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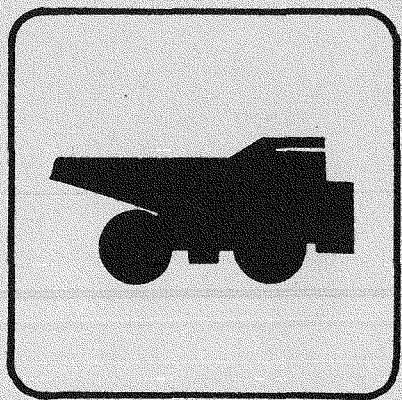
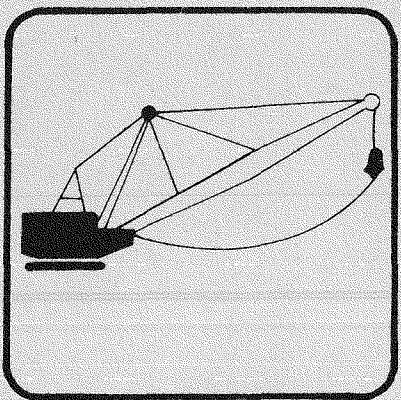
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FINAL REPORT
VOLUME 10

Economics of Large-Scale Surface Coal Mining Using Simulation Modes

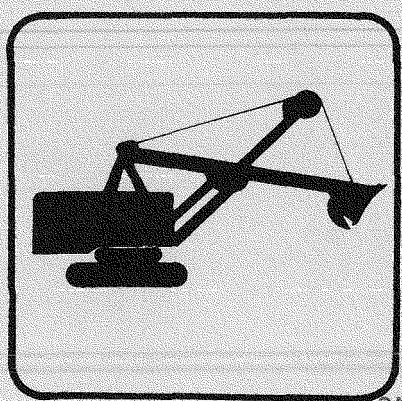
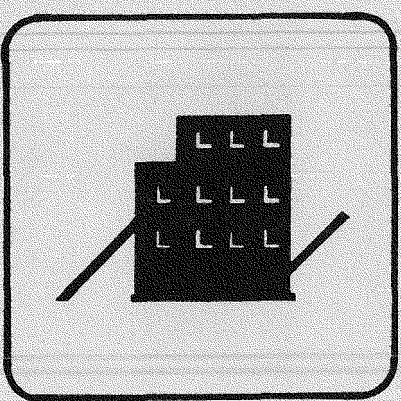
User's Manual for
Area Dragline Macromodel

MASTER



ENERGY RESEARCH &
DEVELOPMENT
ADMINISTRATION

OFFICE OF
FOSSIL ENERGY



WORK PERFORMED UNDER
CONTRACT NO.
EX-76-C-01-1520

FLUOR UTAH, INC.
SAN MATEO, CALIF.

BONNER & MOORE
ASSOCIATES, INC.
HOUSTON, TEXAS

MARCH, 1977

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Final Report
Volume 10

ECONOMICS OF LARGE-SCALE SURFACE COAL MINING
USING SIMULATION MODELS

USER'S MANUAL FOR AREA DRAGLINE MACROMODEL

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Houston, TX 77002

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ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

Under Contract No. EX-76-C-01-1520

ECONOMIC SYSTEM ANALYSIS OF
COAL PRECONVERSION TECHNOLOGY

MASTER

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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 the User's Manual for a computer model which simulates a surface coal mine using a dragline for overburden removal in the area-stripping mining method. The mine may include any of the following operations:

- Overburden drilling and blasting
- Overburden removal
- Coal drilling and blasting
- Coal loading and hauling
- Coal handling and preparation
- Land clearing and reclamation
- General support functions such as premining activities, central facilities, staff and taxes and royalties

The model develops equipment requirements and ownership and operating costs for direct analysis in constant dollars. The model also develops input for processing with the Cash Flow Analysis Model when a discounted cash flow analysis is desired.

This model is 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 the User's Manual for the Area Dragline Macro (ADM) Model which simulates a surface coal mine using draglines for overburden removal in the area-stripping mining method. The user may include any of the following mining functions in the mine under study:

- Overburden drilling and blasting
- Overburden removal
- Coal drilling and blasting
- Coal loading and hauling
- Coal handling and preparation
- Land clearing and reclamation
- General support functions such as premining activities, central facilities, staff and taxes and royalties.

The model sizes primary and secondary equipment and calculates ownership and operating costs for each included operation and for the total project. At user option, the ADM model will prepare all input needed for processing with the Cash Flow Analysis (CFA) Model (report FE-1520-113). The two models permit the analysis of a mining project without cash flow discounting (the ADM reports) or with cash flow discounting (the CFA reports).

This report contains two parts. Part 1, 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 Area Dragline Macro Model.

Part 2 is the User's Manual for the ADM model; it contains four sections and four appendices. The User's Manual explains how to formulate a problem for model solution, the manner in which the model processes problem statements, and the contents of all model output. The appendices contain details of model logic and arithmetic and an example solution.

This model is part of a series of models developed under this contract; references to all project reports are contained in Appendix A of Part 1. Each model is designed

to be used by itself or as part of the system; therefore, each User's Manual was prepared as a stand-alone document. The manuals have been reproduced as parts of the project final reports so that all models would appear in context. Thus, each User's Manual part has its own internal Table of Contents, and paragraph and page numbering.

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.

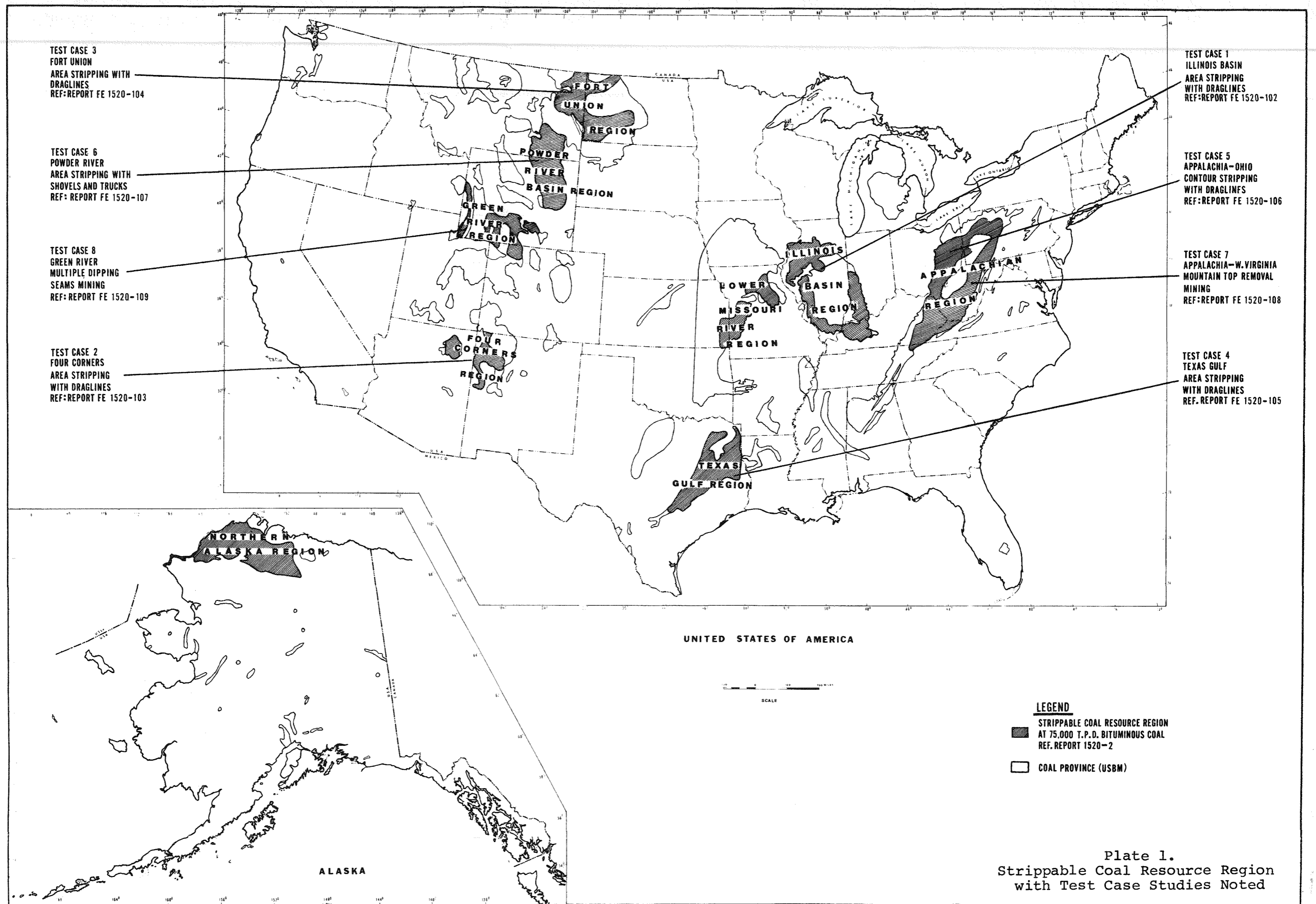
Broad Macro Level. The macromodels simulate an entire mine using a specified mining method identified by the overburden removal method, and provide first-order estimates for the mining complex.

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.

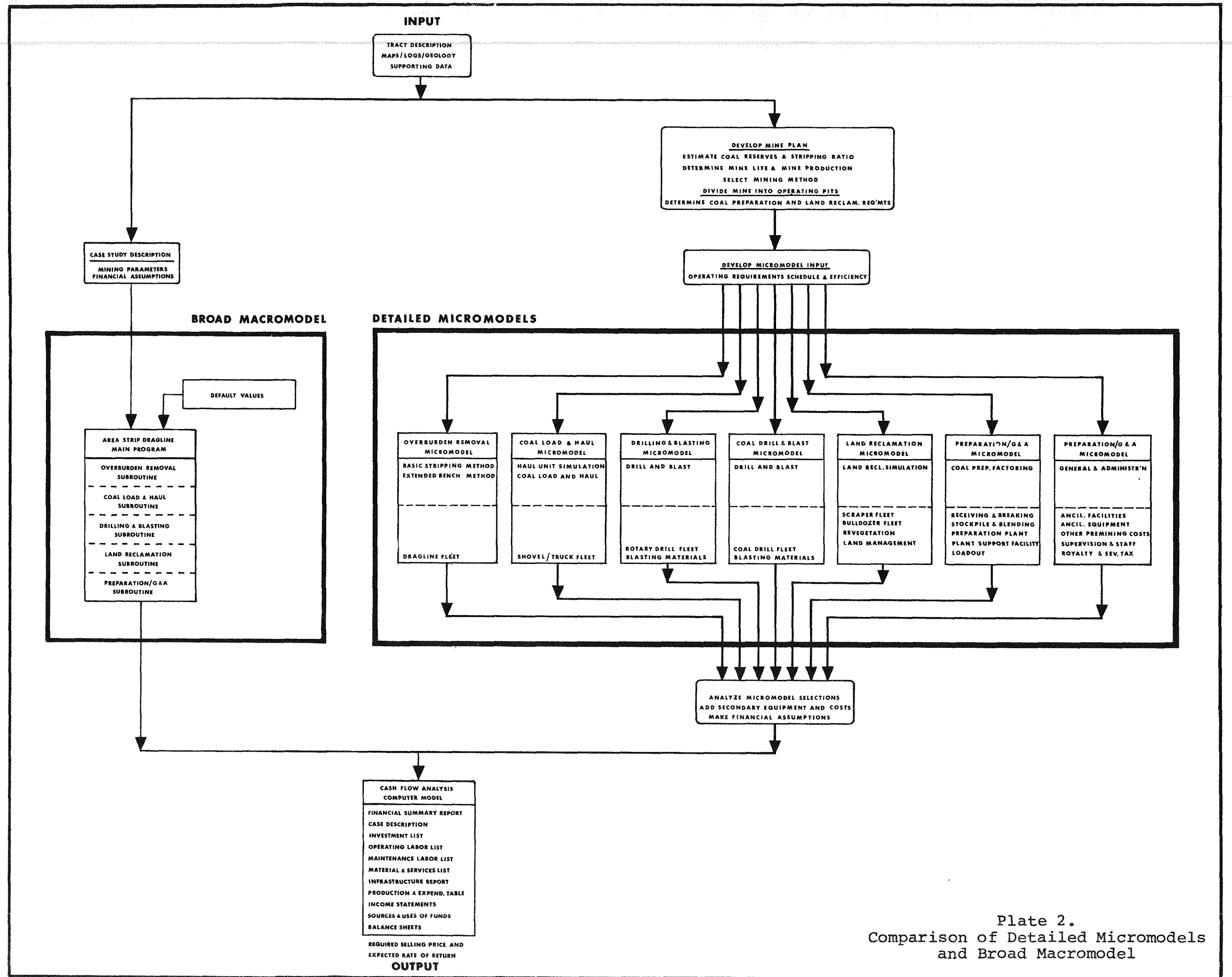


Plate 2.
Comparison of Detailed Micromodels
and Broad Macromodel

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 micromodels 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)				

6

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 THE ADM MODEL

The ADM model determines equipment requirements and estimates ownership and operating costs for all mining operations comprising a complete mine complex. The model assumes a dragline is used to remove overburden in an area in which the terrain and the coal seam are relatively level. The ADM reports provide useful information concerning the mining project; however, the ADM model is intended to develop input for the CFA model so the project analysis will include cash flow discounting. The ADM model analyzes the steady-state operations and determines costs in constant dollars. The CFA model makes a complete financial analysis to determine the coal sales price needed to make a specified return on investment or the return from a specified sales price.

1.7.1 ADM/CFA INPUT

Many model parameters can be set by the user to control the actions of the two models; however, only the following need be set for most case studies:

Mining Parameters

- Thickness of topsoil to be saved
- Average depth of overburden
- Average coal seam thickness
- Equivalent Btu's required from the complex
- Run-of-mine coal heating value
- Revegetation and land management costs

Financial Assumptions

- Paid-in capital/long-term debt ratio
- Surface rights cost
- Mineral rights cost
- Royalties
- State and local severance taxes
- Federal income tax rate
- Long-term debt interest rate
- Short-term debt interest rate
- *Desired return on investment
- *Coal sales price

*If coal sales price is zero, model determines price needed to yield the specified return; if coal sales price is not zero, model will determine return on investment.

The model uses default values for the many other parameters which describe the mining situation and financial conditions. The model has four sets of default parameters for mining in four coal-bearing regions: Illinois Basin, Texas Gulf, Four Corners, and Fort Union. All model parameters are explained in the User's Manual for the user who wishes to study other regions.

1.7.2 THE ADM MODEL

The ADM model consists of a main program and a series of subroutines; each subroutine simulates one mining operation. The main program uses the input and default parameters to determine production requirements for each operation and then uses the subroutines for those operations included in the case.

The model begins by determining the preparation plant run-of-mine coal feed requirements. The production is allocated to one or more operating pit, and the subroutines are used to determine equipment requirements and costs.

The subroutines are based on the following micromodels:

- Basic Stripping Method (FE-1520-114)
- Drilling and Blasting (FE-1520-116)
- Coal Load and Haul (FE-1520-116)
- Land Reclamation Simulation (FE-1520-116)
- Coal Preparation Factoring (FE-1520-116)
- General and Administrative (FE-1520-116)

For each operation, the model generates three types of data: size and quantity of primary equipment and facilities, size and quantity of support equipment, and input for the CFA model. The model summary report details investments and ownership and operating costs.

1.7.3 THE CFA MODEL

The CFA model input, as developed by the ADM model, comprises a complete description of a coal mining project. The CFA model makes the discounted cash flow analysis of the project to determine the sales price required for the specified return on investment or the return on investment from the specified coal sales price. The two models can be used in a single computer run without user intervention. However, the user could intervene and modify the project description to handle special situations. The user could also prepare separate CFA input control files to study changes in financial parameters on a project defined by the ADM model.

1.7.4 RANGE OF APPLICATION

The ADM model default values and internal logic have been defined to study dragline strip mines in the four coal-bearing regions mentioned in paragraph 1.7.1. The user can easily obtain results by setting the parameters listed in paragraph 1.7.1 and using the default file for the region under study. The user also has the option of changing any or all default values to match his own field data and experience or to study another region.

The macromodel has been tested over a range of values for each parameter in each region. These tests are described in reports FE-1520-102 through FE-1520-105. The tests were made to determine the sensitivity of the results to the parameters, but they also indicate the range of expected application of the model.

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

AREA DRAGLINE MACRO (ADM) MODEL
USER'S MANUAL

27 October 1976

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ADM MODEL USER'S MANUAL
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SECTION 1
INTRODUCTION

1.1 PURPOSE AND SCOPE

This manual describes the Area Dragline Macro (ADM) model in sufficient detail so a user can correctly formulate a problem statement to solve one or more cases with the model.

1.2 MODEL BACKGROUND

The model simulates the operation of a surface coal mine which includes the following unit operations:

- ▣ Overburden drilling with rotary drills and blasting with ANFO.
- ▣ Overburden removal with a walking dragline.
- ▣ Coal drilling with auger drills and blasting with ANFO
- ▣ Coal loading with a loading shovel into bottom-dump trucks for hauling.
- ▣ Topsoil removal and re-spreading with self-loading scrapers, and spoil bank regrading with bulldozers.
- ▣ Coal blending, stockpiling, and preparation.
- ▣ Premine and other general and administrative (GAA) functions.

For the first five operations, the model uses a combination of regression equations, exact mathematical relations, and data file costs. Factoring equations are used for the remaining two operations.

The regression equations used in the ADM model were derived from the following micro (detailed) models:

- ▣ Basic (Dragline) Stripping Method
- ▣ Drilling and Blasting
- ▣ Land Reclamation Simulation
- ▣ Coal Load and Haul

These models are described in separate User's Manuals.

Baseline mining situations typical of Illinois Basin area stripping operations were defined for each model. The baseline solutions were reviewed, and a set of control (independent) variables were defined for each model. Five values corresponding to extreme high, expected high, expected average, expected low, and extreme low were defined for each variable.

A series of case studies were run varying the parameters through the defined range of values, and graphs were drawn to illustrate the response of each dependent variable to each independent variable. Based on these cases and graphs, the form of each regression equation was derived, and case studies and correlations were run to develop the regression equation coefficients. The resulting equations are used in the ADM model.

Flow sheets and cost estimates were developed by Fluor Utah for three preparation plants:

- ▣ Crushing and Screening
- ▣ Baum Jig
- ▣ Heavy Media

The user specifies which plant is to be used, and factoring equations scale the baseline flow sheets and costs to fit the problem statement.

The GAA needs for a baseline area strip mine were developed by Fluor Utah. A series of factoring equations are used in the ADM model to scale the GAA requirements to fit the problem statement.

1.3 ORGANIZATION OF THE MANUAL

This manual consists of four sections and four appendices. Following this Introduction:

- ▣ Section 2 describes the model steps. This section is written for the macroeconomic study user, and contains some model equations. It also contains portions of the model output so that user control parameters, model logic, and output are discussed in the context of each mining operation. (For cross-reference, the subsection numbers correspond to section numbers and titles in Appendix B.)
- ▣ Section 3 describes the input controls for the macroeconomic study user. It also describes how to build the ADM input data file.
- ▣ Section 4 contains background information about Appendices B, C, and D.
- ▣ Appendix A contains the complete model output for an example problem. The extracted model output in Section 2 is taken from this example problem. Thus, the Appendix is intended to show the final product.

- Appendix B contains the complete set of model equations, and provides a full exposition of these equations.
- Appendix C contains the complete list of variables which can be controlled by the user.
- Appendix D lists all default values for all controllable model variables.

1.4 USING THIS MANUAL

The ADM model was designed to meet the needs of two users; one user accepts the mining engineering judgments built into the model, and the other wishes to alter those judgments. This manual was written for the first user, but the appendices contain information for the second user. The manual explains how to use the model to solve problems; the appendices contain a complete exposition of the model arithmetic and all variables under user control

For macroeconomic studies, the user need be concerned only with the limited number of variables described in the body of this manual. The user who wishes to alter the model logic needs to understand all of the variables discussed in the body of the manual and defined in the appendices.

The ADM 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 ADM model economic reports are in steady-state or base-year dollars; when an ADM run is followed with a CFA run, the economics include the time-value-of-money effects. The CFA model is described in another manual; only the data files which connect the two models are described in this manual.

The ADM model develops the equipment data cards for the CFA model. The cards are listed in this manual, and are discussed only in the context of the ADM model actions. The manual assumes the user understands the CFA model and the formats and contents of the equipment data cards.

SECTION 2
MODEL OPERATION

2.1 PREPARATION PLANT SIZING

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.

The preparation plant flow sheets were developed for plants feeding 75,000 tons/day of ROM coal, and producing 0.4095×10^{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	Crush & Screen	10990	0.99	1.0036
2	Baum Jig	12760	0.825	1.0373
3	Heavy Media	13084	0.787	1.06

The user sets parameters PPNE and PPNHV to control the plant sizing, and the plant size factoring equation and solution for the example problem are:

$$\begin{aligned} \text{PPNS} &= \text{PPNE} / \text{PPBED} * \text{PPBHV} / \text{PPNHV} * \text{PPBT} \\ &= 0.13\text{E}15 / 0.4095\text{E}15 * 10990 / 12000 * 75000 \\ &= 21805.6 \end{aligned}$$

This example plant produces 21,587 tons/day of prepared coal having an energy content of 12,043.2 Btus/pound.

The ROM coal demanded from the mining complex is 5.45 million tons/year, and the resulting prepared coal production is 5.397 million tons/year. For a 30-year project, the total feed demand is 163.45 million tons, and the production is 161.91 million tons or 3.9×10^{15} equivalent Btus.

2.2 DETERMINE NUMBER OF PITS AND CALCULATE VOLUMES

Factoring equations determine the number of equal-sized operating pits needed to supply the preparation plant. Each pit will be equal to, or less than, the baseline operating pit. The model adjusts the pit dimensions such that an integer number of pits is used. The pit dimensions and expected coal and overburden production rates are calculated.

The baseline pit produced about 1.82 million tons/year of ROM coal. The example problem requires three pits, each producing 1.81713 million tons/year. The resulting stripping ratio is 17.86 (defined as bank cubic yards of overburden/ton of ROM coal), and each dragline must remove 32.46 million cubic yards/year of overburden. The topsoil handled for reclamation is not included in overburden since it is not moved by the dragline.

The four-foot coal seam contains 1,603 tons of ROM coal/acre foot, and the acres disturbed in each pit total 8,501.8.

2.3 OVERBURDEN DRILLING AND BLASTING

A regression equation determines the required number of drills of a predefined size. Data file costs are extended to determine the investment, ownership, and operating costs for drilling. A regression equation determines the explosives costs. Factoring equations determine the required support equipment.

The regression equation which determines the required number of 15-inch rotary drills is:

$RNORD = 5.60855 \begin{matrix} / HC \\ * DBCD / 1E6 \\ * DBHB \\ / DEPR \end{matrix}$ $= 1.809$	<p>PARAMETER VALUES</p> <p>4 .181713E7 71 100</p>
--	---

The regression equation which determine the explosives cost are:

$DBTEC = 111 + 109.22 \begin{matrix} / HC \\ * DBCD / 1E6 \\ * DBHB \\ * DEPRPY \end{matrix}$ $= 1167.84$ $DBTEC = DBTEC + BLCRLO + 1000 = 1167.84 + 30 + 1000$ $= .35035E8$	<p>PARAMETER VALUES</p> <p>4 .181713E7 71 .3</p>
--	--

The model prints the following details concerning the primary equipment for drilling and blasting:

OVERBURDEN DRILL AND BLAST STATISTICS									
DRILL	QT	SH	CG	CP	CN	REF.#			
1.809	2	15.000	440.8	33.04	46.55	16			
RD OWN	RD OPER	#SP	SP OWN	EX TOT	RD \$/T	EX \$/T			
.64686E 07	.82431E 07	0	.00000	.35035E 08	.26987	.64268			

The detail information for single pit is interpreted as follows:

<u>Item</u>	<u>Definition</u>	<u>Value</u>
DRILL	Required Number of Drills	1.809
QT	Number of Drills for Investment	2
SH	Drill Diameter	15 inches
CG	Investment Cost	440.8 M\$
CP	Hourly Ownership Cost	\$33.04
CN	Hourly Operating Cost	\$46.55
REF #	Data File Reference Number	16
RD OWN	Total Ownership Cost	6.4686 MM\$
RD OPER	Total Operating Cost	8.2431 MM\$
#SP	Number of Spare Drills	0
SP OWN	Investment Cost for Spares	0
EX TOT	Total Explosive Cost	35.035 MM\$
RD \$/T	Drilling Cost/Ton of ROM Coal	\$0.27
EX \$/T	Explosive Cost/Ton ROM Coal	\$0.643

The following summary information is printed for drilling and blasting:

QT.		INITIAL INVESTMENT	ANNUAL OWNERSHIP	ANNUAL OPERATING	PROJECT TOTAL	\$/ ROM TON	\$/ DEL TON
6	O.B. ROTARY DRILLS SUPPORT EQUIP.	.264480E 07 623100.	646839. 187019.	.441485E 07 439765.	.151851E 09 .188035E 08	.929 .115	.938 .116
	PROJECT TOTALS	.326790E 07	833858.	.485462E 07	.170654E 09		
TONS DELIVERED =		.161906E 09	COST = 1.05403				\$/TON
BTUS DELIVERED =		.390000E 16	COST = .437575E-01				\$/MM BTU

Since there are three pits in this example solution, the number of drills is six. The ROTARY DRILL data include explosives since they are considered as primary equipment by the model. The items included in the SUPPORT EQUIP. line are discussed later.

The INITIAL INVESTMENT data are simply extensions of the unit cost times the number of units. For example, the drill investment is $440.8 * 6$ or \$2.6448 million.

The ANNUAL OWNERSHIP cost is not an extension of the hourly ownership; it is re-calculated. Ownership costs depend upon the depreciation life of the equipment and the operating hours in the application. The data file cost is determined with average values; the user's problem statement should have the same number for depreciation life (the value should be taken from the data file data), but the operating hours may be different. The ownership cost includes 14 percent of the average annual investment as the cost of insurance, taxes, and interest.

The ANNUAL OPERATING cost for drill and support equipment is an extension of the hourly operating cost. The project total cost is the sum of annual ownership cost and the operating cost, multiplied by the project life. The PROJECT TOTAL is divided by total ROM tons for \$/ROM TON, and by the total prepared coal for \$/DEL TON. The remaining lines are self-explanatory.

The following CFA equipment cards are prepared by the model:

```

*          3 OVERBURDEN DRILL AND BLAST
ECR6 D1  RD16  6  0 3263  97385.2  7  3  .80  1  0 30 3625
ED1  D1  RD16  ROTRY DRILL 15.000 IN 70 HP  B 60R-3ERB
ED2  D1  RD16  440.8 20000  .000  1  2  0  1.000  .000  0
ED3  D1  RD16  10.14  6.76  .00  .00  2.87  .00  7.04
EPO1 D1  RD16  15  5 1.0 18  5 1.0
EPM1 D1  RD16  6 10 1.0
ECR6 D2  BLST  3  0 1631  97385.2  7  3  .00  0  0 30 1813
ED1  D2  BLST  BLASTING
ED3  D2  BLST  .00  .00  .00  .00  .00  .00  716.02
EPO1 D2  BLST  15  1 1.0
ECR6 D3  CD3A  3  0 3263  0  7  3  0  1  0  30 3625
ED1  D3  CD3A  TR TRACTOR  300 HP  C D8K RSPS
ED2  D3  CD3A  135.3 12000  .0  1  2  0  1.  .0  0
ED3  D3  CD3A  3.96  7.00  3.71

```

```

EPM1 D3 CD3A 6 10 1.0
ECRG D4 LD1 3 0 1631 0 7 3 0 1 0 30 1813
ED1 D4 LD1 WH LOADER 1.5 YD 80 HP C9206A
ED2 D4 LD1 36.4 12000 .0 1 2 0 1 .0 0
ED3 D4 LD1 1.06 4.73 1.07 .32
EPM1 D4 LD1 6 10 1.0
ECRG D5 TD1 3 0 1631 0 7 3 0 1 0 30 1813
ED1 D5 TD1 PRILL TRUCK
ED2 D5 TD1 36.0 20000 .0 1 2 0 1 .0 0
ED3 D5 TD1 .95 1.31 .66 .57
EPM1 D5 TD1 6 10 1.0
EPM1 D5 TD1 6 10 1.0
ZZZZZZZZZZZZZZZZZZ

```

The text describing the equipment is contained in the D1 cards. The ECRG cards define the quantity of each item to be included. There are six ROTARY DRILL and three each BLASTING, TR TRACTOR, WH LOADER, and PRILL TRUCK. The later three categories are support equipment, and one of each is assigned by the model to each operating pit.

A complete explanation of these cards is found in the CFA Model User's Manual.

2.4 OVERBURDEN REMOVAL WITH DRAGLINE

The pit geometry is solved to find the required dragline operating radius, and the bucket is sized to meet the production requirements. Regression equations determine the specifications, investment, ownership, and operating costs of a dragline that will have the required radius and production capacity. Factoring equations determine the support equipment needs.

The annual overburden removal demand is converted to a dragline bucket size with the following equation:

$$\begin{aligned} DBSW &= DLSW * (2000 + DEEPLY / (1 + SFB)) / 4740.74 \\ &= 126.124 * (2000 + 3700 / (1.35)) / 4740.74 \\ &= 126.124 \end{aligned}$$

The following equation solves the pit geometry to give the required effective dumping radius for the dragline:

$$\begin{aligned} DLEDR &= 3 + HC * COTB + HBA * (1 + SFB) * COTT \\ &\quad + HBA * COTA + PWF / 4 \\ &= 3 + 5 * .25 + 71 * 1.35 + 71 * .5 + 100 / 4 \\ &= 208.275 \end{aligned}$$

The effective dumping radius measures the dumping radius from a safe working distance from the edge of the high-wall. The model uses an iterative procedure to size a dragline that will provide the needed radius. A series of regression equations (refer to Appendix B) are used to develop the dragline specifications and costs.

