCE COEFFICIENT B	COEF	148.6	148.6	254.1	301.0	301.0	298.4	356.3	556.9
PC PERFORMANCE MAXIMUM	MPH	32.2	32.2	37.7	31.6	31.6	33.6	32.0	33.5
PD BRAKING COEFFICIENT A	COEF	-1.433	-1.433	.0000	.0000	.0000	.0000	.0000	.0000
PE BRAKING COEFFICIENT B	COEF	181.5	181.5	526.9	533.9	533.9	529.0	623.5	444.3
PF BRAKING MAXIMUM	MPH	35.0	35.0	37.7	31.6	31.6	33.7	32.0	33.5
PG TURN, SPOT, & WAIT TIME	MIN	.60	.60	.60	.60	.60	.60	.60	.60
PH TURN AND DUMP TIME	MIN	.50	.50	.57	.60	.64	.64	.66	.70
PJ FUEL CONSUMPTION RATE	G/HR	13.44	13.44	20.40	24.00	24.00	24.00	28.80	38.40
PK NO. DRIVERS + LABOR		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
PL ESTIMATED TIRE LIFE	HOOR	5000.00	5000.00	5000.00	5000.00	5000.00	5000.00	5000.00	5000.00
PM AVERAGE TON MPH RATING		110.0	110.0	200.0	235.0	235.0	280.0	280.0	300.0
P7 DEPRECIATION LIFE	HRS	20000.0	20000.0	30000.0	30000.0	30000.0	30000.0	30000.0	30000.0
P8 AMORTIZATION	HRS	20000.0	20000.0	30000.0	30000.0	30000.0	30000.0	30000.0	30000.0
P9 OPERATING HOURS	H/Y	3262.5	3262.5	3262.5	3262.5	3262.5	3262.5	3262.5	3262.5
PN PRICE DATE	MMYR	1274	1274	0	175	0	0	0	0

OWNERSHIP & OPERATING COST DATA

CA PRICE - FOB FACTORY	M\$	185.6	185.6	295.4	323.1	329.8	345.4	397.6	437.2
CB TIRE PRICE	M\$	12.7	12.7	35.2	41.2	45.7	53.6	53.6	77.8
CC PRICE - LESS TIRES	M\$	172.9	172.9	260.2	281.8	284.2	291.8	344.0	359.4
CD OPTIONS	M\$	6.6	6.6	13.0	14.1	14.2	14.5	17.2	18.0
CE SALES TAX	M\$	11.5	11.5	18.5	20.2	20.6	21.6	24.9	27.3
CF FREIGHT COST	M\$	3.3	3.2	5.3	5.9	6.3	6.9	7.0	8.2
CG TOTAL INVESTMENT	M\$	194.4	194.3	297.0	322.0	325.3	335.0	393.1	412.8
CH AMORTIZATION	\$PHR	9.72	9.72	9.90	10.73	10.84	11.17	13.10	13.76
CI INT., TAXES, & INS.	\$PHR	4.85	4.85	7.07	7.66	7.74	7.97	9.35	9.82
CJ HOURLY OWNERSHIP COSTS	\$PHR	14.57	14.56	16.97	18.40	18.58	19.13	22.45	23.58
CK OPERATING-MAINTENANCE MAT'L	\$PHR	7.24	7.24	7.68	8.40	8.58	8.98	10.34	11.37
CR MAINTENANCE LABOR	\$PHR	4.83	4.83	5.12	5.60	5.72	5.99	6.89	7.58
CL LABOR	\$PHR	11.26	11.26	11.26	11.26	11.26	11.26	11.26	11.26
CM FUEL, OIL, & LUBES	\$PHR	5.24	5.24	7.96	9.36	9.36	9.36	11.23	14.98
CN TIRE COST	\$PHR	2.53	2.53	7.05	8.25	9.13	10.72	10.72	15.57
CO TOTAL OPERATING	\$PHR	31.09	31.09	39.06	42.86	44.04	46.30	50.43	60.74
CO TOTAL OWNERSHIP & OPERATING	\$PHR	45.66	45.66	56.03	61.26	62.62	65.44	72.89	84.32

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TRUCK DATA

FILE DATE = 08/19/76

	25	26	27	28	29	30	31	32
	W050	W050	W075B	W075B	W035CT	W035CT	W075B	W075B
	C050RM	D050RM	B065PM	E065PM	C072UM	D072UM	C075PM	D075PM

SPECIFICATION DATA

		25	26	27	28	29	30	31	32
SA ENGINE-MFG/MODEL	ENG	VT1710C	16V71N	VT1710C	16V71N	NTA855C	12V71N	VTA1710C	16V71T
SC BRAKING HORSEPOWER		635.0	635.0	635.0	635.0	420.0	475.0	700.0	700.0
SD AT RPM		2100.0	2100.0	2100.0	2100.0	2300.0	2100.0	2100.0	2100.0
SE NO. OF CYCLES		4.0	2.0	4.0	2.0	4.0	2.0	4.0	2.0
SF TORQUE CONVERTER	1--0	1	1	1	1	1	1	1	1
SG TURBOCHARGER	1--0	0	0	0	0	0	0	0	0
SH EMPTY VEHICLE WEIGHT	MLBS	75.3	75.3	85.5	85.5	78.7	78.7	91.5	91.5
SI STRUCK CAPACITY - SAE	CUYD	30.80	30.80	38.00	38.00	42.00	42.00	44.00	44.00
SJ HEAPED CAPACITY	CUYD	37.00	37.00	52.00	52.00	48.00	48.00	57.00	57.00
SK SAE RATIO FOR HEAPED CAP.		3.0	3.0	2.0	2.0	3.0	3.0	2.0	2.0
SL RATED PAYLOAD	MLBS	100.0	100.0	130.0	130.0	144.0	144.0	150.0	150.0
SM TIRE TYPE 1A - FRONT	INT	210035	210035	240035	240035	180033	180033	240035	240035
SN TIRE TYPE 1B - FRONT	INT	3214	3214	3614	3614	2413	2413	4214	4214
SO NUMBER OF TIRES	INT	6	6	6	6	6	6	6	6
SP TIRE TYPE 2A - REAR	INT	0	0	0	0	375039	375039	0	0
SQ TIRE TYPE 2B - REAR	INT	0	0	0	0	4413	4413	0	0
SR NUMBER OF TIRES	INT	0	0	0	0	2	2	0	0
SS OVERALL LENGTH	FEET	28.92	28.92	31.50	31.50	52.90	52.90	31.50	31.50
ST OVERALL WIDTH	FEET	13.42	13.42	15.67	15.67	13.50	13.50	15.67	15.67
SU LOADING HEIGHT	FEET	11.83	11.83	12.58	12.58	12.50	12.50	13.12	13.12
SV TURNING CIRCLE	FEET	58.00	58.00	69.00	69.00	63.40	63.40	69.00	69.00
SW SPECIFICATION SHEET DATE	MMYR	973	973	973	973	973	973	973	973

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FILE ID = TD

TRUCK DATA

FILE DATE = 08/19/76

	25	26	27	28	29	30	31	32
	W050	W050	W075B	W075B	W035CT	W035CT	W075B	W075B
	C050RM	D050RM	B065PM	E065PM	C072UM	D072UM	C075PM	D075PM

PERIPHERAL DATA

PA PERFORMANCE COEFFICIENT A	COEF	.0000	.0000	.0000	.6067	.0000	.2872	.3085	.3085
PB PERFORMANCE COEFFICIENT B	COEF	171.8	152.8	165.3	161.3	98.29	114.3	187.2	187.2
PC PERFORMANCE MAXIMUM	MPH	40.5	40.5	47.1	47.0	45.5	45.2	44.0	44.0
PD BRAKING COEFFICIENT A	COEF	.2117	.0000	.5497	.0000	.7975	.1984	.3246	.3246
PE BRAKING COEFFICIENT B	COEF	174.2	181.5	174.2	183.2	160.8	156.7	371.2	371.2
PF BRAKING MAXIMUM	MPH	40.0	40.0	47.2	47.0	45.0	41.0	44.6	44.6
PG TURN, SPOT, & WAIT TIME	MIN	.60	.60	.60	.60	.60	.60	.60	.60
PH TURN AND DUMP TIME	MIN	.50	.50	.53	.53	.54	.54	.55	.55
PJ FUEL CONSUMPTION RATE	G/HR	15.24	15.24	15.24	15.24	10.08	11.40	16.80	16.80
PK NO. DRIVERS + LABOR		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
PL ESTIMATED TIRE LIFE	HR	5000.00	5000.00	5000.00	5000.00	5000.00	5000.00	5000.00	5000.00
PM AVERAGE TON MPH RATING		150.0	150.0	150.0	150.0	163.7	163.7	150.0	150.0
P7 DEPRECIATION LIFE	HRS	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0
P8 AMORTIZATION	HRS	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0
P9 OPERATING HOURS	H/Y	3262.5	3262.5	7467.0	7467.0	7467.0	7467.0	7467.0	7467.0
PN PRICE DATE	MMYR	275	275	275	275	275	275	275	275

OWNERSHIP & OPERATING COST DATA

CA PRICE - FOB FACTORY	M\$	179.4	179.4	225.1	225.1	194.6	194.6	240.1	240.1
CB TIRE PRICE	M\$	20.5	20.5	25.4	25.4	26.8	26.8	28.1	28.1
CC PRICE - LESS TIRES	M\$	158.9	158.9	199.7	199.7	167.8	167.8	212.0	212.0
CD OPTIONS	M\$	9.0	9.0	11.3	11.3	8.4	8.4	12.0	12.0
CE SALES TAX	M\$	11.3	11.3	14.2	14.2	12.2	12.2	15.1	15.1
CF FREIGHT COST	M\$	3.4	3.4	3.8	3.8	3.5	3.5	4.1	4.1
CG TOTAL INVESTMENT	M\$	182.6	182.6	229.0	229.0	191.9	191.9	243.2	243.2
CH AMORTIZATION	\$PHR	9.13	9.13	11.45	11.45	9.60	9.60	12.16	12.16
CI INT., TAXES, & INS.	\$PHR	4.56	4.56	2.95	2.95	2.47	2.47	3.13	3.13
CP HOURLY OWNERSHIP COSTS	\$PHR	13.68	13.68	14.40	14.40	12.07	12.07	15.29	15.29
CJ OPERATING-MAINTENANCE MAT'L	\$PHR	7.00	7.00	8.78	8.78	7.59	7.59	9.36	9.36
CR MAINTENANCE LABOR	\$PHR	4.66	4.66	5.85	5.85	5.06	5.06	6.24	6.24
CL LABOR	\$PHR	11.26	11.26	12.73	12.73	12.73	12.73	12.73	12.73
CK FUEL, OIL, & LUBES	\$PHR	5.94	5.94	5.94	5.94	3.93	4.45	6.55	6.55
CM TIRE COST	\$PHR	4.11	4.11	5.08	5.08	5.36	5.36	5.62	5.62
CN TOTAL OPERATING	\$PHR	32.97	32.97	38.39	38.39	34.67	35.19	40.52	40.52
CO TOTAL OWNERSHIP & OPERATING	\$PHR	46.65	46.65	52.79	52.79	46.74	47.25	55.81	55.81

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TRUCK DATA

FILE DATE = 08/19/76

33	34	35	36	37	38	39	40
W075B	W075B	W075B	W075B	W085C	W085C	W085C	W085C
A075RM	C075RM	D075RM	E075RM	B085PM	C085PM	D085PM	E085PM

SPECIFICATION DATA

SA ENGINE-MFG/MODEL	ENG	VT1710C	VTA1710C	16V71T	16V71N	VTA1710C	VTA1710C	16V71T	16V71T
SC BRAKING HORSEPOWER		635.0	700.0	700.0	635.0	800.0	700.0	700.0	800.0
SD AT RPM		2100.0	2100.0	2100.0	2100.0	2100.0	2100.0	2100.0	2100.0
SE NO. OF CYCLES		4.0	4.0	2.0	2.0	4.0	4.0	2.0	2.0
SF TORQUE CONVERTER	1--0	1	1	1	1	1	1	1	1
SG TURBOCHARGER	1--0	0	0	0	0	0	0	0	0
SH EMPTY VEHICLE WEIGHT	MLBS	89.5	93.9	93.9	89.5	110.1	110.1	110.1	110.1
SI STRUCK CAPACITY - SAE	CUYD	65.00	72.00	72.00	65.00	57.00	57.00	57.00	57.00
SJ HEAPED CAPACITY	CUYD	70.00	80.00	80.00	70.00	75.00	75.00	75.00	75.00
SK SAE RATIO FOR HEAPED CAP.		3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0
SL RATED PAYLOAD	MLBS	150.0	150.0	150.0	150.0	170.0	170.0	170.0	170.0
SM TIRE TYPE 1A - FRONT	INT	240035	240035	240035	240035	240049	240049	240049	240049
SN TIRE TYPE 1B - FRONT	INT	3614	4213	4213	4214	4214	4214	4214	4214
SO NUMBER OF TIRES	INT	6	6	6	6	6	6	6	6
SP TIRE TYPE 2A - REAR	INT	0	0	0	0	0	0	0	0
SQ TIRE TYPE 2B - REAR	INT	0	0	0	0	0	0	0	0
SR NUMBER OF TIRES	INT	0	0	0	0	0	0	0	0
SS OVERALL LENGTH	FEET	30.60	30.60	30.60	31.50	35.92	35.92	35.92	35.92
ST OVERALL WIDTH	FEET	15.90	15.90	15.90	15.67	15.92	15.92	15.92	15.92
SU LOADING HEIGHT	FEET	14.60	14.58	14.58	14.60	14.58	14.58	14.58	14.58
SV TURNING CIRCLE	FEET	69.00	69.00	69.00	69.00	65.00	65.00	65.00	65.00
SW SPECIFICATION SHEET DATE	MMYR	973	973	973	973	974	973	973	973

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PERIPHERAL DATA

		33 W075B A075RM	34 W075B C075RM	35 W075B D075RM	36 W075B E075RM	37 W085C B085PM	38 W085C C085PM	39 W085C D085PM	40 W085C E085PM
PA PERFORMANCE COEFFICIENT A	COEF	-.3020E-01	-.3085	-.3085	-.6067	-.3091	-.3470	-.3470	-.3091
PB PERFORMANCE COEFFICIENT B	COEF	174.6	187.2	187.2	161.3	203.3	186.6	186.6	203.3
PC PERFORMANCE MAXIMUM	MPH	44.0	44.0	44.0	47.0	40.0	40.5	40.5	40.0
PD BRAKING COEFFICIENT A	COEF	-.3246	-.3246	-.3246	.0000	.0000	.0000	.0000	.0000
PE BRAKING COEFFICIENT B	COEF	371.2	371.2	371.2	183.2	359.0	359.0	359.0	359.0
PF BRAKING MAXIMUM	MPH	44.6	44.6	44.6	47.0	38.0	38.0	38.0	38.0
PG TURN, SPOT, & WAIT TIME	MIN	.60	.60	.60	.60	.60	.60	.60	.60
PH TURN AND DUMP TIME	MIN	.55	.55	.55	.55	.57	.57	.57	.57
PJ FUEL CONSUMPTION RATE	G/HR	15.24	16.80	16.80	15.24	19.20	16.80	16.80	19.20
PK NO. DRIVERS + LABOR		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
PL ESTIMATED TIRE LIFE	HOUR	5000.00	5000.00	5000.00	5000.00	5000.00	5000.00	5000.00	5000.00
PM AVERAGE TON MPH RATING		150.0	170.0	170.0	150.0	200.0	200.0	200.0	200.0
P7 DEPRECIATION LIFE	HRS	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0
P8 AMORTIZATION	HRS	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0
P9 OPERATING HOURS	H/Y	3262.5	3262.5	3262.5	3262.5	7467.0	7467.0	7467.0	7467.0
PN PRICE DATE	MMYR	974	974	974	0	275	275	275	275

OWNERSHIP & OPERATING COST DATA

CA PRICE - FNB FACTORY	M\$	228.9	244.1	240.3	228.9	257.3	254.0	254.0	257.3
CB TIRE PRICE	M\$	25.4	24.5	24.5	28.1	35.2	35.2	35.2	35.2
CC PRICE - LESS TIRES	M\$	203.5	219.6	215.8	200.8	222.1	218.8	218.8	222.1
CD OPTIONS	M\$	11.4	37.0	12.0	10.0	12.9	12.7	12.7	12.9
CE SALES TAX	M\$	14.4	16.9	15.1	14.3	16.2	16.0	16.0	16.2
CF FREIGHT COST	M\$	4.0	4.2	4.2	4.0	5.0	5.0	5.0	5.0
CG TOTAL INVESTMENT	M\$	233.3	277.7	247.2	229.2	256.1	252.4	252.4	256.1
CH AMORTIZATION	\$PHR	11.67	13.88	12.36	11.46	12.81	12.62	12.62	12.81
CI INT., TAXES, & INS.	\$PHR	5.82	6.93	6.17	5.72	3.30	3.25	3.25	3.30
CP HOURLY OWNERSHIP COSTS	\$PHR	17.49	20.81	18.53	17.18	16.10	15.87	15.87	16.10
CJ OPERATING-MAINTENANCE MAT'L	\$PHR	8.93	9.52	9.37	8.93	10.03	9.91	9.91	10.03
CR MAINTENANCE LABOR	\$PHR	5.95	6.35	6.25	5.95	6.69	6.60	6.60	6.69
CL LABOR	\$PHR	11.26	11.26	11.26	11.26	12.73	12.73	12.73	12.73
CK FUEL, OIL, & LUBES	\$PHR	5.94	6.55	6.55	5.94	7.49	6.55	6.55	7.49
CM TIRE COST	\$PHR	5.08	4.90	4.90	5.62	7.05	7.05	7.05	7.05
CN TOTAL OPERATING	\$PHR	37.16	38.58	38.33	37.70	43.99	42.84	42.84	43.99
CO TOTAL OWNERSHIP & OPERATING	\$PHR	54.65	59.39	56.85	54.88	60.10	58.71	58.71	60.10

