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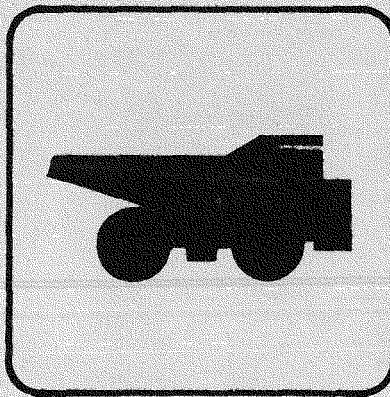
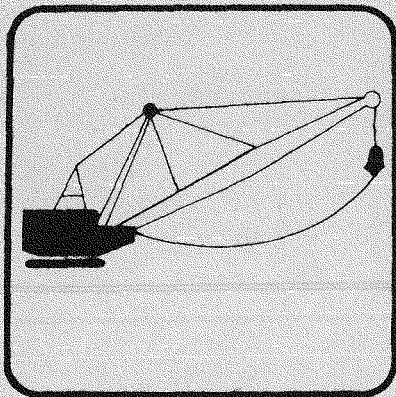
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FINAL REPORT
VOLUME 12

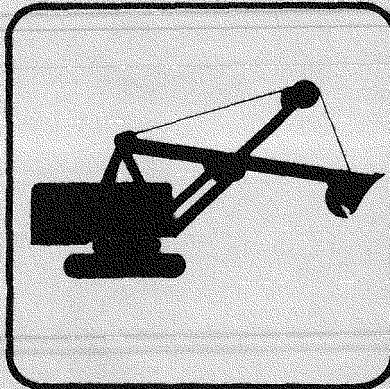
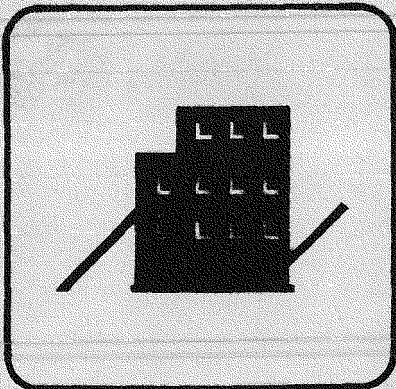
Economics of Large-Scale Surface Coal Mining Using Simulation Modes

User's Manual for Contour
Stripping with Draglines Macromodel



ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION

OFFICE OF FOSSIL ENERGY



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FLUOR UTAH, INC.
SAN MATEO, CALIF.

BONNER & MOORE
ASSOCIATES, INC.
HOUSTON, TEXAS

MARCH, 1977

MASTER

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Final Report
Volume 12

ECONOMICS OF LARGE-SCALE SURFACE COAL MINING
USING SIMULATION MODELS

USER'S MANUAL FOR CONTOUR STRIPPING WITH
DRAGLINES MACROMODEL

FLUOR UTAH, INC.
San Mateo, CA 94402

and

BONNER AND MOORE ASSOCIATES, INC.
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

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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 contour-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 Contour Dragline Macro (CDM) Model which simulates a surface coal mine using draglines for overburden removal in the contour-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 CDM 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 CDM 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 Contour Dragline Macro Model.

Part 2 is the User's Manual for the CDM 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.

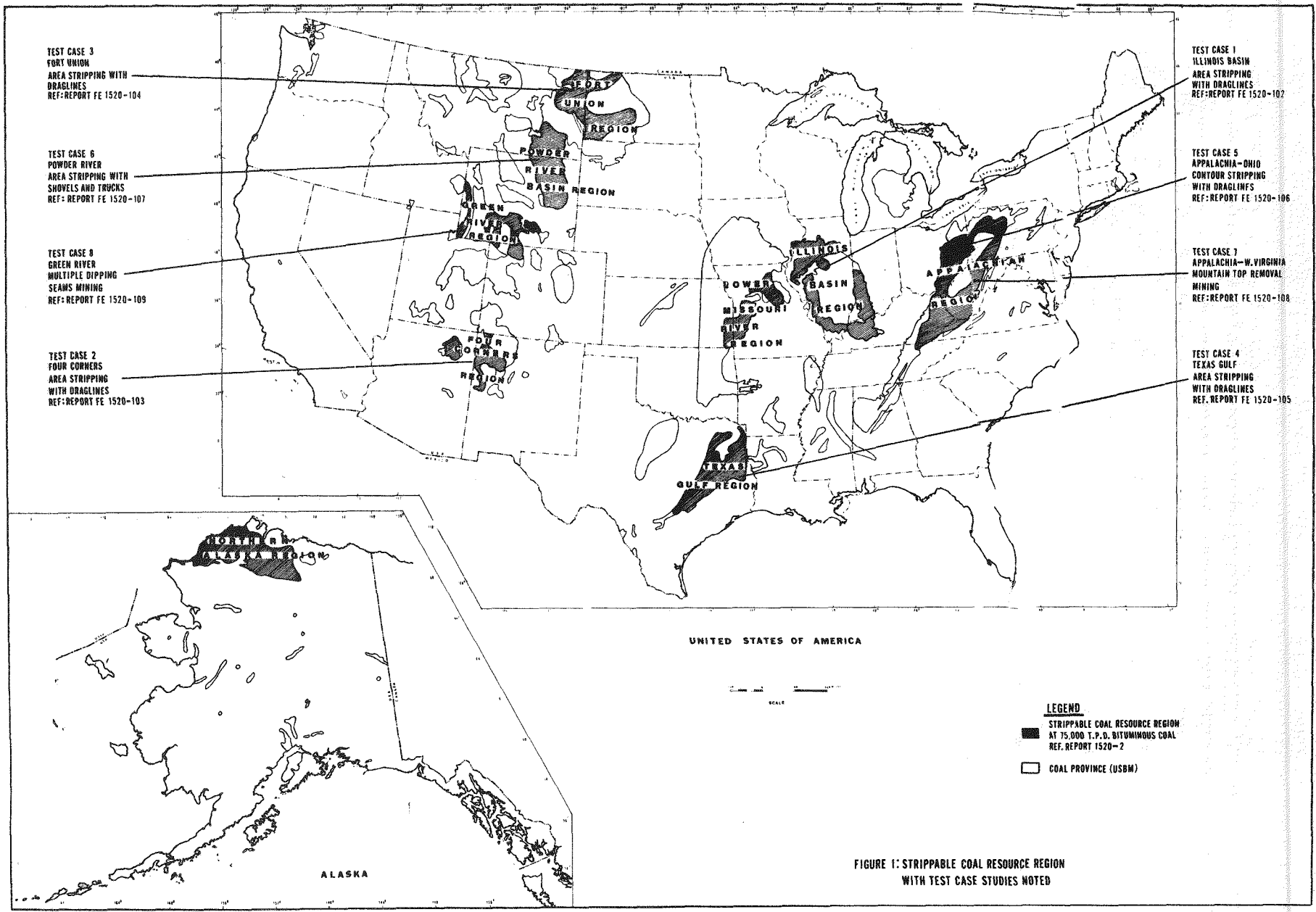


FIGURE 1: STRIPPABLE COAL RESOURCE REGION
WITH TEST CASE STUDIES NOTED

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.

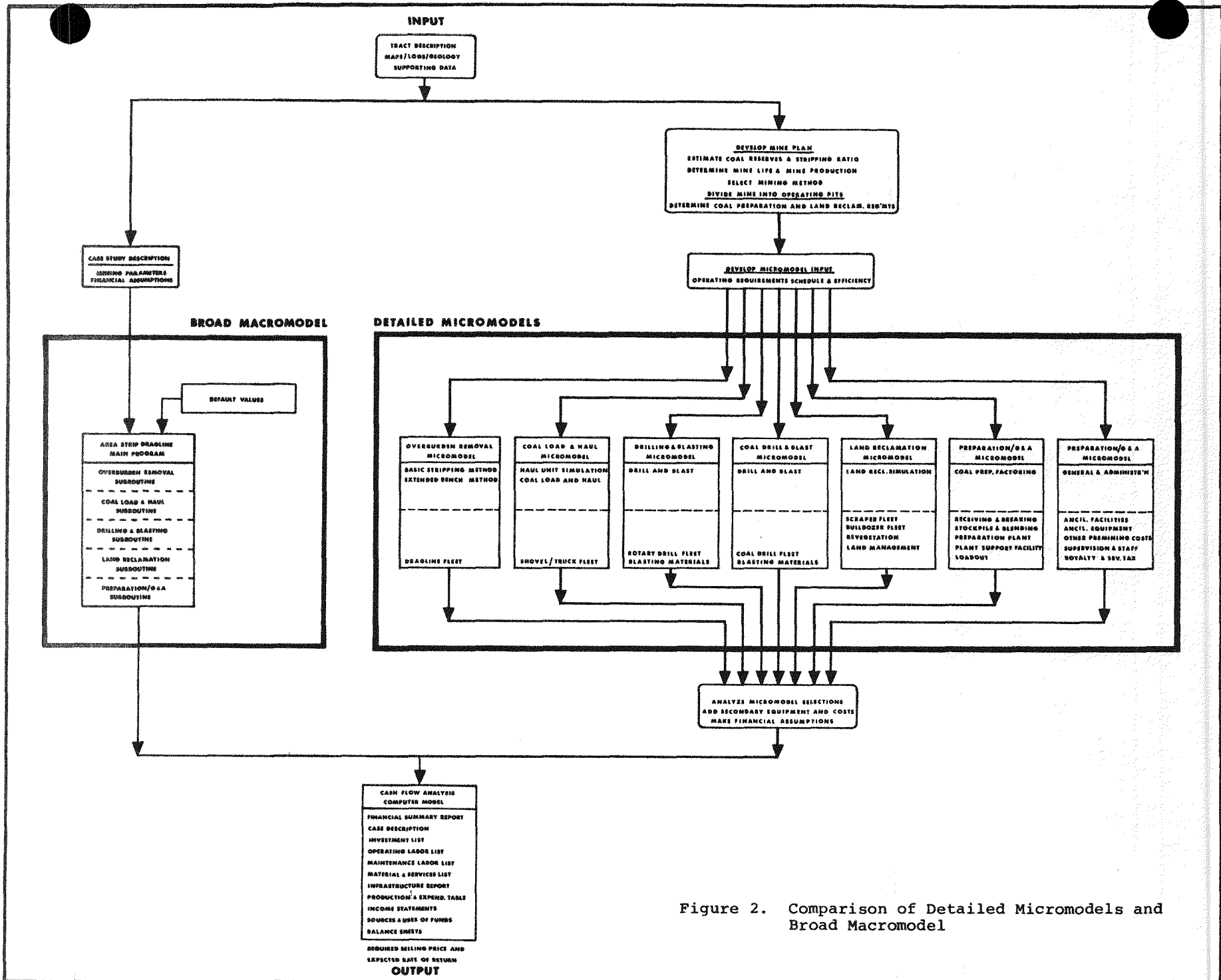


Figure 2. Comparison of Detailed Micromodels and Broad Macromodel

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)	↑	↑	↑
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)				