The model prints the following detail information about the dragline:

DRAGLINE STATISTICS

SA	SB	SW	RMA	X	ST	PE
279.0	35.0	126.1	228.3	28.797	10561.0	6442.0
CA	CI	CM	CN	CO		
12806.	15773.	146.48	97.64	46.38		
CL	CR		TCL	ACR	TCR	
220.490	342.571		.493919E 08	.255798E 07	.767393E 08	

The detail information for a single pit is interpreted as follows:

<u>Item</u>	<u>Definition</u>	<u>Value</u>
SA	Boom Length	279 feet
SB	Boom Angle	35°
SW	Bucket Size	126 cubic yards
RMA	Radius from Boom Foot	228.3 feet
X	Correlation Factor	28.797
ST	Working Weight	10561. M pounds
PE	Peak Electric Demand	6442. KW
CA	Purchase Price	12806 M\$
CI	Investment Cost	15773 M\$
CM	Maintenance Cost	146.48 \$/hour
CN	Maintenance Materials Cost	97.64 \$/hour
CO	Electricity Cost	46.38 \$/hour
CL	Ownership Cost	220.49 \$/hour
CR	Operating Cost	342.57 \$/hour
TCL	Total Ownership Cost	49.3919 MM\$
ACR	Annual Operating Cost	2.55798 MM\$
TCR	Total Operating Cost	76.7393 MM\$

The following summary information is printed for the three dragline pits:

QT.		INITIAL INVESTMENT	ANNUAL OWNERSHIP	ANNUAL OPERATING	PROJECT TOTAL	\$/ ROM TON	\$/ DEL TON
3	DRAGLINES	.473199E 08	.500013E 07	.767393E 07	.380222E 09	2.325	2.348
	SUPPORT EQUIP.	.145038E 08	.171818E 07	.377719E 07	.168624E 09	1.031	1.041
	PROJECT TOTALS	.618236E 08	.671831E 07	.114511E 08	.548846E 09		
	TONS DELIVERED =	.161906E 09	COST = 3.38990	\$/TON			
	BTUS DELIVERED =	.39C000E 16	COST = .140730	\$/MM BTU			

The calculation methods for this summary information are the same as explained under "Drilling and Blasting".

The following CFA equipment data cards are developed by the model:

```

*          4 OVERBURDEN REMOVAL
ECR6 01  DL1      3      0 7467  97385.2      7 3 .80 4 0 30 8297
ED1  01  DL1  DRAGLINE      126 CY 279 FT  10561 279 35
ED2  01  DL1  15773.3      224010      0 1 5 0      1      0 0
ED3  01  DL1  97.64 146.48      .00      .00 46.38      .00      .00
EPO1 01  DL1  2 12  1  8 12  3
EPM1 01  DL1  6 10  1
ECR6 02  CD3      3 0 7467 0 7 3 0 1 0      30 8297
ED1  02  CD3  TR TRACTOR  300 HP      C D8K RPS
ED2  02  CD3  135.3 24000 0.0 1 2 0 1. 0.0 0
ED3  02  CD3  2.00 3.50 1.90 .00 .00 .00 .00
EPO1 02  CD3  2 12 1
EPM1 02  CD3  6 10 1.0
ECR6 03  LD16     3 0 2374 0 7 3 0 1 0      30 2638
ED1  03  LD16  WH LOADER  325 HP      C 988 6A
ED2  03  LD16  123.0 12000 .0 1 2 0 1.0 .0 0
ED3  03  LD16  3.81 20.49 3.93 2.75 .00 .00 .00
EPO1 03  LD16  2 12 1
EPM1 03  LD16  6 10 1.0
ECR6 04  BXCT     3 0 2000 0 6 3 0 1 0      1 2000
ED1  04  BXCT  BOX CUTS      3762 MCY
ED2  04  BXCT  .0 0 .0 0 0 0 1. .0 0
ED3  04  BXCT  0 0 0 0 0 0 1881.
ECR6 05  DL2      3 0 7467 0 7 3 0 4 0      30 8297
ED1  05  DL2  DRAGLINE      31 CY 260 FT
ED2  05  DL2  4576.3 224010      .0 1 5 0 1. .0 0
ED3  05  DL2  30.17 45.25 .00 .00 14.36 .00 .00
EPO1 05  DL2  2 12  2 8 12 1 9 12 1
EPM1 05  DL2  6 10 1.0
ZZZZZZZZZZZZZZZZZZZZ

```

The first dragline is the primary equipment, and there are four support equipment items. The model provides one of the following items for each pit:

- 300-horsepower track-type tractor
- 325-horsepower wheeled loader
- 31-cubic-yard dragline with 300-foot boom
- 3762 thousand-cubic-yard opening box cut

Note that the box cut is treated as a one-time operating expense which is incurred in the sixth year (the other operations start in the seventh year), with an operating cost of \$1881/hour.

2.5 COAL DRILLING AND BLASTING

A regression equation determines the required number of drills of a predefined size. Data file costs are extended to determine the investment, ownership, and operating costs for drilling. Another regression equation determines the explosives costs. Factoring equations determine the required support equipment.

The regression equation which determines the required number of three-inch auger drills is:

$$\begin{aligned}
 RNDQD &= .3 * QBCD / 1E6 * 3263 / QDCRDH \\
 &= .3 * .181713E7 / 1E6 * 3263 / 1632 \\
 &= 1.09
 \end{aligned}$$

The regression equation which determines the total cost of explosives is:

$$\begin{aligned}
 QBTEC &= .05 * QBCD * QLCRLO \\
 &= .05 * .181713E7 * 30 \\
 &= .2725695E7
 \end{aligned}$$

The model prints the following details concerning the primary equipment for drilling and blasting:

CCAL DRILLING AND BLASTING STATISTICS

DRILL	QT	SH	CG	CP	CN	REF.#		
1.090	1	3.000	37.3	3.30	17.46	23		
QD OWN	QD OPER	#SP	SP OWN	EX TOT	QD \$/T	EX \$/T		
.16157E 06	.93173E 06	0	.00000	.27257E 07	.20055E-01	.50000E-01		

The detail information for single pit is interpreted as follows:

<u>Item</u>	<u>Definition</u>	<u>Value</u>
DRILL	Required Number of Drills	1.09
QT	Number of Drill for Investment	1
SH	Drill Diameter	3 inches
CG	Investment Cost	37.3 M\$
CP	Hourly Ownership Cost	\$3.30
CN	Hourly Operating Cost	\$17.46
REF #	Data File Reference Number	23
QD OWN	Total Ownership Cost	0.16157 MM\$
QD OPER	Total Operating Cost	0.93173 MM\$
#SP	Number of Spare Drills	0
SP OWN	Investment Cost for Spares	0
EX TOT	Total Explosive Cost	2.7257 MM\$
QD \$/T	Drilling Cost/Tons of ROM Coal	\$0.02
EX \$/T	Explosive Cost/Ton ROM Coal	\$0.05

The following summary information is printed for drilling and blasting.

QT.		INITIAL INVESTMENT	ANNUAL OWNERSHIP	ANNUAL OPERATING	PROJECT TOTAL	\$/ROM	\$/TON DEL
3	COAL ROTARY DRILLS	111900.	17603.2	358053.	.112697E 08	.069	.070
	SUPPORT EQUIP.	108000.	16989.7	71628.4	.265854E 07	.016	.016
	PROJECT TOTALS	219900.	34592.9	429682.	.139282E 08		

TONS DELIVERED = .161906E 09 COST = .863265E-01 \$/TON
 BTUS DELIVERED = .390000E 16 COST = .357134E-02 \$/MM BTU

Since there are three pits in this solution, the number of drills is "3". The ROTARY DRILL data include explosives since they are considered as primary equipment by the model. The items included in the SUPPORT EQUIP. line are discussed later. The INITIAL INVESTMENT data are simply extensions of the unit cost times the number of units. For example, the drill investment is $37.3 * 3$ or \$111,900.

The ANNUAL OWNERSHIP cost is not an extension of the hourly ownership; it is recalculated. Ownership costs depend upon the depreciation life of the equipment and the operating hours in the application. The data file cost is determined with average values; the user's problem statement should have the same number for depreciation life (the value should be taken from the data file data), but the operating hours may be different. The ownership cost includes 14 percent of the average annual investment as the cost of insurance, taxes, and interest.

The ANNUAL OPERATING cost for drill and support equipment is an extension of the hourly operating cost. The project total cost is the sum of annual ownership cost and the operating cost, multiplied by the project life. The PROJECT TOTAL is divided by total ROM tons for \$/ROM TON and by total prepared coal for \$/DEL TON. The remaining lines are self-explanatory.

The following CFA equipment cards are prepared by the model:

```

*          5 COAL DRILL AND BLAST
ECRG Q1   QD23   3   0 1632 1828.83   7 3 .80 1 0.30 1813
ED1 Q1    QD23 AUGER DRILL 3.000 IN   C D 3-18
ED2 Q1    QD23 37.3 20000 .000 1 2 0 1.000 .000 0
ED3 Q1    QD23 1.02 .68 .00 .00 .90 .00 3.60
EPO1 Q1   QD23 15 1 1.0 0 0 .0
EPM1 Q1   QD23 6 10 1.0
ECRG Q2   QLST   3   0 1632 1828.83   7 3 .00 0 0.30 1813
ED1 Q2    QLST BLASTING
ED3 Q2    QLST .00 .00 .00 .00 .00 .00 55.67
EPO1 Q2   QLST 15 1 1.0 18 5 1.0
ECRG Q5   TDQ1   3 0 1632 0 7 3 0 1 0 30 1813
ED1 Q5    TDQ1 PRILL TRUCK
ED2 Q5    TDQ1 36.0 20000 .0 1 2 0 1. 0. 0
ED3 Q5    TDQ1 .95 1.31 .66 .57
EPO1 Q5   TDQ1 11 1 1.0
EPM1 Q5   TDQ1 6 10 1.0
ZZZZZZZZZZZZZZZZZZ

```

The text describing the equipment is contained in the EDI cards. The ECRG cards define the quantity of each item to be included.

These equipment cards were produced from a problem in which coal is drilled and blasted, but overburden is not. In this case, the support equipment includes one Prill Truck per pit. If overburden is also drilled, the model does not create the Prill Truck equipment cards for coal; the assumption is that the one Prill Truck can serve both operations.

Also, the operating personnel assignments for blasting coal are included only when overburden is drilled and blasted. That is, the EPO1 card under Blasting (EPO1 Q3 QLST) is not written to the equipment file when overburden drilling and blasting is included.

Since the Prill Truck is not assigned when overburden is drilled and blasted, the summary data will not include the support equipment line.

2.6 COAL LOAD AND HAUL

The models use a predefined coal loading shovel and bottom-dump trucks for loading and hauling. First, the production capacity of the shovel is determined. Regression equations determine the haul cycle times for the first and last years of operations. The truck fleet is sized for each of these years, and the equation relating truck fleet to operating year is developed. The initial fleet requirement is rounded up to an integer to set the initial fleet size. The equation is solved to find the year when the demand exceeds the production, and a deferred truck is added to the fleet. The equation is solved again to find when this fleet capacity is exceeded, and another deferred truck is added. This process is repeated for the mine life.

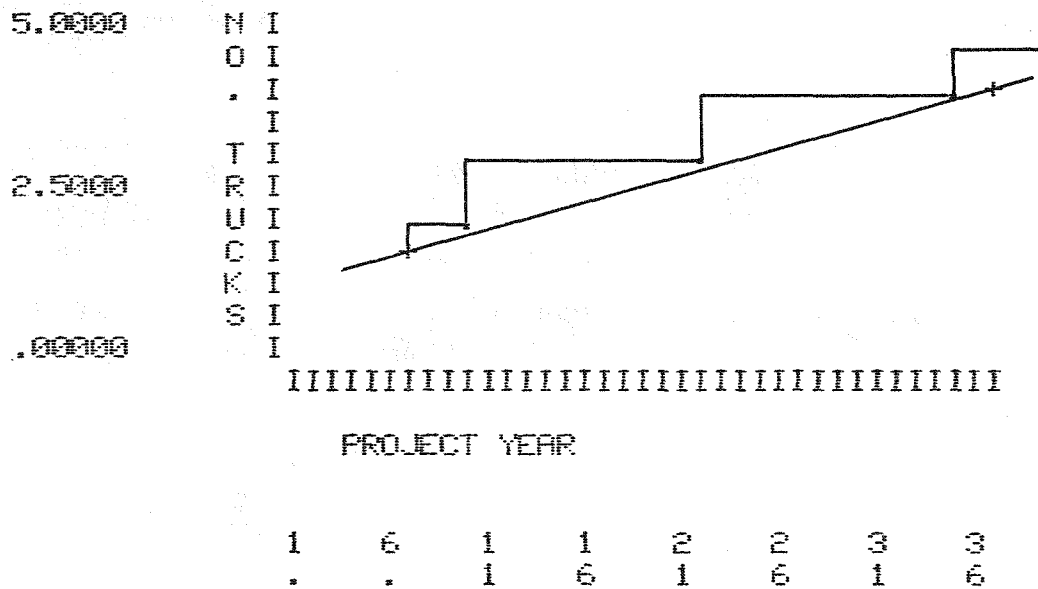
Data file costs are extended to determine investment, ownership, and operating costs. Factoring equations determine the support equipment needs.

The first step is to ascertain shovel production capacity, based on the shovel dipper size, shovel cycle time, truck capacity, and time needed to spot the truck at the shovel for loading. The shovel is required to make an integer number of cycles for a truck load. A regression equation is used to establish the haul cycle time, based on haul distance and the truck weight and horsepower. The production capabilities are converted to required numbers of shovels and trucks.

The model assumes that the loading pit is relatively near the first mining panel, and that the hauling distance will increase as the mining panel advances. As the haul distance increases, the haul cycle time increases; and trucks must be added to the fleet.

The trucks added to the fleet after startup are called deferred trucks, since the investment is deferred until after startup.

The model determines the initial fleet and the deferred trucks (how many and when) with the following procedure: First, the required number of trucks for startup is ascertained as 1.723. The haul distance is then augmented by the full length of panel advance, and the requirement at the project end is determined as 4.157 trucks. Both of these values are rounded up to the next highest integer (2,5) to establish the required fleet sizes. The initial fleet goes into operation in year 7; the fleet of five trucks is needed at the end of the project, or at the beginning of the next year, 37. The model assumes the increase in truck requirements is linear with time, and the following graph can be drawn:



The "+" points on the graph are the initial and final fleets, and the "." points are the fleets of two, three, and four trucks. The horizontal lines intercept the slope in the years in which the truck fleet capacity is exceeded. The following data apply to these points:

<u>No. in Fleet</u>	<u>Year</u>
2	10.41
3	22.74
4	35.06

These data indicate that the capacity of the two-truck fleet is exceeded in year 10, and the first deferred truck is added to the fleet. The three-truck fleet capacity is exceeded in year 22, and the second deferred truck is added. This four-truck fleet capacity is exceeded in year 35, and the third deferred truck is added.

The model prints the following detail information for coal load and haul:

COAL LOAD AND HAUL STATISTICS

SHOVEL	QT	ST	SW		CA	CG	CP	CN	REF.#
.458	1	650	16.0		901.0	1043.0	40.98	51.93	34
TRUCK	QT	SC	SL	DT	CA	CG	CP	CN	REF.#
1.723	2	1200	360	E	433.9	399.3	22.81	54.16	18
SD OWN		SD OPER		TD DWN		TD OPER	SPARE DWN	#SP	\$/TON
.43109E 07		.53826E 07		.44651E 07		.91335E 07	.00000	0	.427

The information applies to the initial fleet in one pit. Deferred trucks and number of pits are taken into account for

the summary calculations. The information can be interpreted as follows:

<u>Item</u>	<u>Definition</u>	<u>Value</u>
SHOVEL	Required Number of Shovels	0.458
QT	Number of Shovels for Investment	1.
ST	Shipping Weight	650 M pounds
SW	Dipper Capacity	16 cubic yards
CA	Purchase Price	901 M\$
CG	Investment Cost	1043 M\$
CP	Hourly Ownership Cost	\$40.98
CN	Hourly Operating Cost	\$51.93
REF #	Data File Reference Number	34
TRUCK	Required Number of Trucks	1.723
QY	Number of Trucks for Investment	2
SC	Truck Horsepower	1200
SL	Truck Payload	360 M pounds
DT	Truck Drive Type	E (electric)
CA	Purchase Price	433.9 M\$
CG	Investment Cost	399.3 M\$
CP	Hourly Ownership Cost	\$22.81
CN	Hourly Operating Cost	\$54.16
REF #	Data File Reference Number	18
SD OWN	Shovel Total Ownership Cost	4.0109 MM\$
SD OPER	Shovel Total Operating Cost	5.0826 MM\$
TD OWN	Truck Total Ownership Cost	4.4651 MM\$
TD OPER	Truck Total Operating Cost	9.1335 MM\$
SPARE OWN	Spares Ownership	0
#SP	Number of Fleet Spares	0
\$/TON	Total Cost/Total ROM Tons	\$0.427/ton

The number of truck fleet spares is set to zero because the model sizes integer fleets, and each fleet has overcapacity. The model assumes the overcapacity will absorb downtime for which fleet spares are normally required.

The model prints the following summary information:

QT.		INITIAL INVESTMENT	ANNUAL OWNERSHIP	ANNUAL OPERATING	PROJECT TOTAL	\$/ ROM	\$/ TON DEL TON
3	SHOVELS, 6 TRUCKS	.552480E 07	847566.	.122961E 07	.623151E 08	.381	.385
	SUPPORT EQUIP.	.101310E 07	268947.	941439.	.363116E 08	.222	.224
	DEFERRED TRUCKS	.359370E 07	669730.	.159027E 07	.331467E 08	.203	.205
	PROJECT TOTALS	.101316E 08	.178624E 07	.376132E 07	.131773E 09		
	TONS DELIVERED =	.141906E 09	COST = .813887				\$/TON
	BTUS DELIVERED =	.390000E 16	COST = .337880E-01				\$/MM BTU

Three shovels and six trucks are required for the three operating pits. This summary information is calculated in the manner explained under "Drilling and Blasting". The initial investment cost for deferred trucks is listed under INITIAL INVESTMENT, even though the investment is actually deferred for cash flow analysis. Since each deferred truck is put into operation after the startup, its operating life is less than that of the initial fleet. The life is taken into account in converting ANNUAL OWNERSHIP and ANNUAL OPERATING costs to PROJECT TOTAL for deferred trucks.

The following CFA equipment cards are developed by the model:

* 6 COAL LOAD AND HAUL												
ECRG	C 1	SD34	3	0	3262	5451	7	3	.80	2	0	30 3625
ED1	C 1	SD34	SHCVEL		16	CU. YD.						H1900CL5045C
ED2	C 1	SD34	1043.00		60000	.00	1	5	0	1.000	.000	0
ED3	C 1	SD34	6.76	20.27	.00	.00	3.44			.00	.00	
EPO1	C 1	SD34	1	5	1.0	8	5	1.0				
EPM1	C 1	SD34	6	10	1.0							
ECRG	C 2	TD18	6	0	3262	5451	7	3	.80	1	0	30 3625
ED1	C 2	TD18	TRUCK		180	TCN						UBD180D180TE
ED2	C 2	TD18	399.300		30000	.00	1	2	0	1.000	.000	0
ED3	C 2	TD18	7.52	11.28	11.23	17.86						
EPO1	C 2	TD18	11	5	1.0							
EPM1	C 2	TD18	6	10	1.0							
ECRG	C 3	L16	3	0	3262	0	7	3	0	1	0	30 3625
ED1	C 3	L16	WH LOADER		325	HP						C 988 GA
ED2	C 3	L16	123.0	12000	.0	1	2	0	1.0	.0	0	
ED3	C 3	L16	3.81	20.49	3.93	2.75	.00	.00	.00			
EPO1	C 3	L16	2	5	1							
EPM1	C 3	L16	6	10	1.0							

```

ECRG C 4 GD5      3 0 3262 0 7 3 0 1 0      30 3625
ED1  C 4 GD5 GRADER      180 HP      C 14G PS
ED2  C 4 GD5      80.1 15000 .0 1 2 0 1. .0 0
ED3  C 4 GD5      1.61 12.93 2.14 1.26 .00 .00 .00
EPO1 C 4 GC5      11 5 1.0
EPM1 C 4 GD5      6 10 1.0
ECRG C 5 PUMP      3 0 1440 0 7 3 0 1 0      30 1440
ED1  C 5 PUMP PUMP SET      125000 GPH
ED2  C 5 PUMP      10.0 21600 .000 1 2 0 1. .0 0
ED3  C 5 PUMP      3.65 1.50 1.09
EPO1 C 5 PUMP      22 5 1.0
EPM1 C 5 PUMP      6 10 1.0
ECRG C 6 TDX2      3 0 1631 0 7 3 0 1 0      30 1812
ED1  C 6 TDX2 H2O TRUCK      5000 GAL
ED2  C 6 TDX2      124.6 20000 .0 1 2 0 1. .0 0
ED3  C 6 TDX2      6.35 5.70 5.65 .50 .00 .50
EPO1 C 6 TCX2      21 1 1.0
EPM1 C 6 TDX2      6 10 1.0
ECRG C 7 TD18      3 0 3262      5451 10 3 0 1 1 27 3625
ECRG C 8 TD18      3 0 3262      5451 22 3 0 1 1 15 3625
ECRG C 9 TD18      3 0 3262      5451 35 3 0 1 1 2 3625
ZZZZZZZZZZZZZZZZ

```

The support equipment consists of one of the following items for each operating pit:

- ▣ 325-horsepower wheeled loader
- ▣ 180-horsepower grader
- ▣ 125,000 gallon/hour pump set
- ▣ 5000-gallon water truck

The loader and grader operate on the two-shift schedule of the shovel and truck. The water truck operates a single shift. The pump set operating hours are set as default values.

2.7 LAND RECLAMATION

Land reclamation uses a predefined self-loading scraper to remove and respread topsoil, and a pre defined bulldozer to regrade soil banks. Regression equations determine the required number of scrapers and bulldozers. Additional bulldozers are defined on the basis of general regrading costs. Data file costs are extended to determine investment and ownership and operating costs. Factoring equations determine the support equipment needs.

The equation for the required number of scrapers is:

$$\begin{aligned}
 \text{RNDSC} &= (.0157 + 5.432 * \text{CDRTY}/\text{HC} \\
 &\quad + 7.3666 * (\text{CDRTY}/\text{HC})^{**2}) \\
 &\quad + \text{HBT} \\
 &= 4.003
 \end{aligned}$$

PARAMETER VALUES
 CDRTY = .181713E7
 HC = 4
 HBT = 1

The equation for the required number of bulldozers is:

$$\begin{aligned}
 \text{RNDSD} &= -.0077476 * \text{CDRTY}/\text{HC} * \text{RCTT} * \text{RCPWF} \\
 &\quad + .000642157 * \text{CDRTY}/\text{HC} * \text{RCTT} * \text{RCPWF}^{**2} \\
 &\quad + .00664438 * \text{CDRTY}/\text{HC} * \text{HBT} \\
 &= 3.52
 \end{aligned}$$

PARAMETER VALUES
 CDRTY = .181713E7
 HC = 4
 RCTT = 1.5
 HBT = 1

Control parameter ROC specifies reclamation costs which cannot be directly simulated by the model. The total cost, in \$/acre, is converted by the model to three cost elements: general bulldozing, revegetation, and land management. The general bulldozing cost, RCCG, is included in

the required-number-of-bulldozers equation, which converts the per-acre cost into a direct equipment element. The other two cost elements are converted to costs on the basis of the acres disturbed.

The model prints the following detail information for scrapers and bulldozers:

LAND RECLAMATION STATISTICS

SCRAPER	QT	SA	SR	CG	CP	CN	REF.#							
4.004	4	32	415	201.1	22.26	38.21	6							
DOZER	QT		SK	CG	CP	CN	REF.#							
3.521	4		410	192.5	21.30	31.18	5							
SC OWN	SC OPER	#SP	SP OWN	CD OWN	CD OPER	#SP	SP OWN	RV TOT\$	LM TOT\$					
.48782E 07	.82610E 07	2	.24041E 07	.46008E 07	.59287E 07	0	.00000	.17004E 07	.85018E 06					

This information can be interpreted as follows:

<u>Item</u>	<u>Definition</u>	<u>Value</u>
SCRAPER	Required Number of Scrapers	4.004
QT	Quantity for Investment	4
SA	Capacity	32 cubic yards
SR	Horsepower	415
CG	Investment Cost	201.1 M\$
CP	Hourly Ownership Cost	\$22.26
CN	Hourly Operating Cost	\$38.21
REF #	Data File Reference Number	6
DOZER	Required Number of Bulldozers	3.521
QT	Quantity for Investment	4
SK	Horsepower	410
CG	Investment Cost	192.5 M\$
CP	Hourly Ownership Cost	\$21.30
CN	Hourly Operating Cost	\$31.18
REF #	Data File Reference Number	5
SC OWN	Scraper Total Ownership Cost	4.8082 MM\$
SC OPER	Scraper Total Operating Cost	8.2610 MM\$
#SP	Number of Spare Scrapers	2
SP OWN	Spare Total Ownership Cost	2.4041 MM\$
CD OWN	Bulldozer Total Ownership Cost	4.6008 MM\$

Item	Definition	Value
CD OPER	Bulldozer Total Operating Cost	5.9287 MM\$
#SP	Number of Spare Bulldozers	0
SP OWN	Spare Bulldozers Total Ownership Cost	0
RV TOT \$	Total Revegetation Cost	1.7004 MM\$
LM TOT \$	Total Land Management Cost	.85018 MM\$

The model prints the following summary information:

QT.		INITIAL INVESTMENT	ANNUAL OWNERSHIP	ANNUAL OPERATING	PROJECT TOTAL ROM	\$/TON	\$/DEL TON
11	DOZERS, 14 SCRAPERS	.493290E 07	.113703E 07	.183531E 07	.891702E 08	.545	.551
	PROJECT TOTALS	.493290E 07	.113703E 07	.183531E 07	.891702E 08		
	TONS DELIVERED =	.161906E 09	COST = .550752	\$/TON			
	BTUS DELIVERED =	.390000E 16	COST = .228642E-01	\$/MM BTU			

The methods to develop summary data are the same as described under "Drilling and Blasting".

The following CFA equipment data cards are developed by the model:

```

+
      7 LAND RECLAMATION
ECRG L1  CD 5  11  0 1800  .850  7  3  .80  1  0 30 2000
ED1  L1  CD 5  TR TRACTOR 410 HP  C D9H RUPS
ED2  L1  CD 5 192.5 12000  .000  1  2  0  1.000  .000  0
ED3  L1  CD 5  5.64 10.32  5.35  .00  .00  .00  .00
EPD1 L1  CD 5 11  6 1.0  0  0  .0  0  0  .0  0  0  0  .0
EPM1 L1  CD 5  6 10 1.0  0  0  .0  0  0  .0  0  0  0  .0
ECRG L2  SC 6  12  2 1800  .850  7  3  .00  1  0 30 2000
ED1  L2  SC 6  SCRAPER 32 CY 415 HP  C 633C E32
ED2  L2  SC 6 201.1 12000  .000  1  2  0  1.000  .000  0
ED3  L2  SC 6  9.19  9.19  5.13  3.55  .00  .00  .00
EPD1 L2  SC 6  2  6 1.0  0  0  .0  0  0  .0  0  0  0  .0
EPM1 L2  SC 6  6 10 1.0  0  0  .0  0  0  .0  0  0  0  .0
ECRG L3  RVGT  1  0 1800  .850  8  3  .00  0  0 30 2000
ED1  L3  RVGT REVEGETATION
ED3  L3  RVGT  .00  .00  .00  .00  .00  .00  94.46
ECRG L4  LMGT  1  0 1800  .850  8  3  .00  0  0 30 2000
ED1  L4  LMGT LAND MGT
ED3  L4  LMGT  .00  .00  .00  .00  .00  .00  47.23
ZZZZZZZZZZZZZZZZZZ

```

2.8 PREPARATION PLANT FACTORING

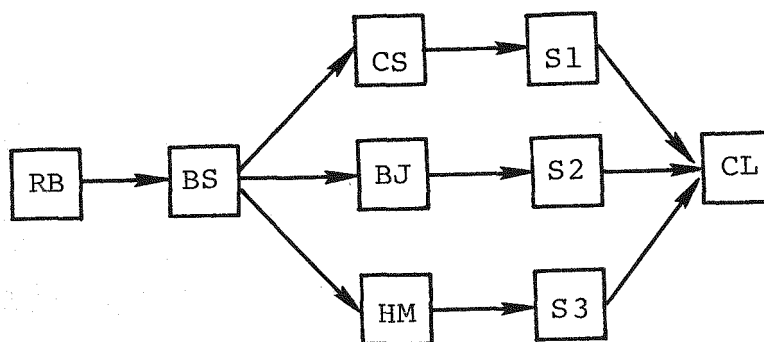
The model develops one of three preparation plants. Each of these plants consists of five operations:

- 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 (Index to Preparation Plant Type). 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 following diagram illustrates the flow through the nine blocks:



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 factoring equation uses PSR, the ratio of the problem plant size to the baseline plant size (where both sizes are measured in units of ROM tons/day). In the example problem, the plant size is 21805.6 tons/day, the baseline plant size is 75,000 tons/day, and the ratio is 0.29074.

Six operating costs are calculated using the equation:

$$HC = F * PSR^X$$

where:

- HC - is \$/hour cost.
- F - is the cost factor.
- X - is the exponent.
- PSR - is plant size ratio,
as defined above.