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FILE ID = TD

TRUCK DATA

FILE DATE = 08/19/76

41	42	43	44	45	46	47	48
W085C	W085C	W085C	W085C	W050T	W050T	W120B	W120B
T085PM	D085RM	E085RM	T085RM	C100TM	D100TM	D120PE	E120PE

SPECIFICATION DATA

		41	42	43	44	45	46	47	48
SA ENGINE-MFG/MODEL	ENG	D348	16V71T	16V71TI	D348	VT1710C	16V71N	12V149T	12V149TI
SC BRAKING HORSEPOWER		850.0	700.0	800.0	850.0	635.0	635.0	1000.0	1200.0
SD AT RPM		2000.0	2100.0	2100.0	2000.0	2100.0	2100.0	1900.0	1900.0
SE NO. OF CYCLES		4.0	2.0	2.0	4.0	4.0	2.0	2.0	2.0
SF TORQUE CONVERTER	1--0	1	1	1	1	1	1	1	1
SG TURBOCHARGER	1--0	0	0	0	0	0	0	0	0
SH EMPTY VEHICLE WEIGHT	MLBS	110.1	114.6	114.6	114.6	120.9	120.9	173.7	173.7
SI STRUCK CAPACITY - SAE	CUYD	57.00	74.50	74.50	74.50	60.00	60.00	77.00	77.00
SJ HEAPED CAPACITY	CUYD	75.00	92.50	92.50	92.50	65.00	65.00	100.00	100.00
SK SAE RATIO FOR HEAPED CAP.		2.0	3.0	3.0	3.0	3.0	3.0	2.0	2.0
SL RATED PAYLOAD	MLBS	170.0	170.0	170.0	170.0	200.0	200.0	240.0	240.0
SM TIRE TYPE 1A - FRONT	INT	240049	240049	240049	240049	210035	210035	300051	300051
SN TIRE TYPE 1B - FRONT	INT	4214	4214	4214	4214	3213	3213	4614	4614
SO NUMBER OF TIRES	INT	6	6	6	6	6	6	6	6
SP TIRE TYPE 2A - REAR	INT	0	0	0	0	210049	210049	0	0
SQ TIRE TYPE 2B - REAR	INT	0	0	0	0	3613	3613	0	0
SR NUMBER OF TIRES	INT	0	0	0	0	4	4	0	0
SS OVERALL LENGTH	FEET	35.92	35.92	35.92	35.92	61.10	61.10	36.08	36.08
ST OVERALL WIDTH	FEET	15.92	15.90	15.90	15.90	16.70	16.70	19.17	19.17
SU LOADING HEIGHT	FEET	14.58	15.00	15.00	15.00	12.90	12.90	17.00	17.00
SV TURNING CIRCLE	FEET	65.00	65.00	65.00	65.00	60.00	60.00	80.00	80.00
SW SPECIFICATION SHEET DATE	MMYR	973	973	973	973	573	573	973	973

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FILE ID • TD

TRUCK DATA

FILE DATE = 08/19/76

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PERIPHERAL DATA

		41 W085C T085PM	42 W085C D085RM	43 W085C E085RM	44 W085C T085RM	45 W050T C100TM	46 W050T D100TM	47 W120B D120PE	48 W120B E120PE
PA PERFORMANCE COEFFICIENT A	CDEF	-.2082	-.3470	-.3091	-.2082	.0000	.0000	-.9037	-.2.663
PB PERFORMANCE COEFFICIENT B	CDEF	227.2	186.6	203.3	227.2	171.8	171.8	306.9	444.7
PC PERFORMANCE MAXIMUM	MPH	38.5	40.5	40.0	38.5	40.5	40.5	35.7	31.2
PD BRAKING COEFFICIENT A	CDEF	-.3087	.0000	.0000	-.3087	-.2117	-.2117	.0000	.0000
PE BRAKING COEFFICIENT B	CDEF	294.7	359.0	359.0	294.7	174.2	174.2	519.0	281.5
PF BRAKING MAXIMUM	MPH	38.5	38.0	38.0	38.5	40.0	40.0	35.3	31.2
PG TURN, SPOT, & WAIT TIME	MIN	.60	.60	.60	.60	1.54	1.54	.60	.60
PH TURN AND DUMP TIME	MIN	.57	.57	.57	.57	.84	.84	.64	.64
PJ FUEL CONSUMPTION RATE	G/HR	20.40	16.80	19.20	20.40	15.24	15.24	24.00	28.80
PK NO. DRIVERS + LABOR		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
PL ESTIMATED TIRE LIFE	HRUR	5000.00	5000.00	5000.00	5000.00	5000.00	5000.00	5000.00	5000.00
PM AVERAGE TON MPH RATING		200.0	200.0	200.0	200.0	179.0	179.0	280.0	280.0
P7 DEPRECIATION LIFE	HRS	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	30000.0	30000.0
P8 AMORTIZATION	HRS	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	30000.0	30000.0
P9 OPERATING HOURS	H/Y	7467.0	3262.5	3262.5	3262.5	3262.5	3262.5	7467.0	7467.0
PN PRICE DATE	MAYR	275	974	974	0	974	974	0	0

OWNERSHIP & OPERATING COST DATA

CA PRICE - FDB FACTORY	M\$	260.2	244.1	247.8	251.0	262.2	262.2	358.1	374.3
CB TIRE PRICE	M\$	35.2	35.2	35.2	35.2	34.3	34.3	53.6	53.6
CC PRICE - LESS TIRES	M\$	225.0	208.9	212.6	215.8	227.9	227.9	304.5	320.7
CD OPTIONS	M\$	13.0	12.2	12.4	12.6	9.0	9.0	17.9	18.7
CE SALES TAX	M\$	16.4	15.4	15.6	15.8	16.3	16.3	22.6	23.6
CF FREIGHT COST	M\$	5.0	5.2	5.2	5.2	5.4	5.4	7.8	7.8
CG TOTAL INVESTMENT	M\$	259.3	241.6	245.7	249.3	258.6	258.6	352.8	370.8
CH AMORTIZATION	\$PHR	12.97	12.08	12.29	12.47	12.93	12.93	11.76	12.36
CI INT., TAXES, & INS.	\$PHR	3.34	6.03	6.13	6.22	6.43	6.43	4.13	4.34
CP HOURLY OWNERSHIP COSTS	\$PHR	16.30	18.11	18.42	18.69	19.38	19.38	15.89	16.70
CJ OPERATING-MAINTENANCE MAT'L	\$PHR	10.15	9.52	9.66	9.79	10.23	10.23	9.31	9.73
CR MAINTENANCE LABOR	\$PHR	6.77	6.35	6.44	6.53	6.82	6.82	6.21	6.49
CL LABOR	\$PHR	12.73	11.26	11.26	11.26	11.26	11.26	12.73	12.73
CK FUEL, OIL, & LUBES	\$PHR	7.96	6.55	7.49	7.96	5.94	5.94	9.36	11.23
CM TIRE COST	\$PHR	7.05	7.05	7.05	7.05	6.87	6.87	10.72	10.72
CN TOTAL OPERATING	\$PHR	44.65	40.72	41.90	42.57	41.11	41.11	48.33	50.90
CO TOTAL OWNERSHIP & OPERATING	\$PHR	60.95	58.83	60.32	61.26	60.49	60.49	64.22	67.60

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FILE ID = TD

TRUCK DATA

FILE DATE = 08/19/76

	49	50	51	52	53	54	55	56
	W120B T120PE	W120B U120PE	W075B C120TM	W075B D120TM	W150CT C150TM	W170C D170PE	W170C E170PE	W3200 D200PE
SPECIFICATION DATA								
SA ENGINE=MFG/MODEL	ENG	D348	D349	VTA1710C	16V71T	12V149T	16V149T	16V149T
SC BRAKING HORSEPOWER		990.0	1200.0	700.0	700.0	1000.0	1600.0	1325.0
SD AT RPM=		2000.0	2000.0	2100.0	2100.0	1900.0	1900.0	1900.0
SE NO. OF CYCLES		4.0	4.0	4.0	2.0	2.0	2.0	2.0
SF TORQUE CONVERTER	1-70	1	1	1	1	1	0	0
SG TURBOCHARGER	1-70	0	0	0	0	0	0	0
SH EMPTY VEHICLE WEIGHT	MLBS	173.7	173.7	128.8	128.8	175.0	220.0	220.0
SI STRUCK CAPACITY - SAE	CUYD	77.00	77.00	133.00	133.00	170.00	79.00	79.00
SJ HEAPED CAPACITY	CUYD	100.00	100.00	150.00	150.00	194.00	117.00	117.00
SK SAE RATIO FOR HEAPED CAP.		2.0	2.0	3.0	3.0	3.0	2.0	2.0
SL RATED PAYLOAD	MLBS	240.0	240.0	240.0	240.0	300.0	340.0	340.0
SM TIRE TYPE 1A - FRONT	INT	300051	300051	240035	240035	270049	360051	360051
SN TIRE TYPE 1B - FRONT	INT	4614	4614	4214	4214	4214	5014	5014
SO NUMBER OF TIRES	INT	6	6	6	6	10	6	6
SP TIRE TYPE 2A - REAR	INT	0	0	240049	240049	0	0	0
SQ TIRE TYPE 2B - REAR	INT	0	0	4214	4214	0	0	0
SR NUMBER OF TIRES	INT	0	0	4	4	0	0	0
SS OVERALL LENGTH	FEET	36.08	36.08	65.17	65.17	74.58	39.00	39.00
ST OVERALL WIDTH	FEET	19.17	19.17	15.92	15.92	16.67	21.67	21.67
SU LOADING HEIGHT	FEET	17.00	17.00	14.92	14.92	15.50	16.33	16.33
SV TURNING CIRCLE	FEET	80.00	80.00	90.00	90.00	80.00	81.00	81.00
SW SPECIFICATION SHEET DATE	MMYR	973	973	474	474	1174	774	774

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FILE ID = TD

TRUCK DATA

FILE DATE = 08/19/76

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PERIPHERAL DATA

		49 W120B T120PE	50 W120B U120PE	51 W075B G120TM	52 W075B D120TM	53 W150CT C150TM	54 W170C D170PE	55 W170C E170PE	56 W3200 D200PE
PA PERFORMANCE COEFFICIENT A	CNEF	-1.754	-2.704	-1.4384	-1.4384	5.516	-1.485	-1.342	-1.8738
PB PERFORMANCE COEFFICIENT B	CNEF	345.7	420.2	183.6	183.6	155.7	491.4	409.3	602.0
PC PERFORMANCE MAXIMUM	MPH	35.2	35.0	43.7	43.7	46.0	33.3	33.1	25.2
PD BRAKING COEFFICIENT A	CNEF	.0000	.0000	-1.2188	-1.2188	.1300E-01	.0000	.0000	.0000
PE BRAKING COEFFICIENT B	CNEF	564.3	564.3	462.1	462.1	446.6	437.9	437.9	1168.
PF BRAKING MAXIMUM	MPH	35.4	35.4	43.7	43.7	43.0	33.3	33.3	25.4
PG TURN, SPOT, & WAIT TIME	MIN	.60	.60	1.69	1.69	1.91	.60	.60	.60
PH TURN AND DUMP TIME	MIN	.64	.64	.93	.93	1.07	.74	.74	.80
PJ FUEL CONSUMPTION RATE	G/HR	23.76	28.80	16.80	16.80	24.00	38.40	31.80	48.00
PK NO. DRIVERS + LABOR		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
PL ESTIMATED TIRE LIFE	HOUR	5000.00	5000.00	5000.00	5000.00	5000.00	5000.00	5000.00	3000.00
PM AVERAGE TON MPH RATING		280.0	280.0	170.0	170.0	235.0	360.0	360.0	360.0
PY DEPRECIATION LIFE	HRS	30000.0	30000.0	20000.0	20000.0	20000.0	30000.0	30000.0	40000.0
P8 AMORTIZATION	HRS	30000.0	30000.0	20000.0	20000.0	20000.0	30000.0	30000.0	40000.0
P9 OPERATING HOURS	H/Y	7467.0	7467.0	3262.5	3262.5	3262.5	7467.0	7467.0	7467.0
PN PRICE DATE	MMYR	0	0	773	0	0	974	974	0

OWNERSHIP & OPERATING COST DATA

CA PRICE - FOB FACTORY	M\$	358.1	367.1	262.8	262.8	317.6	486.3	479.8	854.3
CB TIRE PRICE	M\$	53.6	53.6	51.6	51.6	68.7	95.3	95.3	138.7
CC PRICE - LESS TIRES	M\$	304.5	313.5	211.2	211.2	248.9	391.0	384.5	715.6
CD OPTIONS	M\$	17.9	18.4	13.1	13.1	15.9	24.3	24.0	42.7
CE SALES TAX	M\$	22.6	23.1	16.6	16.6	20.0	30.6	30.2	53.8
CF FREIGHT COST	M\$	7.8	7.8	5.8	5.8	7.9	9.9	9.9	14.7
CG TOTAL INVESTMENT	M\$	352.8	362.9	246.6	246.6	292.6	455.8	448.6	826.9
CH AMORTIZATION	\$PHR	11.76	12.10	12.33	12.33	14.63	15.19	14.95	20.67
CI INT., TAXES, & INS.	\$PHR	4.13	4.25	6.16	6.16	7.30	5.34	5.25	9.20
CJ HOURLY OWNERSHIP COSTS	\$PHR	15.89	16.34	18.49	18.49	21.94	20.53	20.21	29.87
CK OPERATING-MAINTENANCE MAT'L	\$PHR	9.31	9.54	10.25	10.25	12.39	12.64	12.47	16.66
CL MAINTENANCE LABOR	\$PHR	6.21	6.36	6.83	6.83	8.26	8.43	8.32	11.11
CM LABOR	\$PHR	12.73	12.73	11.26	11.26	11.26	12.73	12.73	12.73
CN FUEL, OIL, & LUBES	\$PHR	9.27	11.23	6.55	6.55	9.36	14.98	12.40	18.72
CO TIRE COST	\$PHR	10.72	10.72	10.32	10.32	13.75	19.07	19.07	46.23
CN TOTAL OPERATING	\$PHR	48.24	50.59	45.21	45.21	55.01	67.85	64.99	105.45
CO TOTAL OWNERSHIP & OPERATING	\$PHR	64.13	66.93	63.70	63.70	76.94	88.38	85.20	135.32

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PART 8
MINING EQUIPMENT
DATA FILE PROGRAMS
(MEDFP)

30 December 1974

PART 8
MEDFP USER'S MANUAL
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User's
Manual
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SECTION 1
INTRODUCTION

1.1 GENERAL

The Mining Equipment Data File Programs (MEDFP) are designed to create and print data files for several different classes of mining equipment, e.g., trucks, drills, shovels, dozer, scrapers, and so on. The full set of programs consists of the following:

1) Generalized File Creation Program

This program reads data cards prepared by the mining engineer and creates a file containing a single record for each piece of equipment. This single program is designed to handle all classes of equipment. It is controlled by control and data cards prepared by the engineer. By completing these cards, the engineer can define the contents of each file to fit the equipment contained in the file.

2) Specialized Calculation Programs

One program is designed to handle the Truck Data File. Another program handles other classes of equipment.

3) Generalized Printing Program

This program reads the completed data files and prints the information in the form of a data book. The format of the data book is the same for all classes, even though the information content in each book is to be unique.

1.2 USER/PROGRAMMER INTERACTION

The MEDFP have been designed to permit the user to exercise considerable control over the data file content and, to a limited extent, the format of the files. However, some limits have been placed on this flexibility. As the number of equipment classes and/or the number of users increases, one or more of these limitations may become burdensome. The design intent is that the programs will be modified whenever this occurs.

Some presently imposed limits are "soft" limits, i.e., program modifications are expected and have been provided for. These limits are described in the appropriate portions of this manual.

SECTION 2
CREATING A DATA FILE

2.1 DATA FILE ORGANIZATION

The general organization of the data files is the same for all classes of equipment. The files differ only in information content. Physically, the file consists of a series of records, with one record for each equipment model. This record consists of a series of words (the physical storage unit of the computer), with one word for each data item. A data item describes some aspect of the equipment, and include such categories as model identification, physical dimensions, cost elements, and operating statistics.

Logically, the file is organized into three tables. A table is a columnar arrangement of data, consisting of rows (one row for each data or line item) and columns (one column for each model). For the engineer, setting up a file is analogous to filling in a columnar pad.

One generally follows three steps in setting up a columnar pad to contain a table of information:

- 1) Along the left margin, write appropriate descriptions of the expected contents of each line or row of the pad. These are the line-item identifiers and text.
- 2) Along the top of the pad, write the column headings; these are the column identifiers.
- 3) Write the information to be displayed into the proper row and column intersections.

This same sequence is followed in setting up the data files.

The user is provided with three card forms for setting up the data file. These card forms are as follows:

1) Line Item Text (LIT)

This form is used to define the line-item content of the three tables. With this form, the user (in effect) sets up the row description of the columnar pad.

2) Equipment Model Identification (EMID)

This form is used to enter the identification for each column in the table, i.e., for each equipment model that will be included in the data file. In effect, the user is defining the column headings on the columnar pad.

3) Data Entry (DE)

This form is used to enter the actual data. In effect, the user is filling in the body of the columnar pad.

The formats and rules for completing these card forms are described in paragraphs 2.3 through 2.5.