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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 CDM MODEL

The CDM 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 is gently sloping and the coal seam is relatively level. The CDM reports provide useful information concerning the mining project; however, the CDM model is intended to develop input for the CFA model so the project analysis will include cash flow discounting. The CDM 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 CDM/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 default parameters for mining in the Appalachia-Ohio coal-bearing region. All model parameters are explained in the User's Manual for the user who wishes to study other regions.

1.7.2 THE CDM MODEL

The CDM 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:

- Contour Stripping with Draglines 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 CDM 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 CDM model.

1.7.4 RANGE OF APPLICATION

The CDM model default values and internal logic have been defined to study dragline strip mines in the Appalachia-Ohio coal-bearing region. The user can easily obtain results by setting the parameters listed in paragraph 1.7.1 and using the default file for the region. 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 report FE-1520-106. 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

CONTOUR STRIPPING DRAGLINE

MACRO (CDM) MODEL

USER'S MANUAL

8 December 1976

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 CDM MODEL USER'S MANUAL
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SECTION 1
INTRODUCTION

1.1 PURPOSE AND SCOPE

This manual describes the Contour Stripping Dragline Macro (CDM) 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 portion of the model that simulates overburden removal with a walking dragline is based on the Contour Stripping with Draglines (CSD) detailed micro model. The CSD model is described in a separate User's Manual.

Both the CDM and CSD models simulate the action of a dragline working along hillside contours. The direction of dragline advance is along the outcrop; the direction of panel advance is into the hillside in the direction of increasing overburden heights. The models differ in the method by which the user describes the contour. The CSD model expects the area to be described as a series of sections along the outcrop; the CDM model works from a single section which is assumed to be an average for the area being stripped. The equations which simulate dragline operations are the same in both models; thus, the CDM macro model approximates the CSD micro model.

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

- Drilling and Blasting
- Land Reclamation Simulation
- Coal Load and Haul

These models are described in separate User's Manuals.

Baseline mining situations typical of Ohio contour 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 CDM 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 requirements for a baseline contour strip mine were developed by Fluor Utah. A series of factoring equations are used in the CDM 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 CDM 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.

The CDM 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 CDM 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 CDM model economic reports are in steady-state or base-year dollars; when a CDM 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 CDM 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 CDM 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:

$$\begin{aligned} \text{PPNS} &= \text{PPNE} / \text{PPBED} * \text{PPBHV} / \text{PPNHV} * \text{PPBT} \\ &= 0.13\text{E}15 / 0.4095\text{E}15 * 10990 / 12600 * 75000 \\ &= 20767.2 \end{aligned}$$

This example plant produces 20,559.5 tons/day of prepared coal having an energy content of 12,645.4 Btus/pound.

The ROM coal demand from the mining complex is 5.19 million tons/year, and the resulting prepared coal production is 5.139 million tons/year. For a 30-year project, the total feed demand is 155.75 million tons, and the production is 154.19 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 0.865 million tons/year of ROM coal. The example problem requires six pits, each producing 0.865 million tons/year. The resulting stripping ratio is 12.39 (defined as bank cubic yards of overburden/ton of ROM coal), and each dragline must remove 10.73 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 1603 tons of ROM coal/acre foot, and the acres disturbed in each pit total 4490.3.

2.3 OVERBURDEN REMOVAL WITH DRAGLINE

The model assumes that preliminary stripping has taken place before the dragline begins its operations. This preliminary stripping has removed overburden which is cast onto the outslope to form a bench for the dragline spoils. The coal has been recovered before the bench is formed.

The dragline begins operation on a bench formed above this first highwall. The direction of dragline advance is along the outcrop. Each dragline panel is cut into the hill until an operating limit is reached. The first spoils from the dragline are cast onto the bench on the outslope; subsequent spoils are cast against the first spoil bank.

The user describes the area to be mined as a typical section outcrop. The model operates the dragline to remove overburden from the described section, and calculates the total amount of overburden spoiled and coal recovered.

Generally, the amount of overburden increases as each panel moves into the hillside; thus, at some point, the spoils will be too large to fit into the preceding cut. In this case, the model calculates the amount of coal that would be covered during this operation. In cases where coal is covered, the model assumes that a rehandle operation will be undertaken to recover this coal.

The dragline bucket is sized to meet production needs. Regression equations determine the dragline 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.

2.3.1 Cross-Section Data

The cross-section data describe the heights of overburden above the coal seam. These data are input in the form of a series of x,y coordinates. The model labels for these coordinates are EX and EY for Elevation X and Elevation Y, respectively. The EX coordinates are horizontal distances (in feet) along the top of coal, and the EY coordinates are vertical distances (in feet) above the top of coal. Ten values for EX and EY are permissible.

The EX values are expressed as horizontal distances from the outcrop. The greatest permissible EX value is 3000. The EY values are expressed as heights above the coal. The following EX and EY values are the default section in the CDM model:

<u>EX</u>	<u>EY</u>	
0.0	0.0	(indicating the coal outcrop)
200	23.46	
350	39.72	
650	47.48	
950	58.18	
1250	58.24	
1550	51.92	
1850	41.04	
0	0	
0	0	

The user may alter the section description by changing the value of HBX. The model determines the maximum overburden height specified in the EY points. The ratio of HBX to the maximum is then applied to all of the EY points to scale the elevations up or down, depending on the user's setting of HBX. If the user alters both the EY points and the value of HBX, the effect on the section elevations is compounded.

For example, if the user specified the maximum overburden height HBX as 70 feet instead of the default value of 58.24, the EY points would be as follows:

EY
0.0
28.20
47.74
57.07
69.93
70.00
62.40
49.33
0.0
0.0

The model sets up an internal grid for each one-foot interval along the top of coal, using linear interpolation between the input EX,EY values. Thus, the number of points defined in the input must be sufficient for linear interpolation to properly represent the true slope.

If the user needs to describe a uniform slope from the outcrop to some distance into the hill, a single set of EX and EY values would be sufficient.

2.3.2 Plan-View Data

Plan-view data define the section that approximates the outcrop line of the coal.

The plan-view parameters are RADIUS and ANGLE. RADIUS defines the radius of the curvature for an arc section, or the length of a straight segment. A negative radius specifies an inside turn. Parameter ANGLE is the angle between two radii

that limit the arc length. It must be set to zero when defining a straight segment. The default values for ANGLE and RADIUS are 23.97 degrees and 6550 feet, respectively.

2.3.3 Specifying the Dragline

The CDM model calculates the dragline specifications, using two input variables (EDR and DLSB) and one calculated variable (DLSW). EDR is the effective dumping radius, measured in feet from the top edge of the highwall to the crest of the spoil bank. DLSB is the dragline boom angle, in degrees. The defaults are EDR = 260 and DLSB = 30.

The dragline bucket size (DLSW) is calculated by the CDM model, based on the required production for the dragline:

$$DLSW = BPBY / FFP / CPH / PTF / ESO * SFB / DLCROH$$

where:

- BPBY - is the overburden production demand, in cubic yards/year;
- FFP - is the fill factor for the dragline bucket;
- CPH - is the dragline cycles/hour;
- PTF - is the propel time factor;
- ESO - is the expected efficiency of the dragline operation;
- SFB - is the overburden swell factor; and
- DLCROH- is the operating hours/year.

Each of the independent variables in the above equation is set with a default value, but may be altered by the user. The default values appear in Appendix D.

The remaining dragline data are calculated using correlation equations based on the following correlation factor:

$$DLX = RMA * DLSW / 1000.$$

The dragline DLX factor is contained in most of the correlation equations for other dragline data. These and other equations used by the model are as follows:

$$DLSA = RMA / \text{cosine} (DLSB)$$

$$DLSJ = 36.7449 * DLX^{0.3053}$$

$$DLSH = ECR + DLSJ/2 + SWDH$$

$$DLCA = 981.71 + 410.6 * DLX$$

$$DLCI = -37.54 + 1.23468 * DLCA$$

$$DLCM = 14.50 + 4.583 * DLX$$

$$DLCL = 171695 + 7.0423 * DLX$$

$$DLCN = 9.67 + 3.055 * DLX$$

$$DLCR = 61.962 + 9.7445 * DLX$$

The values are printed in the Dragline Statistics report reproduced and discussed in paragraph 2.3.4.

2.3.4 Overburden Removal Logic

1) The model examines the EX and EY elevation points and scales the profile and variable BEFH using HBX. The EX and EY values are printed to show any effects of scaling. The printout is reproduced below:

	EX	EY
1	.00	.00
2	200.00	23.46
3	350.00	39.72
4	650.00	47.48
5	950.00	58.18
6	1250.00	58.24
7	1550.00	51.92
8	1850.00	41.04

2) The model develops an internal grid of elevations for each foot along the top of coal. This grid is formed by linear interpolation between the user-input data points.