The following table lists the values of F and X for the six cost elements:

	RB	BS	CL	CS	S1	BJ	S2	HM	S3
DLF	68.78	105.53	55.83	79.24	143.62	161.06	166.80	220.21	189.99
DLX	.35	.35	.35	.35	.35	.35	.35	.35	.35
MLF	71.52	81.09	30.56	54.31	174.02	184.13	215.38	249.38	232.32
MLX	.35	.35	.35	.35	.35	.35	.35	.35	.35
MMF	122.07	309.86	10.33	43.67	101.25	287.42	101.25	516.37	101.25
MMX	.80	.80	.80	.80	.50	.75	.50	.70	.50
FCF	.00	.00	.00	12.41	.00	15.45	.00	17.93	.00
FCX	.00	.00	.00	.80	.00	.75	.00	.70	.00
WCF	.00	.00	.00	.00	.00	2.40	.00	4.20	.00
WCX	.00	.00	.00	.00	.00	1.00	.00	1.00	.00
ELF	45.05	99.87	22.12	19.08	128.12	185.00	128.12	314.85	128.12
ELX	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

The first two characters in the row labels of this table identify the cost element, as follows:

- OL - Operating Labor
- ML - Maintenance Labor
- MM - Maintenance Materials
- FC - Fuel
- WC - Water
- EL - Electricity

The same equation form is used to determine capital cost (investment), using the following values of F and X:

<u>Block ID</u>	<u>F</u>	<u>X</u>
RB	17,700	0.8
BS	67,400	0.8
CL	3,600	1.
CS	9,500	0.8
S1	8,100	0.5
BJ	52,100	0.75
S2	8,100	0.5
HM	70,200	0.7
S3	8,100	0.5

In addition to calculating operating and maintenance labor costs as defined above, the model determines the number of personnel for entry into the CFA equipment data cards. The baseline personnel needs are factored with the same equation form, with an exponent of 0.35 for all operating labor. The

following table lists the baseline quantity (F in the factoring equation) and personnel codes:

<u>Block ID</u>	<u>F</u>	<u>Personnel Code</u>
RB	2	13
	2	18
	3	23
BS	8.5	13
	2	23
CL	2	13
	2	18
	1	23
CS	2	13
	2	18
	3	22
	1	23
S1	9.6	11
	4.8	22
BJ	6	13
	2	17
	3	22
	2	23
	2	10
S2	9.6	11
	7.2	22
HM	6	13
	6	17
	3	22
	3	23
	5	5
	2	10
S3	9.6	11
	9.6	22

The personnel codes are explained in the CFA User's Manual.

The pre-assigned maintenance labor codes and fractions entered into the CFA equipment data file are listed in the following table:

<u>Block ID</u>	<u>Personnel Code</u>	<u>F</u>
RB	4	.074
	5	.074
	6	.296
	14	.071
	12	.212
	18	.205
	23	.068
	BS	4
5		.044
6		.261
14		.042
12		.125
18		.401
23		.040
CL		4
	5	.069
	6	.278
	14	.066
	12	.199
	18	.256
	23	.063
	CS	4
5		.064
6		.259
14		.061
12		.187
18		.239
23		.059

<u>Block ID</u>	<u>Personnel Code</u>	<u>F</u>
S1	4	.097
	5	.195
	6	.292
	12	.233
	13	.093
	22	.090
BJ	4	.096
	5	.096
	6	.288
	12	.128
	14	.092
	18	.248
	23	.052
S2	4	.118
	5	.157
	6	.315
	12	.226
	13	.075
	22	.109
HM	4	.113
	5	.099
	6	.311
	12	.122
	14	.068
	18	.248
	23	.039
S3	4	.146
	5	.146
	6	.328
	12	.210
	13	.070
	22	.100

The following detail information is printed:

PREPARATION PLANT STATISTICS

TYPE	SIZE TONS/DAY	BTU/LB	DELIVERED COAL			
			TCNS/YEAR	BTU/YEAR		
1	21805.6	12043.2	.539687E 07	.130000E 15		
			UNIT INVESTMENT	LABOR OWNERSHIP OPERATING	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 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

In this listing, the first set of data lines were developed when the preparation plant is sized as explained in Subsection 2.1. This line recaps the plant size as 21,805.6 tons of ROM coal/day. The prepared coal has a heat content of 12,043.2 Btus/pound; the delivered coal rate of 5.39768 million tons/year yields 0.13×10^{15} equivalent Btus/year. The UNIT INVESTMENT columns lists the capital costs for each block. The hourly costs are printed in three categories: LABOR, OWNERSHIP, and OPERATING. The O&O \$/TON lists the total labor plus ownership plus operating hourly costs, converted to daily costs and divided by the daily feed rate. Thus, the O&O \$/TON figure refers to ROM coal delivered to the preparation plant.

The following summary information is printed:

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
	PROJECT TOTALS	.406266E 08	.429287E 07	.377488E 07	.242033E 09		
	TCNS DELIVERED =	.161906E 09	COST = 1.49489				\$/TON
	BTUS DELIVERED =	.390300E 16	COST = .620597E-01				\$/MM BTU

These data summarize the detail information converted to annual and total figures. Note that the example problem assumes a single preparation plant (defined by default parameters).

It is possible to alter the number of plants through the secondary default parameter, as explained in the appendices. If this is done, the model takes into account the number of units in each block for factoring and extends the factored values to obtain total values. Because the factoring equation is non-linear, the total cost of a number of smaller plants will be greater than the cost of a single plant, where the total feed rate is the same in both cases.

The following lists the CFA equipment data cards for the preparation plant:

```

*
      8 COAL PREPARATION PLANT
ECRG P 1  PRRB      1      0 3625 5396.87      7 3 .80 3 0 30 3625.
ED1  P 1  PKRB REC & BREAK PREP. PLANT
ED2  P 1  PRRB 6588.37      108750 .000 1 5 0 1.000 .000 1
ED3  P 1  PRRB 46.41 45.44      .00 .00 13.10 .00
EPO1 P 1  PRRB 13 5 1.3 18 5 1.3 23 5 1.9
EPM1 P 1  PRRB 4 5 .074 5 5 .074 6 5 .296 14 5 .071 12 5 .212
EPM2 P 1  PRRB 18 5 .205 23 5 .068
ECRG P 2  PRBS      1      0 5438 5396.87      7 3 .80 3 0 30 5438.
ED1  P 2  PRBS BLEND-STOCK PREP. PLANT
ED2  P 2  PRBS 25087.9      163140 .000 1 5 0 1.000 .000 1
ED3  P 2  PRBS 52.63 115.34      .00 .00 29.04 .00
EPO1 P 2  PRBS 13 9 5.5 23 9 1.3
EPM1 P 2  PRBS 4 5 .087 5 5 .044 6 5 .261 14 5 .042 12 5 .125
EPM2 P 2  PRBS 18 5 .401 23 5 .04
ECRG P 3  PRCL      1      0 8712 5396.87      7 3 .80 3 0 30 8712.
ED1  P 3  PRCL COAL LOADOUT PREP. PLANT
ED2  P 3  PRCL 1046.67      261360 .000 1 5 0 1.000 .000 1
ED3  P 3  PRCL 19.83 3.85      .00 .00 6.43 .00
EPO1 P 3  PRCL 13 12 1.3 18 12 1.3 23 12 .6
EPM1 P 3  PRCL 4 5 .069 5 5 .069 6 5 .278 14 5 .066 12 5 .199
EPM2 P 3  PRCL 18 5 .256 23 5 .063
ECRG P 4  PRCS      1      0 5438 5396.87      7 3 .80 3 0 30 5438.
ED1  P 4  PRCS CRUSH-SCREEN PREP. PLANT
ED2  P 4  PRCS 3536.13      163140 .000 1 5 0 1.000 .000 1
ED3  P 4  PRCS 35.25 16.26      4.62 .00 5.55 .00
EPO1 P 4  PRCS 13 9 1.3 18 9 1.3 22 9 1.9 23 9 .6
EPM1 P 4  PRCS 4 5 .131 5 5 .064 6 5 .259 14 5 .061 12 5 .187
EPM2 P 4  PRCS 18 5 .239 23 5 .059
ECRG P 5  PRS1      1      0 2000 5396.87      7 3 .80 3 0 30 2000.
ED1  P 5  PRS1 CS SUPPORT PREP. PLANT
ED2  P 5  PRS1 4367.55      60000 .000 1 5 0 1.000 .000 1
ED3  P 5  PRS1 112.93 54.59      .00 .00 37.25 .00
EPO1 P 5  PRS1 11 5 6.2 22 5 3.1
EPM1 P 5  PRS1 4 5 .097 5 5 .195 6 5 .292 12 5 .233 13 5 .093
EPM2 P 5  PRS1 22 5 .09
ZZZZZZZZZZZZZZZZZZ

```

2.9 GENERAL AND ADMINISTRATIVE

Thirteen functions are included in General and Administrative (G&A):

- 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 four-character name in each of these functions is the Equipment Identifier for the CFA equipment data cards.

Factoring equations are used to scale the baseline G&A costs to the costs for the problem definition. For most functions, the costs are scaled on the basis of total material moved in the complex, measured in cubic yards/year. The model calculates size ratio factor GSR for the problem statement. GSR is the ratio of total yards moved in the defined complex to total yards moved in the baseline complex. Since the example problem is the baseline solution, $GSR = 1$.

The capital cost factoring equation is of the form:

$$CC = CCF * GSR^{EXP}$$

where:

- CC - is the capital cost.
- CF - is the capital cost factor.
- GSR - is the size ratio (explained above).
- EXP - is a factoring exponent.

The CCF and EXP values are shown in the following table:

<u>Function No.</u>	<u>ID</u>	<u>CCF</u>	<u>EXP</u>
1	SITE	3 E 6	0.35
2	BLDG	4.89375 E 6	0.85
3	PWR	4.5 E 6	0.7
4	H2O Plant 1	2 E 5	0.45
	H2O Plant 2	4.5 E 5	0.45
	H2O Plant 3	5.5 E 5	0.45
5	COM	1.25 E 5	0.4
6	MBEO	1.2 E 6	0.85
7	SHEQ	1 E 6	0.45
8	LAND	NA	NA
9	XDRL	NA	NA
10	ENG	6 E 6	0.55
11	EIS	1 E 5	0.25
12	STF	NA	NA
13	RLTX	NA	NA

The Land Rights capital cost is determined on the basis of total acres disturbed in the complex. Two user-set parameters enter per-acre costs for surface rights (GASR) and mineral rights (GAMR). The sum of the two parameters multiplied by the total acres disturbed is the expected Land Rights total cost. Ten percent is taken as initial investment or capital cost, and the remainder is considered to be an operating cost.

The exploration drilling costs are determined on the basis of the expected per-hole drilling cost, the acres disturbed, and the expected number of holes/acre. The default values are \$1000/hole and 40 holes/acre. Thus, the capital cost is 1000 multiplied by ACRES, divided by 40.

There are no capital costs associated with supervisory staff and royalties and severance taxes.

Operating costs are calculated for four of the functions as follows. The Land Rights operating cost is as explained above. The Buildings operating cost covers water and fuel, and uses the factoring equation form shown for capital cost to develop annual costs. The cost factors and exponents are 65000 and 0.9 for fuel, and 250 and 0.75 for water.

The Royalty and Severance Tax costs are determined on the basis of tons of ROM coal, using two user-set parameters:

- 1) GARA - Royalty Amount
- 2) GAST - Severance Tax

Both parameters enter \$/ROM ton costs. A third default parameter (G15UNI) adds expected Union Welfare Payments. The default value of G15UNI is \$0.11/ton. The model converts the total of these \$/ton costs to \$/hour costs.

Three items are calculated for Supervisory Personnel: the cost of office materials and supplies is determined with the capital cost equation, using 18560 as the cost factor and 0.9 as the exponent; the number of staff personnel is determined with the capital cost equation, using 92.8 as the cost factor and 0.9 as the exponent; and the number of staff is multiplied by the baseline annual payroll (\$179,000) to obtain the problem payroll. The costs are converted from annual costs to hourly costs by the model.

The following detail information is printed:

GENERAL & ADMINISTRATIVE COSTS

		UNIT INVESTMENT	OWNERSHIP \$/HOUR	OPERATING \$/HOUR	O&O \$/TON
ROADS & SITE	ANC. FAC.	.30000E 07	155.16	.00	.061
BUILDINGS	ANC. FAC.	.489375E 07	253.10	32.62	.112
ELECT. SYS.	ANC. FAC.	.450000E 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.	.12000E 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	637635.	32.98	.00	.013
CONT. ENG.	PREMINE	.600000E 07	310.31	.00	.121
E. I. S.	PREMINE	.10000E 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

In this testing, the UNIT INVESTMENT column contains the capital costs calculated as explained above. These costs are converted to OWNERSHIP \$/HOUR, using 14 percent as the cost of property taxes and insurance. The OPERATING \$/HOUR figures are also as explained above. The O&O \$/TON data are determined by adding the two hourly costs and dividing by ROM tons/hour.

The following summary information is printed:

QT.	INITIAL INVESTMENT	ANNUAL OWNERSHIP	ANNUAL OPERATING	PROJECT TOTAL	\$/ ROM TON	\$/ DEL TON
GENERAL & ADMIN.	.233215E 08	.241232E 07	.396704E 07	.204139E 09	1.248	1.261
PROJECT TOTALS	.233215E 08	.241232E 07	.396704E 07	.204139E 09		
TONS DELIVERED =	.161906E 09	COST = 1.26085				\$/TON
BTUS DELIVERED =	.390000E 16	COST = .523434E-01				\$/MM BTU

These data are summations of the detail data.

The following CFA equipment data cards are developed:

```

*
          9 GENERAL & ADMINISTRATIVE
ECRG 6 1  SITE      1      0 2000      .000 7 1 .00 3 0 32 2000
ED1  6 1  SITE ROADS & SITE ANC. FAC.
ED2  6 1  SITE 3000.0 64000      .000 1 5 0 1.000 .000 1
ECRG 6 2  BLDG      1      0 2000      .000 7 1 .00 3 0 32 2000
ED1  6 2  BLDG BUILDINGS      ANC. FAC.
ED2  6 2  BLDG 4893.7 64000      .000 1 5 0 1.000 .000 1
ED3  6 2  BLDG      .00      .00 32.50      .00      .00      .12
ECRG 6 3  PWR      1      0 2000      .000 7 1 .00 3 0 32 2000
ED1  6 3  PWR ELECT. SYS.      ANC. FAC.
ED2  6 3  PWR 4500.0 64000      .000 1 5 0 1.000 .000 1
ECRG 6 4  H2O      1      0 2000      .000 7 1 .00 3 0 32 2000
ED1  6 4  H2O WATER SYS.      ANC. FAC.
ED2  6 4  H2O 200.0 64000      .000 1 5 0 1.000 .000 1
ECRG 6 5  COM      1      0 2000      .000 7 1 .00 3 0 32 2000
ED1  6 5  COM COMMUN. SYS.      ANC. FAC.
ED2  6 5  COM 125.0 64000      .000 1 5 0 1.000 .000 1
ECRG 6 6  MBEQ      1      0 2000      .000 7 1 .00 2 0 32 2000
ED1  6 6  MBEQ MOBILE SUP.      ANC. FAC.
ED2  6 6  MBEQ 1200.0 64000      .000 1 5 0 1.000 .000 0
ECRG 6 7  SHEQ      1      0 2000      .000 7 1 .00 2 0 32 2000
ED1  6 7  SHEQ EQUIP. SHOP      ANC. FAC.
ED2  6 7  SHEQ 1000.0 64000      .000 1 5 0 1.000 .000 0
ECRG 6 8  LAND      1      0 2000      .000 7 1 .00 5 0 32 2000
ED1  6 8  LAND LAND RIGHTS      PREMINE
ED2  6 8  LAND 765.2 64000      .000 1 1 0 1.000 .000 0
ED3  6 8  LAND      0.      0.      0.      0.      0.      0.      114.77
ECRG 6 9  XDRL      1      0 2000      .000 7 1 .00 5 0 32 2000
ED1  6 9  XDRL EXPL. DRILL.      PREMINE
ED2  6 9  XDRL 637.6 64000      .000 1 1 0 1.000 .000 0
ECRG 610 ENG      1      0 2000      .000 7 1 .00 6 0 32 2000
ED1  610 ENG CONT. ENG.      PREMINE
ED2  610 ENG 6000.0 64000      .000 1 5 0 1.000 .000 0
ECRG 611 EIS      1      0 2000      .000 7 1 .00 4 0 32 2000
ED1  611 EIS E. I. S.      PREMINE
ED2  611 EIS 1000.0 64000      .000 1 1 0 1.000 .000 0
ECRG 612 STF      1      0 2000      .000 1 9 .00 0 0 32 2000
ED1  612 STF SUPERV. PER.
ED3  612 STF      .00 92.80
EPD1 612 STF 24 3 92
ECRG 613 RLTX      1      0 2000      .000 7 1 .00 0 0 32 2000
ED1  613 RLTX ROY-SEV. TAX
ED3  613 RLTX      0.      0.      0.      0.      0.      0.      919.92
ZZZZZZZZZZZZZZZZZZ
*

```

2.10 COST REGRESSION EQUATIONS

The regression analysis done with the micro models resulted in equations to calculate mining costs in \$/acre and \$/ROM ton. Since the micro models consider only primary equipment, the regression equations develop cost for primary equipment only. The ADM model considers support equipment also, and the regression equations are no longer used in the ADM model.

The equations represent a means for developing first-order costs for each of the operations, and should be of interest to the user. The following paragraphs present the equations for user information.

The cost regression equations for drilling and blasting costs, considering only primary equipment, are:

	BASELINE VALUES
DBDAF = -4723.46 + 11912.2 * PRPY	.3
+ 74.3544 * HBA	71.
+ 165713 / DR3NFH	100.
= 5786.49	
DBDT = DBDAF / CRTAF / HC = 5786.49 / 1603 / 4	
= .9024	

The more exact cost calculating methods now used in the model show a corresponding cost of \$0.913/ton. The principle reason for no longer using the equations is that they do not consider the needed supporting equipment which would add about \$0.12/ton to the primary equipment cost.

The following three regression equations calculate primary dragline costs in \$/acre, \$/hour, and \$/ROM ton:

	BASELINE VALUES
DLDAF = -23747.3 + 689274 * COTR	.5
+ 8388.47 * COTB	1.5
+ 21791.3 * SFB	.35
+ 12.3111 * PMF	100
+ 2.16371 * HBA**2	71
+ 949.718E6 * HC/CIRTY	4 .181713E9
= 13618.4	
DLDH = DLDAF * ACRES / TMY / DLDHY	
= 13168.4 * 8501.8 / 30 / 7467	
= 516.86	
DLDT = DLDAF / CRTAF / HC = 13618.4 / 1603 / 4	
= 2.124	

The costs calculated with these equations differ by about nine percent from those calculated by the model. This fairly large difference results from the fact that the micro model, from which the regression equation was derived, evaluates draglines in the data file; while the ADM model synthesizes a dragline. The dragline file contains 200 models which were available from manufacturers in 1975 when the file was created. The micro model must select a machine from that file. The ADM model does not read data files; it uses correlations to synthesize a dragline, i.e., to develop specifications for a dragline which fits the problem statement exactly. In spite of the differences, the regression equation should be useful for calculating first-order dragline costs.

The two cost regression equations which calculate primary load and haul costs in \$/acre and \$/ROM ton are:

	BASELINE VALUES
CHDAF = -2870.1 + 931.59 * HC	4
+ 2369E6 / CIRTY	.181713E7
+ 1.6546 * CHSDRR	395.63
= 2814.57	
CHDT = CHDAF / CRTAF / HC = 2814.57 / 1603 / 4	
= .44	

The regression cost differs from the present model solution because of the handling of deferred trucks. The micro model simulates the steady-state operation, and uses an average haul distance for fleet sizing. The fleet size developed from the micro model is the average of that obtained with the ADM model, but the cost calculations are different. With the micro model, the fleet is purchased at startup and used for the project life, as contrasted to the deferred truck handling in the ADM model.

The regression equations which calculate land reclamation cost in \$/acre and \$/ton are shown below:

	BASELINE VALUES
RCDAF = -2419.58	
+ 602.582 * CDRTY / 1E6 / HC	.181713E7 4
+ 1673.12 * HBT	1
+ .994926 * RDCG	600
+ .994926 * RDCRU	200
+ .984779 * RCCLM	100
+ 12.5457 * PWF	100
+ 25019.3 * TRF	.06
= 3673.88	
RCIT = RCDAF / CRTAF / 4 = 3637.88 / 1603 / 4	
= .5729	

The regression cost agrees very well with the cost determined by the ADM model.

SECTION 3
MODEL INPUT

3.1 GENERAL

The input to the ADM 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) three output files: a file for regression analysis of interest only to the programmer, 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 three categories:

- 1) Primary Control Parameters
- 2) Primary Default Parameters
- 3) Secondary Default Parameters

For economic studies of the Illinois Basin, the user need be concerned only with the primary control variables. For economic studies of other regions, the user may need to be concerned with the secondary default parameters. The user who wishes to alter the mining engineering aspects of the model needs to be concerned with all three categories.

The secondary default parameters are defined in Appendix C, and their default values are listed in Appendix D. The following paragraphs discuss the primary control and primary default parameters.

3.2.1 Primary Control Parameters

The following is a listing of the primary control parameters:

<u>Default Value</u>	<u>Name</u>	<u>Description</u>
1.	IMCOH	INCLUDE COAL LOAD AND HAUL
1.	IMODS	INCLUDE ROCK DRILL AND BLAST
1.	IMODL	INCLUDE DRAGLINE
1.	IMOGA	INCLUDE GENERAL & ADMINISTRATIVE
1.	IMOLR	INCLUDE RECLAMATION
1.	IMOPF	INCLUDE PREP PLANT
1.	IMODS	INCLUDE COAL DRILL AND BLAST
1	IPPT	PP - INDEX TO PLANT TYPE
0	LOGCA	PRINTS COMMON ARRAYS IF 1 (FOR DEBUG)
1	LOGCF	WRITES CFA CONTROL FILE IF 1
1	LOGDV	PRINTS DEFAULT VARIABLES IF 1
1	LOGEC	WRITES CFA EQUIPMENT FILE IF 1
1.	LOGPA	PRINTS PARAMETERS IF 1
1	LOGRD	PRINTS REGRESS. DATA FILE IF 1
1	LOGSD	WRITES SPECIFICATION DATA IF 1
1	LOGSM	WRITES ECONOMIC SUMMARY IF ONE
50.	GAMR	GAA - MINERAL RIGHTS (\$/ACRE)
.25	GARA	GAA - ROYALTY AMOUNT (\$/TON)
250.	GASR	GAA - SURFACE RIGHTS (\$/ACRE)
0	GAST	GAA - SEVERANCE TAX (\$/TON)
.11	GAUP	GAA - UNION PAYMENT (\$/TON)
71.	HBA	HEIGHT OF OVERBURDEN IN FEET (AVERAGE)
1.	HBT	HEIGHT OF TOPSOIL - FEET
4.	HC	HEIGHT OF COAL IN FEET
10560.	PLF	PANEL LENGTH - FEET
1.3E14	PPMED	PP - COMPLEX ENERGY DEMAND BTU/YEAR
12000.	PPNHU	PP - COAL HEAT VALUE BTU/LB
900.	ROC	RECLAMATION - OTHER COSTS - \$/ACRE

In this listing, the first seven parameter names start with the letters IMO (Include Mining Operation), and allow the user to include or exclude the seven operations in the problem statement. If the variable is set to 1, the operation will be included; if it is set to 0, the operation will not be included.

Parameter IPPT determines the preparation plant type. The variable is set to 1, 2, or 3 for Crushing and Screening, Baum Jig, or Heavy Media, respectively.

Seven parameters that begin with the letters LOG control the output from the model. If the variable is set to 1, the output is generated by the model; if set to 0, the output is suppressed. This controlled output is as follows:

- LOGPA - This switch controls printing the input and calculated variables. When it is set to 1, the model prints the variables in the above listing, along with the values as defined for this case. In addition, a number of intermediate variables calculated by the model are printed. These calculated variables are described in subsection 2.10.
- LOGDV - When this switch is set to 1, the model lists the primary default parameters (refer to paragraph 3.2.2).
- LOGCF - When this switch is set to 1, the model creates a control file data set for the CFA model. The control set will be sent to the file for each case in which LOGCF = 1.
- LOGEC - When this switch is set to 1, the model creates an equipment data set for the CFA model. The complete set of equipment cards for all mining operations with the IMO switch set to 1 is sent to the file.

- LOGSD - When this switch is set to 1, the model writes the detail information lines shown in Section 2 for each mining operation. The mining operation is simulated when the appropriate IMO control is 1, regardless of the LOGSD value. The reverse is not true; LOGSD has no affect when the IMO switch is 0.
- LOGSM - When this switch is set to 1, the model writes the summary information page. This switch controls summary data calculation, as well as printing (of significance only when LOGRD = 1 as defined below).
- LOGRD - When this switch is set to 1, the model creates a file of selected solution data for regression analysis or other studies. (Since the regression data file can be used only by programmers, it is not described in this manual.)

Five variables begin with the letters GA; they enter general and administrative cost data.

The three parameters HBA, HBT, and HC describe the average conditions of the mine site.

Parameter PPNEED sets the demand for the mining complex, and parameter PPNHV sets the average heat content of ROM coal.

Parameter ROC enters reclamation costs for operations not included explicitly in the model. The cost is made up of three elements: general bulldozing, revegetation, and land management.

3.2.2 Primary Default Parameters

The following is a listing of the primary default parameters:

<u>Default Value</u>	<u>Name</u>	<u>Description</u>
63.43	ABHD	ANGLE BURDEN HIGHWALL (DEGREES)
33.69	ABSD	ANGLE BURDEN SPOILS (DEGREES)
76.	ACFD	ANGLE COAL FACE (DEGREES)
.1817E7	CDRTYD	COAL DEMAND ROM TONS/YEAR
9680.	CHHDF	COAL HAUL DISTANCE IN FEET - YEAR 1
3700.	DBPY	DENSITY OF OVERBURDEN BANK LBS/YARD
2160.	DCBPY	DENSITY COAL BANK LBS/YARD
100.	DRSMFH	DRILLING RATE IN SOFT MAT'L. - FT/HR
.92	ECR	EXPECTED COAL RECOVERY FACTOR
185.614	GATYB	GAA - TONS/YEAR - BASELINE
4.095E14	PPBED	PP - BASE ENERGY BTU/YEAR
75E3	PPBT	PP - BASE TONS/DAY
250.	PPDY	PP - OPERATING DAYS/YEAR
.3	PPPY	POWDER RATIO - POUNDS / CU. YD.
100.	PMW	PANEL WIDTH (FEET)
.35	SFB	SWELL FACTOR FOR BURDEN
.35	SFC	SWELL FACTOR FOR COAL
30.	TMY	TOTAL MINING YEARS
.06	TRF	TOTAL RESISTANCE ON TOPSOIL HAUL ROAD

These parameters define the mining situation; the default values are baseline values as used in the micro model cases from which the ADM model was derived. The manner in which the variables are used in the model is explained in the preceding section.

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 ADM and CFA models. Since the ADM 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 ADM parameter. Subject to user control, the ADM 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>ADM Name</u>	<u>CFA Name</u>
IPPT	IPPT\$
CDRTYX	CDRTY\$
GAMR	GAMR\$
GARA	GARA\$
GASR	GASR\$
GAST	GAST\$
SRYT	SRYT\$
HBT	HBT\$
HC	HC\$
PPFTY	PPFTY\$

ADM NameCFA Name

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 ADM model, i.e., they define the mining situation solved by the ADM model. Parameter VCBP contains the heat content of the prepared coal in Btus/pound. It is calculated by the ADM 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.
VALUE - is a numeric value, including a decimal point for fractional values.