2.2 DATA TABLES

Each of the three data tables are referred to, by the user and the program, with a one-character identifier. These identifiers are:

- S - Specification Table

This table contains the physical specifications of the equipment. Data entered into this table include the information normally supplied on vendor specification sheets. In addition, the table may contain information that is calculated by the data file programs.

- P - Peripheral Table

This table contains additional peripheral or ancillary information. It includes a miscellaneous set of data, since it contains all information needed to complete the other two tables. For example, the fuel consumption rate needed to compute the operating costs for vehicles would be included in this table.

- C - Cost Tables

This table includes all ownership and operating cost elements. The entries include data supplied by vendors and/or costs calculated by the data file programs.

Within each table, all lines are identified with a one-character identifier. These identifiers are defined by the user when he completes the LIT form. The user may define the line identifiers by using any letter (A-Z) or single-digit number (0-9).

The combination of table and line identifiers into a two-character code results in a unique identifier for each line within the three tables. For example, SA refers to the 'A' line within the S table, PA refers to the 'A' line within the P table, CA refers to the 'A' line in the C table, SB refers to the 'B' line within the S table, and so on. This two-character code is referred to as the Table-Line ID (TLID) hereafter in this manual.

2.3 LINE ITEM TEXT (LIT) FORM

The LIT form is shown in Figure 2-1. Instructions for completing this form are summarized in Table 1. Figure 2-2 is a listing of the cards from the LIT form for the truck data file. It illustrates the way the form may be completed. The following paragraphs amplify some aspects of the form and the instructions.

The form is used to set up the line (or row) structure of the three data tables, and to enter the descriptive text that will be printed in the data book.

The user has complete freedom in designing the row structure of the three tables. The order in which the lines within the tables are printed in the data book will be the order in which the lines are defined on the LIT form.

The TLID from the form is used by the engineer and the programs as the identifier for the data entries, as explained in paragraph 2.5.

The descriptive text field is printed in the data book exactly as written on the forms. The engineer should include any desired spacing, abbreviations, and punctuation.

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PREPARED BY _____ PROJECT _____

DATE _____ PAGE _____ OF _____

	Eq. Type Id		TL Id		Descriptive Text										Units Code										
	1	2	5	6	7	10	15	20	25	30	35	40	45	50	55	60	65	70	72	73	75	80			
1																									
2																									
3																									
4																									
5																									
6																									
7																									
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Bonner & Moore Associates, Inc.

Figure 2-1. Line Item Text (LIT) Form

TABLE 1

INSTRUCTIONS FOR ENTRIES ON THE LIT FORM

Card Column(s)	Entry
1	'T' (identifies the card type)
2	Blank
3-4	Equipment-type identifier. The two-character code identifies the file
5	Blank
6-7	Text-Line identifier: the first character of this identifier must be C, P, or S; the second may any letter (A-Z) or number (0-9)
8	Blank
9-39	Text describing data to be entered in this line of the table
40	Blank
41-44	Units code. This four-character code must be one of the codes approved for this data file. Refer to the appropriate data book manual for this information.
45-80	Not used by the program. May contain user notes or remain blank.

T TD SA	ENGINE-MFG/MODEL PART A	ENG
T TD SC	BRAKING HORSEPOWER	
T TD SD	AT RPM-	
T TD SE	NO. OF CYCLES	
T TD SF	TORQUE CONVERTER	1--0
T TD SG	TURBOCHARGER	1--0
T TD SH	EMPTY VEHICLE WEIGHT	MLBS
T TD SI	STRUCK CAPACITY - SAE	CUYD
T TD SJ	HEAPED CAPACITY	CUYD
T TD SK	SAE RATIO FOR HEAPED CAP.	
T TD SL	RATED PAYLOAD	MLBS
T TD SM	TIRE TYPE 1A - FRONT	INT
T TD SN	TIRE TYPE 1B - FRONT	INT
T TD SO	NUMBER OF TIRES	INT
T TD SP	TIRE TYPE 2A - REAR	INT
T TD SQ	TIRE TYPE 2B - REAR	INT
T TD SR	NUMBER OF TIRES	INT
T TD SS	OVERALL LENGTH	FEET
T TD ST	OVERALL WIDTH	FEET
T TD SU	LOADING HEIGHT	FEET
T TD SV	TURNING RADIUS	FEET
T TD SW	SPECIFICATION SHEET DATE	MMYR
T TD PA	BRAKING COEFFICIENT A	COEF
T TD PB	BRAKING COEFFICIENT B	COEF
T TD PC	BRAKING MAXIMUM	MPH
T TD PD	PERFORMANCE COEFFICIENT A	COEF
T TD PE	PERFORMANCE COEFFICIENT B	COEF
T TD PF	PERFORMANCE MAXIMUM	MPH
T TD PG	TURN, SPOT, & WAIT TIME	MIN
T TD PH	TURN AND DUMP TIME	MIN
T TD PI	MAINTENANCE LABOR FACT	PCT
T TD PJ	FUEL CONSUMPTION RATE	G/HR
T TD PK	NO. DRIVERS + LABOR	
T TD PL	AVERAGE TIRE LIFE	HOURL
T TD PM	AVERAGE TON MPH RATING	
T TD CA	OWNERSHIP-PRICE - FOB FACTORY	M\$
T TD CB	TIRE PRICE	M\$
T TD CC	PRICE - LESS TIRES	M\$
T TD CD	OPTIONS	M\$
T TD CE	SALES TAX	M\$
T TD CF	FREIGHT COST	M\$
T TD CG	TOTAL INVESTMENT	M\$
T TD CH	DEPRECIATION	\$PHR
T TD CI	INT., TAXES, & INS.	\$PHR
T TD CP	HOURLY OWNERSHIP COSTS	\$PHR
T TD CJ	OPERATING-MAINTENANCE MAT'L	\$PHR
T TD CR	MAINTENANCE LABOR	\$PHR
T TD CK	FUEL, OIL, & LUBES	\$PHR
T TD CL	LABOR	\$PHR
T TD CM	TIRE COST	\$PHR
T TD CN	TOTAL OPERATING	\$PHR
T TD CO	TOTAL OWNERSHIP & OPERATING	\$PHR

Figure 2-2. Sample of LIT Form Listing for Truck Data File

The units code field is used by the programs to control data entry and data book printing. Therefore, the entry in this field must conform to one of the codes defined in the Truck Data File User's Manual.

2.4 EQUIPMENT MODEL IDENTIFICATION (EMID) FORM

The EMID form is shown in Figure 2-3. Instructions for completing the form are summarized in Table 2. Figure 2-4 is a listing of cards from the EMID form for the truck data file.

The user has complete freedom in the 12-character code used for model identification. He may use any desired coding system that will enable him to define a unique code for each model to be included in the data file. However, conventions will be set up for each file so that the print program will print the code in a readable format.

The description field on this form is for user assistance. The program does not read this field. However, when the cards are listed (as in Figure 2.4), the description field will assist the user to interpret the model code.

TABLE 2

INSTRUCTIONS FOR ENTRIES ON THE EMID FORM

Card Column(s)	Entry
1	'E' (identifies the card type)
2	Blank
3-4	Equipment type identifier. The code must be the same as in the LIT forms for this file.
5	Blank
6-17	Equipment model identification. The conventions for this code will follow an agreed-upon convention.
18-20	Blank
21-80	Description. The user should fill in this area to assist in reading the model code.

E TD E100CHC100T	EUCLID COAL HAUL TRAILER WITH CUMMINS ENGINE -100T
E TD E120CHC120T	EUCLID COAL HAUL TRAILER WITH CUMMINS ENGINE -120T
E TD 1330 1036R	INT HARVESTER REAR DUMP WITH IH ENGINE - 36T CAP
E TD 1340 1040R	INT HARVESTER REAR DUMP WITH IH ENGINE - 40T CAP
E TD 1350 C050R	INT HARVESTER REAR DUMP WITH CUMMINS ENG. -50T CAP
E TD 1350 D050R	INT HARVESTER REAR DUMP WITH DET DIESEL ENG.-50T CAP
E TD M120BDC110T	MACK B.D. COAL TRAILER WITH CUMMINS ENG.-110T CAP
E TD U180BDR180T	UNIT RIG COAL B.D. TRAILER WITH RELIANCE ENG - 180T
E TD U18CBDR180U	UNIT RIG ROCK B.D. TRAILER WITH RELIANCE ENG - 180T
E TD W035C C035R	WABCO REAR DUMP COAL TRUCK WITH CUMMINS ENG - 35T
E TD W035C D035R	WABCO REAR DUMP COAL TRUCK WITH DET DIESEL ENG-35T
E TD W050 C050R	WABCO REAR DUMP COAL TRUCK WITH CUMMINS ENG - 50T
E TD W050 D050R	WABCO REAR DUMP COAL TRUCK WITH DET DIESEL ENG-50T
E TD W075B B065P	WABCO REAR DUMP ROCK TRUCK WITH CUMMINS ENG -65T
E TD W075B E065P	WABCO REAR DUMP ROCK TRUCK WITH DET DIESEL ENG-65T
E TD W075B C075P	WABCO REAR DUMP ROCK TRUCK WITH CUMMINS ENG -75T
E TD W075B D075P	WABCO REAR DUMP ROCK TRUCK WITH DET DIESEL ENG-75T
E TD W075B C120T	WABCO BOT. DUMP COAL TRAIL WITH CUMMINS ENG. -120T
E TD W075B D120T	WABCO BOT. DUMP COAL TRAIL WITH DET DIESEL ENG-120T
E TD W075B C120U	WABCO BOT. DUMP ROCK TRAIL WITH CUMMINS ENG -120T
E TD W075B G120U	WABCO BOT. DUMP ROCK TRAIL WITH G.M. ENG -120T
E TD W085C B085P	WABCO REAR DUMP ROCK TRUCK WITH CUMMINS ENG -85T
E TD W085C C085P	WABCO REAR DUMP ROCK TRUCK WITH CUMMINS ENG -85T
E TD W085C D085P	WABCO REAR DUMP ROCK TRUCK WITH DET DIESEL ENG-85T
E TD W085C E085P	WABCO REAR DUMP ROCK TRUCK WITH DET DIESEL ENG-85T
E TD W085C T085P	WABCO REAR DUMP ROCK TRUCK WITH CATERPILAR ENG-85T
E TD W120B D120P	WABCO REAR DUMP ROCK TRUCK WITH DET DIESEL ENG-120T
E TD W120B E120P	WABCO REAR DUMP ROCK TRUCK WITH DET DIESEL ENG-120T
E TD W120B T120P	WABCO REAR DUMP ROCK TRUCK WITH CATERPILAR ENG-120T
E TD W120B U120P	WABCO REAR DUMP ROCK TRUCK WITH CATERPILAR ENG-120T
E TD W150CTC150T	WABCO BOT. DUMP COAL TRAIL WITH CUMMINS ENG -150T
E TD W150CTD150T	WABCO BOT. DUMP COAL TRIAL WITH DET DIESEL ENG-150T
E TD W150CTT150T	WABCO BOT. DUMP COAL TRIAL WITH CATERPILAR ENG-150T
E TD W150CWD130P	WABCO REAR DUMP ROCK TRUCK WITH DET DIESEL ENG-130T
E TD W150CWE130P	WABCO REAR DUMP ROCK TRUCK WITH DET DIESEL ENG-130T
E TD W150CWT130P	WABCO REAR DUMP ROCK TRUCK WITH CATERPILAR ENG-130T
E TD W150CWF150P	WABCO REAR DUMP ROCK TRUCK WITH DET DIESEL ENG-150T
E TD W1700 D170P	WABCO REAR DUMP ROCK TRUCK WITH DET DIESEL ENG-170T
E TD W1700 E170P	WABCO REAR DUMP ROCK TRUCK WITH DET DIESEL ENG-170T
E TD W3200 D200P	WABCO REAR DUMP ROCK TRUCK WITH DET DIESEL ENG-200T

Figure 2-4. Sample of EMID Form Listing
for Truck Data File

2.5 DATA ENTRY (DE) FORM

The DE form is shown in Figure 2-5. Instructions for completing the form are summarized in Table 3. Figure 2-6 is a listing of cards from the DE form for the truck data file.

In some of the data files, the various models will have many of the same data elements. Since entering each element would involve extra work, a facility is provided to instruct the program to use the data already entered into another model. This facility is invoked with the "E" in column 2 of the card. On this card, the user enters a second model identifier in columns 21-32. When the card is processed, the program retrieves the data record referred to by this second identifier, and copies the data into the record for the model specified in the model identification field. Therefore, the user must enter all common data into the referenced model before referring to it with an "E" card.

The card has six data fields, and any or all of these fields can be used to enter data. Each field consists of two columns for TLID and eight columns for the data entry. The TLID in the field indicates into which row of the data tables this entry goes.

The eight columns for the datum in the data field may or may not include a decimal point. If the decimal point is not written, the program assumes it to follow the last column of the field. To enter a decimal fraction, the user writes the decimal point in the proper position.

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PREPARED BY _____ PROJECT _____ DATE _____ PAGE _____ OF _____

Equipment Model Id		TL Id	Datum	TL Id	Datum	TL Id	Datum	TL Id	Datum	TL Id	Datum	TL Id	Datum	TL Id	Datum
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1															
2															
3															
4															
5															
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Figure 2-5. Data Entry (DE) Form

TABLE 3

INSTRUCTIONS FOR ENTRIES ON THE DE FORM

Card Column(s)	Entry
1	'D' (identifies the card type)
2	Blank or the letter "E". "E" is used to refer to a previously completed data record. (Refer to the text for an explanation.)
3-4	Equipment type identifier. Must be the same code as in the LIT forms for this file.
5	Blank
6-17	Equipment model identification. Must be the same as in the EMID form for this file.
18-20	Blank
21-80	Depends upon the entry in column 2. If column 2 is blank:
21-30 31-40 41-50 51-60 61-70 71-80	Six 10-column data fields, where columns 1-2 contain a TLID, and columns 3-10 contain a data entry.
	If column 2 is an 'E':
21-32	The model identifier of a "base" model. (Refer to the text for an explanation.)
33-80	Not used.

D TD 1350 C050R	SA VT1710CSE	4SF	1SH	72.8		
D TD M120BDC110T	SAVTA1710CSC	700SD	2100SE	4SF	1SG	1
D TD M120BDC110T	SH 115.0SI	120SL	220SM	240035SN	3613SO	10
D TD M120BDC110T	SS 59.7ST	14.5SU	13.SW	1174		
D TD A350PWD100U	SA16V71N60SC	560SD	2100SE	2SF	1	
D TD A350PWD100U	SH 120.85SI	60SJ	67SK	3SL	200	
D TD A350PWD100U	SM 180025SN	2413SO	8SP	210049SG	3613SR	4
D TD A350PWD100U	SS 62.67ST	16.75SU	12.92SW	1174		
DETD A350PWC100U	A350PWD100U					
D TD A350PWC100U	SA VT17100SC	56CSD	2100SE	4SF	1SH	121.85
D TD A350PHD100T	SA16V71N60SC	560SD	2100SE	2SF	1	
D TD A350PHD100T	SH 125.665SI	123SJ	136SK	3SL	200	
D TD A350PHD100T	SM 180025SN	2413SO	8SP	210049SG	3613SR	4
D TD A350PHD100T	SS 64.5ST	13.5SU	13.04SW	1174		
DETD A350PHC100T	A350PHD100T					
D TD A350PHC100T	SA VT1710CSC	56CSD	2100SE	4SF	1SH	126.665
D TD U180BDR180T	SAU101W100SC	1200				
D TD U180BDR180T	SH 232.3SI	204SJ	246SK	2SL	360	
D TD U180BDR180T	SM 300051SN	4614SO	10			
D TD U180BDR180T	SS 78.23ST	20.5SU	16.0SW	1174		
DETD U180BDR180U	U180BDR180T					
D TD U180BDR180U	SI 120SJ	150SK	2			
D TD W035C C035R	SA NTA855CSC	450SD	2300SE	4SE	1	
D TD W035C C035R	SH 58.36SI	23SJ	27SK	3SL	70	
D TD W035C C035R	SM 180033SN	2413SO	6			
D TD W035C C035R	SS 25.33ST	12.42SU	11.SV	49.SW	1174	
DETD W035C D035R	W035C C035R					
D TD W035C D035R	SA 12V71NSC	434SD	2100SE	2SF	1	
D TD W050 C050R	SA VT1710CSC	635SD	2100SE	4SF	1	

Figure 2-6. Sample of DE Form Listing
for Truck Data File

PART 9

COAL PREPARATION PLANT DESIGN

The following sections are reprinted for reference from Volume 4 of the Phase I Report entitled "Large-Scale Coal Processing for Coal Conversion" (ref: Report No. 1520-4). Plate references are not included in this reprint, but can be found in the Volume 4 report.

- 4.3 Coal Preparation Plant Design
- 4.4 Raw Coal Receiving and Breaking
- 4.5 Blending and Stockpiling
- 4.6 Crushing and Screening Plant
- 4.7 Baum Jig Plant
- 4.8 Heavy Media Plant
- 4.9 Prepared Coal Loadout
- 4.10 Support Facilities

PART 9

4.3 COAL PREPARATION PLANT DESIGN

4.3.1 DESIGN OF THREE HYPOTHETICAL PLANTS

In an actual situation, the coal preparation plant is designed based on detailed knowledge of the properties of the run-of-mine coal (plant input) and the feedstock specifications of the prepared coal (plant output). For the generalized or hypothetical situation, neither coal properties nor the feed stock specifications are known.

Therefore, to provide three alternatives which would indicate the relative cost of hypothetical coal preparation approaches that might be considered in the future, the following plants have been examined:

- a. Crushing and screening plant
- b. Baum jig plant
- c. Heavy media plant.