3) The model searches the internal grid for the first elevation that is equal to or greater than BEFH (Base Elevation of First Highwall). This determines the EX value for the top of the first highwall. The EX value for the bottom of the first highwall is found by subtracting the product of BEFH times COTA (Highwall Slope) from the top EX. Thus, the model finds the distance along the top of coal for the bottom and top of the first highwall.

4) The model calculates the chord and arc lengths for the outcrop line, based on the settings of ANGLE and RADIUS. If ANGLE is zero; i.e., the section is a straight segment; the model sets CHORD and ARC equal to RADIUS.

5) The model simulates the casting operating, one panel at a time, until a limit is reached. (Limits are explained later in this section.)

The casting sequence of operations begins with the value of PW being set to parameter PWF (Panel Width in Feet). This parameter is set by default to 100 feet. The bottom of the right highwall is set to PW feet from the bottom of the left highwall. The top is found by an iterative search of the internal grid to find the intersection of the highwall with the top of the overburden. The model integrates the elevations between the top of the left highwall and the top of the right highwall to find the average elevation for the overburden to be spoiled (PY). The EX coordinate for the crest of the spoil bank is then set to be EDR feet from the top of the left highwall.

The critical EX coordinates have now been determined, and the model next calculates the radius to be used for the additional swell factor. The spoil radius (RADS) corresponds to the crest of the spoil bank. The coal radius (RADC) corresponds to the midpoint of the panel. The overburden radius (RADB) corresponds to the center of mass of the overburden to be spoiled. This center of mass is the arithmetic average of the EX coordinates for the four points: top and bottom of left highwall, and top and bottom of right highwall. The corresponding arcs are calculated.

The additional swell factor is:

$$ASF = ARCB / ARCS$$

For an outside turn, the spoil radius will be larger than the overburden radius, and ASF will be less than 1; for an inside turn, the reverse is true and ASF will be greater than 1; and for a straight-line segment, ASF will be 1.

The cross-section area to be spoiled (AS) is:

$$AS = PW * PY * SF * ASF.$$

The next action for the model is to determine the dimensions of the spoil bank. For the first panel, the spoil bank is assumed to an isosceles triangle, with the base at the bottom of coal. Thus, its height and base dimensions can be determined algebraically from the value of AS. The subsequent spoils are trapezoidal in shape, and the dimensions are determined by an iterative procedure which finds the spoil bank height to the nearest foot.

The model prints three reports of casting operation data. One report lists radii, arcs, and volumes as follows:

NS	RAD	CHORD	G	ARC							
1.	6550.0	2720.3	23.970	2740.2							
NP	RADS	RADC	RADB	ARCS	ARCC	ARCB	VOLB	RHV	TONC	CTC	
1.	6610.	6313.	6305.	2765.	2641.	2638.	.28428E 06	.00000	42257.	.00000	
2.	6506.	6213.	6203.	2722.	2599.	2595.	.37512E 06	.00000	41588.	.00000	
3.	6402.	6113.	6102.	2678.	2557.	2553.	.40210E 06	.00000	40918.	.00000	
4.	6301.	6013.	6002.	2636.	2516.	2511.	.41977E 06	.00000	40249.	.00000	
5.	6200.	5913.	5901.	2594.	2474.	2469.	.43842E 06	.00000	39580.	.00000	
6.	6098.	5813.	5800.	2551.	2432.	2426.	.46291E 06	.00000	38910.	.00000	
7.	5996.	5713.	5699.	2508.	2390.	2384.	.48684E 06	.00000	38241.	.00000	
8.	5895.	5613.	5599.	2466.	2348.	2342.	.50284E 06	.00000	37572.	.00000	
9.	5794.	5513.	5498.	2424.	2306.	2300.	.49587E 06	.00000	36902.	.00000	
10.	5694.	5413.	5398.	2382.	2265.	2258.	.48702E 06	.00000	36233.	.00000	
11.	5594.	5313.	5299.	2340.	2223.	2217.	.47444E 06	.00000	35564.	.00000	
12.	5495.	5213.	5199.	2299.	2181.	2175.	.44975E 06	.00000	34894.	.00000	
13.	5396.	5113.	5100.	2257.	2139.	2134.	.42466E 06	.00000	34225.	.00000	
14.	5297.	5013.	5000.	2216.	2097.	2092.	.39792E 06	.00000	33555.	.00000	
15.	5198.	4913.	4901.	2175.	2055.	2050.	.36370E 06	.00000	32886.	.00000	
16.	5100.	4813.	4802.	2134.	2014.	2009.	.32991E 06	.00000	32217.	.00000	

PROFILE X,Y SHORT - CAN NOT FIND HIGHWALL FOR PANEL NO. 17

The abbreviations used in this output, and their meanings are as follows:

<u>Abbrev.</u>	<u>Meaning</u>	<u>Description</u>
NS	No. of Section	Section number taken from columns 3-4 of Case Title cards.
RAD	Radius	Value entered via parameter RADIUS.
CHORD	Chord	Calculated length of chord connecting the ends of the radii describing this section. CHORD is set to zero for straight-line segments.
G		Angle enclosed by the two radii; value is entered via parameter ANGLE.
ARC	Arc	Calculated arc length connecting the two radii. This is the length of the coal outcrop that has been defined for this section, and has the same value as RAD for straight-line segments.
NP	No. of Panel	Panels are numbered from the first highwall, in the direction of panel advance.
RADS	Radius of Spoils	Radius of the spoils is calculated to the crest of pile.
RADC	Radius of Coal	Coal radius is calculated to the centerline of coal panel.
RADB	Radius of Burden	Calculated overburden radius is measured to the center of mass of material excavated.
ARCS	Arc Spoils	Arc length is calculated along the crest of spoils.
ARCC	Arc Coal	Arc length is calculated along coal panel centerline.
ARCB	Arc Burden	Overburden arc is calculated along the center of mass.
VOLB	Volume of Burden	Overburden, in bank cubic yards, spoiled from this panel.

<u>Abbrev.</u>	<u>Meaning</u>	<u>Description</u>
RHV	Rehandle Volume	Rehandle volume is the volume of spoils that must be rehandled when coal is covered, measured in bank cubic yards. When this value is zero, no coal is covered.
TONC	Tons Coal	Recoverable tons of coal in this panel.
CTC	Coal Tons Covered	Recoverable tons of coal that have been covered by spoils. This value is zero when the spoils do not overlap the coal; a non-zero value is the amount of coal that would be left in place if spoils were not handled.

The model determined that 16 panels could be stripped before the model exhausted the input description of the section. Note that no rehandle occurs in this example.

The second report lists the panel cross-section dimensions, as follows:

	PXB	PXT	PY	PW	ASF	SA	AS
1	187.00	200.00	29.10	100.00	.9539	3747.1	3747.1
2	287.00	304.00	39.03	100.00	.9535	4978.4	5023.5
3	387.00	408.00	42.53	100.00	.9532	5373.0	5472.2
4	487.00	509.00	45.14	100.00	.9525	5703.3	5804.3
5	587.00	610.00	47.95	100.00	.9518	6003.2	6161.0
6	687.00	712.00	51.51	100.00	.9511	6512.2	6614.0
7	787.00	814.00	55.13	100.00	.9505	6943.8	7074.2
8	887.00	915.00	57.96	100.00	.9497	7386.2	7431.8
9	987.00	1016.00	58.20	100.00	.9490	7291.2	7456.6
10	1087.00	1116.00	58.22	100.00	.9481	7434.9	7452.1
11	1187.00	1216.00	57.79	100.00	.9472	7233.6	7389.4
12	1287.00	1315.00	55.83	100.00	.9462	7022.9	7131.0
13	1387.00	1414.00	53.74	100.00	.9451	6746.6	6856.8
14	1487.00	1513.00	51.36	100.00	.9440	6381.1	6545.1
15	1587.00	1612.00	47.89	100.00	.9429	5930.8	6096.3
16	1687.00	1710.00	44.34	100.00	.9416	5567.2	5636.1
17	1787.00	1808.00	.00	.00	.0000	.0	.0

The abbreviations used in this output are as follows:

<u>Abbrev.</u>	<u>Meaning</u>	<u>Description</u>
PXB	Panel x at Bottom	Coordinate x for bottom of high-wall, measured in feet from outcrop line.
PXT	Panel x at Top	Coordinate x for top of highwall, measured in feet from outcrop line.
PY	Panel y	Average surface elevation, measured in feet from top of coal. The average is taken between the high-wall printed on the same line and that printed on the next line.
PW	Panel Width	Panel width, in feet. Value is taken from the user-set parameter PWF.
ASF	Adjustment Swell Factor	Adjustment swell factor. For a straight-line segment, ASF = 1. It will be greater than 1 when spoils are cast to the inside of a curve, and less than 1 when spoils are cast to the outside.
SA	Spoil Area	Calculated spoil cross-section area, in square feet. This is space available for spoils, as determined by model.
AS	Area to Spoil	Cross-section area of swelled overburden to be spoiled, in square feet.