NAME may refer to any Primary Control, Primary Default, or Secondary Default 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 with record containing only an "*". For example, the following input file was used to develop the example problem contained in Appendix A:

```
1 - 0511 (ADM10511) EXAMPLE PROBLEM FOR USER'S MANUAL
2 - 1 ALL VALUES AT DEFAULT
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 develop the model output included in Section 2 of this manual:

```
1 - 0511 (ADM10511) SEPARATE OPERATIONS FOR FOR USER'S MANUAL
2 - 3 OVERBURDEN DRILL AND BLAST
3 - IMOB=0, IMOD=1, IMOL=0, IMOC=0, IMOP=0, IMOG=0
4 - IMOLR=0, LOGPA=0, LOGDV=0
5 - *
6 - 4 OVERBURDEN REMOVAL
7 - IMOB=0, IMOD=1,*
8 - 5 COAL DRILL AND BLAST
9 - IMOL=0, IMOB=1,*
10 - 6 COAL LOAD AND HAUL
11 - IMOB=0, IMOC=1,*
12 - 7 LAND RECLAMATION
13 - IMOC=0, IMOLR=1,*
14 - 8 COAL PREPARATION PLANT
15 - IMOLR=0, IMOP=1,*
16 - 9 GENERAL & ADMINISTRATIVE
17 - IMOP=0, IMOG=1,*
```

This file contains 17 records, and defines seven cases. Record number 1 is the Run Title card. Records 2, 6, 8, 10, 12, 14, and 16 are Case Title records. Records 5, 7, 9, 11, 13, 15, and 17 contain an "*", and indicate the end of each case input. Records 3 and 4 set switches so that only overburden drilling and blasting will be included in the first case. (The case numbers correspond to the subsection numbers in Section 2.) The IMO switches were reset for each case so that each case would include only one mining operation in the summary listings included in the text of Section 2.

SECTION 4
USING THE REPORT APPENDICES

4.1 MODEL OUTPUT - APPENDIX A

The model output from an example problem is reproduced in Appendix A. The reports included in the output are discussed in Section 2.

The CFA equipment cards from the example are not listed in Appendix A. However, each set of equipment cards is shown in Section 2 under each mining operation, and the file from this example would contain all of the cards listed in Section 2.

There is one difference between the model run which developed the output listed in Section 2 and the run which developed the output in the Appendix A. The Section 2 run included seven cases; one mining operation for each case. The Appendix A run included one case with all mining operations. Thus, the summary reports in Section 2 were developed for each operation, and that of Appendix A includes all operations.

Some items are printed under fixed format, and others under floating format. The fixed format specifies the number of digits printed after the decimal point, and the floating format specifies the number of significant digits to be printed. The total number of print positions allowed for any item depends upon the amount of information to be printed on the line. The intent is to show as much significance as possible within the limits of the print line size.

Detailed data for an equipment unit are generally printed under fixed format, since the order of magnitude of the numbers is known beforehand. Project total data generally are

printed under floating format, since the values can vary through several orders of magnitude. The floating format prints six significant digits when possible; otherwise, five. The computer system decides, as the number is printed, whether or not to use floating notation. If the value can be printed in six spaces, it is; otherwise, floating notation is used. An example of floating notation is:

.473199E 08.

Here the value is read as:

.473199 X 10⁸ or 47.3199 million.

For either format, the value is rounded before printing.

The ADM model contains a large number of named variables to give the user maximum possible control. Named variables can be reset by the user in his input data file.

The ADM model is a collection of subroutines based on a number of micro models. Thus, the variable names are taken from the micro models, except in cases of conflict. The conventions were followed in developing names according to the source of the data item, as follows:

- 1) Micro Model Parameters
- 2) Data File Specification or Cost Data
- 3) CFA Equipment Data Card Data
- 4) ADM Communication Variables

The micro-model names are mostly mnemonic; for example, ACFD is Angle of Coal Face (Degrees), SFB is Swell Factor Burden, and BPBY is Burden Production in Bank Yards/Year.

Data file data names combine the two-character data file code with the two-character line identification. Examples are DLSW, the dragline bucket size; CDCJ, the crawler bulldozer maintenance material cost; and TDSC, the truck horsepower.

The CFA equipment data names contain six characters of the form UUTTF, where UU is the unit operation code, TT is the card type, and FF is the field identifier. The following codes are used in the UU portion of the name:

- BL - Overburden Blasting
- CD - Bulldozer
- CH - Coal Load and Haul
- DB - Overburden Drill and Blast
- GA - General and Administrative

LM - Land Management
 PP - Preparation Plant
 RC - Reclamation
 RD - Overburden Rotary Drill
 RV - Revegetation
 SC - Scraper
 SD - Shovel
 TD - Truck
 QL - Coal Blasting
 QD - Coal Drill
 QB - Coal Drill and Blast

The TFFF codes are used as follows:

<u>TT</u>	<u>FF</u>	<u>Field Description</u>
CR		ECRG Cards
	MO	Mining Operation Code and Sequence Number
	ID	Equipment Identifier
	QT	Quantity
	FS	Fleet Spare
	OH	Operating Hours/Year
	CP	Complex Production
	SY	Start Year
	NY	Number of Years for Startup
	SE	Startup Efficiency Factor
	PL	Purchase Lead Time
	DP	Deferred Purchase Code
	LO	Life of Operation
	SH	Scheduled Hours/Year

<u>TT</u>	<u>FF</u>	<u>Field Description</u>
D2		ED2 Card
	MO	Mining Operation Code and Sequence Number
	ID	Equipment Identifier
	UI	Unit Investment
	DH	Depreciation Hours
	SF	Salvage Fraction
	DM	Depreciation Method Code
	PC	Purchase Method Code
	BY	Base Year for Escalation
	RA	Regional Adjustment Factor
	EF	Escalation Factor
	CO	Construction Code
D3		ED3 Card
	MO	Mining Operation Code and Sequence Number
	ML	Maintenance Labor (\$/hour)
	MM	Maintenance Materials (\$/hour)
	FU	Fuel Cost (\$/hour)
	TI	Time Cost (\$/hour)
	EL	Electricity Cost (\$/hour)
	WA	Water Cost (\$/hour)
	OT	Other Cost (\$/hour)
O1		EP01 Card
	MO	Mining Operation Code and Sequence Number
	C1	Personnel Class Code (1)
	S1	Schedule Code (1)
	Q1	Quantity (1)

Note

S1, C1, and Q1 repeat with "2" or "3" in place of "1".

<u>TT</u>	<u>FF</u>	<u>Field Description</u>
M1		EPM1 Card
	MO	Mining Operation Code and Sequence Number
	C1	Personnel Class Code (1)
	S1	Schedule Code (1)
	F1	Fraction (1)

Note

S1, C1, and F1 may repeat with "2" or "3" in place of "1".

Communication variables stem from FORTRAN conventions. Any variable used in the main program and in one or more subroutines must have different names. Generally, the UU code listed above is used as the first two letters of names used to communicate main program variables to subroutines. Examples are DLSFB transmits SFB to the dragline subroutine, RDCD transmits CDRTY to the overburden drill and blast subroutine, and CHPLF transmits PLF to the coal haul subroutine.

Since there are so many named variables, it is difficult to comply with the conventions in all cases. The meaning of each variable should be clear from the manner of its use as described in preceding sections, in Appendix B, and in the description in Appendix C.

Appendix B presents the model equations with solution data taken from the example problem. The presentation does not match the program exactly. Some details such as input and output have been omitted, and some rearrangement has been made to simplify the presentation.

Some variable names used in this presentation do not appear in Appendix C. Such intermediate variable names are used to simplify the expressions. For an example, refer to page B-6. Variable RDDY (Rotary Drill Depreciation Years) is used in calculating the primary equipment summary data. This variable appears twice in the expression calculating DBAIC (rotary drill annual investment or ownership cost). The use of the intermediate name simplified the DBAIC expression.

Appendix B has been printed on the computer printer. However, all names and numeric values were transcribed from the example output. Appendix B is not the model; it is only a typed presentation of the model. The numeric values have been rounded off for printing; a desk calculator solution of some expressions may not result in the exact printed result due to this rounding.

4.4 MODEL VARIABLE LISTING - APPENDIX C

Appendix C lists all variables which may be controlled by the user. Any variable appearing in this listing may appear in the user's input data file.

A single letter precedes the description and indicates which subroutine uses the variable, as follows:

- A - Main Program
- D - Overburden Drill and Blast
- O - Overburden Removal with the Dragline
- Q - Coal Drill and Blast
- C - Coal Load and Haul
- L - Land Reclamation
- P - Preparation Plant
- G - General and Administrative

Some variable names are followed with numbers in parentheses, e.g., PPEQTY (9). These variables are dimensioned and, if named in the user input file, all values must be set. Thus, if "PPEQTY =" appears in the input file, the "=" must be followed by nine values separated by commas.

Appendix D lists default values for all variables under user control. As in Appendix C, the single letter indicates which subroutine uses the variable.

Dimensioned variables are followed by a series of numeric values according to the dimension. In some cases, (e.g., PPMLF) the name appears on two lines; the values are large, and the nine values could not be contained on a single line.

Note that this list contains only those variables under direct user control. Variables calculated by the model are not included, since any user-set value would be replaced by the calculated value.

APPENDIX A

MODEL OUTPUT FROM EXAMPLE PROBLEM

ADM MODEL ECONOMIC SUMMARY

RUN DATE 14:40 NOV 22, '76 PAGE NO. 1.1

CASE NO. 1028 TITLE (ADM1028) ADM USER'S MANUAL EXAMPLE PROBLEM
 ALT. NO. 1 TITLE ALL PARAMETER VALUES SET FROM DEFAULT FILE

1975 DOLLARS; FINANCIAL PARAMETERS AS PER MICRO MODEL ASSUMPTIONS

I IMCH	1	INCLUDE COAL LOAD AND HAUL
I IMDB	1	INCLUDE ROCK DRILL AND BLAST
I IMDL	1	INCLUDE DRAGLINE
I IMGA	1	INCLUDE GENERAL & ADMINISTRATIVE
I IMGR	1	INCLUDE RECLAMATION
I IMPP	1	INCLUDE PREP PLANT
I IMDB	1	INCLUDE COAL DRILL AND BLAST
I IPPT	1	PP - INDEX TO PLANT TYPE
I LOGCF	1	WRITES CFA CONTROL FILE IF 1
I LOGDV	1	PRINTS DEFAULT VARIABLES IF 1
I LOGEC	1	WRITES CFA EQUIPMENT FILE IF 1
I LOGPA	1	PRINTS PARAMETERS IF 1
I LOGRD	1	PRINTS REGRESS. DATA FILE IF 1
I LOGSD	1	WRITES SPECIFICATION DATA IF 1
I LOGSM	1	WRITES ECONOMIC SUMMARY IF ONE
I GANR	50.0000	GAA - MINERAL RIGHTS (\$/ACRE)
I GARA	.250000	GAA - ROYALTY AMOUNT (\$/TON)
I GASR	257.777	GAA - SURFACE RIGHTS (\$/ACRE)
I GAST	.000000	GAA - SEVERANCE TAX (\$/TON)
I GAUP	.110000	GAA - UNION PAYMENT (\$/TON)
I HBA	71.0000	HEIGHT OF OVERBURDEN IN FEET (AVERAGE)
I HBT	1.00000	HEIGHT OF TOPSOIL - FEET
I HC	4.00000	HEIGHT OF COAL IN FEET
I PLF	10560.0	PANEL LENGTH - FEET
I PPNED	.130000E 15	PP - COMPLEX ENERGY DEMAND BTU/YEAR
I PPNHV	12000.0	PP - COAL HEAT VALUE BTU/LB
I RRC	900.000	RECLAMATION - OTHER COSTS - \$/ACRE
D ABHD	63.4300	ANGLE BURDEN HIGHWALL (DEGREES)
D ABSD	33.6900	ANGLE BURDEN SPOILS (DEGREES)
D ACFD	76.0000	ANGLE COAL FACE (DEGREES)
D CRTYD	.181700E 07	COAL DEMAND ROM TONS/YEAR
D CHHD	9680.00	COAL HAUL DISTANCE IN FEET - YEAR 1
D DRBPY	3700.00	DENSITY OF OVERBURDEN BANK LBS/YARD
D DCBPY	2160.00	DENSITY COAL BANK LBS/YARD
D DRSMFH	100.000	DRILLING RATE IN SOFT MAT'L. - FT/HR
D ECR	.920000	EXPECTED COAL RECOVERY FACTOR
D GATYB	185.614	GAA - TONS/YEAR - BASELINE
D PPBED	.409500E 15	PP - BASE ENERGY BTU/YEAR
D PPBT	75000.0	PP - BASE TONS/DAY
D PPODY	250.000	PP - OPERATING DAYS/YEAR
D PRPY	.300000	POWDER RATIO - POUNDS / CU. YD.
D PWF	100.000	PANEL WIDTH (FEET)
D SFR	.350000	SWELL FACTOR FOR BURDEN
D SFC	.350000	SWELL FACTOR FOR COAL
D TMY	30.0000	TOTAL MINING YEARS
D TRF	.600000E-01	TOTAL RESISTANCE ON TOPSOIL HAUL ROAD
C NPITS	3	NO. OF PITS
C ACRES	8501.80	ACRES
C BRPY	.324618E 08	OVERBURDEN PRODUCTION YARDS/YEAR
C CRTY	.181713E 07	COAL DEMAND ROM TONS/YEAR/PIT
C CRTYX	.545139E 07	COMPLEX COAL DEMAND ROM TONS/YEAR
C CRPY	.168253E 07	COAL DEMAND FOR CLH IN REC. YARDS / YEAR
C COTA	.500111	COTANGENT ABHD

C COTB	.249330	COTANGENT ACFD
C COTT	1.50000	COTANGENT ABSD
C CRTAF	1633.01	COAL REC. TONS/ARCE-FOOT
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 SRYT	17.8643	STRIPPING RATIO YARDS/TONS
C VBBY	.973853E 09	VOL. OVERBURDEN BANK YARDS
C VCBY	.548650E 08	VOL. COAL BANK YARDS
C VCRT	.545139E 08	VOL. COAL ROM TONS

ADM MODEL ECONOMIC SUMMARY RUN DATE 14:40 NOV 22, '76 PAGE NO. 1.2

CASE NO. 1028 TITLE (ADM1028) ADM USER'S MANUAL EXAMPLE PROBLEM
 ALT. NO. 1 TITLE ALL PARAMETER VALUES SET FROM DEFAULT FILE

1975 DOLLARS; FINANCIAL PARAMETERS AS PER MICRO MODEL ASSUMPTIONS

OVERBURDEN DRILL AND BLAST STATISTICS

DRILL	QT	SH	CG	CP	CN	REF.#			
1.809	2	15.000	440.8	33.04	46.55	16			
RD OWN	RD OPER	#SP	SP OWN	EX TOT	RD \$/T	EX \$/T			
.64686E 07	.82431E 07	0	.00000	.35035E 08	.26987	.64268			

DRAGLINE STATISTICS

SA	SB	SW	RMA	X	ST	PE
279.0	35.0	126.1	228.3	28.797	10561.0	6442.0
CA	CI	CM	CN	CO		
12806.	15773.	146.48	97.64	46.38		
CL	CR	TCL	ACR	TCR		
220.490	342.571	.493919E 08	.255798E 07	.767393E 08		

COAL DRILLING AND BLASTING STATISTICS

DRILL	QT	SH	CG	CP	CN	REF.#			
1.090	1	3.000	37.3	3.30	17.46	23			
RD OWN	RD OPER	#SP	SP OWN	EX TOT	RD \$/T	EX \$/T			
.16157E 06	.93173E 06	0	.00000	.27257E 07	.20055E-01	.50000E-01			

COAL LOAD AND HAUL STATISTICS

SHOVEL	QT	ST	SW	CA	CG	CP	CN	REF.#	
.458	1	650	16.0	901.0	1043.0	40.98	51.93	34	
TRUCK	QT	SC	SL	DT	CA	CG	CP	CN	REF.#
1.723	2	1200	360	F	433.9	399.3	22.81	54.16	18
RD OWN	RD OPER	TD OWN	TD OPER	SPARE OWN	#SP	\$/TON			
.40109E 07	.50826E 07	.44651E 07	.91335E 07	.00000	0	.427			

LAND RECLAMATION STATISTICS

SCRAPER	QT	SA	SR	CG	CP	CN	REF.#		
4.004	4	32	415	201.1	22.26	38.21	6		
DOZER	QT		SK	CG	CP	CN	REF.#		
3.521	4		410	192.5	21.30	31.18	5		
SC OWN	SC OPER	#SP	SP OWN	CD OWN	CD OPER	#SP	SP OWN	RV TOT\$	LM TOT\$
.48082E 07	.82610E 07	2	.24041E 07	.46008E 07	.59287E 07	0	.00000	.17004E 07	.85018E 06

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CASE NO. 1028 TITLE (ADM1028) ADM USER'S MANUAL EXAMPLE PROBLEM
 ALT. NO. 1 TITLE ALL PARAMETER VALUES SET FROM DEFAULT FILE

1975 DOLLARS; FINANCIAL PARAMETERS AS PER MICRO MODEL ASSUMPTIONS

PREPARATION PLANT STATISTICS

TYPE	SIZE TONS/DAY	DELIVERED COAL			
		BTU/LB	TONS/YEAR	BTU/YEAR	
1	21805.6	12043.2	.539687E 07	.130000E 15	

		UNIT INVESTMENT	LABOR \$/HOUR	OWNERSHIP \$/HOUR	OPERATING \$/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 LOADOUT	PREP. PLANT	.124667E 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

GENERAL & ADMINISTRATIVE COSTS

		UNIT INVESTMENT	OWNERSHIP \$/HOUR	OPERATING \$/HOUR	O&O \$/TON
ROADS & SITE	ANC. FAC.	.300000E 07	155.16	.00	.061
BUILDINGS	ANC. FAC.	.489375E 07	253.10	32.62	.112
ELECT. SYS.	ANC. FAC.	.450000E 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	637635.	32.98	.00	.013
CONT. ENG.	PREMINE	.600000E 07	310.31	.00	.121
E. I. S.	PREMINE	.100000E 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

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CASE NO. 1028 TITLE (ADM1028) ADM USER'S MANUAL EXAMPLE PROBLEM
 ALT. NO. 1 TITLE ALL PARAMETER VALUES SET FROM DEFAULT FILE

1975 DOLLARS; FINANCIAL PARAMETERS AS PER MICRO MODEL ASSUMPTIONS

QT.		INITIAL INVESTMENT	ANNUAL OWNERSHIP	ANNUAL OPERATING	PROJECT TOTAL	\$/ ROM	\$/ TON DEL TON
6	D.B. ROTARY DRILLS	.264480E 07	646839.	.441485E 07	.151851E 09	.929	.938
	SUPPORT EQUIP.	623100.	187019.	439765.	.188035E 08	.115	.116
3	DRAGLINES	.473199E 08	.500913E 07	.767393E 07	.380222E 09	2.325	2.348
	SUPPORT EQUIP.	.145038E 08	.171818E 07	.377719E 07	.168624E 09	1.031	1.041
3	COAL ROTARY DRILLS	111900.	17603.2	358053.	.112697E 08	.069	.070
3	SHOVELS, 6 TRUCKS	.552480E 07	847566.	.122961E 07	.623151E 08	.381	.385
	SUPPORT EQUIP.	.101310E 07	268947.	941439.	.363116E 08	.222	.224
	DEFERRED TRUCKS	.359370E 07	669730.	.159027E 07	.331467E 08	.203	.205
11	DOZERS, 14 SCRAPERS	.493290E 07	.113703E 07	.183531E 07	.891702E 08	.545	.551
1	PP. 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	.144104E 09	.171806E 08	.296442E 08	.138662E 10		
	TONS DELIVERED =	.161906E 09	COST = 8.56431	\$/TON			
	BTUS DELIVERED =	.390000E 16	COST = .355542	\$/MM BTU			

ADM MODEL ECONOMIC SUMMARY

RUN DATE 14:40 NOV 22, '76 PAGE NO. 1.4

CASE NO. 1028 TITLE (ADM1028) ADM USER'S MANUAL EXAMPLE PROBLEM
 ALT. NO. 1 TITLE ALL PARAMETER VALUES SET FROM DEFAULT FILE

1975 DOLLARS; FINANCIAL PARAMETERS AS PER MICRO MODEL ASSUMPTIONS

QT.		INITIAL INVESTMENT	ANNUAL OWNERSHIP	ANNUAL OPERATING	PROJECT TOTAL	\$/ ROM TON	\$/ DEL TON
6	O.B. ROTARY DRILLS	.264480E 07	646839.	.441485E 07	.151851E 09	.929	.938
	SUPPORT EQUIP.	623100.	187019.	439765.	.188035E 08	.115	.116
3	DRAGLINES	.473199E 08	.500913E 07	.767393E 07	.380222E 09	2.325	2.348
	SUPPORT EQUIP.	.145038E 08	.171818E 07	.377719E 07	.168624E 09	1.031	1.041
3	COAL ROTARY DRILLS	111900.	17603.2	358053.	.112697E 08	.069	.070
3	SHOVELS, 6 TRUCKS	.552483E 07	847566.	.122961E 07	.623151E 08	.381	.385
	SUPPORT EQUIP.	.101310E 07	268947.	941439.	.363116E 08	.222	.224
	DEFERRED TRUCKS	.359370E 07	669730.	.159027E 07	.331467E 08	.203	.205
11	DOZERS, 14 SCRAPERS	.493290E 07	.113703E 07	.183531E 07	.891702E 08	.545	.551
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	.144104E 09	.171806E 08	.296442E 08	.138662E 10		
	TONS DELIVERED =	.161906E 09	COST = 8.56431				\$/TON
	BTUS DELIVERED =	.390000E 16	COST = .355542				\$/MM BTU

APPENDIX B
MODEL EQUATIONS

1. PREPARATION PLANT SIZING.

THE BASELINE PREPARATION PLANT DATA ARE FACTORED TO FIND FEED RATE NEEDED TO MEET ENERGY DEMAND CONSIDERING ROM COAL HEAT VALUE.

IPPT	BASELINE DATA		
	PPBHV	PPBSF	PPBHF
1	10990	.99	1.0036
2	12760	.825	1.0373
3	13084	.787	1.06

PPSF = PPBSF(IPPT) = .99
PPHV = PPBHV(IPPT) = 10990
PPHF = PPBHF(IPPT) = 1.0036

PPNS = PPNE / PPBE * PPHV / PPNHV * PPBT
= .13E15 / .4095E15 * 10990 / 12000 * 75000
= 21805.6

CDRTYX = PPNS * PPODY = 21805.6 * 250 = .549139E7

PPFTY = CDRTYX * PPSF = .545139E7 * .99 = .539687E7

PPFHV = PPNHV * PPHF = 12000 * 1.0036 = 12043.2

PPCRCP = PPFTY / 1000 = .539687E4

TOTAL PROJECT TONS AND BTU'S

XRT = CDRTYX * TMY = .539139E7 * 30 = .163452E9

XIT = PPFTY * TMY = .539688E7 * 30 = .161906E9

XTB = PPNE * TMY = .13E15 * 30 = .39E16

SET COTANGENTS FOR PIT GEOMETRY.

COTA = COTANGENT ABHD = COT (63.43) = .5

COTB = COTANGENT ACFD = COT (76) = .249

COTT = COTANGENT ABSD = COT (33.69) = 1.5

2. DETERMINE NUMBER OF PITS AND CALCULATE VOLUMES

THE MODEL SIZES EACH OPERATING PIT SO AS TO USE AN INTEGER NUMBER OF PITS OF A SIZE EQUAL TO OR LESS THAN BASE-LINE PIT SIZE.

$$\begin{aligned} \text{NPITS} &= \text{INT}(\text{CDRTYX} / \text{CDRTYD} + .8) \\ &= \text{INT}(.545139\text{E}7 / .1817\text{E}7 + .8) = 3 \end{aligned}$$

$$\text{CDRTY} = \text{CDRTYX} / \text{NPITS} = .549139\text{E}7 / 3 = .181713\text{E}7$$

$$\text{VCRT} = \text{CDRTY} * \text{TMY} = .181713\text{E}7 * 30 = .545139\text{E}8$$

$$\begin{aligned} \text{VCBY} &= \text{VCRT} / \text{ECR} / (\text{DCBPY} / 2000) \\ &= .545139\text{E}8 / .92 / (2160 / 2000) = .54865\text{E}8 \end{aligned}$$

$$\text{ACF} = \text{VCBY} * 27 / \text{HC} = .54865\text{E}8 * 27 / 4 = .370338\text{E}9$$

$$\text{VBBY} = \text{VCBY} * \text{HBA} / \text{HC} = .54865\text{E}8 * 71 / 4 = .973853\text{E}9$$

$$\text{SRYT} = \text{VBBY} / \text{VCRT} = .973853\text{E}9 / .545139\text{E}8 = 17.86$$

$$\text{BPBY} = \text{CDRTY} * \text{SRYT} = .181713\text{E}7 * 17.86 = .324618\text{E}8$$

$$\begin{aligned} \text{ACRES} &= \text{VCBY} * 27 / \text{HC} / 43560 \\ &= .54865\text{E}8 * 27 / 4 / 43560 = 8501.8 \end{aligned}$$

$$\begin{aligned} \text{CRTAF} &= 43560 / 27 * \text{DCBPY} / 2000 * \text{ECR} \\ &= 43560 / 27 * 2160 / 2000 * .92 = 1603 \end{aligned}$$

3. OVERBURDEN DRILLING AND BLASTING

PARAMETER VALUES FROM MAIN PROGRAM ARE TRANSFERRED TO VARIABLES IN DRILLING AND BLASTING SUBROUTINE.

BLCRLO = TMY = 30
 RDCRLO = TMY = 30
 DBNP = NPITS = 3
 DBCD = CDRTY = .181713E7
 DBHB = HBA = 71
 DBDR = DRSMFH = 100

A REGRESSION EQUATION IS USED TO DETERMINE THE REQUIRED NUMBER OF ROTARY DRILLS; NUMBER OF SPARES IS SET TO ZERO.

RNORD = 5.60855	/ HC	PARAMETER VALUES
	* DBCD / 1E6	4
	* DBHB	.181713E7
	/ DBDR	71
= 1.809		100

INORD = INT(RNORD + .9) = INT(1.809 + .9)
 = 2
 INOSRD = 0

DBRDTI = INORD * RDCRLO * RDCROH * RDCP
 = 2 * 30 * 3263 * 33.04
 = .646857E7

DBRDTO = RNORD * RDCRLO * RDCROH * RDCN
 = 1.809 * 30 * 3263 * 46.55
 = .824315E7

DBRDFI = INOSRD * RDCRLO * RDCROH * RDCP
 = 0

RDDT = (DBRDTI + DBRDTO + DBRDFI) / (DBCD * RDCRLO)
 = (.646857E7 + .824315E7 + 0) / (.181713E7 * 30)
 = .2698

A REGRESSION EQUATION DETERMINES EXPLOSIVES COSTS.

DBTEC = 111	+ 109.22 / HC	PARAMETER VALUES
	* DBCD / 1E6	4
		.181713E7

* DBHB 71
* DBPRPY .3

= 1167.84

DBTEC = DBTEC * BLCRLO * 1000 = 1167.84 * 30 * 1000
= .35035E8

ECDT = DBTEC / DBCD / BLCRLO = .35035E8 / .181713E7 / 30
= .6427

CFA EQUIPMENT DATA CARD FIELDS ARE SETUP FOR PRIMARY EQUIPMENT.

RDCRQT = INORD * DBNP = 2 * 3 = 6
RDCRFS = INOSRD = 0
RDCRCP = BPBY * DBNP / 1000 = .324618E8 * 3 / 1000
= 97385.2
RDCRNY = DBNP = 3
RDD2UI = RDCG = 440.8
RDD2DH = RDP7 = 20000
RDD3MM = RDCR = 10.14
RDD3ML = RDCJ = 6.76
RDD3EL = RDCK = 2.87
RDD3OT = RDCM = 7.04
BLCRCP = RDCRCP = 97385.2
BLCRNY = DBNP = 3
BLD3OT = DBTEC / BLCROH / BLCRLO
= .35035E8 / 1631 / 30
= 716.02

CFA EQUIPMENT DATA CARD FIELDS FOR SUPPORT EQUIPMENT ARE SET UP.

D3CRQT = DBNP = 3
D3CROH = RDCROH = 3263
D3CRSY = RDCRSY = 7
D3CRNY = DBNP = 3
D3CRSH = RDCRSH = 3625

D4CRQT = DBNP = 3
D4CROH = RDCROH = 1631
D4CRSY = RDCRSY = 7
D4CRNY = DBNP = 3
D4CRSH = RDCRSH = 1813

D5CRQT = DBNP = 3
D5CROH = RDCROH = 1631
D5CRSY = RDCRSY = 7

D5CRNY = DBNP = 3
D5CRSH = RDCRSH = 1813

FIRST DETAIL LINE PRINTS,
RNORD, INORD, RDSH, RDCG, RDCP, RDCN, RDRN

SECOND DETAIL LINE PRINTS,
DBRDTI, DBRDTO, INOSRD, DBRDTI, DBTEC, RDDT, ECDT

PRIMARY EQUIPMENT SUMMARY DATA ARE CALCULATED AND
PRINTED.

DBII = RDD2UI * (RDCRQT + RDCRFS) * 1000
= 440.8 * (6 + 0) * 1000
= .26448E7

RDDY = RDD2DH / RDCROH = 20000 / 3263
= 6.129

DBAIC = DBII * (1 + .07 * (1 + RDDY)) / RDDY
= .26448E7 * (1 + .07 * (1 + 6.129)) / 6.129
= .646839E6

DBAOC = RDCN * RDCROH * RDCRQT + BLD30T * BLCROH * BLCRQT
= 46.55 * 3263 * 6 + 716.02 * 1631 * 3
= .441485E7

DBPT = (DBAIC + DBAOC) * RDCRLO = (.646839E6 + .441485E7) * 30
= .15185E9

DRT = DBPT / XRT = .15185E9 / .163542E9
= .929

DFT = DBPT / XTT = .15185E9 / .161906E9
= .938

RDTNO = RDCRQT + RDCRFS = 6 + 0 = 6

SUMMARY LINE PRINTS,
RDTNO, DBII, DBAIC, DBAOC, DBPT, DRT, DFT

SUPPORT EQUIPMENT SUMMARY DATA ARE CALCULATED AND
PRINTED.

DSECII = (D3CRQT * D3D2UI + D4CRQT * D4D2UI + D5CRQT * D5D2UI)
* 1000

$$= (3 * 135.3 + 3 * 36.4 + 3 * 39) * 1000$$

$$= 623100$$

$$D3DY = D3D2DH / D3CROH = 12000 / 3263 = 3.678$$

$$D3AIC = D3D2UI * 1000 * (1 + .07 * (1 + D3DY)) / D3DY$$

$$* D3CRQT$$

$$= 135.3 * 1000 * (1 + .07 * (1 + 3.678)) / 3.678 * 3$$

$$= 146509.9$$

$$D3AOC = D3CN * D3CROH * D3CRQT = 26.86 * 3263 * 3$$

$$= .262933E6$$

$$D4DY = D4D2DH / D4CROH = 12000 / 1631 = 7.357$$

$$D4AIC = D4D2UI * 1000 * (1 + .07 * (1 + D4DY)) / D4DY$$

$$* D4CRQT$$

$$= 36.4 * 1000 * (1 + .07 * (1 + 7.357)) / 7.357 * 3$$

$$= 23525$$

$$D4AOC = D4CN * D4CROH * D4CRQT = 26.86 * 1631 * 3$$

$$= 21.51 * 1631 * 3$$

$$= .105248E6$$

$$D5DY = D5D2DH / D5CROH = 20000 / 1631 = 12.262$$

$$D5AIC = D5D2UI * 1000 * (1 + .07 * (1 + D5DY)) / D5DY$$

$$* D5CRQT$$

$$= 36 * 1000 * (1 + .07 * (1 + 12.262)) / 12.262 * 3$$

$$= 16963.9$$

$$D5AOC = D5CN * D5CROH * D5CRQT = 14.63 * 1631 * 3$$

$$= 71584.59$$

$$DSEAIC = D3AIC + D4AIC + D5AIC$$

$$= 146509.9 + 23525 + 16983.9$$

$$= 187019$$

$$DSEAOC = D3AOC + D4AOC + D5AOC$$

$$= 262933 + 105248 + 71584$$

$$= 439765$$

$$DSEPT = (DSEAIC + DSEAOC) * RDCRLO$$

$$= (187019 + 439765) * 30$$

$$= .188035E8$$

$$DRT = DSEPT / XRT = .188035E8 / .163542E9$$

$$= .115$$

$$DFT = DSEPT / XTT = .188035E8 / .161906E9$$

$$= .116$$

SUPPORT SUMMARY LINE PRINTS,
DSECII, DSEAIC, DSEAOC, DSEPT, DRT, DFT

4. OVERBURDEN REMOVAL WITH DRAGLINE

PARAMETER VALUES FROM MAIN PROGRAM ARE TRANSFERRED TO VARIABLES IN DRAGLINE SUBROUTINE.

DLCRLO = TMY = 30
DLNP = NPITS = 3

THE DRAGLINE BUCKET IS SIZED TO MEET THE REQUIRED OVERBURDEN PRODUCTION, AND THE PIT GEOMETRY IS SOLVED TO FIND THE NEEDED DLEDR (EFFECTIVE DUMPING RADIUS).

DLSW = BPBY * (1 + SFB) / DLCROH * .02149
= .324618E8 * 1.35 / 7467 * .02149
= 126.124

THE DRAGLINE CORRELATION EQUATIONS ARE BASED ON THE DATA FILE OVRBURDEN DENSITY AND SWELL FACTOR. THE BUCKET SIZE FOR THE PROBLEM IS ADJUSTED TO YIELD A DATA BOOK SIZE, DBSW, FOR THE CORRELATIONS.

DBSW = DLSW * (2000 + DBBPY / (1 + SFB)) / 4740.74
= 126.124 * (2000 + 3700 / (1.35)) / 4740.74
= 126.124

DLEDR = 3 + HC * COTB + HBA * (1 + SFB) * COTT
+ HBA * COTA + PWF / 4
= 3 + 5 * .25 + 71 * 1.35 + 71 * .5 + 100 / 4
= 208.275

THE ABOVE EQUATION FOR EDR ASSUMES THE BOOM FOOT IS A SAFE WORKING DISTANCE FROM THE HIGHWALL, WHEREAS, IN PRACTICE, THE OUTSIDE EDGE OF THE SHOES SHOULD BE A SAFE WORKING DISTANCE FROM THE HIGHWALL. THE MODEL USES AN ITERATIVE PROCEDURE TO FIND THE RMA FOR A DRAGLINE THAT WILL HAVE THE REQUIRED EFFECTIVE RADIUS.

THE FOLLOWING RELATIONS ARE SOLVED IN THIS PROCEDURE.

DLRMA = 1.2 * DLEDR
DLX = DLRMA * DBSW / 1000
DLSH = 2.69 + 1.1156 * DLRMA
DLSJ = 36.745 * DLX**0.3053
DLSE = DLSH - DLRMA

$$\text{CDR} = \text{DLRMA} + \text{DLSE} - \text{DLSJ} / 2$$

THE VALUE OF DLRMA IS REDUCED IN SMALL STEPS FROM THE INITIAL VALUE UNTIL THE VALUE OF CDR (CALCULATED DUMPING RADIUS) IS PRACTICALLY EQUAL TO DLEDR. AT THE END OF THE ITERATIONS,

$$\text{DLRMA} = 228.3$$

THE FOLLOWING REGRESSION EQUATIONS DETERMINE THE DRAGLINE SPECIFICATIONS AND COSTS.

$$\begin{aligned} \text{DLX} &= \text{DLRMA} * \text{DBSW} / 1000 = 228.3 * 126.124 / 1000 \\ &= 28.797 \end{aligned}$$

$$\begin{aligned} \text{DLSA} &= \text{INT}(\text{DLRMA} / \text{COS DLSB} + .9) = \text{INT}(228.3 / \text{COS } 35 + .9) \\ &= 279 \end{aligned}$$

$$\begin{aligned} \text{DLST} &= \text{INT}(729.5 + 341.44 * \text{DLX} + .9) \\ &= \text{INT}(729.5 + 341.44 * 28.797 + .9) \\ &= 10561 \end{aligned}$$

$$\begin{aligned} \text{DLPE} &= \text{INT}(642 + 201.4 * \text{DLX} + .9) \\ &= \text{INT}(642 + 201.4 * 28.797 + .9) \\ &= 6442 \end{aligned}$$

$$\begin{aligned} \text{DLCO} &= \text{DLPE} * \text{DLFDP} * \text{DLCEL} = 6442 * .72 * .01 \\ &= 46.38 \end{aligned}$$

$$\begin{aligned} \text{DLCA} &= 981.71 + 410.6 * \text{DLX} = 981.71 + 410.6 * 28.797 \\ &= 12805.75 \end{aligned}$$

$$\begin{aligned} \text{DLCI} &= -37.54 + 1.23468 * \text{DLCA} = -37.54 + 1.23468 * 12805.75 \\ &= 15773.47 \end{aligned}$$

$$\begin{aligned} \text{DLCM} &= 14.5 + 4.583 * \text{DLX} = 14.5 + 4.583 * 28.797 \\ &= 146.476 \end{aligned}$$

$$\begin{aligned} \text{DLCN} &= 9.67 + 3.055 * \text{DLX} = 9.67 + 3.055 * 28.797 \\ &= 97.644 \end{aligned}$$

$$\begin{aligned} \text{DLCL} &= 17.695 + 7.0423 * \text{DLX} = 17.695 + 7.0423 * 28.797 \\ &= 220.49 \end{aligned}$$

$$\begin{aligned} \text{DLCR} &= 61.962 + 9.7445 * \text{DLX} = 61.962 + 9.7445 * 28.797 \\ &= 342.57 \end{aligned}$$

$$\begin{aligned} \text{DLTCL} &= \text{DLCL} * \text{DLCROH} * \text{DLCRLO} \\ &= 220.49 * 3 * 7467 * 30 \\ &= .493919\text{E}8 \end{aligned}$$

$$\begin{aligned} \text{DLACR} &= \text{DLCR} * \text{DLCROH} = 342.57 * 3 * 7467 \\ &= .255798\text{E}7 \end{aligned}$$

$$\begin{aligned} \text{DLTCR} &= \text{DLACR} * \text{DLCRLO} = .255798\text{E}7 * 30 \\ &= .767393\text{E}8 \end{aligned}$$

FIRST DETAIL LINE PRINTS,
DLISA, DLSEB, DLSW, DLRMA, DLX, DLST, DLPE

SECOND DETAIL LINE PRINTS,
DLCA, DLCI, DLCM, DLCN, DLCO

THIRD DETAIL LINE PRINTS,
DLCL, DLCR, DLTCL, DLACR, DLTCR

CFA EQUIPMENT DATA CARD FIELDS ARE SET UP FOR DRAG-
LINE AND SUPPORT EQUIPMENT.

$$\begin{aligned} \text{DLCRQT} &= \text{DLNP} = 3 \\ \text{DLCRCP} &= \text{BPBY} * \text{DLNP} / 1000 = .324618\text{E}8 * 3 / 1000 \\ &= 97385.2 \\ \text{DLCRNY} &= \text{DLNP} = 3 \\ \text{DLD2UI} &= \text{DLCI} = 15773.5 \\ \text{DLD2DH} &= \text{DLCROH} * \text{DLDY} = 7467 * 30 = 224010 \\ \text{DLD3ML} &= \text{DLCN} = 97.644 \\ \text{DLD3MM} &= \text{DLCM} = 146.476 \\ \text{DLD3EL} &= \text{DLCO} = 46.382 \end{aligned}$$

DL01Q2 IS BASED ON DLSW, AS FOLLOWS
1 FOR BUCKETS 29 YARDS OR LESS
2 FOR BUCKETS FROM 30-64 YARDS
3 FOR BUCKETS 65 YARDS OR GREATER.

$$\begin{aligned} \text{O2CRQT} &= \text{DLNP} = 3 \\ \text{O2CROH} &= \text{DLCROH} = 7467 \\ \text{O2CRSY} &= \text{DLCSY} = 7 \\ \text{O2CRNY} &= \text{DLCRNY} = 3 \\ \text{O2CRSH} &= \text{DLCRSH} = 8297 \end{aligned}$$

$$\begin{aligned} \text{O3CRQT} &= \text{DLNP} = 3 \\ \text{O3CROH} &= \text{DLCROH} * .318 = 2374 \\ \text{O3CRSY} &= \text{DLCSY} = 7 \\ \text{O3CRNY} &= \text{DLCRNY} = 3 \\ \text{O3CRSH} &= \text{DLCRSH} * .318 = 2638 \end{aligned}$$

$$\begin{aligned} \text{O5CRQT} &= \text{DLNP} = 3 \\ \text{O5CROH} &= \text{DLCROH} = 7467 \\ \text{O5CRSY} &= \text{DLCSY} = 7 \\ \text{O5CRNY} &= \text{DLCRNY} = 3 \end{aligned}$$

$$O5CRSH = DLCRSH = 8297$$

$$O4CRQT = DLNP = 3$$

$$O4CRSY = DLCRSY - 1 = 7 - 1 = 6$$

$$O4CRNY = DLCRNY = 3$$

$$XHBA = HBA / TAN ABHD = 71 / TAN 63.43 = 35.5$$

$$\begin{aligned} O4D1S1 &= HBA * (PWF + XHBA) * PLF / 27 / 1000 \\ &= 71 * (100 + 35.5 * 10560 / 27 / 1000 \\ &= 3762.89 \end{aligned}$$

$$\begin{aligned} O4D3OT &= O4D1S1 * 1000 / O4CROH = 3762.89 * 1000 / 2000 \\ &= 1881.14 \end{aligned}$$

THE SUPPORT DRAGLINE IS SIZED TO HAVE THE EDR OF THE PRIMARY MACHINE AND ONE-FOURTH THE BUCKET SIZE. THE SAME PROCEDURE IS FOLLOWED TO DEVELOP SPECIFICATIONS AND COSTS.

THE DRAGLINE SUMMARY COST ELEMENTS ARE CALCULATED AND PRINTED.

$$\begin{aligned} DLII &= DLCRQT * DLD2UI * 1000 = 3 * 15773.3 * 1000 \\ &= .473199E8 \end{aligned}$$

$$\begin{aligned} DLAIC &= DLII * (1 + .07 * (1 + DLDY)) / DLDY \\ &= .473199E8 * (1 + .07 * (1 + 30)) / 30 \\ &= .500013E7 \end{aligned}$$

$$\begin{aligned} DLAOC &= DLCRQT * DLACR = 3 * .255798E7 \\ &= .767393E7 \end{aligned}$$

$$\begin{aligned} DLPT &= (DLAIC + DLAOC) * DLCRLO \\ &= (.500013E7 + .767393E7) * 30 \\ &= .38022E9 \end{aligned}$$

$$\begin{aligned} DRT &= DLPT / XRT = .38022E9 / .163542E9 \\ &= 2.325 \end{aligned}$$

$$\begin{aligned} DFT &= DLPT / XTT = .38022E9 / .161906E9 \\ &= 2.348 \end{aligned}$$

THE SUMMARY LINE PRINTS,
DLNP, DLII, DLAIC, DLAOC, DLPT, DRT, DFT

THE SUPPORT EQUIPMENT SUMMARY DATA ARE CALCULATED AND PRINTED USING THE ABOVE EQUATIONS, BUT FOR ITEMS 2, 3

AND 5. ITEM 4, THE BOX CUT, IS A ONE-TIME EXPENSE AND IS INCLUDED IN PROJECT TOTAL, BUT NOT ANNUAL COSTS.

5. COAL DRILLING AND BLASTING

PARAMETER VALUES FROM MAIN PROGRAM ARE TRANSFERRED TO VARIABLES IN DRILLING AND BLASTING SUBROUTINE.