These plants have been designed based on assumed properties for the incoming coal. A coal that requires slight preparation effort was chosen as the basis for a crushing and screening plant, and a coal that requires a moderate preparation effort was chosen as the basis for a Baum jig plant. Similarly, a coal that requires a great preparation effort was chosen as the basis for design of a plant requiring two-stage heavy media separation and flotation.

For each of the three hypothetical plants being studied, the following general specifications and costs have been estimated:

- a. Capital cost
- b. Yield factor =
$$\frac{(\text{tons output of prepared coal})}{(\text{tons input of run-of-mine coal})}$$
- c. Rated capacity.

Cost extrapolation factors have been developed to be used to establish preparation plant costs as shown in the following formula:

$$\text{Cost nonstandard plant} = \left[\frac{\text{Rated Production nonstandard}}{\text{Rated Production standard plant}} \right]^Y \times \text{Cost standard plant}$$

Where:

Y = plant cost scaling factor.

Support facilities may be required in addition to the preparation plant:

- a. Raw coal receiving and breaking
- b. Blending and stockpiling
- c. Prepared coal loadout
- d. Support facilities.

Capital costs have been estimated for hypothetical designs of each of the additional facilities.

The estimated costs are hypothetical and would vary widely in actual situations. Many alternate process steps, such as grinding, briquetting, thermal drying, etc., that may be required to feed a specific conversion process are not included in the general hypothetical plant designs.

Any one of the hypothetical plants can be combined with one or more of the required additional support facilities to form a complete preparation unit to provide coal for conversion into synthetic fuels. In order to adjust for different production rates, factoring formulas are available for each of the three plants or four facilities. However, due to the different assumptions used in the development of the plants and facilities, the probability of an actual situation matching a theoretical combination is very low; and therefore, any final results should be tempered with great caution.

4.3.2 DESIGN CRITERIA

The following criteria have been used for sizing the three hypothetical plants:

- a. The flowsheets for the three hypothetical plants are based on assumed raw coal properties and prepared coal properties representative of the preparation process. Additional operations not shown on the flowsheets might be required to meet the specifications of a specific conversion process.

- b. The objective of the mining complex is to supply a fixed total Btu quantity, i.e., tonnage times Btu/lb.
- c. The standard plants are sized to handle a production of 75,000 tons per day of run-of-mine coal delivered to the incoming stockpile for 250 operating days per year.
- d. The plant site area is level, and earthwork regarding cuts and fills is not considered.
- e. Electric power is supplied from outside sources at a main distribution substation at the required voltage.
- f. Water, such as makeup water for the wet coal processing plant and fire prevention water, is available in a fresh water pond.
- g. The mines operate on a two-shift-per-day, five-day-per-week basis. Run-of-mine coal is delivered to the run-of-mine hopper at a maximum rate of 6,000 tons per hour (tph). The mines are capable of producing and delivering a minimum of 75,000 tons of coal per day.
- h. The wet processing plants are assumed to operate on a three-shift-per-day, five-day-per-week basis. Raw coal will be delivered to the processing plant at a maximum rate of 4000 tph. The plants will be capable of treating a minimum of 75,000 tons of coal per day.

The assumed characteristics of the raw coals treated and the prepared coals produced from the three plants are summarized in Table 2.

4.3.3 CONVERSION PLANT FEEDSTOCK SPECIFICATIONS

Conversion plant feedstock specifications are defined by the conversion process selected. These specifications and the quality of coal mined determine the preparation method. All current plans indicate the use of conventional mechanical equipment for preparation. Selection should be based on a balance between capital investment and coal utilization. Equipment selected will differ from that used in conventional coal preparation plants because the particle size distribution (size consist) must be controlled closely for maximum economy. This objective also requires close coordination between mine and plant for optimum accomplishment.

TABLE 2. PLANT CHARACTERISTICS

HYPOTHETICAL CRUSHING AND SCREENING PLANT

	RAW COAL*	PREPARED COAL	TONS REMOVED
Tonnage per day			
Total	75,000	74,250	
Ash	13,950 (18.6%)	13,360 (18.4%)	290
Sulfur	1,130 (1.51%)	1,110 (1.50%)	20
Heat Value			
Btu/lb	10,990	11,030	
Btu/day	$1,648 \times 10^9$	$1,638 \times 10^9$	

HYPOTHETICAL BAUM JIG PLANT

	RAW COAL*	PREPARED COAL	TONS REMOVED
Tonnage per day			
Total	75,000	61,875	
Ash	10,350 (13.8%)	4,890 (7.9%)	5,460
Sulfur	1,065 (1.42%)	375 (.61%)	690
Heat value			
Btu/lb	12,760	13,236	
Btu/day	$1,914 \times 10^9$	$1,638 \times 10^9$	

HYPOTHETICAL HEAVY MEDIA PLANT

	RAW COAL*	PREPARED COAL	TONS REMOVED
Tonnage per day			
Total	75,000	59,025	
Ash	10,875 (14.5%)	5,015 (8.5%)	5,860
Sulfur	1,120 (1.49%)	420 (.71%)	700
Heat value			
Btu/lb	13,084	13,870	
Btu/day	$1,963 \times 10^9$	$1,638 \times 10^9$	

*Raw coal characteristics are different for each plant and represent progressively more difficult preparation efforts required. See the detailed raw coal characteristics in the plant description sections.

Control of Size Consist

Coal preparation is necessary to insure that the required size of material is delivered to the conversion plant. Each general type of conversion process, i.e., fixed bed, fluid bed, and entrained bed reactor, has its own size consist requirements. Fixed bed reactors require a sized coal, essentially 1-1/2 inch x 1/8 inch. This size range is tightly controlled to achieve maximum gasifier output with minimum process difficulties from fine coal carry-over in the gas stream. The fluid bed reactors require fine coal, essentially 1/4 inch x 0 in size. Entrained bed reactors require pulverized coal.

Potential Benefits of Coal Beneficiation

Three main benefits of coal beneficiation can be:

- a. An increase in Btu content per unit weight of the coal, therefore increasing the gas yield per unit weight of the coal. Conversely, to maintain a constant gas output, the input of coal would be reduced as well as the materials handling process.
- b. The reduction in the ash content of the coal. The ash content of the coal is an inert material from which no synthetic natural gas will be yielded. Therefore, this material must be handled through the conversion process with no benefit. The materials handling system for the feed coal to the conversion plant could be decreased if ash were removed prior to conversion.

The thermal efficiency of the conversion process would be increased as the ash content is reduced because the inert materials draw considerable heat from the thermodynamically balanced reaction. This requires more air for the exothermic part of the reaction to bring about an equilibrium state again. This situation has the effect of giving a leaner end product due to nitrogen dilution.

As the ash content of the coal increases, the size and costs involved with ash handling system from the conversion process also increases. This handling system normally includes quenching, screening, cycloning, thickening, and producing a wet ash product for disposal.

Disposal problems may be encountered due to the size distribution of the ash and ash dump instability compared with a coal preparation plant refuse.

- c. The reduction of sulfur. The sulfur contained in coal is converted during the conversion process to hydrogen sulfide, which has to be stripped from the product. The stripper must be regenerated, which releases an H_2S -rich gas stream that can be converted to elemental sulfur by further processing. The capital and operating costs of this system would increase with increase in sulfur content of the coal. The economics of the removal system depend also on the traditionally fluctuating market for elemental sulfur.

In summary, the overall costs involved in coal conversion can be affected greatly by the characteristics of the feedstock supplied to the conversion complex. Therefore, an economic analysis should be performed, and the overall economic optimum process, including coal mining, preparation, transportation and conversion can be determined. The results of such an economic analysis would yield data of the type shown in Figure 1. In generalized terms, as the costs of coal beneficiation increase, the costs of conversion decrease. There is an optimum point where the total costs of the conversion and beneficiation are at a minimum, and this point will determine the economic optimum degree of coal preparation. In addition, coal preparation will deliver a product of greater uniformity which will benefit the economics of conversion as well.

4.4 RAW COAL RECEIVING AND BREAKING

For this study the run-of-mine or raw coal receiving and breaking requirements will be assumed common to all three plants. The receiving and breaking of a plant is designed to handle 75,000 tons per day over a 16-hour period with a forecast availability of 95 percent. This would enable the majority of coal mining to be performed during daylight hours, which would provide for a corresponding reduction in dilution of the coal. Because a plant of this size would have to be designed with flexibility, it was decided to utilize six 1,000-ton-per-hour streams, which allows preventative maintenance shutdowns one line at a time.

The general arrangement of the raw coal receiving and breaking facilities is shown on Plate 300-05. The raw coal receiving and breaking equipment is shown in Figure 2 and Table 3.

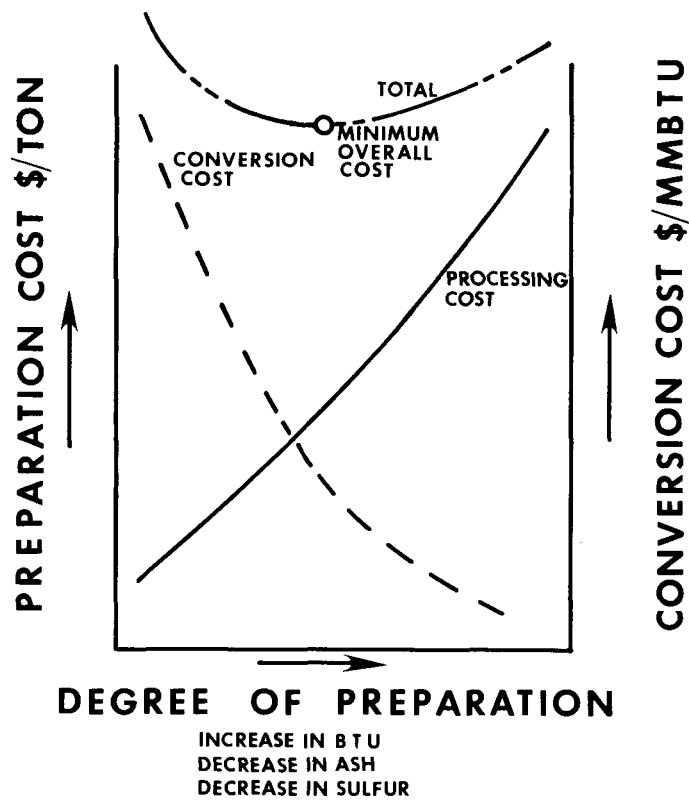


Figure 1. Relationship of Coal Preparation Costs and Coal Conversion Costs

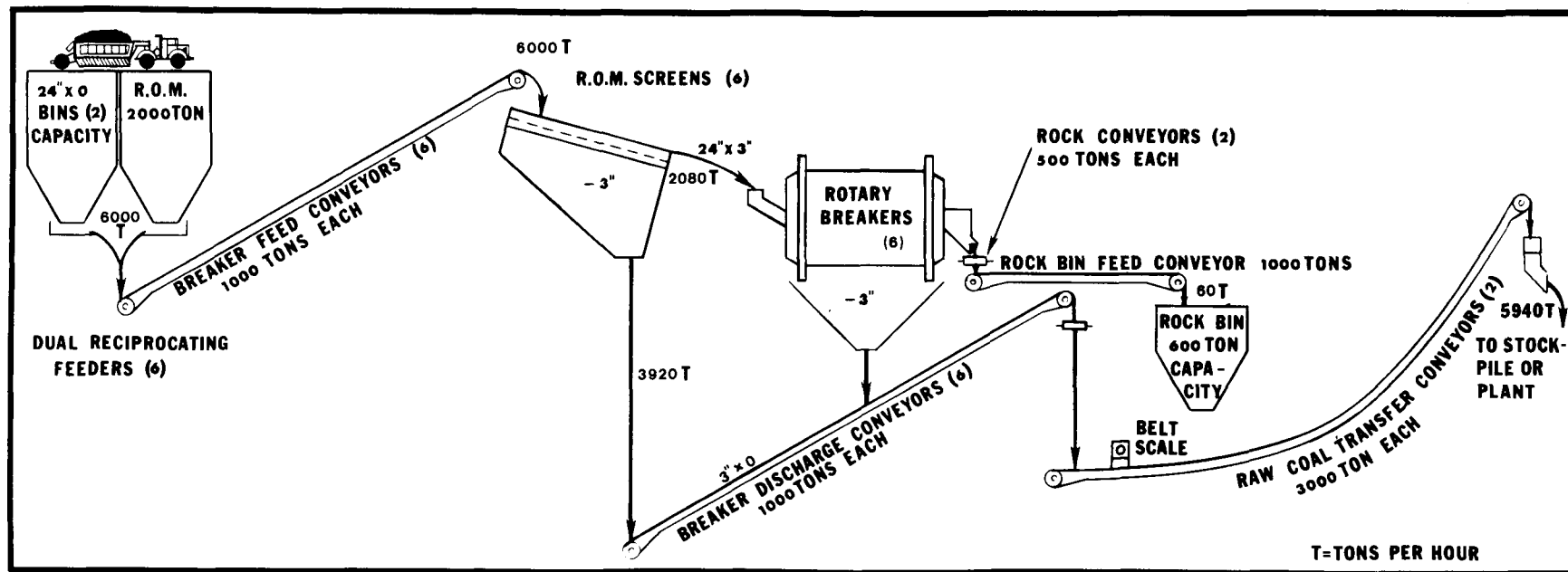


Figure 2. Hypothetical Coal Receiving and Breaking for a
75,000-Tons-Per-Day Plant

The run-of-mine coal will be received from the mine trucks in either of two 2,000-ton capacity receiving hoppers. Each receiving hopper will be equipped with a double runway and a 24-inch x 24-inch grizzly. Material which cannot pass through the grizzly requires reduction or removal to avoid blocking the grid openings. Run-of-mine coal will be dumped through the grizzly by continuously moving bottom dump trucks.

Each receiving hopper will be equipped with three dual reciprocating feeders which will meter the run-of-mine coal to one of the three breaker feed conveyors.

The run-of-mine coal will be delivered to six vibrating scalping screens with 3-inch apertures. These screens will remove minus 3-inch coal from the run-of-mine coal prior to feeding to the coal breakers. The oversize from these screens, i.e., 24-inch x 3-inch coal, will feed from the screens into rotary breakers.

Six rotary breakers, equipped with 3.5-inch perforations, will be provided to break the 24-inch x 3-inch coal to minus 3 inch. Tramp material or hard rock material that is not broken by the tumbling action of the breakers will be rejected as waste material from the discharge spirals of the breakers.

The scalping screen undersize coal and the broken coal from the rotary breakers will fall onto six breaker discharge conveyors. The breaker discharge conveyors, in two groups of three, will deliver coal to two raw coal collector conveyors, which will in turn deliver the coal to raw coal transfer conveyors. The amount of coal on each of these conveyors will be measured by two belt scales for inventory or accounting purposes.

The discharged or waste material from the rotary breakers will be collected by two slowly moving rock conveyors which will deliver to a rock bin feed conveyor. This conveyor will deliver to a 200-ton capacity rock bin where the rock material will be discharged into trucks for disposal.

The raw coal transfer conveyors will deliver either to a blending and stockpiling system or directly to the treatment plant via a raw coal sampling system. This system will take a representative sample of the coal according to ASTM D2234, "Collection of a gross sample of coal." This sample will be crushed and further divided within the sampling system to give a manageable sample for quality control analysis.

The capital cost of the hypothetical raw coal receiving and breaking facilities is estimated to be \$17,700,000. The cost is purely hypothetical indicating the capital intensity of raw coal receiving and breaking when dealing with high tonnage operations. The cost is based upon allowances for excavation, structures, equipment, electrical installation, piping, dust collection, etc., and also includes all costs for installations.

TABLE 3. MAJOR EQUIPMENT LISTING - RAW COAL RECEIVING AND BREAKING

Number Required	Unit Description
2	24-inch x 0 run-of-mine hopper
6	Run-of-mine reciprocating feeders
6	Breaker feed conveyors
6	Run-of-mine vibrating screens
6	Run-of-mine rotary breakers
1	No. 1 rock conveyor
1	No. 2 rock conveyor
1	Rock bin feed conveyor
1	Rock bin
6	Breaker discharge conveyors
2	Raw coal collector conveyors
2	Raw coal transfer conveyors
2	Run-of-mine belt scale
2	Raw coal sampling system

4.5 BLENDING AND STOCKPILING

4.5.1 DESIGN CONSIDERATIONS

Extensive blending and stockpiling facilities at a very large coal mining operation may be required.

Blending requirements are based on an estimate of the variation of incoming coal, the effects of coal preparation on product uniformity, and the acceptability of the feedstock to the conversion plant.

Stockpiling requirements are based on an estimate of force majeure protection for the supply of raw coal to the preparation plant and for the supply of prepared coal to the conversion plant or transportation system. Stockpiling requirements also must take into account different operating schedules for mining, coal preparation, and transport.

Thus, the actual extent of blending and stockpiling for a particular plant may vary from a very modest effort to an extensive facility, and should be designed for the specific situation.

Some benefits of a blending system are summarized below:

Blending raw coal will minimize variations in both size distribution and ash content prior to feeding the coal to the treatment plant. Blending coal after treatment will minimize variations in size distribution, ash content, sulfur content, and Btu content prior to feeding the coal to the conversion plant.

In any mine, the physical analysis of the run-of-mine coal varies in different locations. This variation is usually found in all three dimensions of the face or pit. Blending the coal prior to treatment and conversion may reduce the cost of mining operations, and possibly make available for use some coal formerly discarded as waste. Also, it may eliminate the extra expense of selective mining to provide uniform product.

Blending may also increase the total output of a mine and, in effect, increase its reserves. This is because submarginal coal reserves containing an uneconomical percentage of certain components (e.g., high ash content, or high sulfur content or low Btu) can be mixed with higher grade components to produce an acceptable product for the conversion process. The incoming raw coals or treated coals can be added to the same respective blending pile, and a predetermined uniform product recovered. Analysis and quantity of the incoming material is sufficient to determine a composite analysis of the entire pile.