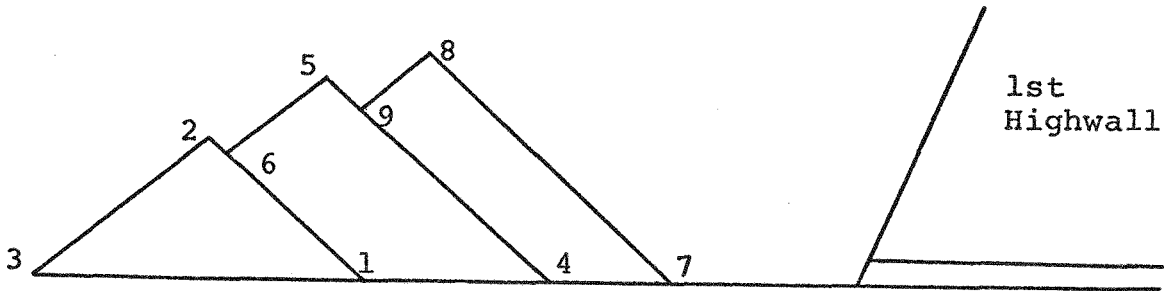
The third report lists the spoil bank cross-section coordinates, as follows:

	SX	SY
1	14.97	.00
2	-60.00	49.98
3	-134.97	.00
4	135.97	.00
5	44.00	61.31
6	-16.50	20.98
7	247.96	.00
8	148.00	66.64
9	92.00	29.31
10	355.46	.00
11	249.00	70.67
12	195.25	35.14
13	461.46	.00
14	350.00	74.30
15	297.00	36.97
16	569.45	.00
17	452.00	78.30
18	398.00	42.30
19	677.45	.00

20	554.00	82.30
21	500.00	46.30
22	784.94	.00
23	655.00	86.63
24	601.25	50.80
25	887.94	.00
26	756.00	87.96
27	704.50	53.63
28	990.44	.00
29	856.00	89.62
30	804.75	55.46
31	1089.53	.00
32	956.00	89.28
33	906.25	56.12
34	1187.43	.00
35	1055.00	88.28
36	1006.25	55.78
37	1283.42	.00
38	1154.00	86.28
39	1106.00	54.28
40	1377.92	.00
41	1253.00	83.28
42	1205.75	51.78
43	1470.92	.00
44	1352.00	79.27
45	1305.50	48.28
46	1563.41	.00
47	1450.00	75.60
48	1403.75	44.77

The SX column contains x coordinate values, in feet;
 and the SY column contains y coordinate values, in feet.
 The sequence numbers refer to points on a cross-
 section drawing, as shown below:

NOT DRAWN TO SCALE



SPOIL BANKS

The casting sequence is continued for each panel, until one of the following four limits is reached:

- SPOILS OVERLAP COAL BY xx FEET ON PANEL n

When the spoils overlap the coal, the amount of overlap (in feet) is compared to the value of $PO * PW$. This stop indicates that the overlap exceeds the Percent Overlap tolerance.

- PROFILE X, Y SHORT - CAN NOT FIND HIGHWALL FOR PANEL n

The user-specified EX, EY values do not extend far enough. The model is unable to determine an elevation for the right highwall for this panel.

- SPOIL TOO SMALL ON PANEL n

The value of ASF is small, and the cross-section area to be spoiled is too small for the model geometry. The model assumes the spoil will be trapezoidal - a very small spoil would be triangular. The model is not set up to handle this condition, since the condition is not likely to occur in a real operation. Probably, the input radius is too small and the effect of ASF has become exaggerated.

- AS - AREA TO SPOIL TOO LARGE ON PANEL n

This is the reverse of the preceding condition. The spoil actually overlaps the preceding spoil bank.

NOTE

If either of the last two conditions is reached, the case run is aborted and no information regarding this case is passed to the CFA model.

- 6) The dragline specifications are determined; the printed report is reproduced below:

DRAGLINE STATISTICS

SA	SB	SW	RMA	X	ST	PE
307.0	30.0	43.0	265.7	12.543	5011.0	3168.0
CA	CI	CM	CN	CO		
6132.	7533.	71.98	47.99	22.81		
CL	CR		TCL		ACR	TCR
106.023	184.182		.237502E 08		.137529E 07	.412587E 08

These data are a recap of the calculated dragline data, and the printing of this section of output is controlled by parameter LOGSD. (LOGSD is discussed in Section 3 of this manual.) The detail information for a single pit is interpreted as follows:

<u>Item</u>	<u>Definition</u>	<u>Value</u>
SA	Boom Length	307. feet
SB	Boom Angle	30°
SW	Bucket Size	43 cubic yards
RMA	Radius from Boom Foot	265.7 feet
X	Correlation Factor	12.543
ST	Working Weight	5011 M pounds
PE	Peak Electric Demand	3168 KW
CA	Purchase Price	6132 M\$
CI	Investment Cost	7533 M\$

<u>Item</u>	<u>Definition</u>	<u>Value</u>
CM	Maintenance Labor Cost	\$71.98/hour
CN	Maintenance Materials Cost	\$47.99/hour
CO	Electricity Cost	\$22.81/hour
CL	Ownership Cost	\$106.02/hour
CR	Operating Cost	\$184.18/hour
TCL	Total Ownership Cost	23.7502 MM\$
ACR	Annual Operating Cost	1.37529 MM\$
TCR	Total Operating Cost	41.2587 MM\$

7) The model prepares a summary listing showing volumes of overburden and coal, stripping ratios, and operating days for each panel, as follows:

OVERBURDEN BANK CUBIC YARDS (THOUSANDS)											WITH REHANDLE					
12	1	13	2	14	3	15	4	16	5	SUM	6	7	8	9	10	11
449.7	284.3	424.7	375.1	397.9	402.1	363.7	419.8	329.9	438.4	6795.5	462.9	486.8	502.8	495.9	487.0	474.4

COAL RECOVERED TCNS											WITH REHANDLE					
12	1	13	2	14	3	15	4	16	5	SUM	6	7	8	9	10	11
32103.	38877.	31487.	38261.	30871.	37645.	30255.	37029.	29639.	36413.	548127.	35798.	35182.	34566.	33950.	33334.	32718.

STRIPPING RATIO											WITH REHANDLE					
12	1	13	2	14	3	15	4	16	5	SUM	6	7	8	9	10	11
14.01	7.31	13.49	9.80	12.89	10.68	12.02	11.34	11.13	12.04	12.40	12.93	13.84	14.55	14.61	14.61	14.50

DAYS IN PANEL											WITH REHANDLE					
12	1	13	2	14	3	15	4	16	5	SUM	6	7	8	9	10	11
19.3	9.7	14.4	12.8	13.5	13.7	12.4	14.3	11.2	14.9	231.2	15.8	16.6	17.1	16.9	16.6	16.1

There are four tables of data in the above listing. Each table contains four lines: the first two lines present panel numbers, and the second two lines present data values as shown by the heading lines. The word "SUM" appears above the total figures. Thus, the value lines contain 17 figures: values for 16 panels, and the total for the section.

The OVERBURDEN BANK CUBIC YARDS (THOUSANDS) table presents the total volume of overburden removed from each panel. When spoils overlap coal, the overburden volumes are augmented by the amount of rehandle material.

The COAL RECOVERED TONS table presents the amount of coal recovered from each panel. The CDM model always rehandles any overlap spoils to recover all coal; however, the in-place volume is adjusted by ECR (Expected Coal Recovery Factor). This treatment contrasts with the detailed CSD model which presents both the rehandle and the no rehandle cases.

The STRIPPING RATIO is the total bank cubic yards of overburden and rehandle divided by total recovered tons of coal. The value presented under SUM is the quotient of the corresponding sums, and represents the average stripping ratio for the section.

The DAYS IN PANEL table is calculated from the OVERBURDEN table, using the production capacity of the dragline. The figures represent the number of operating days in each panel.

8) The model determines the number of sections of this size that would be needed to meet the project coal demand from this single dragline pit, and develops the overall costs. The following report is printed:

***** WITH REHANDLE *****

NSEC	YS	NDL	ACRES	TOTC					
47.359	.633	1.000	4490.29	.259590E 08					
#	YRS	TCL	ACR	TCR	OAD	\$/A			\$/T
1.	30.000	.237502E 08	.137529E 07	.412587E 08	.650090E 08	14477.7			2.50430

The abbreviations used in this cost summary are as follows:

<u>Abbrev.</u>	<u>Meaning</u>	<u>Descriptions</u>
NSEC	No. Sections	Number of sections per operating pit that would be needed to provide the coal demand.
YS	Years/Section	Number of calendar years dragline must operate in this section to strip all overburden.
NDL	No. Draglines	Number of draglines required to uncover coal demand.
ACRES	Acres	Number of surface acres disturbed in this pit. Acres are measured from outslope of first spoil bank to top of final highwall, using distance along coal centerline.
TOTC	Total Coal	Total recovered coal demand (i.e., CDRTY * TMY).
#	No.	Number of draglines that must be purchased to meet coal demand.
YRS	Years	Years of dragline operation.
TCL	Total CL	Total ownership costs for draglines when operating for YRS years, with salvage value equal to non-depreciated value at the end.
ACR	Annual CR	Annual operating costs for draglines.

<u>Abbrev.</u>	<u>Meaning</u>	<u>Description</u>
TCR	Total CR	Total operating costs associated with YRS years of operation.
OAO	Ownership & Operating	Total ownership plus total operating costs for YRS years.
\$/A	\$/Acre	Total ownership plus total operating costs, divided by acres.
\$/T	\$/Ton	Total ownership plus total operating costs, divided by total recovered tons of coal.