```
QLCRLO = TMY = 30
QDCRLO = TMY = 30
QBNP = NPITS = 3
QBCD = CDRTY = .181713E7
QBHB = HBA = 71
QBDR = DRSMFH = 100
```

A REGRESSION EQUATION IS USED TO DETERMINE THE REQUIRED NUMBER OF ROTARY DRILLS; NUMBER OF SPARES IS SET TO ZERO.

```
RNOQD = .3 * QBCD / 1E6 * 3263 / QDCROH
      = .3 * .181713E7 / 1E6 * 3263 / 1632
      = 1.09
```

```
INOQD = INT(RNOQD + .9) = INT(1.09 + .9)
      = 1
```

```
INOSQD = 0
```

```
QBQDTI = INOQD * QDCRLO * QDCROH * QDCP
      = 1 * 30 * 1632 * 3.30
      = .161568E6
```

```
QBQDTO = RNOQD * QDCRLO * QDCROH * QDCN
      = 1.09 * 30 * 1632 * 46.55
      = .93173E6
```

```
QBQDFI = INOSQD * QDCRLO * QDCROH * QDCP
      = 0
```

```
QDDT = (QBQDTI + QBQDTO + QBQDFI) / (QBCD * QDCRLO)
      = (.161568E6 + .93173E6 + 0) / (.181713E7 * 30)
      = .02
```

A REGRESSION EQUATION DETERMINES EXPLOSIVES COSTS.

```
QBTEC = .05 * QBCD * QLCRLO
      = .05 * .181713E7 * 30
      = .2725695E7
```

```
ECDT = QBTEC / QBCD / QLCRLO = .27257E6 / .181713E7 / 30
      = .05
```

CFA EQUIPMENT DATA CARD FIELDS ARE SETUP FOR PRIMARY EQUIPMENT.

QDCRQT = INOQD * QBNP = 1 * 3 = 3
QDCRFS = INOSQD = 0
QDCRCP = CDRTY / ECR * 2000 / DCBPY / 1000 * NPITS
= .181713E7 / .92 * 2000 / 2160 / 1000 * 1
= 1828.8
QDCRNY = QBNP = 3
QDD2UI = QDCG = 37.3
QDD2DH = QDP7 = 20000
QDD3MM = QDCR = 1.02
QDD3ML = QDCJ = .68
QDD3EL = QDCK = .90
QDD3OT = QDCM = 3.60
QLCRCP = QDCRCP = 1828.8
QLCRNY = QBNP = 3
QLD3OT = QBTEC / QLCROH / QLCRLO
= .27257E6 / 1632 / 30
= 55.67

CFA EQUIPMENT DATA CARD FIELDS FOR SUPPORT EQUIPMENT ARE SET UP.

Q5CRQT = QBNP = 3
Q5CROH = QDCROH = 1632
Q5CRSY = QDCRSY = 7
Q5CRNY = QBNP = 3
Q5CRSH = QDCRSH = 1813

Q5 SUPPORT CARDS (PRILL TRUCK) ARE GENERATED ONLY WHEN IMODB = 0.

FIRST DETAIL LINE PRINTS,
RNOQD, INOQD, QDSH, QDCG, QDCP, QDCN, QDRN

SECOND DETAIL LINE PRINTS,
QBQDTI, QBQDTO, INOSQD, QBQDTI, QBTEC, QDDT, ECDT

PRIMARY EQUIPMENT SUMMARY DATA ARE CALCULATED AND PRINTED.

QBII = QDD2UI * (QDCRQT + QDCRFS) * 1000
= 37.3 * (3 + 0) * 1000
= 111900

$$\begin{aligned} \text{QDDY} &= \text{QDD2DH} / \text{QDCROH} = 20000 / 1632 \\ &= 6.129 \end{aligned}$$

$$\begin{aligned} \text{QBAIC} &= \text{QBII} * (1 + .07 * (1 + \text{QDDY})) / \text{QDDY} \\ &= 111900 * (1 + .07 * (1 + 6.129)) / 6.129 \\ &= 17603.2 \end{aligned}$$

$$\begin{aligned} \text{QBAOC} &= \text{QDCN} * \text{QDCROH} * \text{QDCRQT} + \text{QLD3OT} * \text{QLCROH} * \text{QLCRQT} \\ &= 17.46 * 1632 * 6 + 55.67 * 1632 * 3 \\ &= 358053 \end{aligned}$$

$$\begin{aligned} \text{QBPT} &= (\text{QBAIC} + \text{QBAOC}) * \text{QDCRLO} = (17603.2 + 358053) * 30 \\ &= .112697\text{E}8 \end{aligned}$$

$$\begin{aligned} \text{DRT} &= \text{QBPT} / \text{XRT} = .112697\text{E}8 / .163542\text{E}9 \\ &= .069 \end{aligned}$$

$$\begin{aligned} \text{DFT} &= \text{QBPT} / \text{XTT} = .112697\text{E}8 / .161906\text{E}9 \\ &= .070 \end{aligned}$$

$$\text{QDTNO} = \text{QDCRQT} + \text{QDCRFS} = 6 + 0 = 6$$

SUMMARY LINE PRINTS,
QDTNO, QBII, QBAIC, QBAOC, QBPT, DRT, DFT

SUPPORT EQUIPMENT SUMMARY DATA ARE CALCULATED AND
PRINTED.

$$\begin{aligned} \text{Q5CII} &= \text{Q5CRQT} * \text{Q5D2UI} * 1000 \\ &= 3 * 39 * 1000 \\ &= 108000 \end{aligned}$$

$$\text{Q5DY} = \text{Q5D2DH} / \text{Q5CROH} = 20000 / 1632 = 12.255$$

$$\begin{aligned} \text{Q5AIC} &= \text{Q5D2UI} * 1000 * (1 + .07 * (1 + \text{Q5DY})) / \text{Q5DY} \\ &\quad * \text{Q5CRQT} \\ &= 36 * 1000 * (1 + .07 * (1 + 12.255)) / 12.255 * 3 \\ &= 16989.7 \end{aligned}$$

$$\begin{aligned} \text{Q5AOC} &= \text{Q5CN} * \text{Q5CROH} * \text{Q5CRQT} = 14.63 * 1632 * 3 \\ &= 71628.4 \end{aligned}$$

$$\begin{aligned} \text{Q5PT} &= (\text{Q5AIC} + \text{Q5AOC}) * \text{QDCRLO} \\ &= (16989.7 + 71628.4) * 30 \\ &= .265854\text{E}7 \end{aligned}$$

$$\text{DRT} = \text{Q5PT} / \text{XRT} = .265854\text{E}7 / .163542\text{E}9$$

= .01626

DFT = Q5PT / XTT = ..265854E7 / .161906E9
= .01642

SUPPORT SUMMARY LINE PRINTS,
Q5CII, Q5AIC, Q5AOC, Q5PT, DRT, DFT

6. COAL LOAD AND HAUL

PARAMETERS FROM MAIN PROGRAM ARE TRANSFERRED TO VARIABLES IN THE SUBROUTINE, AND SOME ADDITIONAL VARIABLES ARE CALCULATED.

```
SDCRLO = TMY = 30
TDCRLO = TMY = 30
CHPLF = PLF = 10560
CHHD = CHHDF + (HBA + HBT) * (1 + SFB) / .04
      = 9680 + (71 + 1) * (1 + .35) / .04
      = 12110
SFC1 = 1 + SFC = 1 + .35 = 1.35
DCBTY = DCBPY / 2000 = 2160 / 2000 = 1.08
CDRYY = CDRTY / DCBTY = .171813E7 / 1.08 = .168253E7
CHSDRR = CHHD * .03267 = 12110 * .03267 = 395.63
```

THE SHOVEL PRODUCTION CAPACITY AND REQUIRED PRODUCTION ARE CALCULATED AND USED TO DETERMINE THE REQUIRED NUMBER OF LOADING SHOVELS.

```
EBWT = SDSW * (1 + CHSD) * CHFF * DCBTY / SFC1
      = 16 * (1 + 0) * .95 * 1.08 / 1.35
      = 12.16
```

```
SPL = INT(TDSL / 2 * (1 + CHTO) / EBWT)
      = INT(360 / 2 * (1 + .1) / 12.16)
      = 16
```

```
TTL = SPL * CHCT + CHSW = 16 * .5 + 0 = 8
TRHR = 50 / TTL = 50 / 8 = 6.25
STCAP = SPL * EBWT * TRHR / DCBTY = 16 * 12.16 * 6.25 / 1.08
      = 1125.93
```

```
CAPAC = CDRYY / SDCROH = .168253E7 / 3263
      = 515.797
SDNO = CAPAC / STCAP = 515.797 / 1125.93
      = .4581
ISDNO = INT(SDNO + .9) = INT(.4581 + .9) = 1
```

A REGRESSION EQUATION DETERMINES HAUL CYCLE TIME, AND THE REQUIRED NUMBER OF TRUCKS FOR STARTUP ARE CALCULATED.