4.5.2 HYPOTHETICAL SITUATION

To emphasize the potential impact of blending and stockpiling, the following is included:

The situation is based on the following hypothetical assumptions for a 75,000-tons-per-day operation:

- a. Run-of-mine coal has a Btu variance of +2000 Btu/lb.
- b. Prepared coal has a required conversion plant feedstock specification of +250 Btu/lb.
- c. A minimum of two days' stockpile is required due to differing operating schedules.

- d. A minimum of 500,000 tons stockpile is required for force majeure protection.
- e. No additional blending is required to meet feedstock specifications for ash content, sulfur content, or size consist.
- f. Coal properties allow open storage with no provisions for prevention of combustion or decrepitation.

To meet all the parameters previously mentioned, twelve 125,000-ton stockpiles are required. Note that the size and quantity of the stockpiles depend on the assumed variation of raw coal and the assumed tolerance on cleaned coal, as well as the operating and shipping schedule and the need for force majeure protection. The actual number required for any specific plant would vary widely depending on the assumptions and conditions present, as well as an analysis of the effect of coal washing on the uniformity of the cleaned coal.

4.5.3 EQUIPMENT FOR HYPOTHETICAL SITUATION

The equipment required for the twelve hypothetical 125,000-ton stockpiles would include conveyors, stackers, reclaimers, and loadout facilities as shown in Figure 3 and Table 4.

The raw coal will be delivered from the coal receiving and breaking system and distributed by conveyors to two of the three stacker feed conveyors. These stacker feed conveyors will deliver the coal to two double luffing boom, rail-mounted traveling stackers. These stackers will deposit the coal in thin layers to form a long wedge-shaped pile. For this hypothetical situation the "chevron method" of blending has been selected, which means that the discharge point of the stacker boom is always located above the center line of the pile. The double boom stackers will enable raw coal to be stockpiled on both sides of the feed conveyors.

Raw coal will be reclaimed for feeding to the treatment plant by two rail-mounted traveling reclaimers. These reclaimers will span the width of the coal pile and will reclaim across the cross section of the pile to give a uniform feed to the treatment plant. The reclaimers will deliver the raw coal to conveyor systems for delivery to the treatment plant.

A rail-mounted transfer car at one end of the stockpile will be used to transfer both the stackers and the reclaimers from pile to pile, as required.

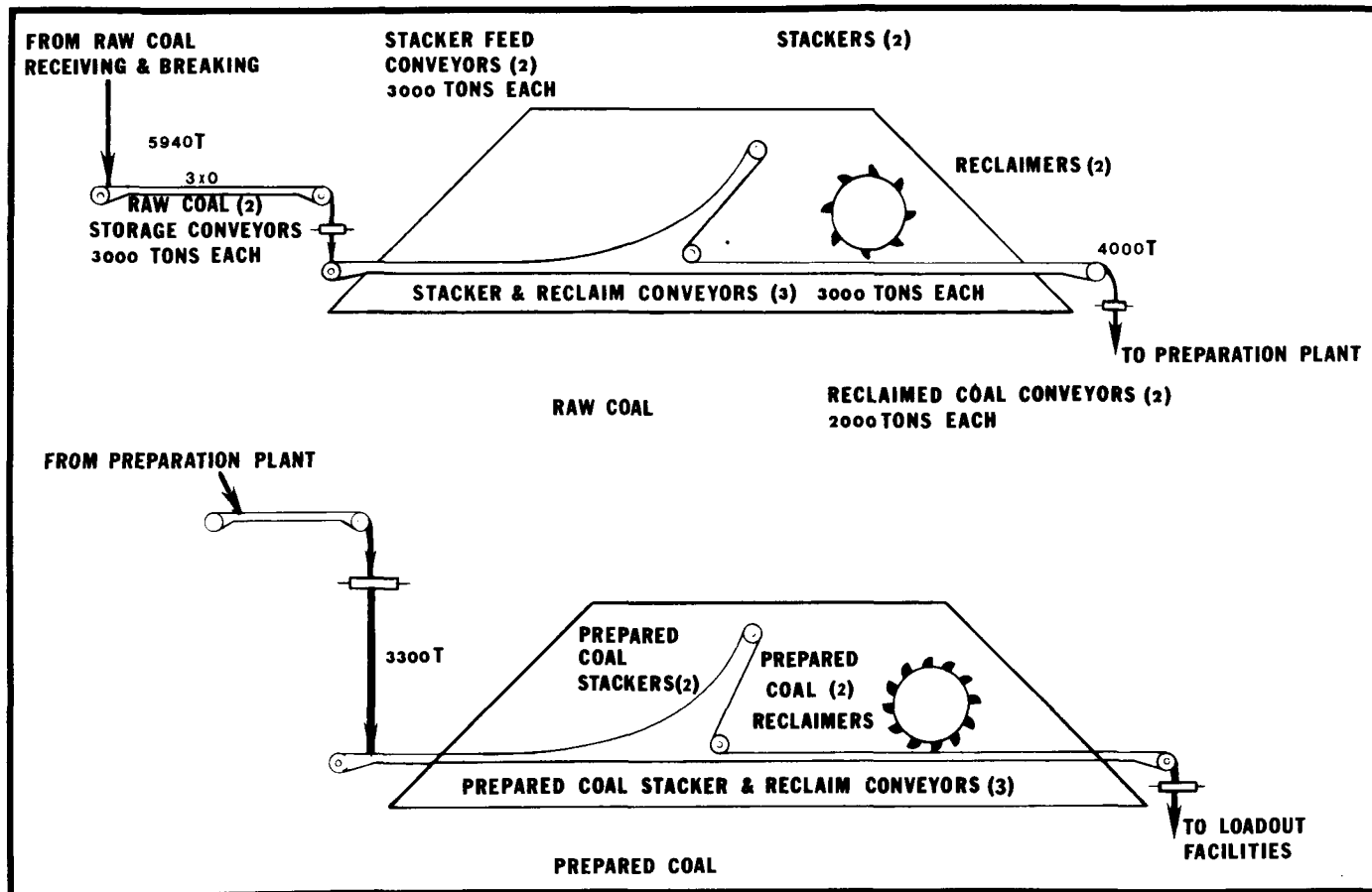


Figure 3. Hypothetical Blending and Stockpiling for a 75,000-Tons-Per-Day Plant

An identical system utilizing the "chevron method" of blending has been selected for the stockpiling of the treated coal. In this case, the reclaimed treated coal will be delivered to a conveyor system for delivery to a unit train loadout facility for shipment to the conversion plant. This loadout facility will allow the continuous automatic loading and weighing of unit train railroad cars.

TABLE 4. MAJOR EQUIPMENT LISTING - HYPOTHETICAL BLENDING AND STOCKPILING

Number Required	Unit Description
2	Raw coal storage conveyors
2	Stacker feed conveyors
3	Stacker and reclaim conveyors
2	Raw coal stackers
2	Raw coal reclaimers
2	Reclaimed coal conveyors
2	Prepared coal storage conveyors
2	Prepared coal stacker feed conveyors
3	Prepared coal stacker and reclaim conveyors
2	Prepared coal stackers
2	Prepared coal reclaimers
2	Collector conveyors

The general arrangement of this equipment is shown on Plate 300-04. The blending and stockpiling facilities will cover approximately 100 acres, which emphasizes the large space requirements for such a facility.

The estimated capital cost of the blending and stockpiling facility is \$67,400,000, and is based upon breakdown of equipment, labor, materials, and subcontract fees. This cost is purely hypothetical and would vary according to an actual situation; nevertheless, this cost does serve to highlight the importance of studying blending and stockpiling requirements in detail.

Coal conversion processes may not require the degree of preparation described in this volume; however, the benefits of coal preparation are usually recognized as more becomes known about the conversion process.

4.6 CRUSHING AND SCREENING PLANT

4.6.1 PLANT DESCRIPTION - CRUSHING AND SCREENING

The standard crushing and screening plant design is based on an assumed raw coal size distribution as shown in Table 5 and Figure 4. This plant is designed for a situation requiring relatively slight preparation effort. (Actual equipment selection and design is determined by desired end-product size consist.)

TABLE 5. RAW COAL SIZE DISTRIBUTION -
CRUSHING AND SCREENING

Size Fraction	Weight (percent)	Cumulative Weight (percent)	Size Fraction	Weight (percent)	Cumulative Weight (percent)
3" x 2-1/4"	2.0	2.0	1/4" x 1/8"	6.1	80.4
2-1/4" x 1-1/4"	31.6	33.6	1/8" x 28 mesh	7.6	88.0
1-1/4" x 7/8"	15.3	48.9	28 x 60 mesh	1.7	89.7
7/8" x 1/2"	15.2	64.1	60 x 200 mesh	1.7	91.4
1/2" x 1/4"	10.2	74.3	200 mesh x 0	8.6	

A flowsheet describing the crushing and screening plant is shown on Plate 300-01.

The 3-inch x 0 raw coal will be fed to the crushing and screening plant directly from a raw coal receiving and breaking facility or from a blending/stockpiling facility by conveyors. The coal will pass under magnets which will remove any undesirable tramp iron prior to further processing. The raw coal will be distributed into any of four 500-ton capacity surge bins utilizing shuttle conveyors. The incoming raw coal will be weighed by belt scales for inventory purposes.

The raw coal will be metered from each of the surge bins with vibrating feeders, which deliver the coal to four vibrating screens. These screens will be equipped with decks of 1-1/4-inch perforations. The oversize from the screens, i.e., 3-inch x 1-1/4-inch coal, will pass into double roll crushers set to crush the coal to minus 1-1/4-inch. The crushed coal will fall to collecting conveyors to recombine with the undersize products from the screens. The final crushed coal product will be conveyed to a product stockpiling/blending facility or directly to a unit train loadout facility.

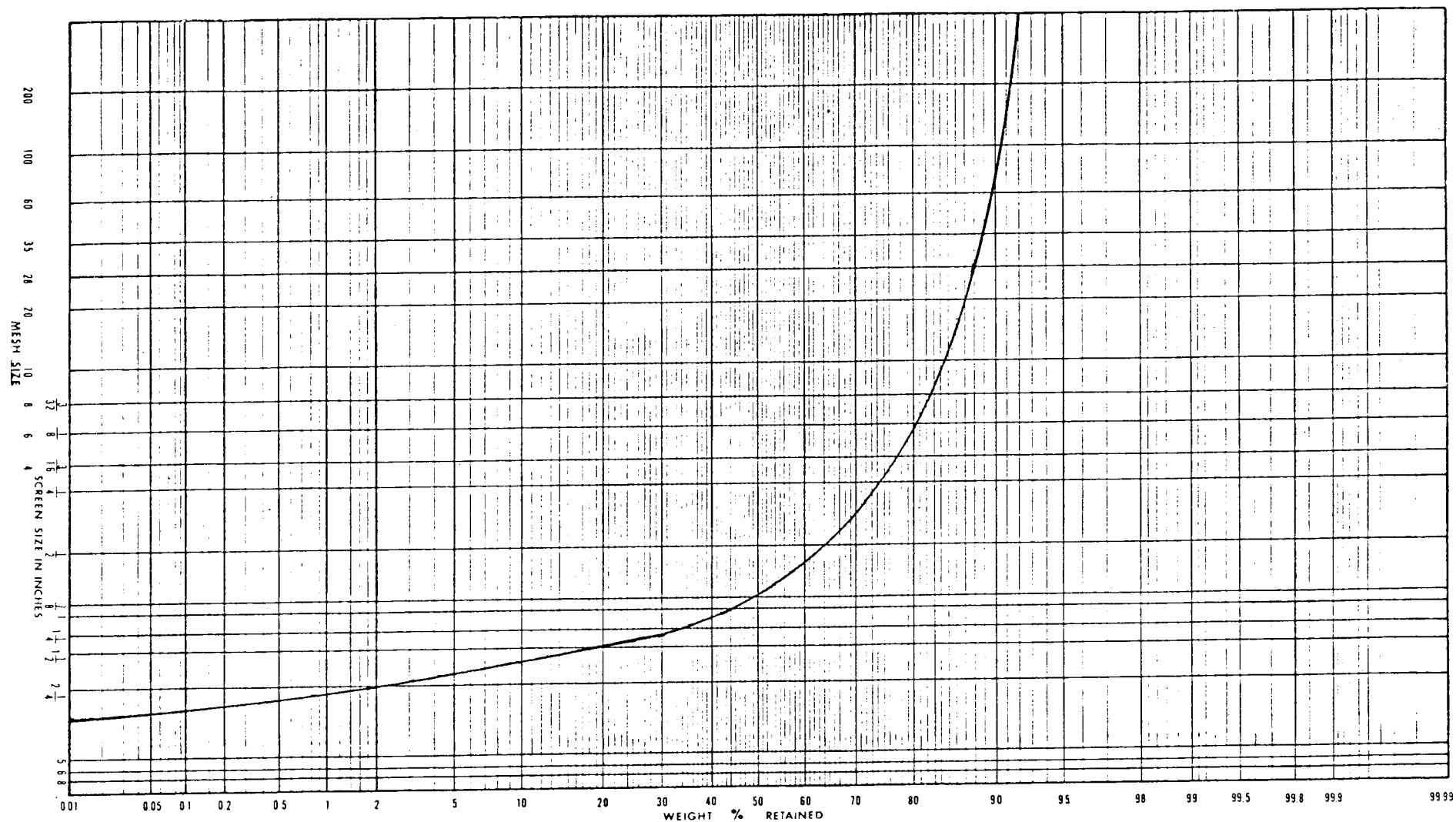


Figure 4. Raw Coal Size Distribution - Crushing and Screening Plant

Equipment sizing for all three hypothetical plants is based upon the largest unit capacities currently manufactured.

The equipment for the crushing and screening plant is shown in Table 6.

TABLE 6. MAJOR EQUIPMENT LISTING -
CRUSHING AND SCREENING PLANT

Number Required	Unit Description
2	Raw coal bin feed conveyors
2	Belt scales
2	Raw coal tramp iron magnets
2	Raw coal shuttle conveyors
4	Raw coal feed bins
4	Vibrating feeders
4	Classifying screens
4	Coal crushers
2	Coal collector conveyors

The general arrangement of the crushing and screening plant is shown on Plate 300-06.

4.6.2 OPERATING CAPACITY - CRUSHING AND SCREENING PLANT

The rated capacity of the standard crushing and screening plant is 75,000 tons per day of raw coal operating 250 days per year giving an annual capacity of 18,750,000 tons per year of raw coal.

The plant has a hypothetical yield factor of .99 (tons output of prepared coal divided by tons input of raw coal) giving a plant-rated output capacity of 74,250 tons per day of prepared coal or an annual capacity of 18,688,000 tons per year of prepared coal.

4.6.3 ESTIMATED CAPITAL COSTS - CRUSHING AND SCREENING PLANT

The capital cost of the standard 75,000-ton-per-day crushing and screening plant is estimated to be \$9,500,000.

This cost estimate is for a complete turn-key facility and is based on the following assumptions:

- a. The purpose of the estimate is to provide a first-order estimate of preparation plant capital cost for use as one element in estimating the price of coal ready to ship for a variety of situations.

- b. This estimate is not a definitive estimate and should not be used or interpreted as such.
- c. The estimate is based on a hypothetical plant with only the plant equipment detailed to the point of an equipment list.
- d. The plant design is not universal; specific situations might require resizing much of the equipment, or adding or deleting many items such as blending systems, thermal dryers, briquetting systems, grinding systems, etc.
- e. Prices are for the first quarter of 1975. Equipment prices are based on written and verbal quotations from vendors.
- f. Labor is based on similar projects using productivity and rates from the Gulf Coast.
- g. Bulk material quantities are based on similar projects for such items as foundations, structures, buildings, and equipment supporters.
- h. Subcontracted electrical cost is based on connected horsepower; subcontracted painting cost is based on tonnage; subcontracted miscellaneous cost is based on similar projects.
- i. Piping within the structures is factored to the equipment plus a fire line, air line, and water line.
- j. Instrumentation cost is factored to equipment to be instrumented based on a minimum system panel in the area of the equipment.
- k. Dust collection cost is based on a factor plus experience on similar projects.
- l. The estimate excludes main power to plant area, water supply to the plant area, railroad systems, price escalation, and the cost of land.
- m. All costs include allowance for construction contingency and fee.
- n. The plant is located at or near sea level.

4.7 BAUM JIG PLANT

4.7.1 PLANT DESCRIPTION - BAUM JIG

The Baum jig plant design is based on an assumed raw coal size distribution as shown in Table 7 and Figure 5, and on an assumed washability analysis as shown in Table 8 and Figure 6. The hypothetical washability data indicates a simple separation problem; therefore, jigging will function satisfactorily. A flowsheet describing the Baum jig plant is shown in Plate 300-02.

TABLE 7. RAW COAL SIZE DISTRIBUTION -
COAL PREPARATION JIG PLANT

Size Fraction	Weight (percent)	Cumulative Weight (percent)
3" x 2-1/4"	2.0	2.0
2-1/4" x 1-1/4"	28.4	30.4
1-1/4" x 7/8"	12.7	43.1
7/8" x 1/2"	13.1	56.2
1/2" x 1/4"	9.0	65.2
1/4" x 1/8"	7.3	72.5
1/8" x 28 mesh	14.1	86.6
28 x 60 mesh	3.9	90.5
60 x 200 mesh	3.5	94.0
200 mesh x 0	6.0	100.0

The 3-inch x 0 raw coal will be fed to the Baum jig plant directly from a raw coal receiving and breaking facility or from a blending/stockpiling facility by conveyors as previously described for the crushing and screening plant.