In the example problem, 47.359 sections, as described in the input, are required to meet the coal demand in the user's problem; with 0.633 years required to strip each section. The total acres disturbed are 4490.29 per operating pit. The total coal recovered is 25.959 million tons. The cost of operating the dragline is as follows:

Total Ownership Cost	23.7502 MM\$
Annual Operating Cost	1.3753 MM\$
Total Operating Cost	41.259 MM\$
Total Ownership and Operating Cost	65.009 MM\$
\$/Acre	\$14,477.7
\$/Ton of ROM Coal	\$2.5043

9) The following summary information is printed for the six dragline pits:

QT.		INITIAL INVESTMENT	ANNUAL OWNERSHIP	ANNUAL OPERATING	PROJECT TOTAL	\$/ ROM TON	\$/ DEL TON
6	DRAGLINES	.451986E 08	.477598E 07	.825174E 07	.390831E 09	2.509	2.535
	SUPPORT EQUIP.	.154980E 07	534991.	.184891E 07	.715171E 08	.459	.464
	PROJECT TOTALS	.467484E 08	.531097E 07	.101007E 08	.462348E 09		
	TONS DELIVERED =	.154196E 09	COST = 2.99844				\$/TON
	BTUS DELIVERED =	.390000E 16	COST = .118551				\$/MM BTU

This information indicates that six draglines are needed to provide stripping capacity to meet the project coal demand for the area, as calculated in Section 2.2. The items making up the SUPPORT EQUIP. are itemized below. The INITIAL INVESTMENT column contains the calculated purchase costs of equipment. The ANNUAL OWNERSHIP column shows the annual depreciation costs, plus 14 percent of the average required capital as the cost of insurance and property taxes. The ANNUAL OPERATING column contains the extension of the hourly operating costs multiplied by operating hours/year for each unit of equipment. The PROJECT TOTAL column contains the results of the ANNUAL OWNERSHIP plus ANNUAL OPERATING costs, multiplied by the number of project years. The \$/ROM TON is the PROJECT TOTAL divided by the tons of ROM coal from the complex. The \$/DEL TON is the PROJECT TOTAL divided by the total tons of prepared coal from the complex. The PROJECT TOTALS line presents sums of the preceding data lines. The remaining two lines are self-explanatory.

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

```

*
      3 OVERBURDEN REMOVAL USING DRAGLINES
FCRG 01  D11      6  0 7467 64366.4  7 3 .80 4 0 30 8297
FD1  01  D11  DRAGLINE      43. CY 307 FT 5011 307 30
ED2  01  D11  7533.09      224010      0 1 5 0 1 0 0
ED3  01  D11  47.99 71.98      .00      .00 22.81      .00      .00
EPD1 01  D11  2 12 1 8 12 2
EPM1 01  D11  6 10 1
ECRG 02  CE3      6 0 7467 0 7 3 0 1 0      30 8297
ED1  02  CD3  TR TRACTOR 300 HP      C DBK RPS
ED2  02  CD3  135.3 2400C 0.0 1 2 0 1. 0.0 0
ED3  02  CD3  3.96 7.00 3.71 .00 .00 .00 .00
EPD1 02  CD3  2 12 1
EPM1 02  CD3  6 10 1.0
ECRG 03  LD16      6 0 2374 0 7 3 0 1 0      30 2638
ED1  03  LD16  WH LOADER 325 HP      C 988 GA
ED2  03  LD16  123.0 120CC .0 1 2 0 1.0 .0 0
ED3  03  LD16  3.81 20.49 3.93 2.75 .00 .00 .00
EPD1 03  LD16  2 12 1
EPM1 03  LD16  6 10 1.0
ECRG P  PPCP 3 0 3625 5139.88      7 0 .80 3 0      30 3625
ZZZZZZZZZZZZZZZZZZ

```

The model provides one of the following items for each pit for SUPPORT EQUIP.:

- 300-horsepower track-type tractor
- 325-horsepower wheeled loader

One aspect about this set of CFA equipment cards and others shown in Section 2 deserves special attention. The ECRG card which begins "ECRG P PPCP" (the next-to-the-last card shown on this page) refers to the preparation plant. This card is developed by the CDM model whenever coal preparation is not simulated in a particular case. The CFA model takes the coal production figures from the preparation plant cards whenever the preparation plant is included. When it is not included, this card provides the required figures to the CFA model. Since each mining operation was run as a single case to provide the samples of output found in Section 2, this card will appear in all of the examples of the equipment data cards except those generated for the preparation plant example.

2.4 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:

	PARAMETER VALUES
RNORD = 5.60855 / HC	4
* DBCD / 1E6	.865E6
* DBHB	49.27
/ DBDR	100
= .598	

The regression equations which determine the explosives cost are:

	PARAMETER VALUES
DBTEC = 111 + 109.22 / HC	4
* DBCD / 1E6	.865E6
* DBHB	49.27
* DBPRPY	.3
= 460.11	
DBTEC = DBTEC * BLCRLO * 1000 = 460.11 * 30 * 1000	
= .13808E8	

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.#			
.598	1	15.000	440.8	33.04	46.55	16			
RD OWN	RD OPER	#SP	SP OWN	EX TOT	RD \$/T	EX \$/T			
.32343E 07	.27241E 07	0	.00000	.13808E 08	.22953	.53190			

The detail information for single pit is interpreted as follows:

<u>Item</u>	<u>Definition</u>	<u>Value</u>
DRILL	Required Number of Drills	.598
QT	Number of Drills for Investment	1
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	3.2343 MM\$
RD OPER	Total Operating Cost	2.7241 MM\$
#SP	Number of Spare Drills	0
SP PWN	Investment Cost for Spares	0
EX TOT	Total Explosive Cost	13.808 MM\$
RD \$/T	Drilling Cost/Tons of ROM Coal	\$0.229
EX \$/T	Explosive Cost/Ton ROM Coal	\$0.532

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 .124620E 07	646839. 374038.	.367288E 07 879531.	.129592E 09 .376070E 08	.832 .241	.840 .244
	PROJECT TOTALS	.389100E 07	.102088E 07	.455241E 07	.167199E 09		
TONS DELIVERED =		.154196E 09	COST = 1.08432	\$/TON			
BTUS DELIVERED =		.390000E 16	COST = .428714E-01	\$/MM BTU			

Since there are six 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 M\$ * 6 or 2.6448 MM\$.

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:

```

*          4 OVERBURDEN DRILLING AND BLASTING
ECRG 01  RD16  6  0 3263 64366.4  7 3 .80 1 0 30 3625
ED1  01  RD16 ROTRY DRILL 15.000 IN 70 HP  B 60R-3ERB
ED2  01  RC16 440.8 20000 .000 1 2 0 1.000 .000 0
ED3  01  RC16 10.14 6.76 .00 .00 2.87 .00 7.04
EPO1 01  RC16 15 5 1.0 18 5 1.0
EPM1 01  RD16 6 10 1.0
ECRG 02  BLST  6  0 1631 64366.4  7 3 .00 0 0 30 1813
ED1  02  BLST BLASTING
ED3  02  BLST .00 .00 .00 .00 .00 .00 282.19
EPO1 02  BLST 15 1 1.0
ECRG 03  CC3A  6  0 3263 0 7 3 0 1 0 30 3625
ED1  03  CD3A TR TRACTOR 300 HP  C DBK RSPS
ED2  03  CC3A 135.3 12000 .0 1 2 0 1. .0 0
ED3  03  CC3A 3.96 7.00 3.71
EPO1 03  CD3A 11 5 1
EPM1 03  CC3A 6 10 1.0
ECRG 04  LD1  6  0 1631 0 7 3 0 1 0 30 1813
ED1  04  LD1 WH LOADER 1.5 YD 80 HP  C920GA
ED2  04  LC1  36.4 12000 .0 1 2 0 1. .0 0
ED3  04  LD1 1.06 4.73 1.07 .32
EPO1 04  LC1 11 1 1
EPM1 04  LD1 6 10 1.0
ECRG 05  YDX1  6  0 1631 0 7 3 0 1 0 30 1813
ED1  05  TDX1 PRILL TRUCK
ED2  05  TDX1 36.0 20000 .0 1 2 0 1. 0. 0
ED3  05  YCX1 .95 1.31 .66 .57
EPO1 05  TDX1 11 1 1.0
EPM1 05  TDX1 6 10 1.0
ECRG P  PFCP  3  0 3625 5139.88  7 0 .80 3 0 30 3625
ZZZZZZZZZZZZZZZZ

```

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 each ROTARY DRILL, 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 User's Manual.

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 rotary drills is:

$$\begin{aligned} \text{RNOQD} &= .3 * \text{QBCD} / 1\text{E}6 * 1632 / \text{QDCROH} \\ &= .3 * .865\text{E}6 / 1\text{E}6 * 1632 / 1632 \\ &= .260 \end{aligned}$$

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

$$\begin{aligned} \text{QBTEC} &= .05 * \text{QBCD} * \text{QLORLO} \\ &= .05 * .865\text{E}6 * 30 \\ &= .12979\text{E}7 \end{aligned}$$

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.#		
.260	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	.22191E 06	0	.00000	.12979E 07	.14772E-01	.50000E-01		

The detail information for single pit in interpreted as follows:

<u>Item</u>	<u>Definition</u>	<u>Value</u>
DRILL	Required Number of Drills	.260
QT	Number of Drills 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	0.22191 MM\$
#SP	Number of Spare Drills	0
SP OWN	Investment Cost for Spares	0
EX TOT	Total Explosive Cost	1.2979 MM\$
RD \$/T	Drilling Cost/Tons of ROM Coal	\$0.0148
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 TON
6	COAL ROTARY DRILLS	223800.	35206.4	430558.	.139729E 08	.090	.091
	SUPPORT EQUIP.	216000.	33979.4	143257.	.531709E 07	.034	.034
	PROJECT TOTALS	439800.	69185.7	573815.	.192900E 08		
TONS DELIVERED = .154196E 09		COST = .125100				\$/TON	
BTUS DELIVERED = .390000E 16		COST = .494615E-02				\$/MM BTU	

Since there are six pits in this solution, the number of drills is "6". 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 M\$ * 6 = \$223.8 M\$.