```
CHHDM = CHHD / 5280 = 12110 / 5280 = 2.29356
```

$$\begin{aligned}
TDCT &= 7.41 + CHCT * SPL \\
&\quad + .26673 * CHHDM \\
&\quad + 20.434 * TDSL * CHHDM / TDSC \\
&= 7.41 + .5 * 16 \\
&\quad + .026673 * 2.29356 \\
&\quad + 20.434 * 360 * 2.29356 / 1200 \\
&= 29.53
\end{aligned}$$

$$\begin{aligned}
TDNO &= STCAP * DCBTY * SDNO / (50 / TDCT * SPL * EBWT) \\
&= 1125.92 * 1.08 * .4581 / (50 / 29.5 * 16 * 12.16) \\
&= 1.723
\end{aligned}$$

$$ITDNO = INT(TDNO + .9) = INT(1.723 + .9) = 2$$

THE SHOVEL/TRUCK COSTS ARE CALCULATED AND DETAIL LINES ARE PRINTED.

$$\begin{aligned}
STOAO &= ISDNO * SDCP + SDNO * SDCN + ITDNO * TDCP + TDNO * TDCN \\
&= 1 * 40.98 + .4581 * 51.93 + 2 * 22.81 + 1.723 * 54.16 \\
&= 203.71
\end{aligned}$$

$$\begin{aligned}
SDTCP &= ISDNO * SDCP * SDCROH * SDCRLO \\
&= 1 * 40.98 * 3262 * 30 \\
&= .40109E7
\end{aligned}$$

$$\begin{aligned}
SDTCN &= ISDNO * SDCN * SDCROH * SDCRLO \\
&= 1 * 51.93 * 3262 * 30 \\
&= .50826E7
\end{aligned}$$

$$\begin{aligned}
TDTCP &= ITDNO * TDCP * TDCROH * TDCRLO \\
&= 2 * 22.81 * 3262 * 30 \\
&= .44651E7
\end{aligned}$$

$$\begin{aligned}
TDTCN &= TDNO * TDCN * TDCROH * TDCRLO \\
&= 1.723 * 54.16 * 3262 * 30 \\
&= .91335E7
\end{aligned}$$

$$\begin{aligned}
TDCRFS &= 0 \\
TDSCP &= TDCRFS * TDCP * TDCROH * TDCRLO = 0
\end{aligned}$$

$$\begin{aligned}
SDII &= SDCG = 1043 \\
TDII &= TDCG = 339.3
\end{aligned}$$

$$\begin{aligned}
STDT &= STOAO * DCBTY / (CDRY / SDCROH) \\
&= 203.71 * 1.08 / (.168253E7 / 3263) \\
&= .427
\end{aligned}$$

THE FIRST DETAIL LINE PRINTS,

SDNO, ISDNO, SDST, SDSW, SDCA, SDCG, SDCP, SDCN, SDRN

THE SECOND DETAIL LINE PRINTS,
TDNO, ITDNO, TDSC, TDSL, TDDT, TDCA, TDCG, TDCP, TDCN, TDRN

THE THIRD DETAIL LINE PRINTS,
SDTCP, SDTCN, TDTCP, TDTCN, TDSCP, TDCRFS, STDT

CFA EQUIPMENT DATA CARD FIELDS ARE SET UP.

SDCRQT = ISDNO * CHNP = 1 * 3 = 3
SDCRCP = CDRY * DCBTY * CHNP / 1000
= .162853E7 * 1.08 * 3 / 1000
= 5451.3
SDCRNY = CHNP = 3
SDD2UI = SDCG = 1043
SDD2DH = SDP7 = 60000
SDD3ML = SDCR = 6.76
SDD3MM = SDCJ = 20.27
SDD3EL = SDCK = 3.44
TDCRQT = ITDNO * CHNP = 2 * 3 = 6
TDCRCP = SDCRCP = 5451.3
TDCRNY = CHNP = 3
TDD2UI = TDCG = 339.3
TDD2DH = TDP7 = 30000
TDD3ML = TDCR = 7.52
TDD3MM = TDCJ = 11.28
TDD3FU = TDCK = 11.23
TDD3TI = TDCM = 17.86

SUPPORT EQUIPMENT

C3CRQT = CHNP = 3
C3CROH = SDCROH = 3262
C3CRNY = CHNP = 3
C3CRSY = SDCRSY = 7
C3CRSH = SDCRSH = 3625

C4CRQT = CHNP = 3
C4CROH = SDCROH = 3262
C4CRNY = CHNP = 3
C4CRSY = SDCRSY = 7
C4CRSH = SDCRSH = 3625

C5CRQT = CHNP * 2 = 3 * 2 = 6
C5CROH = 1440
C5CRNY = CHNP = 3
C5CRSY = SDCRSY = 7
C5CRSH = C5CROH = 1440

C6CROT = CHNP = 3
 C6CROH = SDCROH / 2 = 3262 / 2 = 1631
 C6CRNY = CHNP = 3
 C6CRSY = SDCRSY = 7
 C6CRSH = SDCRSH / 2 = 3625 / 2 = 1812.5

THE NUMBER OF DEFERRED TRUCKS IS BASED ON THE HAUL DISTANCE IN THE LAST PROJECT YEAR.

RTF = TDNO = 1.723
 AHD = ACRES * 43560 / PLF = 8501.8 * 43560 / 10560
 = 35069.9

CHHD = CHHD + AHD = 12110 + 35069.9
 = 47179.9

CHHDM = CHHD / 5280 = 8.9356

TDCT = 7.41 + CHCT * SPL
 + .26673 * CHHDM
 + 20.434 * TDSL * CHHDM / TDSC
 = 7.41 + .5 * 16
 + .026673 * 8.9356
 + 20.434 360 * 8.9356 / 1200
 = 72.57

TDNO = STCAP * DCBTY * SDNO / (50 / TDCT * SPL * EBWT)
 = 1125.92 * 1.08 * .4581 / (50 / 72.57 * 16 * 12.16)
 = 4.157

THE MODEL ASSUMES A STRAIGHT-LINE RELATION BETWEEN NUMBER TRUCKS AND START YEAR. THE TWO EQUATIONS FOR FIRST AND LAST YEARS ARE:

YF = A + B * RTF
 YL = A + B * RTL
 SUBSTITUTING YF = 7, YL = 36, RTF = 1.723, RTL = 4.157,
 AND SOLVING YIELDS VALUES FOR A AND B:
 A = -14.2351
 B = 12.3245

THE INITIAL FLEET IS RTF ROUNDED UP TO INTEGER, OR 2. THE EQUATION IS SOLVED TO FIND THE YEAR IN WHICH THE CAPACITY OF THIS FLEET IS EXCEEDED - YEAR 10. THE FIRST DEFERRED TRUCK IS ADDED IN YEAR 10, AND THE EQUATION SOLVED AGAIN TO FIND THE YEAR WHEN CAPACITY IS EXCEEDED - YEAR 22. ANOTHER DEFERRED TRUCK IS ADDED AND THE NEXT YEAR FOUND TO BE 35.

ONE DEFERRED TRUCK IS ADDED FOR EACH PIT. THE LIFE OF THE DEFERRED TRUCK OPERATIONS IS REDUCED ACCORDING TO THE DELAY IN START UP.

THUS,

DTCRSY = 10, DTCRLO = 27

DTCRSY = 22, DTCRLO = 15

DTCRSY = 35, DTCRLO = 2

THE SUMMARY COST ELEMENTS ARE CALCULATED AND PRINTED FOR BOTH PRIMARY AND SUPPORT EQUIPMENT AND DEFERRED TRUCKS. SINCE THE FORM OF THE EQUATIONS IS DEMONSTRATED IN DRILLING AND BLASTING AND OVERBURDEN REMOVAL, IT SHOULD NOT BE NECESSARY TO REPEAT THEM FOR COAL LOAD AND HAUL.

7. LAND RECLAMATION

PARAMETERS FROM MAIN PROGRAM ARE TRANSFERRED TO VARIABLES IN THE LAND RECLAMATION SUBROUTINE.

LMCRLO = TMY = 30
CDCRLO = TMY = 30
SCCRLO = TMY = 30
RVCRLD = TMY = 30
RCNP = NPITS = 3
RCCG = ROC * 6 / 9 = 900 * 6 / 9 = 600
RCCLM = ROC / 9 = 900 / 9 = 100
RCCRV = ROC * 2 / 9 = 900 * 2 / 9 = 200
RCTT = 1 / COTT = 1 / 1.5 = .667

A REGRESSION EQUATION DETERMINES THE REQUIRED NUMBER OF SCRAPERS AND COSTS ARE CALCULATED.

$X = \text{CDRTY} / 1\text{E}6 / \text{HC} = .181713\text{E}7 / 1\text{E}6 / 4 = .45428$

$\text{RNOSC} = (.0157 + 5.432 * X$
 $+ 7.3666 * (X)**2)$
 $* \text{HBT}$
 $= 4.003$

PARAMETER VALUES

$X = .45428$

$\text{HBT} = 1$

$\text{INOSC} = \text{INT}(\text{RNOSC} + .9) = \text{INT}(4.266 + .9) = 5$

$\text{INOSSC} = \text{INT}(\text{INOSC} * \text{RCNP} * .1 + .9)$
 $= \text{INT}(5 * 3 * .1 + .9) = 2$

$\text{RCSCFI} = \text{INOSC} * \text{SCCP} * \text{SCCROH} * \text{SCCRLO}$
 $= 5 * 22.26 * 1800 * 30$
 $= .60102\text{E}7$

$\text{RCSCTO} = \text{RNOSC} * \text{SCCN} * \text{SCCROH} * \text{SCCRLO}$
 $= 4.266 * 38.21 * 1800 * 30$
 $= .88022\text{E}7$

$\text{RCSCFI} = \text{INOSSC} * \text{SCCP} * \text{SCCROH} * \text{SCCRLO}$
 $= 2 * 22.26 * 1800 * 30$
 $= .240408\text{E}7$

$\text{SCDT} = (\text{RCSCFI} + \text{RCSCTO} + \text{RCSCFI}) / \text{CDRTY} / \text{SCCRLO}$
 $= (.60102\text{E}7 + .88022\text{E}7 + .240405\text{E}7) / .181713\text{E}7 / 30$
 $= .3158$

A REGRESSION EQUATION DETERMINES THE REQUIRED NUMBER OF DOZERS AND COSTS ARE CALCULATED.

PARAMETER VALUES

$$\begin{aligned} \text{RNOCD} &= -.0077476 * X * \text{RCTT} * \text{RCPWF} & X &= .45428 \\ &+ .000642157 * X * \text{RCTT} * \text{RCPWF}^{**2} & \text{RCTT} &= .667 \\ &+ .00664438 * X * \text{RCCG} & \text{RCCG} &= 600 \\ & & \text{RCPWF} &= 100 \\ &= 3.52 \end{aligned}$$

$$\text{INOC D} = \text{INT}(\text{RNOCD} + .9) = \text{INT}(3.62 + .9) = 4$$

$$\text{INOSCD} = 0$$

$$\begin{aligned} \text{RCCDTI} &= \text{INOC D} * \text{CDCP} * \text{CDCROH} * \text{CDCRLO} \\ &= 4 * 21.30 * 1800 * 30 \\ &= .46008\text{E}7 \end{aligned}$$

$$\begin{aligned} \text{RCCDTO} &= \text{RNOCD} * \text{CDCN} * \text{CDCROH} * \text{CDCRLO} \\ &= 3.62 * 31.18 * 1800 * 30 \\ &= .60953\text{E}7 \end{aligned}$$

$$\begin{aligned} \text{RCCDFI} &= \text{INOSCD} * \text{CDCP} * \text{CDCROH} * \text{CDCRLO} \\ &= 0 * 21.30 * 1800 * 30 \\ &= 0 \end{aligned}$$

$$\begin{aligned} \text{CDDT} &= (\text{RCCDTI} + \text{RCCDTO} + \text{RCCDFI}) / \text{CDRTY} / \text{CDCRLO} \\ &= (.46008\text{E}7 + .60953\text{E}7 + 0) / .181713\text{E}7 / 30 \\ &= .1962 \end{aligned}$$

REVEGETATION AND LAND MANAGEMENT COSTS ARE CALCULATED.

$$\text{RCRVTD} = \text{RCCRV} * \text{ACRES} = 200 * 8501.8 = .170036\text{E}7$$

$$\text{RCLMTD} = \text{RCCLM} * \text{ACRES} = 100 * 8501.8 = .85018\text{E}6$$

FIRST DETAIL LINE PRINTS,
RNOSC, INOSC, SCSA, SCSR, SCCG, SCCP, SCCN, SCR N

SECOND DETAIL LINE PRINTS,
RNOCD, INOC D, CDSK, CDCG, CDCP, CDCN, CDR N

THIRD DETAIL LINE PRINTS,
RCSCTI, RCSCTO, INOSSC, RCSCFI, RCCDTI, RCCDTO, INOSCD,
RCCDFI, RCRVTD, RCLMTD

$CDCRQT = INOCD * RCNP = 4 * 3 = 12$
 $CDCRFS = INOSCD = 2$
 $CDCRCP = ACRES / CDCRLO * RCNP / 1000$
 $= 8105.8 / 30 * 3 / 1000$
 $= .85018$

$CDCRNY = RCNP = 3$
 $CDD2UI = CDCG = 192.5$
 $CDD2DH = CDP7 = 12000$
 $CDD3ML = CDCR = 5.64$
 $CDD3MM = CDCJ = 10.32$
 $CDD3FU = CDCK = 5.35$

$SCCRQT = INOSC * RCNP = 5 * 3 = 15$
 $SCCRFS = INOSSC = 2$
 $SCCRCP = CDCRCP = .85018$
 $SCCRNY = RCNP = 3$
 $SCD2UI = SCCG = 201.1$
 $SCD2DH = SCP7 = 12000$
 $SCD3ML = SCCR = 9.19$
 $SCD3MM = SCCJ = 9.19$
 $SCD3FU = SCCK = 5.13$
 $SCD3TI = SCCM = 3.55$

$RVCRCP = CDCRCP = .81058$
 $RVCRNY = RCNP = 3$

$RVD30T = ACRES / CDCRLO * RCCR / RVCROH * RCNP$
 $= 8501.8 / 30 * 200 / 1800 * 3$
 $= 94.46$

$LMCRCP = CDCRCP = .85018$
 $LMCRNY = RCNP = 3$
 $LMD30T = ACRES / LMCRLD * RCCLM / LMCROH * RCNP$
 $= 8501.8 / 30 * 100 / 1800 * 3$
 $= 47.23$

SUMMARY COST ELEMENTS ARE CALCULATED AND PRINTED.
 THE EQUATIONS ARE THE SAME AS DEMONSTRATED UNDER DRILLING
 AND BLASTING AND OVERBURDEN STRIPPING, AND ARE NOT REPEATED
 FOR LAND RECLAMATION.

8. PREPARATION PLANT FACTORING

PARAMETERS FROM MAIN PROGRAM ARE TRANSFERRED TO VARIABLES IN THE SUBROUTINE.

PPCRLO = TMY = 30
PPSDY = PPODY = 250

THE PREPARATION PLANT HAS 9 BLOCKS WHICH ARE COMBINED ON THE BASIS OF THE PLANT TYPE SWITCH, IPPT. SEE TEXT.

THE FOLLOWING EQUATIONS INCLUDE SUBSCRIPTS TO INDICATE THAT CALCULATION IS MADE FOR EACH OF THE 9 BOXES. THE EXAMPLE APPLIES TO I = 1.

PSF = PPNS / PPEQTY(I) / 75000
= 21805.6 / 1 / 75000
= .29074

PPCC = PPCCF(I) * PSF**PPCCX(I) * PPEQTY(I)
= 17700 * .29074**0.8 * 1
= 6588.37

PPD2DH = PPOWCF(I) * PPDY = 3625 * 30 = 108750

THE FOLLOWING TWO CALCULATIONS ARE MADE FOR J = 1 TO 8.

PPPS(J,2) = PPSF(I,J) * PSF**PPPSX(I)
PPPS(J,1) = PPOS(I)

THE VALUES FOR THE FIRST THREE J'S ARE:

J	PPPSF	PPPS(J,2)	PPPS(J,1)
1	2	1.3	5
2	2	1.3	5
3	3	1.9	5

PPML = PPMLF(I) * PSF**PPMLX(I)
= 72.52 * .29074**0.35 = 46.41

PPMM = PPMMF(I) * PSF**PPMMX(I)
= 122.07 * .29074**0.8 = 45.44

PPFC = PPFCF(I) * PSF**PPFCX(I)
= 0 * .29074**0 = 0

$$\begin{aligned} \text{FOR I} &= 4, \\ &= 12.41 * .29074^{**0.8} = 4.62 \end{aligned}$$

$$\text{PPWC} = \text{PPWCF(I)} * \text{PSF}^{**}\text{PPWCX(I)}$$

$$\begin{aligned} \text{FOR I} &= 6, \\ &= 2.40 * .29074^{**1} = .6978 \end{aligned}$$

$$\begin{aligned} \text{PPEP} &= \text{PPEPF(I)} * \text{PSF}^{**}\text{PPEPX(I)} \\ &= 45.05 * .29074^{**1} = 13.10 \end{aligned}$$

$$\begin{aligned} \text{PPLC} &= \text{PPLCF(I)} * \text{PSF}^{**}\text{PPLCX(I)} \\ &= 68.78 * .29074^{**0.35} = 44.64 \end{aligned}$$

(PPLC IS USED IN COST CALCULATIONS, BUT NOT IN CFA CARDS.)

$$\begin{aligned} \text{PPOWC} &= \text{PPCC} * (1 + .07 * (1 + \text{PPDY})) / \text{PPDY} * 1000 \\ &\quad / \text{PPOWCF(I)} \\ &= 6588.38 * (1 + .07 * (1 + 30)) / 30 * 1000 / 3265 \\ &= 192.047 \end{aligned}$$

$$\begin{aligned} \text{PPOPC} &= \text{PPML} + \text{PPMM} + \text{PPFC} + \text{PPWC} + \text{PPEP} + \text{PPLC} \\ &= 46.41 + 45.44 + 0 + 0 + 13.10 + 44.64 \\ &= 149.59 \end{aligned}$$

$$\begin{aligned} \text{PPDT} &= (\text{PPOWC} + \text{PPOPC}) * \text{PPDTF(I)} / \text{PPNS} \\ &= (192.047 + 149.59) * 14.5 / 21805.6 \\ &= .22718 \end{aligned}$$

THE HOURLY OPERATING COSTS HAVE BEEN CALCULATED FOR EACH UNIT AS SPECIFIED IN PPEQTY. THE COSTS ARE MULTIPLIED BY PPEQTY BEFORE THE DETAIL PRINT LINE IS WRITTEN.

CFA EQUIPMENT CARDS ARE WRITTEN FOR EACH BLOCK INCLUDED IN THE PREPARATION PLANT TYPE. THE FOLLOWING ITEMS ARE TRANSFERRED TO DATA CARD FIELDS, AND THE REMAINING DATA ARE WRITTEN DIRECTLY IN THE CARD FORMATS.

$$\begin{aligned} \text{PPCRQT} &= \text{INT}(\text{PPEQTY(I)} + .99) = \text{INT}(1 + .99) = 1 \\ \text{PPCROH} &= \text{PPOWCF(I)} = 3625 \end{aligned}$$

SUMMARY DATA ARE CALCULATED AND PRINTED.

$$\begin{aligned} \text{PPCC} &= \text{PPCC} * 1000. \\ \text{SPPDT} &= \text{SUMMATION OF ALL PPDT} = 1.493 \\ \text{PPII} &= \text{SUMMATION OF ALL PPCC TIMES PPEQTY} = .406226\text{E8} \\ \text{PPACC} &= \text{SUMMATION OF ALL PPOWC TIMES PPOWCF} = .429287\text{E7} \\ \text{PPAOC} &= \text{SUMMATION OF ALL PPOPC TIMES PPOWCF} = .377488\text{E7} \end{aligned}$$

PPDT = SUMMATION OF ALL PPDT = 1.493

PPPT = (PPACC + PPAOC. * PPCRLO
= (.429287E7 + .377488E7) * 30
= .242033E9

DRT = PPPT / XRT = .242.33E9 / .163542E9 = 1.48

DFT = PPPT / XTT = .242033E9 / .161906E9 = 1.495

SUMMARY LINE PRINTS,
PPCRQT, IPPT, PPII, PPACC, PPAOC, PPPT, DRT, DFT

9. GENERAL AND ADMINISTRATIVE

THERE ARE 13 ELEMENTS IN THE GAA FILE, AS FOLLOWS:

1. SITE ROADS & SITE ANC. FAC.
2. BLDG BUILDINGS ANC. FAC.
3. PWR ELECT. SYS. ANC. FAC.
4. H2O WATER SYS. ANC. FAC.
5. COM COMMUN. SYS. ANC. FAC.
6. MBEQ MOBILE SUP. ANC. FAC.
7. SHEQ EQUIP. SHOP ANC. FAC.
8. LAND LAND RIGHTS PREMINE
9. XDRL EXPL. DRILL. PREMINE
10. ENG CONT. ENG. PREMINE
11. EIS E. I. S. PREMINE
12. STF SUPERV. PER.
13. RLTX ROY-SEV. TAX

THE FIRST FOUR CHARACTERS IN EACH LINE ABOVE IS USED AS THE EQUIPMENT IDENTIFIER; THE REMAINING TEXT IS WRITTEN IN THE ED1 CARDS.

PARAMETERS FROM THE MAIN PROGRAM ARE TRANSFERRED TO VARIABLES IN THE SUBROUTINE, AND SOME VARIABLES ARE CALCULATED.

$$GTAD = ACRES * NPITS = 8501.8 * .3 = 25505.4$$

$$\begin{aligned} GTTY &= (CDRTYX + BPBY * DBBPY / 2000 * NPITS) / 1E6 \\ &= (.545139E7 + .324618E8 * 3700 / 2000 * 3) / 1E6 \\ &= 185.614 \end{aligned}$$

$$GSR = GTTY / GATYB = 185.614 / 185.614 = 1$$

$$\begin{aligned} G8MR &= GAMR = 50 \\ G8SR &= GASR = 250 \\ G8YRS &= TMY = 30 \\ G15ROY &= GARA = .25 \\ G15STX &= GAST = 0 \\ G15UNI &= GAUP .11 \end{aligned}$$

CFA ECRG AND ED1 CARDS ARE WRITTEN FOR EACH ELEMENT USING DEFAULT VALUES. THE FOLLOWING CALCULATIONS FOR EACH ELEMENT DEVELOP ED2 AND ED3 DATA, AS APPROPRIATE. TWO EXCEPTIONS ARE MADE FOR LIFE AND NO. YEARS:

$$\text{GACRLO} = \text{TMY} + \text{NPITS} - 1 = 30 + 3 - 1 = 32$$

$$\text{GACRNY}(12) = \text{NPITS} + 6$$

$$\begin{aligned}\text{GCDRTY} &= \text{XRT} / \text{GACRLO} = .163542\text{E}9 / 32 \\ &= .511069\text{E}7\end{aligned}$$

1) ROADS & SITE WORK

$$\begin{aligned}\text{GAD2UI} &= \text{G1CCF} * \text{GSR} ** \text{G1EXP} / 1000 \\ &= 3\text{E}6 * 1 ** 0.35 / 1000 = 3000\end{aligned}$$

2) BUILDINGS

$$\begin{aligned}\text{GAD2UI} &= \text{G2SQF} * \text{GSR} ** \text{G2EXP1} * \text{G2DSQF} / 1000 \\ &= 135\text{E}3 * 1 ** 0.85 * 36.25 / 1000 \\ &= 4893.75\end{aligned}$$

$$\begin{aligned}\text{FUEL} &= \text{G2MSFF} * \text{GSR} ** \text{G2EXP2} / \text{GACROH}(2) \\ &= 65\text{E}3 * 1 ** 0.9 / 2000 = 32.50\end{aligned}$$

$$\begin{aligned}\text{WATER} &= \text{G2MSFW} * \text{GSR} ** \text{G2EXP3} / \text{GACROH}(2) \\ &= 250 * 1 ** 0.75 / 2000 = .125\end{aligned}$$

$$\begin{aligned}\text{GTOPRC} &= \text{FUEL} + \text{WATER} = 32.50 + .125 = 32.625 \\ \text{GTOPRC} &\text{ IS OPERATING COST IN } \$/\text{HOUR}.\end{aligned}$$

3) ELECTRIC POWER SYSTEM.

$$\begin{aligned}\text{GAD2UI} &= \text{G3CCF} * \text{GSR} ** \text{G3EXP} / 1000 \\ &= 45\text{E}5 * 1 ** 0.7 / 1000 = 4500\end{aligned}$$

4) WATER SYSTEM - DEPENDS IN IPPT

$$\begin{aligned}\text{GAD2UI} &= \text{G4ACCF} * \text{GSR} * \text{G4EXP} / 1000 \\ &= 2\text{E}5 * 1 ** 0.45 / 1000 = 200 \text{ (FOR IPPT = 1)}\end{aligned}$$

$$\begin{aligned}\text{GAD2UI} &= \text{G4BCCF} * \text{GSR} ** \text{G4EXP} / 1000 \\ &= 4.5\text{E}5 * 1 ** 0.45 / 1000 = 450 \text{ (FOR IPPT = 2)}\end{aligned}$$

$$\begin{aligned}\text{GAD2UI} &= \text{G4CCCF} * \text{GSR} ** \text{G4EXP} / 1000 \\ &= 5.5\text{E}5 * 1 ** 0.45 / 1000 = 550 \text{ (FOR IPPT = 3)}\end{aligned}$$

5) COMMUNICATIONS SYSTEM

$$\begin{aligned}\text{GAD2UI} &= \text{G5CCF} * \text{GSR} ** \text{G5EXP} / 1000 \\ &= 125\text{E}3 * 1 ** 0.4 / 1000 = 125\end{aligned}$$

6) MOBILE SUPPORT

$$\begin{aligned}\text{GAD2UI} &= \text{G6CCF} * \text{GSR} ** \text{G6EXP} / 1000 \\ &= 12\text{E}5 * 1 ** 0.85 / 1000 = 1200\end{aligned}$$

7) SHOP

$$\begin{aligned} \text{GAD2UI} &= \text{G7CCF} * \text{GSR} ** \text{G7EXP} / 1000 \\ &= 1\text{E}6 * 1 ** 0.45 / 1000 = 1000 \end{aligned}$$

8) LAND RIGHTS

$$\begin{aligned} \text{GAD2UI} &= \text{G8PERC} * (\text{G8SR} + \text{G8MR}) * \text{GTAD} / 1000 \\ &= .1 * (250 + 50) * .255054\text{E}5 / 1000 = 765.162 \end{aligned}$$

$$\begin{aligned} \text{GTOPRC} &= (1 - \text{G8PERC}) * (\text{G8SR} + \text{G8MR}) * \text{GTAD} / \text{GACROH}(8) \\ &= (1 - .1) * (250 + 50) * .255054\text{E}5 / 2000 = 114.774 \end{aligned}$$

9) EXPLORATION DRILLING

$$\begin{aligned} \text{GAD2UI} &= \text{G9CCF} * \text{GTAD} / \text{G9AHOL} / 1000 \\ &= 1000 * .255054\text{E}5 / 40 / 1000 = 637.635 \end{aligned}$$

10) ENGINEERING

$$\begin{aligned} \text{GAD2UI} &= \text{G10CCF} * \text{GSR} ** \text{G10EXP} / 1000 \\ &= 6\text{E}6 * 1 ** 0.55 / 1000 = 6000 \end{aligned}$$

11) E.I.S.

$$\begin{aligned} \text{GAD2UI} &= \text{G11CCF} * \text{GSR} ** \text{G11EXP} / 1000 \\ &= 1\text{E}6 * 1 ** 0.25 / 1000 = 1000 \end{aligned}$$

12) STAFF

$$\begin{aligned} \text{GAD3MM} &= \text{G13PRC} * \text{G13MPW} * \text{GSR} ** \text{G13EXP} * \text{G13FCT} / \text{GACROH} \\ &= .16 * 580 * 1 ** 0.9 * 2000 / 2000 = 92.80 \end{aligned}$$

$$\begin{aligned} \text{GA01Q1} &= \text{INT}(\text{G13PRC} * \text{G13MPW} * \text{GSR} ** \text{G13EXP}) \\ &= \text{INT}=.16 * 580 * 1 ** 0.9) = 92 \end{aligned}$$

$$\begin{aligned} \text{GTOPRC} &= \text{GAD3MM} + \text{G13AWR} * \text{GA01Q1} / \text{GACROH} \\ &= 92.80 + 17900 + 92 / 2000 = 916.20 \end{aligned}$$

13) ROYALTY, SEVERANCE TAX AND UNION WELFARE

$$\begin{aligned} \text{GTOPRC} &= (\text{G15ROY} + \text{G15STX} + \text{G15UNI}) * \text{GCDRTY} / \text{GACROH} \\ &= (.25 + 0 + .11) * .511069\text{E}7 / 2000 = 919.92 \end{aligned}$$

THE UNIT INVESTMENTS, GAD2UI, AND HOURLY OPERATING COSTS, GTOPRC, ARE CALCULATED AS SHOWN ABOVE.

HOURLY OWNERSHIP COSTS ARE CALCULATED FOR EACH

ELEMENT (FIGURES ARE FOR FIRST ELEMENT ONLY.)

$$\begin{aligned} \text{GTOWNC} &= \text{GAD2UI} * 1000 * (1 + .07 * (1 + \text{GACRLO})) \\ &\quad / \text{GACRLO} / \text{GACROH} \\ &= 3000 * 1000 * (1 + .07 * (1 + 32)) / 32 / 2000 \\ &= 155.156 \end{aligned}$$

HOURLY O & O (\$/TON) IS CALCULATED FOR EACH ELEMENT.

$$\begin{aligned} \text{GOOTON} &= (\text{GTOWNC} + \text{GTOPRC}) * \text{GACROH} / \text{CDRTYX} \\ &= 155.156 + 0) * 2000 / .511069\text{E}7 = .0607 \end{aligned}$$

DETAIL FOR EACH ELEMENT PRINTS,
GAD2UI, GTOWNC, GTOPRC, GOOTON

SUMMARY COSTS ARE CALCULATED AND PRINTED.

$$\begin{aligned} \text{GAII} &= \text{SUMMATION OF ALL GAD2UI TIMES 1000} = .233215\text{E}8 \\ \text{GAOWC} &= \text{SUMMATION OF ALL GTOWNC TIMES HOURS/YEAR} = .241232\text{E}7 \\ \text{GAOPC} &= \text{SUMMATION OF ALL GTOPRC TIMES HOURS/YEAR} = .396704\text{E}7 \\ \text{GADT} &= \text{SUMMATION OF ALL GADT} = 1.248 \end{aligned}$$