Baum Jig Cleaning Circuit

The raw coal will be metered from each of the surge bins with vibrating feeders, which deliver the coal to prewetting launders prior to the four Baum jig washboxes. The raw coal will be extensively wetted prior to feeding into the washboxes. These washboxes will produce a cleaned coal product which will be sluiced to eight cleaned coal classifying screens. A middlings product will be extracted from the discharge end of the washbox by bucket elevators. The perforated buckets of these elevators will allow partial dewatering of the middlings product, which will be crushed to minus 1-1/4 inch using a hammer mill. The crushed middlings will be fed to the rewash washboxes for secondary

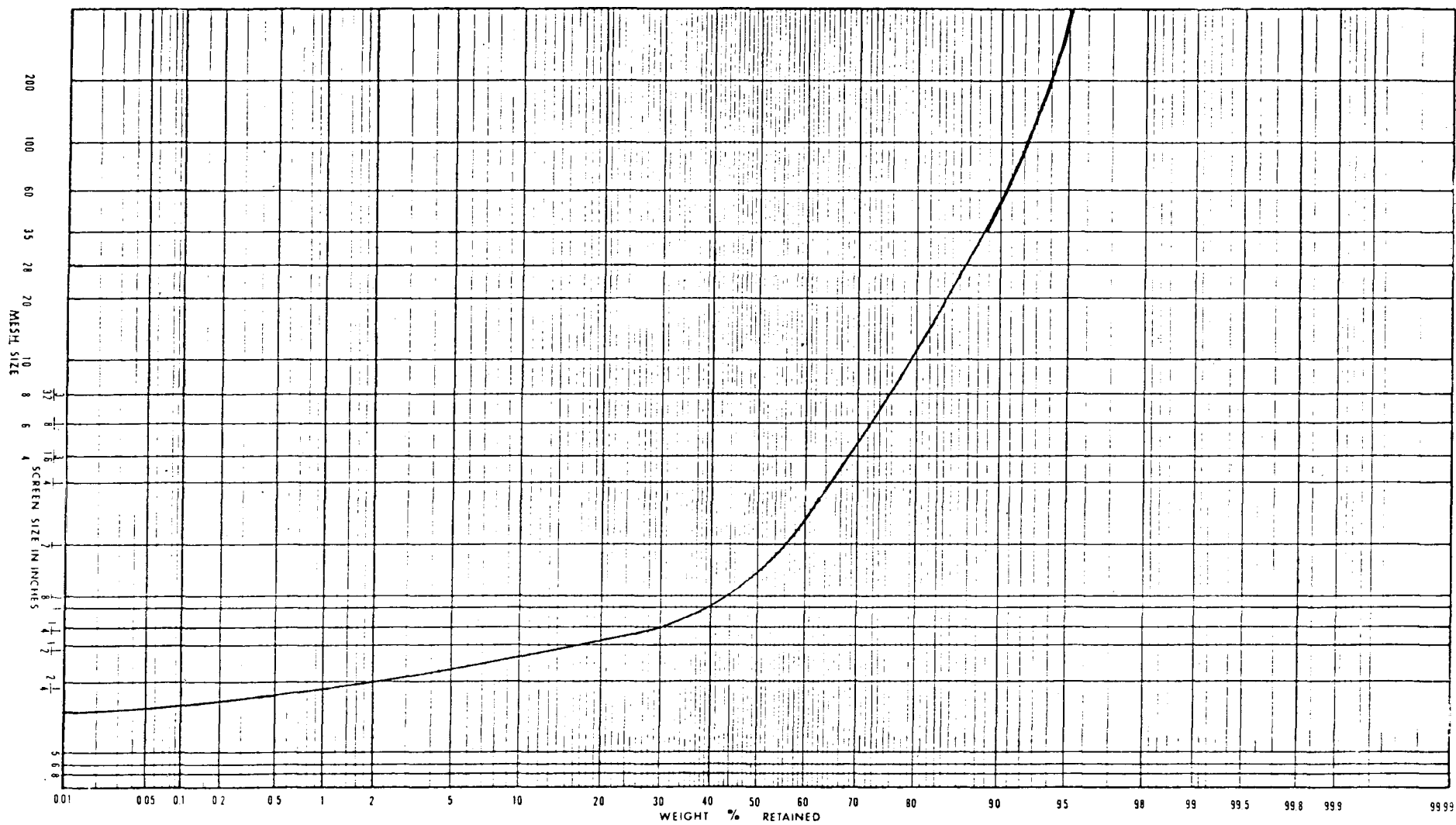


Figure 5. Raw Coal Size Distribution - Jig Plant

TABLE 8 . WASHABILITY ANALYSIS - COAL PREPARATION JIG PLANT

SPECIFIC GRAVITY	PERCENT FLOATS		PERCENT ASH		PERCENT SULFUR		BTU/LB	
	Fraction	Cumulative	Fraction	Cumulative	Fraction	Cumulative	Fraction	Cumulative
- 1.25	34.0	34.0	5.1	5.1	0.36	0.36	13,840	13,840
1.25 x 1.30	40.4	74.4	8.4	6.9	0.74	0.56	13,320	13,450
1.30 x 1.35	5.9	80.3	16.4	7.6	1.19	0.61	12,964	13,330
1.35 x 1.40	3.2	83.5	23.1	8.2	1.56	0.65	12,550	13,270
1.40 x 1.45	2.4	85.9	22.9	8.6	2.50	0.70	11,766	13,200
1.45 x 1.50	1.4	87.3	26.5	8.9	2.67	0.74	11,329	13,170
1.50 x 1.55	1.5	88.8	27.3	9.2	3.33	0.78	10,122	13,120
1.55 x 1.60	0.9	89.7	28.9	9.4	3.57	0.81	9,300	13,090
1.60 x 1.65	1.8	91.5	30.0	9.7	4.44	0.86	7,910	13,040
1.65 x 1.70	2.0	93.5	42.0	10.4	6.00	0.97	5,620	12,960
1.70 x 1.75	2.8	96.3	47.4	11.3	7.07	1.12	3,010	12,870
1.75 +	3.7	100.0	78.9	13.8	9.19	1.42	1,620	12,760

LEGEND

- 1 CHARACTERISTIC ASH CURVE —————
- 2 ± 0.1 SPECIFIC GRAVITY CURVE — * — * — * 4 CUMULATIVE FLOATS SULFUR CURVE — · — — —
- 3 SPECIFIC GRAVITY CURVE — · — — — 5 CUMULATIVE FLOATS B.T.U. CURVE — · — — —

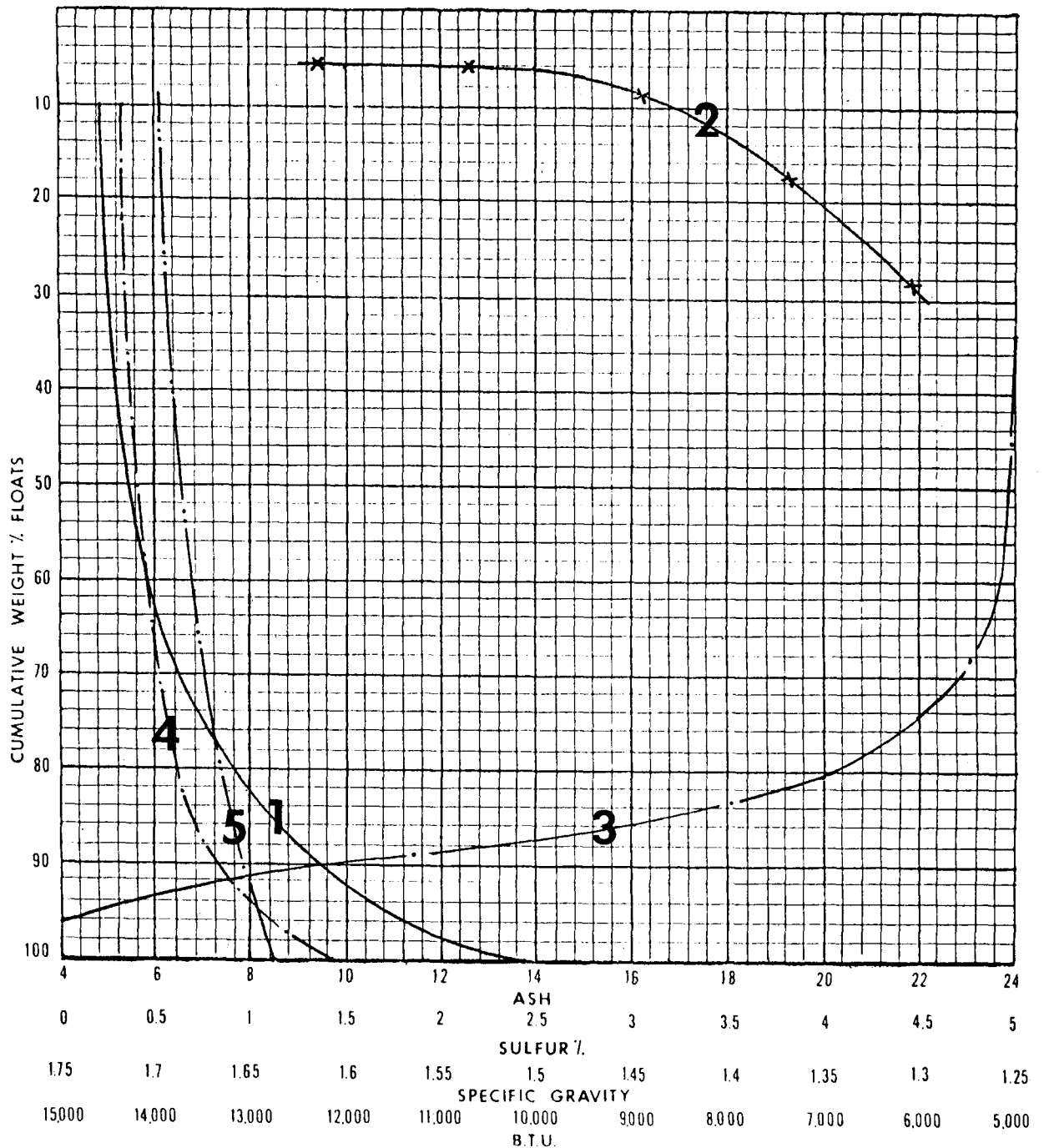


Figure 6. Washability Curves - Jig Plant

cleaning. The float product from these rewash washboxes will be sluiced by water to four middlings dewatering screens. The sink products from both the primary washboxes and the secondary or rewash washboxes will be extracted by dewatering bucket elevators which will deliver to the rejects conveyor.

The two rejects conveyors will deliver the reject material to a 600-ton capacity bin. This material will be discharged from the bin into dump trucks to be hauled to a refuse disposal area or back-hauled into the mine area.

Cleaned Coal Dewatering and Crushing Circuit

The cleaned coal from the primary washboxes will be classified by vibrating screens at 1-1/4 inch and 1/4 inch. The oversize from the top deck of these screens, i.e., 3-inch x 1-1/4-inch cleaned coal, will be fed through double roll crushers set to crush the coal to minus 1-1/4 inch. The crushed coal will be recombined with the oversize from the bottom deck of the screens, i.e., 1-1/4-inch x 1/4-inch cleaned coal, to form a portion of the final product. The undersize from the cleaned coal classifying screens, i.e., 1/4 inch x 0, will flow by gravity as water slurry to four small coal sumps.

Middlings Treatment Circuit

The middlings product from the secondary washboxes will be screened by vibrating screens at 1/4 inch. The oversize from these screens, i.e., 1-1/4-inch x 1/4-inch middlings, will be recombined with plus 1/4-inch cleaned coal as final product. The undersize from the middlings screens, i.e., 1/4 inch x 0, will flow by gravity as water slurry to the four small coal sumps.

Small Coal Dewatering Circuit

The coal/water slurry from the small coal sumps will be pumped to four banks of six large diameter classifying cyclones. These cyclones will classify the 1/4-inch x 0 coal at approximately 48 mesh. The 1/4-inch x 48 mesh cyclone underflow will flow to eight small coal sieve bends, each of which will feed a vibrating dewatering screen. These screens will deliver the "overproduct" to basket-type centrifuges where final dewatering will take place. The dewatered centrifuge products will be collected by conveyor for delivery to the final product conveyors. The cyclone overflows, the sieve bend and screen underflows, and the effluents from the small coal centrifuges will flow by gravity to the four fine coal sumps.

Fine Coal Dewatering Circuit

The coal/water slurry from the fine coal sumps will be pumped to sixteen banks of 20 small diameter classifying cyclones. These cyclones will classify the 48-mesh x 0 coal at approximately 270 mesh. The 48-mesh x 270-mesh cyclone underflow will flow to 24 fine coal screen-bowl centrifuges, where final dewatering of the fine coal will take place. The dewatered centrifuge products will be collected by conveyor for delivery to the final product conveyors. The cyclone overflows and the effluents from the fine coal centrifuges will flow by gravity to two thickeners.

Cleaned Coal Collection and Sampling Circuit

All the cleaned coal products will be collected by conveyors and conveyed through a prepared coal sampling system. This system will take a representative sample of the coal according to ASTM D2234, "Collection of a gross sample of coal." This sample will be crushed and further divided within the sampling system to give a manageable sample for quality control analysis. The final product will be conveyed to either a blending/stockpiling facility or directly to a unit train loadout facility.

Water Recovery Circuit

The plant effluent water will be treated in two conventional rake-type thickeners which will separate the flocculated solids from the water. The thickener underflow will be pumped to a sludge pond where the solids will settle and a relatively clear water will overflow to a fresh water pond. Water from this fresh water pond will be returned to either of two clarified water sumps by vertical pumps. The thickener overflow water will also flow by gravity to either of the two clarified water sumps. Any makeup water required to compensate process losses will be added to these clarified water sumps. Relatively clear water will be pumped from the clarified water sumps to either of four head tanks situated above each stream of the plant. These head tanks will supply water for the washboxes and for spray water used on the classifying screens.

The equipment required for the Baum jig plant is shown in Table 9.

4.7.2 OPERATING CAPACITY - BAUM JIG PLANT

The rated capacity of the standard Baum jig plant is 75,000 tons per day of raw coal operating 250 days per year, giving an annual capacity of 18,750,000 tons per year of raw coal.

The plant has a hypothetical yield factor of .825 (output of prepared coal divided by input of raw coal), giving a plant-rated output capacity of 61,875 tons per day of prepared coal or an annual capacity of 15,468,750 tons per year of prepared coal.

TABLE 9. MAJOR EQUIPMENT LISTING -
BAUM JIG PLANT

Number Required	Unit Description
2	Raw coal bin feed conveyors
2	Belt scales
2	Raw coal tramp iron magnets
2	Raw coal shuttle conveyors
4	Raw coal feed bins
4	Vibrating feeders
4	Washboxes with rewash
1	No. 1 rejects conveyor
1	No. 2 rejects conveyor
1	Refuse bin
8	Cleaned coal classifying screens
4	Middlings screens
4	Cleaned coal crushers
2	Course coal collector conveyors
8	Small coal sumps
16	Small coal pumps
4	Small coal cyclones
8	Small coal sieve bends
8	Small coal screens
12	Small coal centrifuges
2	Small coal collector conveyors
8	Fine coal sumps
24	Fine coal pumps
16	Fine coal cyclones
24	Fine coal centrifuges
2	Fine coal collector conveyors
2	Belt scales
2	Prepared coal collector conveyors
2	Prepared coal transfer conveyors
2	Prepared coal sampling systems
2	Thickeners
2	Clarified water sumps
12	Clarified water pumps
4	Clarified water head tanks
4	Thickener underflow pumps
1	Sludge and fresh water pond
3	Reclaimed water pumps
2	Floor drainage sumps
2	Floor drainage pumps

The general arrangement required for the Baum jig plant is shown in Plate 300-07.

4.7.3 ESTIMATED CAPITAL COSTS - BAUM JIG PLANT

The capital cost of the standard 75,000-tons-per-day Baum jig plant is estimated to be \$52,100,000. This cost estimate is for a complete turn-key facility and is based on the following assumptions:

- a. The purpose of the estimate is to provide a first-order estimate of preparation plant capital cost for use as one element in estimating the price of coal ready to ship for a variety of situations.
- b. This estimate is not a definitive estimate and should not be used or interpreted as such.
- c. The estimate is based on a hypothetical plant with only the plant equipment detailed to the point of an equipment list.
- d. The plant design is not universal; specific situations might require resizing much of the equipment, or adding or deleting many items such as blending systems, thermal dryers, briquetting systems, grinding systems, etc.
- e. Prices are for the first quarter of 1975. Equipment prices are based on written and verbal quotations from vendors.
- f. Labor is based on similar projects using productivity and rates from the Gulf Coast.
- g. Bulk material quantities are based on similar projects for such items as foundations, structures, buildings, and equipment supports.
- h. Subcontracted electrical cost is based on connected horsepower; subcontracted painting cost is based on tonnage; subcontracted miscellaneous cost is based on similar projects.
- i. Piping within the structures is factored to the equipment and includes a fire line, air line, and water line.
- j. Instrumentation cost is factored to equipment to be instrumented based on a minimum system panel in the area of the equipment.

- k. Dust collection cost is based on a factor plus experience on similar projects.
- l. The estimate excludes main power to plant area, water supply to the plant area, railroad systems, price escalation, and the cost of land.
- m. All costs include allowance for construction contingency and fee.
- n. The plant is located at or near sea level.