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 DRILLING AND BLASTING
ECFG Q1   QD23      6      0 1632 5225.24      7 3 .80 1 0 30 1313
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      6      0 1632 5225.24      7 3 .00 0 0 30 1813
ED1  Q2   CLST BLASTING
ED3  Q2   CLST .00 .00 .00 .00 .00 .00 26.51
EPO1 Q2   QLST 15 1 1.0
ECRG Q5   TCQ1      6 0 1632 0 7 3 0 1 0 30 1813
ED1  Q5   TDQ1 PRILL TRUCK
ED2  Q5   TCQ1 36.0 20000 .0 1 2 0 1. 0. 0
ED3  Q5   TCQ1 .95 1.31 .66 .57
EPO1 Q5   TCQ1 11 1 1.0
EPM1 Q5   TCQ1 6 10 1.0
ECRG P   PPCP 3 0 3625 5139.88      7 0 .80 3 0 30 3625
ZZZZZZZZZZZZZZZZZZ

```

The text describing the equipment is contained in the ED1 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 consists of 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 not 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 EQUIP. line.

2.6 COAL LOAD AND HAUL

The model uses a predefined coal loading shovel and bottom-dump truck for loading and hauling. First, the production capacity of the shovel is determined. A regression equation determines the haul cycle time for the average year of operation. The truck fleet is sized for this year, and the fleet requirement is rounded up to an integer to set the average fleet size. 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 approximately the same distance from the coal dump site during the life of the mine, eliminating the need for deferred trucks for this mining method. A number of spare trucks are purchased to maintain production during truck downtimes.

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.#
.592	1	425	12.0		688.0	763.4	20.77	46.79	31
TRUCK	QT	SC	SL	DT	CA	CG	CP	CN	REF.#
3.750	4	1000	300	E	317.6	292.6	21.94	55.01	53
SD OWN	SD OPER	TD OWN	TD OPER	SPARE OWN	#SP	\$/TON			
.10163E 07	.22894E 07	.42941E 07	.10093E 08	.32206E 07	3	.752			

The information applies to the initial fleet in one pit.
 The 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	0.582
QT	Number of Shovels for Investment	1.
ST	Shipping Weight	425 M pounds
SW	Dipper Capacity	12 cubic yards
CA	Purchase Price	688 M\$
CG	Investment Cost	763.4 M\$
CP	Hourly Ownership Cost	\$20.77
CN	Hourly Operating Cost	\$46.79
REF.#	Data File Reference Number	31
TRUCK	Required Number of Trucks	3.750
QY	Number of Trucks for Investment	4
SC	Truck Horsepower	1000
SL	Truck Payload	300 M pounds
DT	Truck Drive Type	E (electric)
CA	Purchase Price	317.6 M\$
CG	Investment Cost	292.6 M\$
CP	Hourly Ownership Cost	\$21.94
CN	Hourly Operating Cost	\$55.01
REF.#	Data File Reference Number	53
SD OWN	Shovel Total Ownership Cost	1.0163 MM\$
SD OPER	Shovel Total Operating Cost	2.2894 MM\$
TD OWN	Truck Total Ownership Cost	4.2941 MM\$
TD OPER	Truck Total Operating Cost	10.093 MM\$
SPARE OWN	Spares Ownership	3.2206 MM\$
#SP	Number of Fleet Spares	3
\$/TON	Total Cost/Total ROM Tons	\$0.752/ton

The model prints the following summary information:

QT.		INITIAL INVESTMENT	ANNUAL OWNERSHIP	ANNUAL OPERATING	PROJECT TOTAL RCM	\$/ TON	\$/ DEL TON
6	SHOVELS, 27 TRUCKS SUPPORT EQUIP.	.124806E 08 .202620E 07	.169623E 07 374591.	.249879E 07 .115346E 07	.125851E 09 .458414E 08	.808 .294	.816 .297
	PROJECT TOTALS	.145068E 08	.207082E 07	.365225E 07	.171692E 09		
	TONS DELIVERED =	.154196E 09	COST = 1.11346				\$/TON
	BTUS DELIVERED =	.390000E 16	COST = .440236E-01				\$/MM BTU

Here, six shovels and 27 trucks are required for the six operating pits. This summary information is calculated in the manner explained under "Drilling and Blasting".

The following CFA equipment cards are developed by the model:

```

*
      6 COAL LOAD AND HAUL
ECRG C 1 SD21      6 0 1631      5191 7 3 .80 2 0 30 1813
ED1  C 1 SD31 SHOVEL      12 CU. YD.      H1600 4635C
ED2  C 1 SD31 763.400      60000 .00 1 5 0 1.000 .000 0
ED3  C 1 SD31 5.01 15.03 .00 .00 2.30 .00 .00
EPO1 C 1 SD31 1 1 1.0 8 1 1.0
EPM1 C 1 SD31 6 10 1.0
ECRG C 2 TC53      24 3 1631      5191 7 3 .80 1 0 30 1813
ED1  C 2 TD53 TRUCK      150 TON      W150CTC150TM
ED2  C 2 TD53 292.600      20000 .00 1 2 0 1.000 .000 0
ED3  C 2 TD53 8.26 12.39 9.36 13.75
EPO1 C 2 TD53 11 1 1.0
EPM1 C 2 TC53 6 10 1.0
ECRG C 3 L16      6 0 1631 0 7 3 0 1 0 30 1813
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 11 1 1
EPM1 C 3 L16 6 10 1.0
ECRG C 4 GD5      6 0 1631 0 7 3 0 1 0 30 1813
ED1  C 4 GC5 GRADER      180 HP      C 146 PS
ED2  C 4 GC5 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 1 1.0
EPM1 C 4 GD5 6 10 1.0
ECRG C 5 PUMP      6 0 1440 0 7 3 0 1 0 30 1440
ED1  C 5 PLMP PUMP SET      125000 GPH
ED2  C 5 PLMP 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 1 1.0
EPM1 C 5 PLMP 6 10 1.0
ECRG C 6 TCX2      6 0 1631 0 7 3 0 1 0 30 1813
ED1  C 6 TDX2 H20 TRUCK      5000 GAL
ED2  C 6 TCX2 124 5 20000 .0 1 2 0 1. .0 0
ED3  C 6 TDX2 6.35 5.70 5.65 .50 .00 .50
EPO1 C 6 TDX2 11 1 1.0
EPM1 C 6 TCX2 6 10 1.0
ECRG P PPCP 3 0 3625 5139.88 7 0 .80 3 0 30 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, grader, and the water truck operate a single shift. The pump set operating hours are set as default values.

2.7 LAND RECLAMATION

Land reclamation uses a pre-defined self-loading scraper to remove and respread topsoil, and a pre-defined bulldozer to regrade spoil 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:

	PARAMETER VALUES
RNOSC = .66 * 4 / HC	4
* HBT / .5	.5
* CDRTY / 865300	865300
= .66	

The equation for the required number of bulldozers is:

$$\begin{aligned}
 X &= CDRTY / 1E6 / HC = 865300 / 1E6 / 4 = .21633 \\
 RNOCD &= -.00384704 * X * RCTT * RCPWF \\
 &\quad +.000618916 * X * RCTT * RCPWF^2 \\
 &\quad +.00660554 * X * RCCG \\
 &= -.00384704 * .21633 * .666 * 100 \\
 &\quad +.000618916 * .21633 * .666 * 100^2 \\
 &\quad +.00660554 * .21633 * 600. \\
 &= 1.694
 \end{aligned}$$

Control parameter ROC specifies reclamation costs which cannot be directly simulated by the model. The total cost, in dollars/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.#						
.660	1	32	415	201.1	22.26	38.21	6						
DOZER	QT		SK	CG	CP	CN	REF.#						
1.694	2		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\$			
.11119E 07		.12597E 07	0	.00000	.21279E 07	.26391E 07	1	.10639E 07	.89806E 06	.44903E 06			

This information can be interpreted as follows:

<u>Item</u>	<u>Definition</u>	<u>Value</u>
SCRAPER	Required Number of Scrapers	.66
QT	Quantity for Investment	1
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	1.694
QT	Quantity for Investment	2
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	1.1119 MM\$
SC OPER	Scraper Total Operating Cost	1.2597 MM\$
#SP	Number of Spare Scrapers	0
SP OWN	Spare Total Ownership Cost	0
CD OWN	Bulldozer Total Ownership Cost	2.1279 MM\$
CD OPER	Bulldozer Total Operating Cost	2.6391 MM\$
#SP	Number of Spare Bulldozers	1
SP OWN	Spare Bulldozers Total Ownership Cost	1.0639 MM\$
RV TOT \$	Total Revegetation Cost	.8906 MM\$
LM TOT \$	Total Land Management Cost	.44903 MM\$

The model prints the following summary information:

QT.		INITIAL INVESTMENT	ANNUAL OWNERSHIP	ANNUAL OPERATING	PROJECT TOTAL	\$/ ROM	\$/ TON DEL	TON
12	DOZERS, 4 SCRAPERS	.311440E 07	680379.	.114687E 07	.548175E 08	.352	.356	
	PROJECT TOTALS	.311440E 07	680379.	.114687E 07	.548175E 08			
	TONS DELIVERED =	.154196E 09	COST = .355504				\$/TON	
	BTUS DELIVERED =	.39C000E 16	COST = .140558E-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  1 1665  .898  7  3  .80  1  0  30 1850
ED1  L1  CD 5  TR TRACTOR  410 HP  C D9H RUPS
EO2  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
EPO1 L1  CC 5 11  6 1.0  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
ECRG L2  SC 6  4  0 1665  .898  7  3  .00  1  0  30 1850
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
EO3  L2  SC 6  9.19  9.19  5.13  3.55  .00  .00  .00
EPO1 L2  SC 6  2  6 1.0  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
ECRG L3  RVGT  1  0 1665  .898  8  3  .00  0  0  30 1850
ED1  L3  RVGT REVEGETATION
EO3  L3  RVGT  .00  .00  .00  .00  .00  107.87
ECPG L4  LMGT  1  0 1665  .898  8  3  .00  0  0  30 1850
ED1  L4  LMGT LAND MGT
EO3  L4  LMGT  .00  .00  .00  .00  .00  53.94
ECRG P  PPCP  3  0 3625  5139.88  7  0  .80  3  0  30 3625
ZZZZZZZZZZZZZZZZ

```

2.8 PREPARATION PLANT FACTORING

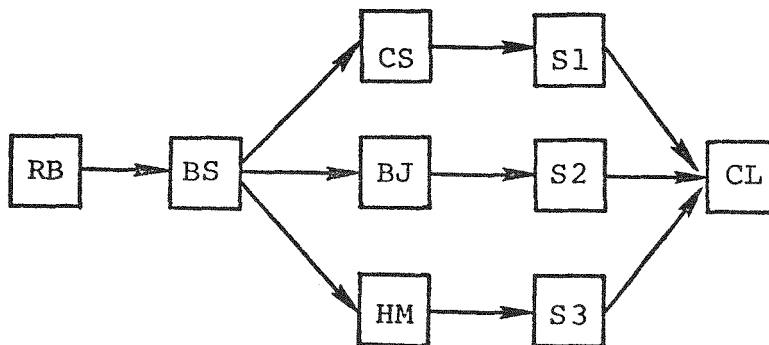
The model develops one of three preparation plants. Each of these plants consists of five operations:

- 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). The example problem requires three preparation plants with a combined feed rate of 20767.2 ROM tons/day. Each plant feeds 6922.4 tons/day, and the size ratio is 0.0923. All preparation plant data are calculated on the basis of the individual plants, but the figures presented in the preparation plant reports are totals for the complex.

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	314.65	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:

Block ID	<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

The model also 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	.087
	5	.044
	6	.261
	14	.042
	12	.125
	18	.401
	23	.040
CL	4	.069
	5	.069
	6	.278
	14	.066
	12	.199
	18	.256
	23	.063
CS	4	.131
	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
S2	23	.052
	4	.118
	5	.157
	6	.315
	12	.226
	13	.075
HM	22	.109
	4	.113
	5	.099
	6	.311
	12	.122
	14	.068
S3	18	.248
	23	.039
	4	.146
	5	.146
	6	.328
	12	.210
	13	.070
	22	.100

The following detail information is printed:

PREPARATION PLANT STATISTICS						
TYPE	SIZE TCNS/DAY	DELIVERED COAL				
		BTU/LB	TONS/YEAR	BTU/YEAR		
1	20767.2	12645.4	.513988E 07	.130000E 15		
		UNIT INVESTMENT	LABOR	OWNERSHIP	OPERATING	O&O
			\$/HOUR			\$/TON
REC & BREAK	PREP. PLANT	.789316E 07	89.62	230.08	249.72	.335
BLEND-STOCK	PREP. PLANT	.300564E 08	137.50	584.03	409.00	1.040
COAL LOADCUT	PREP. PLANT	996824.	72.75	12.09	123.30	.251
CRUSH-SCREEN	PREP. PLANT	.423644E 07	103.25	82.32	204.31	.300
CS SUPPORT	PREP. PLANT	.738251E 07	187.13	390.04	541.64	.359
		.505653E 08				2.285

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 20,767.2 tons of ROM coal/day. The prepared coal has a heat content of 12645.4 Btus/pound; the delivered coal rate of 5.13988 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
3	PR. PLANT TYPE 1	.505653E 08	.534306E 07	.639779E 07	.352226E 09	2.261	2.284
	PROJECT TOTALS	.505653E 08	.534306E 07	.639779E 07	.352226E 09		
	TONS DELIVERED =	.154196E 09	COST =	2.28427		\$/TON	
	BTUS DELIVERED =	.390000E 16	COST =	.903141E-01		\$/MM BTU	

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

Note that all figures in the two preceding printouts apply to the complex of three plants. The size and costs for a single plant can be obtained by dividing the printed values by the number of plants (i.e., by 3 for this example).

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

```

*          8 PREPARATION PLANT
ECRG P 1 PRRB 3 0 3625 5139.88 7 3 .80 3 0 30 3625.
ED1 P 1 PRRB REC & BREAK PREP. PLANT
ED2 P 1 PRRB 2631.05 108750 .000 1 5 0 1.000 .000 1
ED3 P 1 PRRB 31.06 18.15 .00 .00 4.16 .00
FPO1 P 1 PRRB 13 5 .87 18 5 .87 23 5 1.30
FPM1 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 3 0 5438 5139.88 7 3 .80 3 0 30 5438.
ED1 P 2 PRBS BLEND-STOCK PREP. PLANT
ED2 P 2 PRBS 10018.8 163140 .000 1 5 0 1.000 .000 1
ED3 P 2 PRBS 35.22 46.06 .00 .00 9.22 .00
FPO1 P 2 PRBS 13 9 3.69 23 9 .87
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 .040
ECRG P 3 PRCL 3 0 8712 5139.88 7 3 .80 3 0 30 8712.
ED1 P 3 PRCL COAL LOADOUT PREP. PLANT
ED2 P 3 PRCL 332.275 261360 .000 1 5 0 1.000 .000 1
ED3 P 3 PRCL 13.27 1.54 .00 .00 2.04 .00
EPO1 P 3 PRCL 13 12 .87 18 12 .87 23 12 .43
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 3 0 5438 5139.88 7 3 .80 3 0 30 5438.
ED1 P 4 PRCS CRUSH-SCREEN PREP. PLANT
ED2 P 4 PRCS 1412.15 163140 .000 1 5 0 1.000 .000 1
ED3 P 4 PRCS 23.59 6.49 1.84 .00 1.76 .00
FPO1 P 4 PRCS 13 9 .87 18 9 .87 22 9 1.30 23 9 .43
FPM1 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 3 0 2000 5139.88 7 3 .80 3 0 30 2000.
ED1 P 5 PRS1 CS SUPPORT PREP. PLANT
ED2 P 5 PRS1 2460.84 60000 .000 1 5 0 1.000 .000 1
ED3 P 5 PRS1 75.58 30.76 .00 .00 11.83 .00
FPO1 P 5 PRS1 11 5 4.17 22 5 2.08
FPM1 P 5 PRS1 4 5 .097 5 5 .195 6 5 .292 12 5 .233 13 5 .093
EPM2 P 5 PRS1 22 5 .090
ZZZZZZZZZZZZZZZZ

```

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 millions of 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.
- CCF - 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	3E6	0.35
2	BLDG	4.89375E6	0.85
3	PWR	4.5E6	0.7
4	H2O Plant 1	2E5	0.45
	H2O Plant 2	4.5E5	0.45
	H2O Plant 3	5.5E5	0.45
5	COM	1.25E5	0.4
6	MBEO	1.2E6	0.85
7	SHEQ	1E6	0.45
8	LAND	NA	NA
9	XDRL	NA	NA
10	ENG	6E6	0.55
11	EIS	1E5	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 200 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 157440 as the cost factor and 0.9 as the exponent; the number of staff personnel is determined with the capital cost equation, using 78.72 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.	.300000E 07	155.16	.00	.064
BUILDINGS ANC. FAC.	.489375E 07	253.10	32.60	.117
ELECT. SYS. ANC. FAC.	.450000E 07	232.73	.00	.096
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	.026
EQUIP. SHOP ANC. FAC.	.100000E 07	51.72	.00	.021
LAND RIGHTS PREMINE	808251.	41.80	121.24	.067
EXPL. DRILL. PREMINE	673542.	34.83	.00	.014
CONT. ENG. PREMINE	.600000E 07	310.31	.00	.128
E. I. S. PREMINE	.100000E 07	51.72	.00	.021
SUPERV. PER.	.000000	.00	776.82	.319
ROY-SEV. TAX	.000000	.00	876.12	.360
	.234005E 08	1210.24	1806.77	1.240

TOTAL MM TONS/YEAR 144.545
 TOTAL ACRES DISTURBED 26941.7

In this listing, 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 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.	.234005E 08	.242049E 07	.361354E 07	.193089E 09	1.240	1.252
PROJECT TOTALS	.234005E 08	.242049E 07	.361354E 07	.193089E 09		
TONS DELIVERED = .154196E 09 COST = 1.25223 \$/TON						
BTUS DELIVERED = .390000E 16 COST = .495100E-01 \$/MM BTU						

These data are summations of the detail data.

The following CFA equipment data cards are developed:

```

*
          9 GENERAL AND ADMINISTRATIVE
ECRG P   PPCP  3 0 3625 5139.88      7 3 .80 3 0 30 3625
ECRG G 1  SITE      1 0 2000 .000 7 1 .00 3 0 32 2000
ED1 G 1  SITE ROADS & SITE ANC. FAC.
ED2 G 1  SITE 3000.0 64000 .000 1 5 0 1.000 .000 1
ECRG G 2  BLDG      1 0 2000 .000 7 1 .00 3 0 32 2000
ED1 G 2  BLDG BUILDINGS ANC. FAC.
ED2 G 2  BLDG 4893.7 64000 .000 1 5 0 1.000 .000 1
ED3 G 2  BLDG .00 .00 32.50 .00 .00 .10
ECRG G 3  PWR      1 0 2000 .000 7 1 .00 3 0 32 2000
ED1 G 3  PWR ELECT. SYS. ANC. FAC.
ED2 G 3  PWR 4500.0 64000 .000 1 5 0 1.000 .000 1
ECRG G 4  H2O      1 0 2000 .000 7 1 .00 3 0 32 2000
ED1 G 4  H2O WATER SYS. ANC. FAC.
ED2 G 4  H2O 200.0 64000 .000 1 5 0 1.000 .000 1
ECRG G 5  CCM      1 0 2000 .000 7 1 .00 3 0 32 2000
ED1 G 5  CCM COMMUN. SYS. ANC. FAC.
ED2 G 5  CCM 125.0 64000 .000 1 5 0 1.000 .000 1
ECRG G 6  MREQ     1 0 2000 .000 7 1 .00 2 0 32 2000
ED1 G 6  MREQ MOBILE SUP. ANC. FAC.
ED2 G 6  MREQ 1200.0 64000 .000 1 5 0 1.000 .000 0
ECRG G 7  SHEQ     1 0 2000 .000 7 1 .00 2 0 32 2000
ED1 G 7  SHEQ EQUIP. SHOP ANC. FAC.
ED2 G 7  SHEQ 1000.0 64000 .000 1 5 0 1.000 .000 0
ECRG G 8  LAND     1 0 2000 .000 7 1 .00 5 0 32 2000
ED1 G 8  LAND LAND RIGHTS PREMINE
ED2 G 8  LAND 808.3 64000 .000 1 1 0 1.000 .000 0
ED3 G 8  LAND 0. 0. 0. 0. 0. 0. 121.24
ECRG G 9  XDRL     1 0 2000 .000 7 1 .00 5 0 32 2000
ED1 G 9  XDRL EXPL. DRILL. PREMINE
ED2 G 9  XDRL 673.5 64000 .000 1 1 0 1.000 .000 0
ECRG G10  ENG      1 0 2000 .000 7 1 .00 6 0 32 2000
ED1 G10  ENG CCNT. ENG. PREMINE
ED2 G10  ENG 6000.0 64000 .000 1 5 0 1.000 .000 0
ECRG G11  FIS      1 0 2000 .000 7 1 .00 4 0 32 2000
ED1 G11  FIS E. I. S. PREMINE
ED2 G11  FIS 1000.0 64000 .000 1 1 0 1.000 .000 0
ECRG G12  STF      1 0 2000 .000 1 12 .00 0 0 32 2000
ED1 G12  STF SUPERV. PER.
ED3 G12  STF .00 78.72
EPC1 G12  STF 24 3 78
ECRG G13  RLTX     1 0 2000 .000 7 1 .00 0 0 32 2000
ED1 G13  RLTX RDY-SEV. TAX
ED3 G13  RLTX 0. 0. 0. 0. 0. 0. 876.12
ZZZZZZZZZZZZZZZZ
    