$$\begin{aligned} \text{GAPT} &= (\text{GAOWC} + \text{GAOPC}) * \text{GACRLO} \\ &= (.241232\text{E}7 + .396704\text{E}7) * 32 \\ &= .204139\text{E}9 \end{aligned}$$

$$\text{DRT} = \text{GAPT} / \text{XRT} = .204139\text{E}9 / .163542\text{E}9 = 1.248$$

$$\text{DFT} = \text{GAPT} / \text{XTT} = .204139\text{E}9 / .161906\text{E}9 = 1.261$$

THE SUMMARY LINE PRINTS,
GAII, GAOWC, GAAOC, GAPT, DRT, DFT

8) PROJECT TOTALS

AS EACH SUMMARY LINE IS PRINTED, TOTALS ARE MADE AND
THE FINAL TOTAL LINE IS SUMMATION OF SUMMARY DATA.

THE FINAL TWO REPORT LINES PRINT TOTAL TONS DELIVERED,
\$/TON, TOTAL BTU'S DELIVERED AND \$/MILLION BTU'S.

APPENDIX C
MODEL VARIABLE LISTING

ABHD	A ANGLE BURDEN HIGHWALL (DEGREES)
ABSD	A ANGLE BURDEN SPOILS (DEGREES)
ACFD	A ANGLE COAL FACE (DEGREES)
ACRES	A ACRES
ADH	C ADDED HAUL DIST. FOR DEF. TRUCKS
BLCRCP	D BLASTING COMPLEX PRODUCTION - M YDS/YEAR
BLCRDP	D BLASTING DEFERRED PURCHASE
BLCRFS	D BLASTING FLEET SPARES
BLCRID	D BLASTING EQUIPMENT ID
BLCRLO	D BLASTING LIFE OF OPERATION
BLCRMO	D BLASTING MINING OPERATION
BLCRNY	D BLASTING NUMBER OF YEARS STARTUP
BLCROH	D BLASTING OPERATING HOURS / YEAR
BLCRPL	D BLASTING PURCHASE LEAD TIME
BLCRQT	D BLASTING QUANTITY
BLCRSE	D BLASTING STARTUP EFFICIENCY
BLCRSH	D BLASTING SCHEDULED HOURS / YEAR
BLCRSY	D BLASTING START YEAR
BLD1ID	D EQUIPMENT ID
BLD1MO	D MINING OPERATION
BLD3ID	D EQUIPMENT ID
BLD3MO	D MINING OPERATION
BLD3OT	D BLASTING HOURLY OTHER COST - \$/HR
BLO1C1	D BLASTING OPERATOR CLASS 1
BLO1ID	D EQUIPMENT ID
BLO1MO	D MINING OPERATION
BLO1Q1	D BLASTING OPERATOR QUANTITY 1
BLO1S1	D BLASTING OPERATOR SCHEDULE 1
BPBY	A OVERBURDEN PRODUCTION YARDS/YEAR
CAPAC	C DEMAND RATE HOURLY SHOVEL CAPACITY
CDCG	L DOZER UNIT INVESTMENT - M\$
CDCJ	L DOZER HOURLY MAINT. MATL COST - \$/HR
CDCK	L DOZER HOURLY FUEL COST - \$/HR
CDCN	L DOZER HOURLY OPERATING COST - \$/HR
CDCP	L DOZER HOURLY OWNERSHIP COST - \$/HR
CDCR	L DOZER HOURLY MAINT. LABOR COST - \$/HR
CDCRCP	L DOZER COMPLEX PRODUCTION - M ACRES/YEAR
CDCRDP	L DOZER DEFERRED PURCHASE
CDCRFS	L DOZER FLEET SPARES
CDCRID	L DOZER EQUIPMENT ID
CDCRLO	L DOZER LIFE OF OPERATION
CDCRMO	L DOZER MINING OPERATION
CDCRNY	L DOZER NO. OF YEARS STARTUP
CDCROH	L DOZER OPERATING HOURS/YEAR
CDCRPL	L DOZER PURCHASE LEAD TIME
CDCRQT	L DOZER EQUIPMENT QUANTITY
CDCRSE	L DOZER STARTUP EFFICIENCY
CDCRSH	L DOZER SCHEDULED HOURS/YEAR
CDCRSY	L DOZER START YEAR
CDDT	L COST OF DOZERS - \$/TON
CDD1ID	L EQUIPMENT ID

CDD1MO	L MINING OPERATION
CDD2BY	L DOZER BASE YEAR
CDD2CO	L DOZER CONSTRUCTION CODE
CDD2DH	L DOZER DEPRECIATION LIFE
CDD2DM	L DOZER DEPRECIATION METHOD
CDD2EF	L DOZER INVESTMENT ESCALATION FACTOR
CDD2ID	L EQUIPMENT ID
CDD2MO	L MINING OPERATION
CDD2PC	L DOZER PURCHASE CODE
CDD2RA	L DOZER REGIONAL INVESTMENT ADJUSTMENT
CDD2SF	L DOZER SALVAGE FRACTION
CDD2UI	L DOZER UNIT INVESTMENT - M\$
CDD3FU	L DOZER HOURLY FUEL COST - \$/HR
CDD3ID	L EQUIPMENT ID
CDD3ML	L DOZER HOURLY MAINT. LABOR - \$/HR
CDD3MM	L DOZER HOURLY MAINT. MATERIALS - \$/HR
CDD3MO	L MINING OPERATION
CDMIC1	L DOZER MAINT. LABOR CLASS 1
CDMIF1	L DOZER MAINT. LABOR FRACTION 1
CDM1ID	L EQUIPMENT ID
CDM1MO	L MINING OPERATION
CDM1S1	L DOZER MAINT. LABOR SCHEDULE 1
CDO1C1	L DOZER OPERATOR CLASS 1
CDO1ID	L EQUIPMENT ID
CDO1MO	L MINING OPERATION
CDO1Q1	L DOZER OPERATOR QUANTITY 1
CDO1S1	L DOZER OPERATOR SCHEDULE 1
CDP7	L DOZER DEPRECIATION HOURS
CDRN	L DOZER DATA FILE REFERENCE NO.
CDRTY	A COAL DEMAND ROM TONS/YEAR/PIT
CDRTYD	A COAL DEMAND ROM TONS/YEAR
CDRTYX	A COMPLEX COAL DEMAND ROM TONS/YEAR
CDRYR	A COAL DEMAND FOR CLH IN REC. YARDS / YEAR
CDSK	L DOZER HORSEPOWER
CHCT	C CH - SHOVEL CYCLE TIME (MIN)
CHFF	C CH - SHOVEL BUCKET FILL FACTOR
CHHD	C CH - HAUL DISTANCE (FEET)
CHHDF	A COAL HAUL DISTANCE IN FEET - YEAR 1
CHNP	C CH - NUMBER OF PITS
CHRYR	C CH - COAL DEMAND (ROM YARDS/YEAR)
CHSDRR	C CH - SUM OF DIS. AND ROLLING RESISTANCE
CHSO	C CH - SHOVEL OVERLOAD FACTOR
CHSW	C CH - TRUCK SPOT AND WAIT TIME (MIN)
CHTO	C CH - TRUCK PAYLOAD TOLERANCE
COTA	A COTANGENT ABHD
COTB	A COTANGENT ACFD
COTT	A COTANGENT ABSD
CRTAF	A COAL ROM TONS/ARCE-FOOT
DBBD	D BURDEN DEMAND - BANK CU YD / YR
DBBPY	A DENSITY OF OVERBURDEN BANK LBS/YARD
DBC D	D COAL DEMAND - ROM TONS / YR

DBDR	D DRILLING RATE IN SOFT MATERIAL - FT/HR
DBHB	D HEIGHT OF OVERBURDEN - FEET
DBNP	D DRILLING AND BLASTING NUMBER OF PITS
DBPRPY	D POWDER RATIO
DBRDFI	D DRILL FLEET SPARES INVESTMENT
DBRDTI	D DRILL TOTAL INVESTMENT
DBRDTO	D DRILL TOTAL OPERATING
DBTEC	D TOTAL EXPLOSIVE COST
DCBPY	A DENSITY COAL BANK LBS/YARD
DCBTY	C DENSITY OF COAL (BANK TONS/YARD)
DLABHD	O OVERBURDEN HIGHWALL ANGLE - DEGREES
DLACR	O ANNUAL OPERATING COSTS
DLBYY	O DL - OVERBURDEN PRODUCTION
DLCA	O DL - PURCHASE PRICE IN M \$
DLCEL	O DL - COST OF ELECTRICITY
DLCI	O DL - TOTAL INVESTMENT M \$
DLCL	O HOURLY OWNERSHIP COST
DLCM	O DL - MAIN. LABOR \$/HOUR
DLCN	O DL - MAIN. MATERIALS \$/HOUR
DLCO	O DL - ELECTRIC COST
DLCR	O HOURLY OPERATING COST
DLCRDP	O EC - DEFERRED PURCHASE
DLCRFS	O EC - FLEET SPARES
DLCRID	O EC - EQUIP. ID
DLCRLO	O EC - LIFE OF OPERATION
DLCRMO	O EC - MINING OPERATION
DLCRNY	O EC - NO. YEARS STARTUP
DLCROH	O EC - OPERATING HOURS/YEAR
DLCRPL	O EC - PURCHASE LEAD TIME
DLCRQT	O EC - EQUIP. QUANT.
DLCRSE	O EC - STARTUP EFF. FACTOR
DLCRSH	O EC - SCHEDULED HOURS/YEAR
DLCRSY	C EC - STARTING YEAR
DLDY	C DL - DEPRECIATION YEARS
DLD2BY	O ED2 - BASE YEAR
DLD2CC	O ED2 - CONSTANT
DLD2DH	O ED2 - DEPRECIATION HOURS
DLD2DM	O ED2 - DEPRECIATION METHOD
DLD2EF	O ED2 - ESCALATION FACTOR
DLD2ID	O ED2 - ECID
DLD2PC	C ED2 - PURCHASE CODE
DLD2RA	C ED2 - REGIONAL ADJUSTMENT
DLD2SF	O ED2 - SALVAGE FACTOR
DLD2UI	O ED2 - UNIT INVESTMENT
DLD3EL	O ED3 - ELECTRIC POWER COST
DLD3FU	O ED3 - FUELS
DLD3ID	O ED3 - ECID
DLD3ML	O ED3 - MAINTENANCE LABOR
DLD3MM	O ED3 - MAINTENANCE MATERIALS
DLD3OT	O ED3 - OTHER
DLD3TI	O ED3 - TIRES

DLD3WA	O	ED3 - WATER
DLFDP	O	DL - DIGGING POWER FACTOR
DLHBA	O	OVERBURDEN HEIGHT - AVERAGE - FEET
DLNP	O	DL - NO. OF PITS
DLOHY	O	DL - OPERATING HOURS/YEAR
DLO1C1	O	EPO1 - OPERATOR CLASS CODE
DLO1C2	C	EPO1 - OILER CLASS CODE
DLO1C3	O	EPO1 - GROUNDMAN CLASS CODE
DLO1ID	O	EPO1 - ECID
DLO1Q1	O	EPO1 - OPERATOR QUANT.
DLO1Q2	O	EPO1 - OILER QUANT.
DLO1Q3	O	EPO1 - GROUNDMAN QUANT.
DLO1S1	O	EPO1 - OPERATOR SCHED CODE
DLO1S2	O	EPO1 - OILER SCHED CODE
DLO1S3	C	EPO1 - GROUNDMAN SCHED CODE
DLPE	O	DL - PEAK 15-MINUTE DEMAND
DLPLF	O	PANEL LENGTH - FEET
DLPWF	O	PANEL WIDTH - FEET
DLRMA	O	DL - RMA
DLSA	O	DL - BOOM LENGTH IN FEET
DLSB	O	DL - BOOM ANGLE
DLSE	O	DL - BOOM FOOT TO CENTER
DLSH	O	DL - DUMPING RADIUS
DLSHY	O	DL - SCHEDULED HOURS/YEAR
DLSJ	O	DL - WIDTH OVER BOTH SHOES
DLST	C	DL - WEIGHT IN M LBS
DLSW	O	DL - BUCKET SIZE
DLTCL	O	TOTAL OWNERSHIP COST
DLTCR	O	TOTAL OPERATING COSTS
DLX	O	DL - X FACTOR
DRSMFH	A	DRILLING RATE IN SOFT MAT'L. - FT/HR
DTCRLO	C	DEFERRED TRUCK LIFE OF OPERATION
DTCRSY	C	DEFERRED TRUCK STARTING YEAR
EBWT	C	EFFECTIVE SHOVEL BUCKET WEIGHT IN TONS
ECDT	D	EXPLOSIVE COST - \$/TON
ECOT	Q	EXPLOSIVE COST - \$/TON
ECR	A	EXPECTED COAL RECOVERY FACTOR
GAAOC	G	ANNUAL OPERATING COST
GACRLD (13)	G	LIFE OF OPERATION
GACRNY (13)	G	NO. OF START-UP YEARS
GACROH (13)	G	OPERATING HOURS
GACRPL (13)	G	PURCHASE LEAD TIME
GACRQT (13)	G	EQUIPMENT QUANTITY
GACRSY (13)	G	START YEAR
GADT	G	DOLLARS/TON OF FEED COAL
GADY	G	DEPRECIATION YEARS
GAD2BY (11)	G	BASE YEAR
GAD2CO (11)	G	CONSTRUCTION
GAD2DM (11)	G	DEPRECIATION METHOD
GAD2EF (11)	G	ESCALATION FRACTION
GAD2PC (11)	G	PURCHASE CODE

GAD2RA (11)	G REGIONAL ADJ.
GAD2SF (11)	G SALVAGE FRACTION
GAD2UI (11)	G UNIT INVESTMENT
GAD3MM	G HOURLY MAINT. MATL. COST
GAI	G INITIAL INVESTMENT
GAMR	A GAA - MINERAL RIGHTS (\$/ACRE)
GAOIQ1	G CP. LABOR QUANTITY
GAPT	G TOTAL \$ FOR PROJECT
GARA	A GAA - ROYALTY AMOUNT (\$/TON)
GASR	A GAA - SURFACE RIGHTS (\$/ACRE)
GAST	A GAA - SEVERANCE TAX (\$/TON)
GATYB	A GAA - TONS/YEAR - BASELINE
GAUP	A GAA - UNION PAYMENT (\$/TON)
GCDRTY	G COAL DEMAND ROM TONS/YEAR
GTAD	G TOTAL ACRES DISTURBED
GTTY	G COMPLEX TOTAL TONS PER YEAR
GTTYB	G BASELINE TOTAL TONS PER YEAR
G1CCF	G CAPITAL COST FACT FOR ROADS & SITE WORK
G1EXP	G EXP. FOR ROADS & SITE WORK CAPITAL COST
G1OCCF	G CAPITAL COST FACT. FOR CONTRACT ENG.
G1OEXP	G EXP. FOR CONTR. ENG. CAPITAL COST CALC.
G11CCF	G CAPITAL COST FACT FOR E. I. S.
G11EXP	G EXP. FOR E.I.S. CAPITAL COST CALC.
G13AWR	G ANNUAL AVERAGE WAGE RATE
G13EXP	G EXP. FOR STAFF OPER. MANPOWER CALC.
G13FCT	G MAT. & SER. FACT FOR STAFF CALC.
G13MPW	G MANPOWER FACT FOR STAFF CALC.
G13OCL	G OPERATOR CLASS FOR STAFF MATERIAL & SER.
G13OSC	G OPERATOR SCHEDULE FOR STAFF MAT. & SER.
G13PRC	G PERCENTAGE FOR STAFF OPER. MANPOWER CALC.
G15ROY	G ROYALTY FOR ROY. & SEV. TAX
G15STX	G SEV. TAX FOR ROYALTY & SEV. TAX
G15UNI	G UNION WELF. FOR ROYALTY & SEV. TAX
G2DSQF	G \$ / SQUARE FEET FOR BLDG CAP. COST CALC.
G2EXP1	G EXP. FOR BUILDINGS FUEL CALC.
G2EXP2	G EXP. FOR FUEL (BLDG) MAT. & SERV. CALC.
G2EXP3	G EXP. FOR WATER (BLDG) MAT. & SERV. CALC.
G2MSFF	G MATERIAL & SER. FACT FOR FUEL (BUILDINGS)
G2MSFW	G MATERIAL & SER. FACT FOR WATER (BLDG)
G2SQF	G SQUARE FEET FOR BLDG CAPITAL COST CALC.
G3CCF	G CAPITAL COST FACT FOR ELECTR. POWER SYST.
G3EXP	G EXP. FOR ELECTR. POWER SYST. CAP. COST
G4ACCF	G CAPITAL COST FACTOR 1 FOR WATER SYSTEM
G4BCCF	G CAPITAL COST FACTOR 2 FOR WATER SYSTEM
G4CCCF	G CAPITAL COST FACTOR 3 FOR WATER SYSTEM
G4EXP	G EXPONENT FOR WATER SYSTEM CAPITAL COST
G5CCF	G CAPITAL COST FACTOR FOR COMM. SYSTEM
G5EXP	G EXPONENT FOR COMMUN. SYSTEM CAPITAL COST
G6CCF	G CAPITAL COST FACTOR FOR MOBILE SUPPORT
G6EXP	G EXPONENT FOR MOBILE SUPPORT CAPITAL COST
G7CCF	G CAPITAL COST FACTOR FOR SHOP

G7EXP	G EXPONENT FOR SHOP CAPITAL COST CALC
G8MR	G MINERAL RIGHT \$/ACRE FOR LAND RIGHT
G8PERC	G PERCENTAGE FOR LAND RIGHTS CAPITAL COST
G8SR	G SURFACE RIGHT \$/ACRE FOR LAND RIGHT COST
G8YRS	G NO. OF YEARS FOR LAND RIGHT MAT. & SERV.
G9AHOL	G ACRES / HOLE FOR EXPL. DRILLING CAP. COST
G9CCF	G CAPITAL COST FACTOR FOR EXPL. DRILLING
HBA	A HEIGHT OF OVERBURDEN IN FEET (AVERAGE)
HBT	A HEIGHT OF TOPSOIL - FEET
HC	A HEIGHT OF COAL IN FEET
IGPT	G PLANT SWITCH
IMOCB	A INCLUDE COAL LOAD AND HAUL
IMODB	A INCLUDE DRILLING AND BLASTING
IMODL	A INCLUDE DRAGLINE
IMOGA	A INCLUDE GENERAL & ADMINISTRATIVE
IMOLR	A INCLUDE RECLAMATION
IMOPP	A INCLUDE PREP PLANT
INOCB	L NUMBER OF DOZERS PER PIT - INTEGER
INOQB	Q NUMBER OF DRILLS - INTEGER
INORC	D NUMBER OF DRILLS - INTEGER
INOSC	L NUMBER OF SCRAPERS PER PIT - INTEGER
INOSCB	L NUMBER OF SPARE DOZERS PER PIT - INTEGER
INOSQB	Q NUMBER OF SPARE DRILLS - INTEGER
INOSRC	D NUMBER OF SPARE DRILLS - INTEGER
INOSSC	L NUMBER OF SPARE SCRAPERS / PIT - INTEGER
IPLSW	P PLANT SWITCH
IPPT	A PP - INDEX TO PLANT TYPE
LMCRCP	L LAND MGT. COMPLEX PRODUCTION - M ACRES/YR
LMCRDP	L LAND MGT. DEFERRED PURCHASE
LMCRFS	L LAND MGT. FLEET SPARES
LMCRID	L LAND MGT. EQUIPMENT ID
LMCRLO	L LAND MGT. LIFE OF OPERATION
LMCRMO	L LAND MGT. MINING OPERATION
LMCRNY	L LAND MGT. NO. OF YEARS STARTUP
LMCROH	L LAND MGT. OPERATING HOURS/YEAR
LMCRPL	L LAND MGT. PURCHASE LEAD TIME
LMCRQT	L LAND MGT. EQUIPMENT QUANTITY
LMCRSE	L LAND MGT. STARTUP EFFICIENCY
LMCRSH	L LAND MGT. SCHEDULED HOURS/YEAR
LMCRSY	L LAND MGT. START YEAR
LMD1ID	L EQUIPMENT ID
LMD1MO	L MINING OPERATION
LMD3ID	L EQUIPMENT ID
LMD3MC	L MINING OPERATION
LMD3OT	L LAND MGT. HOURLY OTHER - \$/HR
LOGCA	A LOGS COMMON ARRAYS IF 1 (FOR DEBUG)
LOGCF	A WRITES CFA CONTROL FILE IF 1
LOGDV	A LOGS DEFAULT VARIABLES IF 1
LOGEC	A WRITES CFA EQUIPMENT FILE IF 1
LOGEC	P WRITE ECRG FILE IF 1
LOGPA	A LOGS PARAMETERS IF 1

LOGPD		G LOG SWITCH FOR PP STATISTICS
LOGPE		G LOG SWITCH FOR ECRG CARDS
LOGRD		A WRITES REGRESS. DATA FILE IF 1
LOGSD		A LOGS SPECIFICATION DATA IF 1
LOGSD		P LOGSWITCH FOR INPUT PARAMETERS
LOGSM		A LOGS ECONOMIC SUMMARY IF ONE
NPITS		A NO. OF PITS
OAQLO		C LEAST COST O AND O FOR SHOVEL/TRUCK COMB
PL		C TRUCK PAYLOAD IN TONS
PLF		A PANEL LENGTH - FEET
PLH		C PROJECT LIFE IN HOURS
PNPS		P NEW PLANT SIZE
PPACC		P ANNUAL CAPITAL COST
PPAOC		P ANNUAL OPERATING COST
PPBED		A PP - BASE ENERGY BTU/YEAR
PPBHF		A PP - BASE HEAT VALUE FACTORS
PPBHV		A PP - BASE HEAT VALUES
PPBSF		A PP - SIZE FACTORS
PPBT		A PP - BASE TONS/DAY
PPCC		P NEW PLANT CAPITAL COST
PPCCF	(9)	P PLANT CAPITAL COST FACTOR
PPCCX	(9)	P PLANT CAPITAL COST EXPONENT
PPCRCP		P COMPLEX PRODUCTION
PPCRLO		P LIFE OF OPERATION
PPCRNY		P NO. OF START-UP YEARS
PPCROH		P OPERATING HOURS
PPCRPL		P PURCHASE LEAD TIME
PPCRQT		P EQUIPMENT QUANTITY
PPCRSE		P START-UP EFFICIENCY
PPCRSY		P START YEAR
PPDT		P O & O \$/TON
PPDTF	(9)	P O & O \$/TON FACTOR
PPDY		P DEPRECIATION YEARS
PPD2BY		P BASE YEAR
PPD2CO		P CONSTRUCTION CODE
PPD2DH		P DEPRECIATION HRS
PPD2DM		P DEPRECIATION METHOD
PPD2EF		P ESCALATION FRACTION
PPD2PC		P PURCHASE CODE
PPD2RA		P REGIONAL ADJ.
PPD2SF		P SALVAGE FRACTION
PPEP		P ELECTRIC POWER/SCHED. HR.
PPEPF		P ELECTRIC POWER FACTOR
PPEPX		P ELECTRIC POWER EXPONENT
PPEQTY	(9)	P EQUIPMENT QUANTITY
PPFC		P FUEL COST/SCHED. HR.
PPFCF	(9)	P FUEL COST/SCHED. HR. FACTOR
PPFCX	(9)	P FUEL COST/SCHED. HR. EXPONENT
PPFHV		A PP - FINAL HEAT VALUE
PPFTY		A PP - FINISHED COAL TONS/YEAR
PPHF		A PP - HEAT VALUE FACTOR FOR IPPT

PPHV		A PP - HEAT VALUE FOR IPPT
PPII		P INITIAL INVESTMENT
PPLC		P OPER. LABOR COST/SCHED. HR.
PPLCF	(9)	P OPER. LABOR COST/SCHED. HR. FACTOR
PPLCX	(9)	P OPER. LABOR COST/SCHED. HR. EXPONENT
PPML		P MAINT. LABOR COST/SCHED. HR.
PPMLF	(9)	P MAINT. LABOR COST/SCHED. HR. FACTOR
PPMLX	(9)	P MAINT. LABOR COST/SCHED. HR. EXPONENT
PPMM		P MAINT. MATERIALS & SERVICES/SCHED. HR.
PPMMF	(9)	P MAINT. MATL. & SERV./SCHED. HR. FACTOR
PPMMX	(9)	P MAINT. MATL. & SERV./SCHED. HR. EXPONENT
PPMS	(9)	P MAINT. PER. SCHED. CODES
PPNED		A PP - COMPLEX ENERGY DEMAND BTU/YEAR
PPNHV		A PP - COAL HEAT VALUE BTU/LB
PPNS		A PP - COMPLEX SIZE TONS/DAY
PPODY		A PP - OPERATING DAYS/YEAR
PPOPC		P TOTAL OPERATING COST/SCHED. HR.
PPOS	(9)	P OPERATING SCHEDULES
PPOWC		P TOTAL OWNERSHIP COST/SCHED. HR.
PPOWCF	(9)	P TOTAL OWNERSHIP COST/SCHED. HR. FACTOR
PPOIF	(9)	P ELECTRIC POWER/SCHED. HR. FACTOR
PPOIX	(9)	P ELECTRIC POWER/SCHED. HR. EXPONENT
PPOC	(9,8)	P OPERATING PERSONNEL CLASS CODES
PPMC	(9,8)	P MAINT. PERSONNEL CLASS CODES
PPMC	(9,8)	P MAINT. PERSONNEL FRACTIONS
PPPSF	(9,8)	P OPERATING PERSONNEL SCHED. HR. FACTOR
PPPSX		P OPERATING PERSONNEL SCHED. HR. EXPONENT
PPSDY		P SCHEDULED DAYS/YEAR
PPSF		A PP - SIZE FACTOR FOR IPPT
PPWC		P WATER COST/SCHED. HR.
PPWCF	(9)	P WATER COST/SCHED. HR. FACTOR
PPWCX	(9)	P WATER COST/SCHED. HR. EXPONENT
PRPY		A POWDER RATIO - POUNDS / CU. YD.
PWF		A PANEL WIDTH (FEET)
QBBD		Q BURDEN DEMAND - BANK CU YD / YR
QBCD		Q COAL DEMAND - ROM TONS / YR
QBDR		Q DRILLING RATE IN SOFT MATERIAL - FT/HR
QBHB		Q HEIGHT OF OVERBURDEN - FEET
QBNP		Q DRILLING AND BLASTING NUMBER OF PITS
QBPRPY		Q POWDER RATIO
QBQDFI		Q DRILL FLEET SPARES INVESTMENT
QBQDTI		Q DRILL TOTAL INVESTMENT
QBQDTC		Q DRILL TOTAL OPERATING
QBTEC		Q TOTAL EXPLOSIVE COST
QDCG		Q ROT DRILL TOTAL INVESTMENT
QDCJ		Q ROT DRILL HOURLY MAINT. MATL COST - \$/HR
QDCK		Q ROT DRILL HOURLY UTILITIES COST - \$/HR
QDCM		Q ROT DRILL HOURLY BIT & PIPE COST - \$/HR
QDCN		Q ROT DRILL HOURLY OPERATING COST - \$/HR
QDCP		Q ROT DRILL HOURLY OWNERSHIP COST - \$/HR
QDCR		Q ROT DRILL HOURLY MAINT. LABOR COST - \$/HR

QDCRCP	Q DRILL COMPLEX PRODUCTION - M YDS/YEAR
QDCRDP	Q DRILL DEFERRED PURCHASE
QDCRFS	Q DRILL FLEET SPARES
QDCRID	Q DRILL EQUIPMENT ID
QDCRLO	Q DRILL LIFE OF OPERATION
QDCRMC	Q DRILL MINING OPERATION
QDCRNY	Q DRILL NUMBER OF YEARS STARTUP
QDCROH	Q DRILL OPERATING HOURS / YEAR
QDCRPL	Q DRILL PURCHASE LEAD TIME
QDCRQT	Q DRILL QUANTITY
QDCRSE	Q DRILL STARTUP EFFICIENCY
QDCRSH	Q DRILL SCHEDULED HOURS / YEAR
QDCRSY	Q DRILL START YEAR
QDDT	Q DRILLING COST - \$/TON
QDD1ID	Q EQUIPMENT ID
QDD1MO	Q MINING OPERATION
QDD2BY	Q DRILL INVESTMENT BASE YEAR
QDD2CO	Q DRILL CONSTRUCTION CODE
QDD2DH	Q DRILL DEPRECIATION LIFE - HOURS
QDD2DM	Q DRILL DEPRECIATION METHOD
QDD2EF	Q DRILL ESCALATION FACTOR
QDD2ID	Q EQUIPMENT ID
QDD2MO	Q MINING OPERATION
QDD2PC	Q DRILL PURCHASE CODE
QDD2RA	Q DRILL REGIONAL ADJUSTMENT FACTOR
QDD2SF	Q DRILL SALVAGE FRACTION
QDD2UI	Q DRILL UNIT INVESTMENT - M\$
QDD3EL	Q DRILL HOURLY ELECTRIC COST - \$/HR
QDD3ID	Q EQUIPMENT ID
QDD3ML	Q DRILL HOURLY MAINT. LABOR COST - \$/HR
QDD3MM	Q DRILL HOURLY MAINT. MATERIAL COST - \$/HR
QDD3MO	Q MINING OPERATION
QDD3OT	Q DRILL HOURLY OTHER COST - \$/HR
QDM1C1	Q DRILL MAINT. LABOR CLASS 1
QDM1F1	Q DRILL MAINT. LABOR FRACTION 1
QDM1ID	Q EQUIPMENT ID
QDM1MO	Q MINING OPERATION
QDM1S1	Q DRILL MAINT. LABOR SCHEDULE 1
QDD1C1	Q DRILL OPERATOR CLASS 1
QDD1C2	Q DRILL OPERATOR CLASS 2
QDD1ID	Q EQUIPMENT ID
QDD1MO	Q MINING OPERATION
QDD1Q1	Q DRILL OPERATOR QUANTITY 1
QDD1Q2	Q DRILL OPERATOR QUANTITY 2
QDD1S1	Q DRILL OPERATOR SCHEDULE 1
QDD1S2	Q DRILL OPERATOR SCHEDULE 2
QDP7	Q ROTARY DRILL DEPRECIATION HOURS
QDRN	Q DRILL DATA FILE REFERENCE NUMBER
QDSF	Q ROTARY DRIVE HORSEPOWER
QDSH	Q ROTARY DRILL BIT DIAMETER
QLCRCP	Q BLASTING COMPLEX PRODUCTION - M YDS/YEAR

QLCRDP	Q BLASTING DEFERRED PURCHASE
QLCRFS	Q BLASTING FLEET SPARES
QLCRID	Q BLASTING EQUIPMENT ID
QLCRLO	Q BLASTING LIFE OF OPERATION
QLCRMO	Q BLASTING MINING OPERATION
QLCRNY	Q BLASTING NUMBER OF YEARS STARTUP
QLCRGH	Q BLASTING OPERATING HOURS / YEAR
QLCRPL	Q BLASTING PURCHASE LEAD TIME
QLCRQT	Q BLASTING QUANTITY
QLCRSE	Q BLASTING STARTUP EFFICIENCY
QLCRSH	Q BLASTING SCHEDULED HOURS / YEAR
QLCRSY	Q BLASTING START YEAR
QLD1ID	Q EQUIPMENT ID
QLD1MC	Q MINING OPERATION
QLD3ID	Q EQUIPMENT ID
QLD3MC	Q MINING OPERATION
QLD3OT	Q BLASTING HOURLY OTHER COST - \$/HR
QLO1C1	Q BLASTING OPERATOR CLASS 1
QLO1ID	Q EQUIPMENT ID
QLO1MC	Q MINING OPERATION
QLO1Q1	Q BLASTING OPERATOR QUANTITY 1
QLO1S1	Q BLASTING OPERATOR SCHEDULE 1
RCAC	L RECLAMATION TOTAL ACRES
RCCD	L COAL DEMAND - ROM TONS / YEAR
RCCDFI	L DOZER SPARES TOTAL INVESTMENT COST - \$
RCCDTI	L DOZER TOTAL INVESTMENT COST - \$
RCCDTC	L DOZER TOTAL OPERATING COST - \$
RCCG	L RECLAMATION GENERAL DOZING COST - \$/ACRE
RCCLM	L LAND MANAGEMENT COST - \$/ACRE
RCCRV	L REVEGETATION COST - \$/ACRE
RCHBT	L HEIGHT OF TOPSOIL - FEET
RCHC	L HEIGHT OF COAL - FEET
RCNP	L NUMBER OF PITS
RCPLH	L PROJECT LIFE IN HOURS
RCPWF	L PANEL WIDTH - FEET
RCSCFI	L SCRAPER SPARES TOTAL INVESTMENT - \$
RCSCTI	L SCRAPER TOTAL INVESTMENT COST - \$
RCSCTO	L SCRAPER TOTAL OPERATING COST - \$
RCTRF	L TOTAL RESISTANCE ON TOPSOIL HAUL ROAD
RDCG	D ROT DRILL TOTAL INVESTMENT