4.8 HEAVY MEDIA PLANT

4.8.1 PLANT DESCRIPTION - HEAVY MEDIA

The heavy media plant design is based on assumed raw coal size distribution as shown in Table 10 and Figure 7, and on an assumed washability analysis as shown in Table 11 and Figure 8. The hypothetical washability data indicates a difficult separation problem. Jigging, for example, would produce an excess of "misplace material," i.e., too much reject in the coal and too much coal in the reject. A flowsheet describing the heavy media plant is shown in Plate 300-03.

TABLE 10. RAW COAL SIZE DISTRIBUTION -
HEAVY MEDIA PLANT

Size Fraction	Weight (percent)	Cumulative Weight (percent)
3" x 2-1/4"	0.2	0.2
2-1/4" x 1-1/4"	2.2	2.4
1-1/4" x 1-1/4"	4.2	6.6
7/8" x 1/2"	16.1	22.7
1/2" x 1/4"	27.1	49.8
1/4" x 1/8"	15.6	65.4
1/8" x 28 mesh	20.6	86.0
28 x 60 mesh	4.0	90.0
60 x 200 mesh	3.7	93.7
200 mesh x 0	6.3	100.0

The plant is designed to operate 24 hours per day, and will consist of four 1,000-ton-per-hour streams.

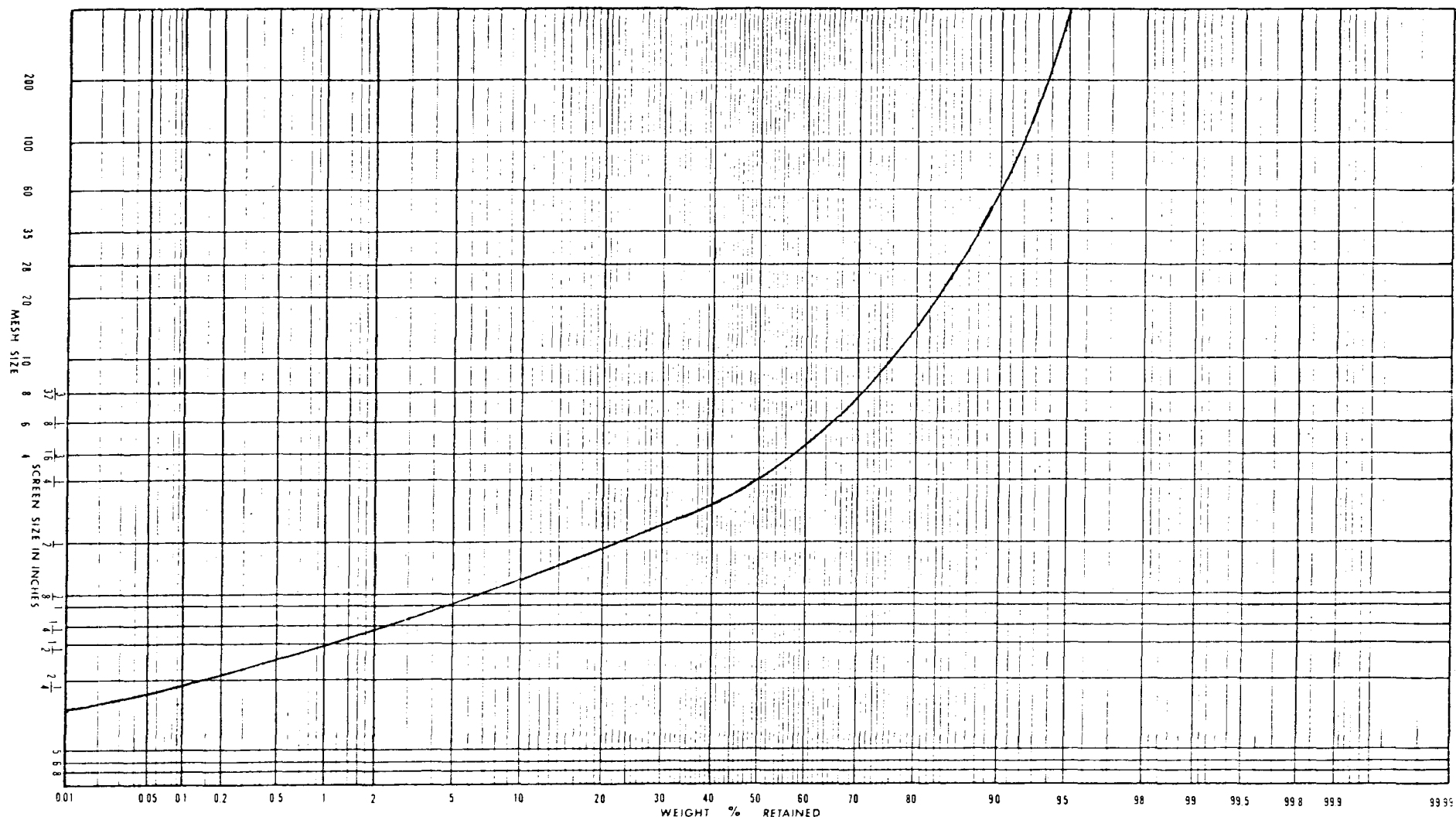


Figure 7. Raw Coal Size Distribution - Heavy Media Plant

TABLE 11. WASHABILITY ANALYSIS - COAL PREPARATION HEAVY MEDIA PLANT

SPECIFIC GRAVITY	PERCENT FLOATS		PERCENT ASH		PERCENT SULFUR		BTU/LB	
	Fraction	Cumulative	Fraction	Cumulative	Fraction	Cumulative	Fraction	Cumulative
- 1.25	10.8	10.8	4.9	4.9	0.33	0.33	14,450	14,450
1.25 x 1.30	39.4	50.2	6.4	6.1	0.49	0.46	14,208	14,260
1.30 x 1.35	16.5	66.7	10.5	7.2	0.90	0.57	13,492	14,070
1.35 x 1.40	9.1	75.8	15.5	8.2	1.49	0.68	12,737	13,910
1.40 x 1.45	6.8	82.6	17.9	9.0	2.14	0.80	11,724	13,730
1.45 x 1.50	5.2	87.8	24.2	9.9	3.16	0.94	11,028	13,570
1.50 x 1.55	4.0	91.8	30.6	10.8	4.15	1.08	10,128	13,420
1.55 x 1.60	1.5	93.3	35.7	11.2	4.81	1.14	9,688	13,360
1.60 x 1.65	0.6	93.9	42.5	11.4	5.62	1.17	8,665	13,330
1.65 x 1.70	1.5	95.4	43.2	11.9	5.84	1.24	7,513	13,270
1.70 x 1.75	2.8	98.2	50.5	13.0	6.50	1.39	4,659	13,110
1.75 +	1.8	100.0	86.3	14.5	7.94	1.49	1,166	13,084

LEGEND

- 1 CHARACTERISTIC ASH CURVE —————
- 2 ± 0.1 SPECIFIC GRAVITY CURVE — * — * — * 4 CUMULATIVE FLOATS SULFUR CURVE — · — · — ·
- 3 SPECIFIC GRAVITY CURVE — · — · — · 5 CUMULATIVE FLOATS B.T.U. CURVE — · — · — ·

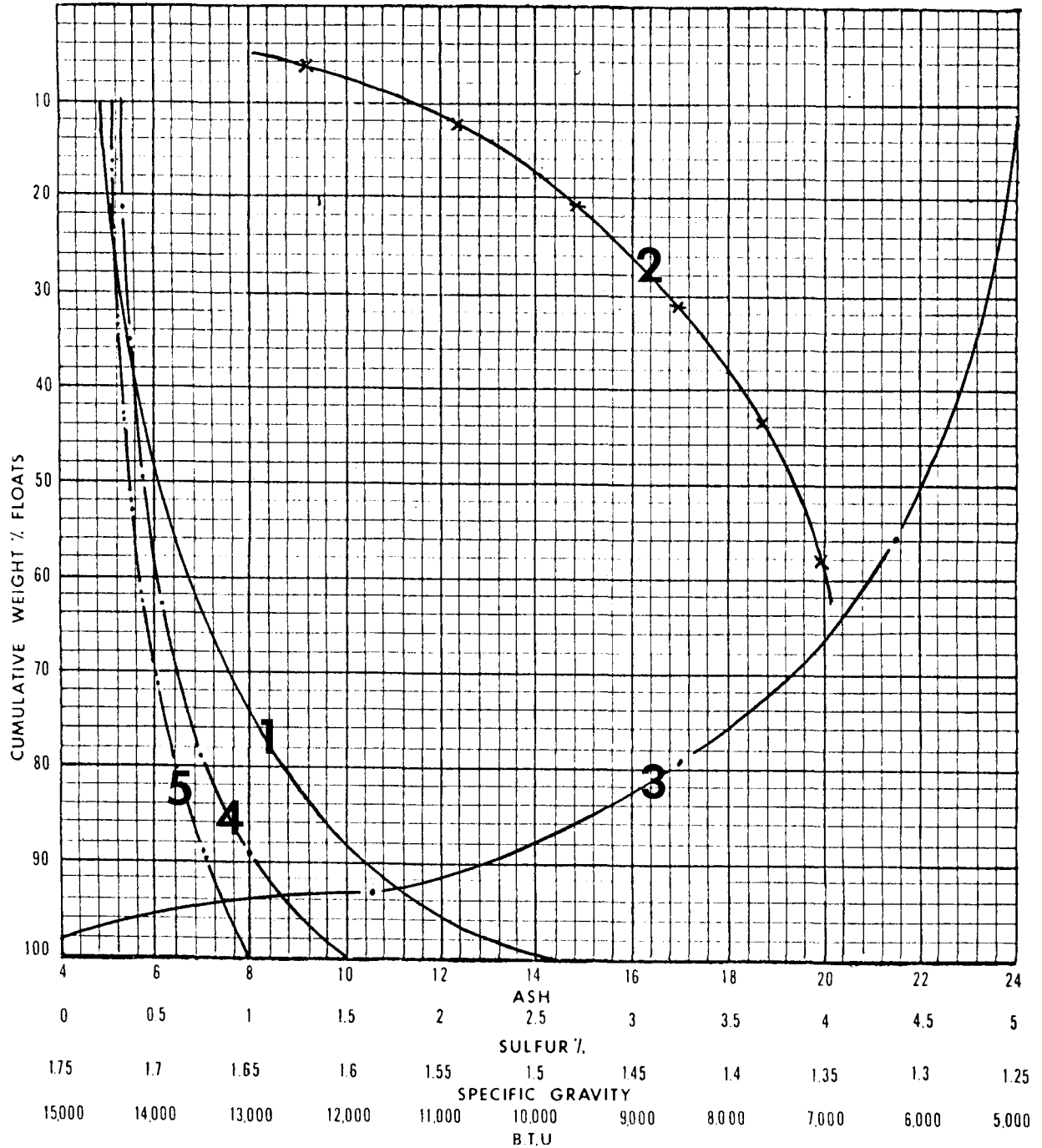


Figure 8. Washability Curves - Heavy Media Plant

The 3-inch x 0 raw coal will be fed to the heavy media plant directly from a raw coal receiving and breaking facility or from a blending/stockpiling facility by conveyors as previously described for the crushing and screening plant.

Raw Coal Screening

The raw coal will be metered from each of the surge bins with vibrating feeders, which deliver the coal to prewetting launders prior to the four primary raw coal vibrating screens fitted with decks of 3/8-inch apertures. The oversize from the primary screens will flow to identical secondary screens. The oversize from the secondary screens, i.e., 3-inch x 3/8-inch raw coal, will fall into one of the four heavy media separating vessels. The underflow from these screens will be a raw coal/water slurry and will flow by gravity to the four raw coal sumps.

Coarse Coal Cleaning Circuit

The heavy media vessels will produce cleaned coal, middlings, and refuse, by utilizing two different heavy medias within the vessel, each having a different specific gravity. The low specific gravity medium will produce the cleaned coal as a float material, and the sink material will be retreated at the higher specific gravity. This will produce the middlings as a float material and the refuse as the sink material. Each of the products will flow by gravity from the heavy media vessel together with a portion of the heavy media suspension.

Each of three products and their associated magnetite suspension will flow over 1-mm aperture fixed sieves which allows some of the magnetite media to drain from the coarse products. Eight fixed sieves will be provided for the cleaned coal products and four fixed sieves will be provided for each of the middlings and refuse products. The oversize product from each fixed sieve will flow to a 1-mm aperture vibrating screen. The first section of these screens will allow the heavy media to further drain from the products. The second section of these screens will allow magnetite to be rinsed from the products by water sprays.

Dense Media Recovery - Low Gravity Circuit

The drained heavy media from each of the cleaned coal fixed sieves and from the primary section of the rinsing screens will flow by gravity to any of the four low gravity dense medium collecting sumps. Water and/or magnetite slurry will be added to this sump as required to maintain the correct operating level within the sump and also maintain the correct medium specific gravity for the system. If the sump

levels rise above the desired operating levels, a portion of the medium will be diverted from these sumps to the magnetite recovery circuit. The low gravity medium will be pumped from each sump to the respective primary heavy media vessel.

Dense Media Recovery - High Gravity Circuit

The drained heavy media from each of the middlings and refuse fixed sieves and from the primary section of the rinsing screens will flow by gravity to any of the four high gravity sumps. Water and/or magnetite slurry will be added to this sump as required to maintain the correct operating level within the sump and also maintain the correct medium specific gravity for the system. If the sump levels rise above the desired operating levels, a portion of the medium will be diverted from these sumps to the magnetite recovery circuit. The high gravity medium will be pumped from each sump to the respective secondary heavy media vessel.

Dense Media Recovery - Dilute Gravity Circuit

The magnetite and water from the secondary section of each of the coarse product rinsing screens will flow by gravity to the dilute medium sumps. The treatment of this material for magnetite recovery is discussed below.

Cleaned Coal - Crushing Circuit

The 3-inch x 3/8-inch cleaned coal product from each magnetite drain and rinse screen will be fed through double roll crushers set to crush the coal to minus 1-1/4 inch. The crushed coal will be conveyed to the final product conveyors.

Middlings Treatment Circuit

The 3-inch x 3/8-inch middlings product from each magnetite drain and rinse screen will be fed through double roll crushers set to crush the middlings to minus 3/8 inch. The crushed middlings will fall by gravity to any of the four raw coal sumps for further treatment. This crushing stage will liberate free coal from any "false middlings" present. False middlings are banded coal/waste particles as mined.

Refuse Disposal

The 3-inch x 3/8-inch refuse product from each magnetite drain and rinse screen will be conveyed to a 1,200-capacity refuse bin for disposal.

Fine Coal Desliming Circuit

The 3/8-inch x 0 raw coal slurry plus the crushed middlings will be pumped by four raw coal distributors to 16 desliming

systems. The feed to each system will pass over a 3/4-mm aperture sieve bend prior to being fed to a 1/4-mm aperture vibrating screen. The purpose of this system is to remove the majority of the minus 1/2-mm material from the 3/8-inch x 0 raw coal prior to treatment in heavy media cyclones. This must be achieved to give stable gravity control within the heavy media cyclone circuit.

The undersize raw coal, i.e., minus 1/2 mm, from these sieve bends and screens will flow by gravity to a fine coal sump. The oversize raw coal, i.e., 3/8 inch x 1/2 mm, will fall into any of eight heavy media cyclone feed sumps.

3/8-inch x 1/2-mm Cleaning and Dewatering Circuit

The raw coal is mixed with magnetite and water, in the correct proportion to give the desired separation, and pumped by distributors to any of 32 heavy media cyclones. These cyclones will produce a cleaned coal and a refuse product.

The cleaned coal plus magnetite slurry will flow over any of 32 1-mm aperture sieve bends which will allow some of the magnetite to drain from the cleaned coal. The oversize product from each sieve bend will flow to a 1/2-mm aperture vibrating screen. The first section of these screens will allow the heavy media to further drain from the cleaned coal. The second section of these screens will allow the magnetite to be rinsed from the products by water sprays. The refuse products from the cyclones will be treated with eight sieve bend/vibrating screen systems identical to the cleaned coal systems.

The 3/8-inch x 1/2-mm cleaned coal product from the magnetite drain and rinse screens will be further dewatered utilizing vibrating basket-type centrifuges. The water effluent from these centrifuges will flow to the dilute medium sumps and the dewatered cleaned coal will be conveyed to the final product conveyors.

Dense Media Recovery - High Gravity Circuit

The drained heavy media from each of the cleaned coal and refuse sieve bends and from the primary section of the rinsing screens will flow by gravity to eight heavy media cyclone feed sumps for recirculation. Water and/or magnetite slurry will be added to these sumps as required to maintain both the correct operating level within the sumps and also the correct medium specific gravity for the system. If the sump levels rise above the desired operating levels, some medium will be diverted from these sumps to the magnetite recovery circuit.

Dense Media Recovery - Dilute Gravity Circuit

The magnetite and water from the secondary section of each cyclone product rinsing screen will flow by gravity to the dilute medium sumps. This material plus the similar material from the heavy media vessel circuits will be treated for magnetite recovery.

The dilute medium will be pumped to 32 primary wet magnetic separators. The magnetite slurry or overdense medium recovered from these separators will flow to overdense storage sumps for reuse.

Refuse Disposal

The 3/8-inch x 1/2-mm refuse product from each magnetite drain and rinse screen will be conveyed to a 1,200-ton capacity refuse bin to combine with the 3-inch x 3/8-inch refuse. This material will be discharged from the bin into dump trucks to be hauled to a refuse disposal area or back-hauled into the mine area.

1/2-mm x 0 Froth Flotation Circuit

The 1/2-mm x 0 raw coal slurry from the fine coal sumps will be pumped to eight banks of three large diameter classifying cyclones to give a nominal separation of 100 mesh. The 1/2-mm x 100-mesh cyclone underflow will flow to four banks of six coarse coal flotation machines via conditioners. By the addition of reagents and air injection, the coal will float, and it will be scraped off the slurry surface. The refuse material will pass through the cells and will be discharged to the refuse thickeners. The 100-mesh x 0 cyclone overflow will flow to eight banks of four fine coal flotation machines by conditioners. A similar process will produce a froth coal concentrate and a refuse product.

Froth Dewatering Circuit

The coal concentrates from all flotation machines will be filtered utilizing vacuum filters. The dewatered filter coal will be discharged to conveyors to be carried to the final product conveyors. The filtrate water from the filters will be used as spray water on the secondary raw coal screens.

The underflow from the primary magnetic separators, which flows to settling tanks, will be used for spray water on all the magnetite drain and rinse screens. Clarified water will also be used for spray water at this stage. The underflow from the settling tanks will be pumped to 16 secondary wet magnetic separators. The magnetite slurry or overdense medium recovered from these separators will flow to the

overdense storage sumps for reuse. The underflow from the secondary magnetic separators will contain some coal and refuse slimes, and will be used as spray water on the secondary raw coal screens. The coal in the underflow can therefore be recovered.

In addition, the refuse from the flotation machines will be treated in either of two conventional rake-type thickeners which will separate the flocculated solids from the water. The thickener underflow will be pumped to a refuse pond where the solids will settle, and a relatively clear water will overflow to a fresh water pond. Water will be returned from this fresh water pond to either of two clarified water sumps by vertical pumps. The thickener overflow water will also flow by gravity to either of the two clarified water sumps. Any makeup water required to compensate process losses will be added to these clarified water sumps. Clarified water will be pumped from these sumps for use as spray water for screens and for makeup to maintain sump operating levels.

Cleaned Coal Collection and Sampling Circuit

All the cleaned coal products will be collected by conveyors and conveyed through a prepared coal sampling system. This system will take a representative sample of the coal according to ASTM D2234, "Collection of a gross sample of coal." This sample will be crushed and further divided within the sampling system to give a manageable sample for quality control analysis. The final product will be conveyed to either a blending/stockpiling facility or directly to a unit train loadout facility.

The equipment required for the heavy media plant is shown in Table 12.

The general arrangement required for the heavy media plant is shown in Plates 300-08, 300-09, 300-10, and 300-11.

TABLE 12. MAJOR EQUIPMENT LISTING -
HEAVY MEDIA PLANT

Number Required	Unit Description
2	Raw coal bin feed conveyors
2	Belt scales
2	Raw coal tramp iron magnets
2	Raw coal shuttle conveyors
4	Raw coal feed bins

TABLE 12. (Continued)

Number Required	Unit Description
4	Vibrating feeders
8	Raw coal screens
4	Heavy media separators
8	Coarse cleaned coal fixed sieves
8	Coarse cleaned coal screens
4	Middlings fixed sieves
4	Middlings screens
4	Coarse refuse fixed sieves
4	Coarse refuse screens
4	Middlings crushers
8	Cleaned coal crushers
4	Low gravity distribution boxes
4	Low gravity sumps
8	Low gravity pumps
4	High gravity distribution boxes
4	High gravity sumps
8	High gravity pumps
2	Coarse coal collector conveyors
1	Refuse collector conveyor No. 1
1	Refuse collector conveyor No. 2
4	Raw coal sump
8	Raw coal pump
4	Raw coal distributors
16	Desliming sieve bends
16	Desliming screens
4	Fine coal sumps
12	Fine coal pumps
8	Cyclone feed primary distributors
16	Cyclone feed secondary distributors
32	Heavy media cyclones
32	Cleaned coal sieve bends
32	Cleaned coal screens
8	Fine refuse sieve bends
8	Fine refuse screens
24	Cleaned coal centrifuges
8	Correct medium distribution boxes
8	Cyclone feed sumps
16	Cyclone feed pumps
4	Centrifuged coal collector conveyors
8	Fine coal flotation cells
8	Coarse coal flotation cells
16	Fine coal flotation cells
24	Fine coal filters
24	Filtrate pumps
24	Vacuum pumps

TABLE 12. (Continued)

Number Required	Unit Description
2	Refuse thickeners
2	Clarified water sumps
6	Clarified water pumps
4	Thickener underflow pumps
1	Sludge and fresh water pond
3	Reclaimed water pumps
4	Clarified water head tanks
8	Filter cake collector conveyors
2	Fine refuse collector conveyors
2	Fine refuse transfer conveyors
1	Refuse bin
4	Bath dilute medium sumps
4	Cyclone dilute medium sumps
8	Bath dilute medium pumps
8	Cyclone dilute medium pumps
8	Primary magnetic separator distributors
4	Secondary magnetic separator distributors
32	Primary magnetic separators
4	Settling tanks
4	Settling tank underflow sumps
8	Settling tank underflow pumps
4	Settling tank overflow sumps
8	Settling tank overflow pumps
4	Effluent sumps
8	Effluent pumps
16	Secondary magnetic separators
4	Overdense sumps
8	Overdense pumps
4	Overdense distributor
1	Magnetite storage and handling system
3	Floor drainage sumps
3	Floor drainage pumps
2	Belt scales
2	Prepared coal collector conveyors
2	Prepared coal transfer conveyors
2	Prepared coal sampling systems

4.8.2 OPERATING CAPACITY - HEAVY MEDIA PLANT

The rate capacity of the standard heavy media plant is 75,000 tons per day of raw coal operating 250 days per year, giving an annual capacity of 18,750,000 tons per year of raw coal.

The plant has a hypothetical yield factor of .787 (output of prepared coal divided by input of raw coal), giving a plant rated output capacity of 59,025 tons per day of prepared coal, or an annual capacity of 14,756,250 tons per year of prepared coal.

4.8.3 ESTIMATED CAPITAL COSTS - HEAVY MEDIA PLANT

The capital cost of the standard 75,000 tons per day heavy media plant is estimated to be \$70,200,000. This cost estimate is for a complete turn-key facility and is based on the following assumptions:

- a. The purpose of the estimate is to provide a first-order estimate of preparation plant capital cost for use as one element in estimating the price of coal ready to ship for a variety of situations.
- b. This estimate is not a definitive estimate and should not be used or interpreted as such.
- c. The estimate is based on a hypothetical plant with only the plant equipment detailed with an equipment list.
- d. The plant design is not universal; specific situations might require resizing much of the equipment, or adding or deleting many items such as blending systems, thermal dryers, briquetting systems, grounding systems, etc.
- e. Prices are for the first quarter of 1975. Equipment prices are based on written and verbal quotations from vendors.
- f. Labor is based on similar projects using productivity and rates from the Gulf Coast.
- g. Bulk material quantities are based on similar projects for such items as foundations, structures, buildings, and equipment supports.
- h. Subcontracted electrical cost is based on connected horsepower; subcontracted painting cost is based on tonnage; subcontracted miscellaneous cost is based on similar projects.
- i. Piping within the structures is factored to the equipment plus a fire line, air line, and water line.

- j. Instrumentation costs are factored to equipment to be instrumented based on a minimum system panel in the area of the equipment.
- k. Dust collection cost is based on a factor plus experience on similar projects.
- l. The estimate excludes main power and water supply to the plant area, railroad systems, price escalation, and the cost of land.
- m. All costs include allowance for construction contingency and fee.
- n. The plant is located at or near sea level.

4.9 PREPARED COAL LOADOUT

The prepared coal loadout facilities will be common to all three plants. This section has been designed to load unit trains at a rate of 5,000 tons per hour.

The prepared coal loadout equipment is listed in Table 13 and shown in Figure 9.

TABLE 13. MAJOR EQUIPMENT LISTING -
PREPARED COAL LOADOUT

Number Required	Unit Description
2	Loadout conveyors
2	Belt scales
2	Loadout sampling systems
1	Loadout bin
1	Track scale

Product coal will be conveyed to the loadout system from the blending/stockpiling facility, or directly from the processing plant. A sampling system will sample the coal as it is being loaded into the unit trains. This system will take a representative sample of the coal according to ASTM D2234, "Collection of gross sample of coal." This sample would then be crushed and further divided within the sample system to give a manageable sample for analysis of the final shipped coal.

The coal will be delivered into a 200-ton capacity loadout bin situated over the rail track. The continuously moving unit trains will be loaded automatically by car sensors, and the cars will be weighed automatically by an "in-motion" track scale.

The installed capital cost of the coal loadout facility is estimated to be \$3,600,000.

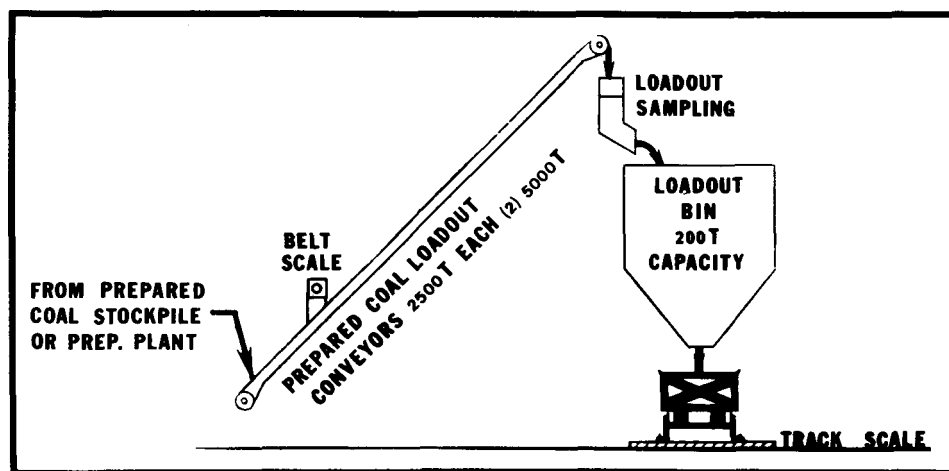


Figure 9. Prepared Coal Loadout

4.10 SUPPORT FACILITIES

Support facilities for a self-supporting turn-key operation include plant offices, warehouse, changehouse, maintenance shop and analytical laboratory plus allowances for plant roads and fencing, yard piping and sanitary system.

Hypothetical support facilities for a 75,000-tons-per-day plant are estimated to have a capital cost of \$8,100,000. Actual costs would vary depending on the extent and complexity of the overall preparation effort, on the potential sharing of facilities with other parts of the mine complex, and on the potential subcontracting of maintenance, warehousing, and laboratory operations.



PART 10

BASELINE VALUES FOR CPF AND GAA

The following tables show the baseline values created for CPF and GAA for a mining complex rated at 75,000 tons per day production:

Table 1. CPF Baseline Values

Table 2. CPF Personnel Quantity Baseline Values

Table 3. GAA Baseline Values

Table 4. GAA Baseline Exponents

TABLE 1. CPF Baseline Values

(75,000 tons per day plant size)

	RECEIVE BREAK	STOCK BLEND	LOADOUT	CRUSH SCREEN	C.S. SUPPORT	BAUM JIG	B.J. SUPPORT	HEAVY MEDIA	H.M. SUPPORT
CAPITAL COST	17,700,000	67,400,000	3,600,000	9,500,000	8,100,000	52,100,000	8,100,000	70,200,000	8,100,000
MAINT LABOR COST/HR	71.52	81.09	30.56	54.31	174.02	184.13	215.38	249.38	232.32
MAINT MATL & SVC COST/HR	122.07	309.86	10.33	43.67	101.25	287.42	101.25	516.37	101.25
FUEL COST/HR	-	-	-	12.41	-	15.45	-	17.93	-
WATER COST/HR	-	-	-	-	-	4.65	-	82.38	-
POWER COST/HR	45.05	99.87	22.12	19.08	128.12	185.00	128.12	314.65	128.17
OPER LABOR COST/HR	68.78	105.53	55.83	79.24	143.62	161.06	166.80	220.21	189.99
EXPONENT CAPITAL COST	.8	.8	1.0	.8	.5	.75	.5	.7	.5
EXPONENT MAINT LABOR	.35	.35	.35	.35	.35	.35	.35	.35	.35
EXPONENT MAINT MATL	.8	.8	1.0	.8	.5	.75	.5	.7	.5
EXPONENT FUEL	-	-	-	.8	-	.75	-	.7	-
EXPONENT WATER	-	-	-	-	-	1.0	-	1.0	-
EXPONENT POWER	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
EXPONENT OPER LABOR	.35	.35	.35	.35	.35	.35	.35	.35	.35
HRS/YEAR	3625	5438	8712	5438	2000	5438	2000	5438	2000

TABLE 2. CPF Personnel Quantity Baseline Values

(75,000 tons per day plant size)

		RECEIVE BREAK	STOCK BLEND	LOADOUT	CRUSH SCREEN	C.S. SUPPORT	BAUM JIG	B.J. SUPPORT	HEAVY MEDIA	H.M. SUPPORT
OPERATORS CLASS	5 QTY/SHIFT									
	10						2		5	
	11					9.6		9.6	2	9.6
	13	2	8.5	2	2		6		6	
	17						2			
	18	2		2	2				6	
	22				3	4.8	3	7.2	3	9.6
	23	3	2	1	1		3		2	
MAINT CLASS	4 PERCENT	7.4	8.7	6.9	13.1	9.7	9.6	11.8	11.3	14.6
	5	7.4	4.4	6.9	6.4	19.5	9.6	15.7	9.9	14.6
	6	29.6	26.1	27.8	25.9	29.2	28.8	31.5	31.1	32.8
	12	21.2	12.5	19.9	18.7	23.3	12.8	22.6	12.2	21.0
	13					9.3		7.5		7.0
	14	7.1	4.2	6.6	6.1		9.2		6.8	
	18	20.5	40.1	25.6	23.9		24.8		24.8	
	22					9.0		10.9		10.0
	23	6.8	4.0	6.3	5.9		5.2		3.9	

TABLE 3. GAA Baseline Values

BASELINE MINE CHARACTERISTICS

	DRAGLINE MINING					SHOVEL/TRUCK MINING		
	ILLINOIS	OHIO	FOUR C.	FT. UNION	TEXAS	POWDER R.	GREEN R.	W. VA.
GCDTPY Coal Demand, Tons Per Year	5,451,538	5,191,938	7,261,098	9,253,536	9,319,444	7,977,860	6,382,290	5,131,000
GEGR Expected Coal Recovery	.92							
GSR Stripping Ratio	16.435	13.42	4.5	3.5	3.5	2.602	7.00	11.97
GDBBPY Density of O'Bur, Bank/lb/CuYD	3700	4330	4230	2935	4190	4190	4290	4290
GTTYBS Total Tons of Mat'l Per Yr. Baseline	185.617	169.157	82.378	60.915	83.596	58.647	110.545	148.329
GTAD Total Acres Distrubed	25,506.7	24,300.0	11,324	15,587	18,838	3,583.0	9,987	20,000

BASELINE COST ESTIMATES

G1CCF Site Work, \$	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	350,000	1,500,000	1,500,000
G2SQF Buildings, Sq. Ft.	135,000	135,000	135,000	135,000	135,000	200,000	155,000	155,000
G2\$SQF Building Cost Per Sq. Ft.	36.25							
G2MSFF Annual Fuel Cost, \$	65,000	65,000	65,000	65,000	65,000	105,000	80,000	80,000
G2MSFW Annual Water Cost, \$	250	200	250	250	250	300	900	375
G3CCF Power System Cost, \$	4,500,000	4,500,000	4,500,000	4,500,000	4,500,000	5,000,000	8,900,000	2,500,000
G4ACCF H2O System Cost, Crushing Plant, \$	200,000							
G4BCCF H2O System Cost, Jig Plant, \$	150,000							
G4CCCF H2O System Cost, Media Plant, \$	550,000							
G5CCF Communications System	125,000	125,000	125,000	125,000	125,000	250,000	250,000	250,000
G6CCF Mobil Equipment	1,200,000							
G7CCF Shop Equipment	1,000,000							
G8PERC Land, Down Payment, Fraction	.10							
G8SR Land, Surface Rights, \$/acre	250							
G8MR Land, Mineral Rights, \$/acre	50							
G8YRS Life of Operation, Years	30							
G9CCF Exploration Drilling, \$/Hole	1,000	1,000	1,000	1,000	1,000	500	1,000	1,000
G9AHØL Exploration Drilling, Acres/Hole	40	40	40	40	40	40	40	80
G10CCF Engineering	6,000,000							
G11CCF Environmental Impact Report	1,000,000							
G13PRC Staff Pers., Fraction of Union Pers.	.16	.16	.16	.16	.16	.22	.16	.25
G13MPW Total Union Manpower Estimate	580	492	580	580	580	694	2,058	800
G13FCT Supplies, \$/Year per Staff Person	2,000							
G13ØCL Work Classification-Staff	24							
G13ØSC Work Schedule-Staff	3							
G13AWR Average Staff Annual Wage Rate, \$	17,900							
G15ØY Royalty on Coal, \$/Ton	.25							
G15STX Severance Tax, \$/Ton	.00							
G15UNI Union Persion Fund, \$/Ton	.11							

TABLE 4. GAA BASELINE EXPONENTS

G1EXP	Exponent for Extrapolation-Site Work	.35
G2EXP1	Exponent for Extrapolation-Buildings	.85
G2EXP2	Exponent for Extrapolation-Fuel	.90
G2EXP3	Exponent for Extrapolation-Water	.75
G3EXP	Exponent for Extrapolation-Power	.70
G4EXP	Exponent for Extrapolation-H2O System	.45
G5EXP	Exponent for Extrapolation-Communications	.40
G6EXP	Exponent for Extrapolation-Mo. Eq.	.85
G7EXP	Exponent for Extrapolation-Shop Eq.	.45
G10EXP	Exponent for Extrapolation-Engineering	.55
G11EXP	Exponent for Extrapolation-Env.Imp.Report	.25
G13EXP	Exponent for Extrapolation-Staff Pers.	.90