RDCJ	D ROT DRILL HOURLY MAINT. MATL COST - \$/HR
ROCK	D ROT DRILL HOURLY UTILITIES COST - \$/HR
RDCM	D ROT DRILL HOURLY BIT & PIPE COST - \$/HR
RDCN	D ROT DRILL HOURLY OPERATING COST - \$/HR
RDCP	D ROT DRILL HOURLY OWNERSHIP COST - \$/HR
RDCR	D ROT DRILL HOURLY MAINT. LABOR COST - \$/HR
RDCRCP	D DRILL COMPLEX PRODUCTION - M YDS/YEAR
RDCRDP	D DRILL DEFERRED PURCHASE
RDCRFS	D DRILL FLEET SPARES
RDCRID	D DRILL EQUIPMENT ID
RDCRLO	D DRILL LIFE OF OPERATION

RDCRMO	D DRILL MINING OPERATION
RDCRNY	D DRILL NUMBER OF YEARS STARTUP
RDCROH	D DRILL OPERATING HOURS / YEAR
RDCRPL	D DRILL PURCHASE LEAD TIME
RDCRQT	D DRILL QUANTITY
RDCRSE	D DRILL STARTUP EFFICIENCY
RDCRSH	D DRILL SCHEDULED HOURS / YEAR
RDCRSY	D DRILL START YEAR
RDDT	D DRILLING COST - \$/TON
RDD1ID	D EQUIPMENT ID
RDD1MO	D MINING OPERATION
RDD2BY	D DRILL INVESTMENT BASE YEAR
RDD2CC	D DRILL CONSTRUCTION CODE
RDD2DH	D DRILL DEPRECIATION LIFE - HOURS
RDD2DM	D DRILL DEPRECIATION METHOD
RDD2EF	D DRILL ESCALATION FACTOR
RDD2ID	D EQUIPMENT ID
RDD2MO	D MINING OPERATION
RDD2PC	D DRILL PURCHASE CODE
RDD2RA	D DRILL REGIONAL ADJUSTMENT FACTOR
RDD2SF	D DRILL SALVAGE FRACTION
RDD2UI	D DRILL UNIT INVESTMENT - M\$
RDD3EL	D DRILL HOURLY ELECTRIC COST - \$/HR
RDD3ID	D EQUIPMENT ID
RDD3ML	D DRILL HOURLY MAINT. LABOR COST - \$/HR
RDD3MM	D DRILL HOURLY MAINT. MATERIAL COST - \$/HR
RDD3MO	D MINING OPERATION
RDD3OT	D DRILL HOURLY OTHER COST - \$/HR
RDM1C1	D DRILL MAINT. LABOR CLASS 1
RDM1F1	D DRILL MAINT. LABOR FRACTION 1
RDM1ID	D EQUIPMENT ID
RDM1MO	D MINING OPERATION
RDM1S1	D DRILL MAINT. LABOR SCHEDULE 1
RDD1C1	D DRILL OPERATOR CLASS 1
RDD1C2	D DRILL OPERATOR CLASS 2
RDD1ID	D EQUIPMENT ID
RDD1MO	D MINING OPERATION
RDD1Q1	D DRILL OPERATOR QUANTITY 1
RDD1Q2	D DRILL OPERATOR QUANTITY 2
RDD1S1	D DRILL OPERATOR SCHEDULE 1
RDD1S2	D DRILL OPERATOR SCHEDULE 2
RDP7	D ROTARY DRILL DEPRECIATION HOURS
RDRN	D DRILL DATA FILE REFERENCE NUMBER
RDSF	D ROTARY DRIVE HORSEPOWER
RDSH	D ROTARY DRILL BIT DIAMETER
RNOCD	L REQ. NO. OF DOZERS PER PIT - FRACTIONAL
RNOQD	Q NUMBER OF DRILLS - FRACTIONAL
RNRD	D NUMBER OF DRILLS - FRACTIONAL
RNOSC	L REQUIRED NUMBER OF SCRAPERS - FRACTIONAL
ROC	A RECLAMATION - OTHER COSTS - \$/ACRE
RVCRCP	L REVEG. COMPLEX PRODUCTION - M ACRES/YEAR

RVCRDP	L REVEG. DEFERRED PURCHASE
RVCRFS	L REVEG. FLEET SPARES
RVCRID	L REVEG. EQUIPMENT ID
RVCRLO	L REVEG. LIFE OF OPERATION
RVCRMO	L REVEG. MINING OPERATION
RVCRNY	L REVEG. NO. OF YEARS STARTUP
RVCRCH	L REVEG. OPERATING HOURS/YEAR
RVCRPL	L REVEG. PURCHASE LEAD TIME
RVCRQT	L REVEG. EQUIPMENT QUANTITY
RVCRSE	L REVEG. STARTUP EFFICIENCY
RVCRSH	L REVEG. SCHEDULED HOURS/YEAR
RVCRSY	L REVEG. START YEAR
RVD1ID	L EQUIPMENT ID
RVD1MO	L MINING OPERATION
RVD3ID	L EQUIPMENT ID
RVD3MO	L MINING OPERATION
RVD3OT	L REVEGETATION HOURLY OTHER - \$/HR
SCCG	L SCRAPER UNIT INVESTMENT - M\$
SCCJ	L SCRAPER HOURLY MAINT. MATL COST - \$/HR
SCCK	L SCRAPER HOURLY FUEL COST - \$/HR
SCCM	L SCRAPER HOURLY TIRE COST - \$/HR
SCCN	L SCRAPER HOURLY OPERATING COST - \$/HR
SCCP	L SCRAPER HOURLY OWNERSHIP COST - \$/HR
SCCR	L SCRAPER HOURLY MAINT. LABOR COST - \$/HR
SCCRCP	L SCRAPER COMPLEX PRODUCTION - M ACRES/YEAR
SCCRDP	L SCRAPER DEFERRED PURCHASE
SCCRFS	L SCRAPER FLEET SPARES
SCCRID	L SCRAPER EQUIPMENT ID
SCCRLO	L SCRAPER LIFE OF OPERATION
SCCRMO	L SCRAPER MINING OPERATION
SCCRNY	L SCRAPER NO. OF YEARS STARTUP
SCCROH	L SCRAPER OPERATING HOURS/YEAR
SCCRPL	L SCRAPER PURCHASE LEAD TIME
SCCRQT	L SCRAPER EQUIPMENT QUANTITY
SCCRSE	L SCRAPER STARTUP EFFICIENCY
SCCRSH	L SCRAPER SCHEDULED HOURS/YEAR
SCCRSY	L SCRAPER START YEAR
SCDT	L COST OF SCRAPERS - \$/TON
SCD1ID	L EQUIPMENT ID
SCD1MO	L MINING OPERATION
SCD2BY	L SCRAPER BASE YEAR
SCD2CO	L SCRAPER CONSTRUCTION CODE
SCD2DH	L SCRAPER DEPRECIATION LIFE
SCD2DM	L SCRAPER DEPRECIATION METHOD
SCD2EF	L SCRAPER INVESTMENT ESCALATION FACTOR
SCD2ID	L EQUIPMENT ID
SCD2MO	L MINING OPERATION
SCD2PC	L SCRAPER PURCHASE CODE
SCD2RA	L SCRAPER REGIONAL INVESTMENT ADJUSTMENT
SCD2SF	L SCRAPER SALVAGE FRACTION
SCD2UI	L SCRAPER UNIT INVESTMENT - M\$

SCD3FU	L SCRAPER HOURLY FUEL COST - \$/HR
SCD3ID	L EQUIPMENT ID
SCD3ML	L SCRAPER HOURLY MAINT. LABOR - \$/HR
SCD3MM	L SCRAPER HOURLY MAINT. MATERIALS - \$/HR
SCD3MC	L MINING OPERATION
SCD3TI	L SCRAPER HOURLY TIRE COST - \$/HR
SCM1C1	L SCRAPER MAINT. LABOR CLASS 1
SCM1F1	L SCRAPER MAINT. LABOR FRACTION 1
SCM1ID	L EQUIPMENT ID
SCM1MO	L MINING OPERATION
SCM1S1	L SCRAPER MAINT. LABOR SCHEDULE 1
SC01C1	L SCRAPER OPERATOR CLASS 1
SC01ID	L EQUIPMENT ID
SC01MO	L MINING OPERATION
SC01Q1	L SCRAPER OPERATOR QUANTITY 1
SC01S1	L SCRAPER OPERATOR SCHEDULE 1
SCP7	L SCRAPER DEPRECIATION HOURS
SCRN	L SCRAPER DATA FILE REFERENCE NO.
SCSA	L SCRAPER HEAPED CAPACITY - CU.YDS.
SCSR	L SCRAPER HORSEPOWER
SDCA	C SHOVEL PURCHASE PRICE - M\$
SDCG	C SHOVEL INVESTMENT COST - M\$
SDCJ	C SHOVEL HOURLY MAINT. MATL. COST - \$/HR
SDCK	C SHOVEL HOURLY UTILITIES COST - \$/HR
SDCN	C SHOVEL HOURLY OPERATING COST - \$/HR
SDCP	C SHOVEL HOURLY OWNERSHIP COST - \$/HR
SDCR	C SHOVEL HOURLY MAINT. LABOR COST - \$/HR
SDCRCP	C SHOVEL COMPLEX PRODUCTION
SDCRDP	C SHOVEL DEFERRED PURCHASE
SDCRFS	C SHOVEL FLEET SPARES
SDCRID	C EQUIPMENT ID
SDCRLO	C SHOVEL LIFE OF OPERATION
SDCRMC	C MINING OPERATION
SDCRNY	C SHOVEL NO. YEARS STARTUP
SDCRCH	C SHOVEL OPERATING HOURS/YEAR
SDCRPL	C SHOVEL PURCHASE LEAD TIME
SDCRQT	C SHOVEL EQUIPMENT QUANTITY
SDCRSE	C SHOVEL STARTUP EFF. FACTOR
SDCRSH	C SHOVEL SCHEDULED HOURS/YEAR
SDCRSY	C SHOVEL STARTING YEAR
SDD1ID	C EQUIPMENT ID
SDD1MO	C MINING OPERATION
SDD2BY	C SHOVEL BUY YEAR
SDD2CO	C SHOVEL CONSTRUCTION CODE
SDD2DH	C SHOVEL DEPRECIATION HOURS
SDD2DM	C SHOVEL DEPRECIATION METHOD
SDD2FF	C SHOVEL INVESTMENT ESCALATION FRACTION
SDD2ID	C EQUIPMENT ID
SDD2MO	C MINING OPERATION
SDD2PC	C SHOVEL PURCHASE CODE
SDD2RA	C SHOVEL REGIONAL INVESTMENT ADJUSTMENT

SDD2SF	C SHOVEL SALVAGE FRACTION
SDD2UI	C SHOVEL UNIT INVESTMENT - M\$
SDD3EL	C SHOVEL HOURLY UTILITIES COST - \$/HR
SDD3ID	C EQUIPMENT ID
SDD3ML	C SHOVEL HOURLY MAINT. LABOR COST - \$/HR
SDD3MM	C SHOVEL HOURLY MAINT. MATERIALS COST \$/HR
SDD3MC	C MINING OPERATION
SDII	C LEAST COST SHOVEL INVESTMENT COST
SDI1ID	C EQUIPMENT ID
SDM1C1	C SHOVEL MAINT. LABOR CLASS 1
SDM1F1	C SHOVEL MAINT. LABOR FRACTION 1
SDM1ID	C EQUIPMENT ID
SDM1MO	C MINING OPERATION
SDM1S1	C SHOVEL MAINT. LABOR SCHEDULE 1
SDNO	C INTEGER NUMBER OF SHOVELS REQUIRED / PIT
SDO1C1	C SHOVEL OPERATOR CLASS 1
SDO1C2	C SHOVEL OPERATOR CLASS 2
SDO1ID	C MINING OPERATION
SDO1MC	C MINING OPERATION
SDO1Q1	C SHOVEL OPERATOR QUANTITY 1
SDO1Q2	C SHOVEL OPERATOR QUANTITY 2
SDO1S1	C SHOVEL OPERATOR SCHEDULE 1
SDO1S2	C SHOVEL OPERATOR SCHEDULE 2
SDP7	C SHOVEL DEPRECIATION HOURS
SDRN	C SHOVEL DATA FILE REFERENCE NUMBER
SDST	C SHOVEL WORKING WEIGHT - M LBS
SDSW	C SHOVEL DIPPER CAPACITY - CU. YDS.
SFB	A SWELL FACTOR FOR BURDEN
SFC	A SWELL FACTOR FOR COAL
SFC1	C SWELL FACTOR OF COAL PLUS 1
SPL	C SHOVEL SWINGS PER TRUCK LOAD
SRYT	A STRIPPING RATIO YARDS/TONS
STCAP	C SHOVEL/TRUCK PRODUCTION CAP. - YDS. / HR
STDT	C COMBINATION COST PER TON - \$/TON
STKY	C SHOVEL - TRUCK COMBINATION KEY
STLC (6)	C LEAST COST SHOVEL/TRUCK DATA
STDAO	C OWNERSHIP AND OPERATING COST - \$/HR/PIT
TDCA	C TRUCK PURCHASE PRICE - M\$
TDCG	C TRUCK INVESTMENT COST - M\$
TDCJ	C TRUCK HOURLY MAINT. MATERIALS COST - \$/HR
TDCK	C TRUCK HOURLY FUEL COST - \$/HR
TDCM	C TRUCK HOURLY TIRE COST - \$/HR
TDCN	C TRUCK HOURLY OPERATING COST - \$/HR
TDCP	C TRUCK HOURLY OWNERSHIP COST - \$/HR
TDCR	C TRUCK HOURLY MAINT. LABOR COST - \$/HR
TDCRDP	C TRUCK DEFERRED PURCHASE
TDCRFS	C TRUCK FLEET SPARES
TDCRID	C EQUIPMENT ID
TDCRLO	C TRUCK LIFE OF OPERATION
TDCRMO	C MINING OPERATION
TDCRNY	C TRUCK NO. YEARS STARTUP

TDCROH	C TRUCK OPERATING HOURS/YEAR
TDCRPL	C TRUCK PURCHASE LEAD TIME
TDCRQT	C TRUCK EQUIPMENT QUANTITY
TDCRSE	C TRUCK STARTUP EFF. FACTOR
TDCRSH	C TRUCK SCHEDULED HOURS/YEAR
TDCRSY	C TRUCK STARTING YEAR
TDCT	C TRUCK CYCLE TIME - MIN.
TDDT	C TRUCK DRIVE TYPE
TDD1ID	C EQUIPMENT ID
TDD1MO	C MINING OPERATION
TDD2BY	C TRUCK BUY YEAR
TDD2CO	C TRUCK CONSTRUCTION CODE
TDD2DH	C TRUCK DEPRECIATION HOURS
TDD2DM	C TRUCK DEPRECIATION METHOD
TDD2EF	C TRUCK ESCALATION FRACTION
TDD2ID	C EQUIPMENT ID
TDD2MO	C MINING OPERATION
TDD2PC	C TRUCK PURCHASE CODE
TDD2RA	C TRUCK REGIONAL INVESTMENT ADJUSTMENT
TDD2SF	C TRUCK SALVAGE FRACTION
TDD2UI	C TRUCK UNIT INVESTMENT -M\$
TDD3FU	C TRUCK HOURLY FUEL COST - \$/HR
TDD3ID	C EQUIPMENT ID
TDD3ML	C TRUCK HOURLY MAINT. LABOR COST - \$/HR
TDD3MM	C TRUCK HOURLY MAINT. MATERIALS COST - \$/HR
TDD3MO	C MINING OPERATION
TDD3TI	C TRUCK HOURLY TIRE COST - \$/HR
TDII	C LEAST COST TRUCK INVESTMENT COST
TDM1C1	C TRUCK MAINT. LABOR CLASS 1
TDM1F1	C TRUCK MAINT. LABOR FRACTION 1
TDM1ID	C EQUIPMENT ID
TDM1MO	C MINING OPERATION
TDM1S1	C TRUCK MAINT. LABOR SCHEDULE 1
TDND	C INTEGER NUMBER OF TRUCKS REQUIRED / PIT
TDO1C1	C TRUCK OPERATOR CLASS 1
TDO1ID	C EQUIPMENT ID
TDO1MO	C MINING OPERATION
TDO1Q1	C TRUCK OPERATOR QUANTITY 1
TDO1S1	C TRUCK OPERATOR SCHEDULE 1
TDP7	C TRUCK DEPRECIATION HOURS
TDRN	C TRUCK DATA FILE REFERENCE FILE NUMBER
TDSC	C TRUCK HORSEPOWER
TDSL	C TRUCK PAYLOAD - M LBS
TMY	A TOTAL MINING YEARS
TRF	A TOTAL RESISTANCE ON TOPSOIL HAUL ROAD
TRHR	C NO. OF TRUCKS SHOVEL CAN LOAD IN 1 HOUR
TTL	C TIME FOR SHOVEL TO LOAD TRUCK
VBBY	A VOL. OVERBURDEN BANK YARDS
VCBY	A VOL. COAL BANK YARDS
VCRT	A VOL. CCAL REM TONS
XNS	C FRACTIONAL NUMBER OF SHOVELS REQUIRED

XNT
XRT
XTB
XTT

C FRACTIONAL NUMBER OF TRUCKS REQUIRED
A TOTAL ROM TONS FOR PROJECT LIFE
A TOTAL BTU'S FOR PROJECT LIFE
A TOTAL PREP TONS FOR PROJECT LIFE

APPENDIX D

MODEL DEFAULT VALUE LISTING

ABHD	A	63.4300
ABSD	A	33.6900
ACFD	A	76.0000
BLCRDP	D	0.
BLCRFS	D	0.
BLCROH	D	1631.
BLCRPL	D	0.
BLCRQT	D	1.
BLCRSE	D	0.
BLCRSH	D	1813.
BLCRSY	D	7.
BLO1C1	D	15.
BLO1Q1	D	1.0
BLO1S1	D	1.
CDCG	L	192.5
CDCJ	L	10.32
CDCK	L	5.35
CDCN	L	31.18
CDCP	L	21.30
CDCR	L	5.64
CDCRDP	L	0.
CDCROH	L	1800.
CDCRPL	L	1.
CDCRSE	L	.8
CDCRSH	L	2000.
CDCRSY	L	7.
CDD2BY	L	0.
CDD2CG	L	0.
CDD2DM	L	1.
CDD2EF	L	0.0
CDD2PC	L	2.
CDD2RA	L	1.
CDD2SF	L	0.0
CDMIC1	L	6.
CDM1F1	L	1.0
CDM1S1	L	10.
CDD1C1	L	11.
CDD1Q1	L	1.0
CDD1S1	L	6.
CDP7	L	12000.
CDRN	L	5.
CDRTYD	A	.181700E 07
CDSK	L	410.
CHCT	C	.5
CHFF	C	0.95
CHHDF	A	12110.0
CHSO	C	.0
CHSW	C	0.
CHTO	C	.1
C3CN	C	45.31
C3D2DH	C	12000.

C3D2UI	C	123.0
C4CN	C	29.20
C4D2DH	C	15000.
C4D2UI	C	80.1
C5CN	C	15.90
C5D2DH	C	21600.
C5D2UI	C	10.0
C6CN	C	29.32
C6D2DH	C	20000.
C6D2UI	C	124.6
DBBPY	A	3700.00
DCBPY	A	2160.00
DLCEL	C	.100000E-01
DLCRDP	O	.000000
DLCRFS	O	.000000
DLCRGH	O	7467.00
DLCRPL	O	4.00000
DLCRSE	C	.800000
DLCRSH	C	8297.00
DLCRSY	O	7.00000
DLDY	O	30.0000
DLD1F1	O	.000000
DLD1F2	O	.000000
DLD1F3	C	.000000
DLD1ID	C	.000000
DLD1S1	C	70.0000
DLD1S2	O	.000000
DLD1S3	O	.000000
DLD1S4	O	.000000
DLD1T1	O	.000000
DLD1T2	O	.000000
DLD1T3	C	.000000
DLD2BY	O	0.00000
DLD2CD	C	.000000
DLD2DM	O	1.00000
DLD2EF	O	.000000
DLD2ID	C	.000000
DLD2PC	O	5.00000
DLD2RA	O	1.00000
DLD2SF	C	.000000
DLD3FU	O	.000000
DLD3ID	O	.000000
DLD3CT	C	.000000
DLD3TI	O	.000000
DLD3WA	O	.000000
DLFDP	O	.720000
DLMIC1	O	6
DLMIQ1	C	1
DLMIS1	O	10
DLNP	C	8.00000
DLOHY	C	7467.00

DLO1C1	C	2.00000
DLO1C2	C	8.00000
DLO1C3	C	9.00000
DLO1ID	C	.000000
DLO1Q1	C	1.00000
DLO1Q2	C	1.00000
DLO1Q3	C	1.00000
DLO1S1	C	12.0000
DLO1S2	C	12.0000
DLO1S3	C	12.0000
DLSB	C	35.0000
DLSHY	C	8297.00
DRSMFH	A	100.000
D3CN	D	26.86
D3D2DH	D	12000
D3D2UI	D	135.3
D4CN	D	21.51
D4D2DH	D	12000
D4D2UI	D	36.4
D5CN	D	14.63
D5D2DH	D	20000
D5D2UI	D	36.0
ECR	A	.920000
GACRNY	G	1 1 1 1 1 1 1 1 1 1 1 9 1
GACRDH	G	13*2000.
GACRPL	G	3 3 3 3 3 2 2 5 5 6 4 0 0
GACRQT	G	1 1 1 1 1 1 1 1 1 1 1 1 1
GACRSY	G	7 7 7 7 7 7 7 7 7 7 7 1 7
GADY	G	30.
GAD2BY	G	0 0 0 0 0 0 0 0 0 0 0
GAD2CO	G	1 1 1 1 1 0 0 0 0 0 0
GAD2DM	G	1 1 1 1 1 1 1 1 1 1 1
GAD2EF	G	0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.
GAD2PC	G	5 5 5 5 5 5 5 1 1 5 1
GAD2RA	G	1 1 1 1 1 1 1 1 1 1 1
GAMR	A	50.0000
GARA	A	.250000
GASR	A	250.000
GAST	A	.000000
GATYB	A	185.614
GAUP	A	.110000
GTTYB	G	185.614
G1CCF	G	3000000.
G1EXP	G	.35
G10CCF	G	6000000.
G10EXP	G	.55
G11CCF	G	1000000.
G11EXP	G	.25
G13AWR	G	17900.
G13EXP	G	.9
G13FCT	G	2000

G13MPW	G	580.
G13OCL	G	24
G13OSC	G	3
G13PRC	G	.16
G2DSQF	G	36.25
G2EXP1	G	.85
G2EXP2	G	.9
G2EXP3	G	.75
G2MSFF	G	65000.
G2MSFW	G	250.
G2SQF	G	135000.
G3CCF	G	450000.
G3EXP	G	.7
G4ACCF	G	200000.
G4BCCF	G	450000.
G4CCCF	G	550000.
G4EXP	G	.45
G5CCF	G	125000.
G5EXP	G	.4
G6CCF	G	1200000.
G6EXP	G	.85
G7CCF	G	1000000.
G7EXP	G	.45
G8PERC	G	.1
G9AHOL	G	40.
G9CCF	G	1000.
HBA	A	71.0000
HBT	A	1.00000
HC	A	4.00000
IMOCH	A	1
IMODB	A	1
IMODL	A	1
IMOGA	A	1
IMOLR	A	1
IMOPP	A	1
IPPT	A	1
LFCDC	A	4
LFCDE	A	5
LFIN	A	2
LFLP	A	108
LFRD	A	10
LMCRDP	L	0.
LMCRFS	L	0.
LMCROH	L	1800.
LMCRPL	L	0.
LMCRCT	L	1.
LMCRSE	L	0.0
LMCRSH	L	2000.
LMCRSY	L	8.
LOGCA	A	0
LOGCF	A	1

LOGDV	A	1							
LOGEC	A	1							
LOGPA	A	1							
LOGRD	A	1							
LOGSD	A	1							
LOGSM	A	1							
PLF	A	10560.0							
PPBED	A	.409500E 15							
PPBT	A	75000.0							
PPCCF	P	17700. 67400. 3600. 9500. 8100. 52100.							
PPCCF	P	8100. 70200. 8100.							
PPCCX	P	.8 .8 1.0 .8 .5 .75 .5 .7 .5							
PPCRLO	P	30.							
PPCRPL	P	3							
PPCRSE	P	.8							
PPCRSY	P	7							
PPDTF	P	14.5 21.75 38.45 21.75 8. 21.75 8.							
PPDTF	P	21.75 8.							
PPDY	P	30							
PPD2BY	P	0							
PPD2CO	P	1							
PPD2EF	P	0							
PPD2PC	P	1							
PPD2RA	P	1							
PPD2SF	P	0							
PPEQTY	P	1. 1. 1. 1. 1. 1. 1. 1. 1.							
PPFCF	P	0. 0. 0. 12.41 0. 15.45 0. 17.93 0.							
PPFCX	P	0. 0. 0. .8 0. .75 0. .7 0.							
PPLCF	P	68.78 105.53 55.83 79.24 143.62 161.06							
PPLCF	P	166.80 220.21 189.99							
PPLCX	P	.35 .35 .35 .35 .35 .35 .35 .35 .35 .35							
PPMLF	P	71.52 81.09 30.56 54.31 174.02 184.13							
PPMLF	P	215.38 249.38 232.32							
PPMLX	P	.35 .35 .35 .35 .35 .35 .35 .35 .35 .35							
PPMMF	P	122.07 309.86 10.33 43.67 101.25 287.42							
PPMMF	P	101.25 516.37 101.25							
PPMMX	P	.8 .8 .8 .8 .5 .75 .5 .7 .5							
PPMS	P	9*5							
PPNED	A	.130000E 15							
PPNHV	A	12000.0							
PPODY	A	250.000							
PPDS	P	5 9 12 9 5 9 5 9 5							
PPOWCF	P	3625. 5438. 8712. 5438. 2000. 5438.							
PPOWCF	P	2000. 5438. 2000.							
PPOLF	P	45.05 99.87 22.12 19.08 128.12 185.							
PPOLF	P	128.12 314.65 128.12							
PPDIX	P	1. 1. 1. 1. 1. 1. 1. 1. 1.							
PPPSF-1	P	2. 2. 3. 0. 0. 0. 0. 0. 0.							
PPPSF-2	P	8.5 2. 0. 0. 0. 0. 0. 0. 0.							
PPPSF-3	P	2. 2. 1. 0. 0. 0. 0. 0. 0.							
PPPSF-4	P	2. 2. 3. 1. 0. 0. 0. 0. 0.							

PPPSF-5	P	9.6	4.8	0.	0.	0.	0.	0.	0.
PPPSF-6	P	6.	2.	3.	3.	2.	0.	0.	0.
PPPSF-7	P	9.6	7.2	0.	0.	0.	0.	0.	0.
PPPSF-8	P	6.	6.	3.	5.	2.	2.	0.	0.
PPPSF-9	P	9.6	9.6	0.	0.	0.	0.	0.	0.
PPOC-1	P	13,	18,	23,	5*0				
PPOC-2	P	13,	23,	6*0					
PPOC-3	P	13,	18,	23,	5*0				
PPOC-4	P	13,	18,	22,	23,	4*0			
PPOC-5	P	11,	22,	6*0					
PPOC-6	P	13,	17,	22,	23,	10,	3*0		
PPOC-7	P	11,	22,	6*0					
PPOC-8	P	13,	17,	22,	5,	23,	10,	2*0	
PPOC-9	P	11,	22,	6*0					
PPMC-1	P	4,	5,	6,	14,	12,	18,	23,	0
PPMC-2	P	4,	5,	6,	14,	12,	18,	23,	0
PPMC-3	P	4,	5,	6,	14,	12,	18,	23,	0
PPMC-4	P	4,	5,	6,	14,	12,	18,	23,	0
PPMC-5	P	4,	5,	6,	12,	13,	22,	0,	0
PPMC-6	P	4,	5,	6,	14,	12,	18,	23,	0
PPMC-7	P	4,	5,	6,	12,	13,	22,	0,	0
PPMC-8	P	4,	5,	6,	14,	12,	18,	23,	0
PPMC-9	P	4,	5,	6,	12,	13,	22,	0,	0
PPMF-1	P	.074,	.074,	.296,	.071,	.212,	.205,	.068,	0
PPMF-2	P	.087,	.044,	.261,	.042,	.125,	.401,	.04,	0
PPMF-3	P	.069,	.069,	.278,	.066,	.199,	.256,	.063,	0
PPMF-4	P	.131,	.064,	.259,	.061,	.187,	.239,	.059,	0
PPMF-5	P	.097,	.195,	.292,	.233,	.093,	.09,	0,	0
PPMF-6	P	.096,	.096,	.288,	.092,	.128,	.248,	.052,	0
PPMF-7	P	.118,	.157,	.315,	.226,	.075,	.109,	0,	0
PPMF-8	P	.113,	.099,	.311,	.068,	.122,	.248,	.039,	0
PPMF-9	P	.146,	.146,	.328,	.210,	.070,	.100,	0,	0
PPPSX	P	.35	.35	.35	.35	.35	.35	.35	.35
PPSDY	P	250							
PPWCF	P	0.	0.	0.	0.	2.40	0.	4.20	0.
PPWCX	P	0.	0.	0.	0.	1.	0.	1.	0.
PRPY	A	.300000							
PWF	A	100.000							
QDCG	Q	37.3							
QDCJ	Q	.68							
QDCK	Q	.90							
QDCM	Q	3.6							
QDCN	Q	17.46							
QDCP	Q	3.30							
QDCQDP	Q	0.							
QDCR	Q	1.02							
QDCROH	Q	1632.							
QDCRPL	Q	1.							
QDCRSE	Q	.80							
QDCRSH	Q	1813.							
QDCRSY	Q	7.							

QDD2BY	Q	0
QDD2CO	Q	0
QDD2DM	Q	1
QDD2EF	Q	0.0
QDD2PC	Q	2
QDD2RA	Q	1.0
QDD2SF	Q	0.0
QDM1C1	Q	6.
QDM1F1	Q	1.0
QDM1S1	Q	10.
QDO1C1	Q	15.
QDO1C2	Q	18.
QDO1Q1	Q	1.
QDO1Q2	Q	1.
QDO1S1	Q	1.
QDO1S2	Q	5.
QDP7	Q	20000.
QDRN	Q	23.
QLCQDP	Q	0.
QLCRFS	Q	0.
QLCROH	Q	1632.
QLCRPL	Q	0.
QLCRQT	Q	1.
QLCRSE	Q	0.
QLCRSH	Q	1813.
QLCRSY	Q	7.
QLO1C1	Q	15.
QLO1Q1	Q	1.0
QLO1S1	Q	1.
QQSH	Q	3.
Q5CN	Q	14.63
Q5D2DH	Q	20000
Q5D2UI	Q	36.0
RDCG	D	440.8
RDCJ	D	6.76
RDCK	D	2.87
RDCM	D	7.04
RDCN	D	46.55
RDCP	D	33.04
RDCR	D	10.14
RDCRDP	D	0.
RDCROH	D	3263.
RDCRPL	D	1.
RDCRSE	D	.80
RDCRSH	D	3625.
RDCRSY	D	7.
RDD2BY	D	0
RDD2CO	D	0
RDD2DM	D	1
RDD2EF	D	0.0
RDD2PC	D	2

RDD2RA	D	1.0
RDD2SF	D	0.0
RDM1C1	D	6.
RDM1F1	D	1.0
RDM1S1	D	10.
RDO1C1	D	15.
RDO1C2	D	18.
RDO1Q1	D	1.
RDO1Q2	D	1.
RDO1S1	D	5.
RDO1S2	D	5.
RDP7	D	20000.
RDRN	D	16.
RDSF	D	70.
RDSH	D	15.
ROC	A	900.000
RVCRDP	L	0.
RVCRFS	L	0.
RVCRQH	L	1800.
RVCRPL	L	0.
RVCRQT	L	1.
RVCRSE	L	0.0
RVCRSH	L	2000.
RVCRSY	L	8.
SCCG	L	201.1
SCCJ	L	9.19
SCCK	L	5.13
SCCM	L	3.55
SCCN	L	38.21
SCCP	L	22.26
SCCR	L	9.19
SCCRDP	L	0.
SCCRQH	L	1800.
SCCRPL	L	1.
SCCRSE	L	0.0
SCCRSH	L	2000.
SCCRSY	L	7.
SCD2BY	L	0.
SCD2CC	L	0.
SCD2DM	L	1.
SCD2EF	L	0.0
SCD2PC	L	2.
SCD2RA	L	1.
SCD2SF	L	0.0
SCM1C1	L	6.
SCM1F1	L	1.0
SCM1S1	L	10.
SCO1C1	L	2.
SCO1Q1	L	1.0
SCO1S1	L	6.
SCP7	L	12000.

SCRN	L	6.
SCSA	L	32.
SCSR	L	415.
SDCA	C	901.
SDCG	C	1043.
SDCJ	C	20.27
SDCK	C	3.44
SDCN	C	51.93
SDCP	C	40.98
SDCR	C	6.76
SDCRDP	C	0.
SDCRFS	C	0.
SDCRID	C	0.
SDCRLO	C	30.
SDCRMC	C	0.
SDCROH	C	3262.5
SDCRPL	C	2.
SDCRSE	C	.8
SDCRSH	C	3625.
SDCRSY	C	7.
SDD2BY	C	0.
SDD2CC	C	0.
SDD2DM	C	1.
SDD2EF	C	0.
SDD2PC	C	5.
SDD2RA	C	1.
SDD2SF	C	0.
SDM1C1	C	6.
SDM1F1	C	1.0
SDM1S1	C	10.
SDO1C1	C	1.
SDO1C2	C	8.
SDO1Q1	C	1.
SDO1Q2	C	1.
SDO1S1	C	5.
SDO1S2	C	5.
SDP7	C	60000.
SDRN	C	34.
SDST	C	650.
SDSW	C	16.
SFB	A	.350000
SFC	A	.350000
TDCA	C	433.9
TDCG	C	399.3
TDCJ	C	11.28
TDCK	C	11.23
TDCM	C	17.86
TDCN	C	54.16
TDCP	C	22.81
TDCR	C	7.52
TDCRDP	C	0.

TDCRFS	C	0.
TDCRID	C	0.
TDCRMO	C	0.
TDCROH	C	3262.5
TDCRPL	C	1.
TDCRSE	C	.8
TDCRSH	C	3625.
TDCRSY	C	7.
TDD2BY	C	0.
TDD2CO	C	0.
TDD2DM	C	1.
TDD2EF	C	0.
TDD2PC	C	2.
TDD2RA	C	1.
TDD2SF	C	0.
TDM1C1	C	6.
TDM1F1	C	1.0
TDM1S1	C	10.
TDO1C1	C	11.
TDO1Q1	C	1.
TDO1S1	C	5.
TDP7	C	30000.
TDRN	C	18
TDSC	C	1200.
TDSL	C	360.
TMY	A	30.0000
TRF	A	.600000E-01