```

SECTION 3
MODEL INPUT

3.1 GENERAL

The input to the CDM 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 Ohio, 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.	IMDCH	INCLUDE COAL LOAD AND HAUL
1.	IMDDB	INCLUDE ROCK DRILL AND BLAST
1.	IMDDL	INCLUDE OVERBURDEN REMOVAL W/ DRAGLINES
1.	IMDGA	INCLUDE GENERAL & ADMINISTRATIVE
1.	IMDLR	INCLUDE RECLAMATION
1.	IMDPP	INCLUDE PREP PLANT
0.	IMDQB	INCLUDE COAL DRILL AND BLAST
1	IPPT	PP - INDEX TO PLANT TYPE
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
260.	EDR	EFFECTIVE DUMPING RADIUS
50.	GAMB	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)
.5	HBT	HEIGHT OF TOPSOIL - FEET
58.24	HBX	HEIGHT OF OVERBURDEN IN FEET (MAXIMUM)
4.	HC	HEIGHT OF COAL IN FEET
1.3E14	PPNEE	PP - COMPLEX ENERGY DEMAND BTU/YEAR
12600.	PPNHV	PP - COAL HEAT VALUE BTU/LB
900.	RDC	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 begin with the letters LOG; they 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:

- 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.
- LOGDV - When this switch is set to 1, the model lists the primary default parameters (refer to paragraph 3.2.2).
- 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.
- 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.

- 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.)

- 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 effect 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).

Note that two parameters control the output from the overburden removal section of the CDM model. Parameter LOGSD, discussed above, controls the printing of the Dragline Statistics report. If LOGSD = 1, the dragline statistics are printed; if LOGSD = 0, the dragline data do not appear.

In addition to LOGSD, secondary default parameter LOGDL controls the remainder of the stripping operation printout. The following information is printed when LOGDL = 1:

- 1) EX and EY values after scaling
- 2) Radii, arcs, and volumes
- 3) Panel cross-section dimensions
- 4) Spoil bank cross-section coordinates
- 5) Summary report for overburden volumes, coal tonnages, stripping ratios, and days in panel
- 6) Number of sections and acres report

If LOGDL = 0, none of this output will appear in the case run.

These two LOG parameters are mutually exclusive of each other. One may be set to 1 without affecting the printout controlled by the other. By default, LOGDL = 1.

Parameter EDR sets the effective dumping radius of the dragline.

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

The three parameters HBX, HBT, and HC describe the overburden, topsoil, and coal thicknesses.

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>
63.435	ABHD	ANGLE BURDEN HIGHWALL (DEGREES)
33.689	ABSD	ANGLE BURDEN SPOILS (DEGREES)
76.	ACFD	ANGLE COAL FACE (DEGREES)
.865E6	CDRTYD	COAL DEMAND ROM TONS/YEAR
6600.	CHHDF	COAL HAUL DISTANCE IN FEET - AVERAGE
4330.	DBBPY	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
144.545	GATYB	GAA - TONS/YEAR - BASELINE
4.095E14	PBED	PP - BASE ENERGY BTU/YEAR
75E3	PBPT	PP - BASE TONS/DAY
250.	PPODY	PP - OPERATING DAYS/YEAR
.3	PRPY	POWDER RATIO - POUNDS / CU. YD.
100.	PWF	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 CDM 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 CDM and CFA models. Since the CDM 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 CDM parameter. Subject to user control, the CDM 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>CDM 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\$

<u>CDM Name</u>	<u>CFA Name</u>
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 CDM model, i.e., they define the mining situation solved by the CDM model. Parameter VCBP contains the heat content of the prepared coal in Btus/pound. It is calculated by the CDM 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 cannot 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 - 0503 (CDMD0503) SAMPLE PROBLEM FOR USER'S MANUAL
2 - 1 CONTOUR STRIPPING WITH DRAGLINES
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 - 0503 (CDMD0503) SAMPLE PROBLEM FOR USER'S MANUAL
2 - 3 OVERBURDEN REMOVAL USING DRAGLINES
3 - IMDB=0,IMDCH=0,IMDDL=1,IMDGA=0,IMDLR=0,IMOPP=0
4 - IMDB=0
5 - LOGPA=0,LOGDV=0,*
6 - 4 OVERBURDEN DRILLING AND BLASTING
7 - IMDB=1,IMDDL=0,*
8 - 5 COAL DRILLING AND BLASTING
9 - IMDB=0,IMDB=1,*
10 - 6 COAL LOAD AND HAUL
11 - IMDB=0,IMDCH=1,*
12 - 7 LAND RECLAMATION
13 - IMDCH=0,IMDLR=1,*
14 - 8 PREPARATION PLANT
15 - IMDLR=0,IMOPP=1*
16 - 9 GENERAL AND ADMINISTRATIVE
17 - IMOPP=0,IMDGA=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 removal using draglines 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 seven mining operations. Thus, the summary reports in Section 2 were developed for each operation, and that of Appendix A includes six 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.

4.2 VARIABLE-NAMING CONVENTIONS

The CDM 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 CDM 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) CDM 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 UUTFF, 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 TTFB 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 sub-routines 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, DBCD transmits CDRTY to the overburden drill and blast subroutine, and CHAC transmits ACRES 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-12. 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.

4.5 DEFAULT VALUE LISTING - APPENDIX D

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

CDM MODEL ECONOMIC SUMMARY

RUN DATE 14:33 DEC 10, '76 PAGE NO. 1.1

RUN NO. 503 TITLE (CDM00503) SAMPLE PROBLEM FOR USER'S MANUAL
CASE NO. 1 TITLE CCNTOUR STRIPPING WITH DRAGLINES

1975 DOLLARS; FINANCIAL PARAMETERS AS PER MICRO MODEL ASSUMPTIONS

NS	RAD	CHORD	G	ARC							
1.	6550.0	2720.3	23.970	2740.2							
NP	RADS	RADC	RADB	APCS	ARCC	ARCB	VOLB	RHV	TONC	CTC	
1.	6610.	6313.	6305.	2765.	2641.	2638.	.28428E 06	.00000	42257.	.00000	
2.	6506.	6213.	6203.	2722.	2599.	2595.	.37512E 06	.00000	41588.	.00000	
3.	6402.	6113.	6102.	2678.	2557.	2553.	.40210E 06	.00000	40918.	.00000	
4.	6301.	6013.	6002.	2636.	2516.	2511.	.41977E 06	.00000	40249.	.00000	
5.	6200.	5913.	5901.	2594.	2474.	2469.	.43842E 06	.00000	39580.	.00000	
6.	6098.	5813.	5800.	2551.	2432.	2426.	.46291E 06	.00000	38910.	.00000	
7.	5996.	5713.	5699.	2508.	2390.	2394.	.48684E 06	.00000	38241.	.00000	
8.	5895.	5613.	5599.	2466.	2348.	2342.	.50284E 06	.00000	37572.	.00000	
9.	5794.	5513.	5498.	2424.	2306.	2300.	.49587E 06	.00000	36902.	.00000	
10.	5694.	5413.	5398.	2382.	2265.	2258.	.48702E 06	.00000	36233.	.00000	
11.	5594.	5313.	5299.	2340.	2223.	2217.	.47444E 06	.00000	35564.	.00000	
12.	5495.	5213.	5199.	2299.	2181.	2175.	.44975E 06	.00000	34894.	.00000	
13.	5396.	5113.	5100.	2257.	2139.	2134.	.42466E 06	.00000	34225.	.00000	
14.	5297.	5013.	5000.	2216.	2097.	2092.	.39792E 06	.00000	33555.	.00000	
15.	5198.	4913.	4901.	2175.	2055.	2050.	.36370E 06	.00000	32886.	.00000	
16.	5100.	4813.	4802.	2134.	2014.	2009.	.32991E 06	.00000	32217.	.00000	

PROFILE X,Y SHORT - CAN NOT FIND HIGHWALL FOR PANEL NO. 17

CDM MODEL ECONOMIC SUMMARY

RUN DATE 14:33 DEC 10, '76 PAGE NO. 1.2

RUN NO. 503 TITLE (CCMO0503) SAMPLE PROBLEM FOR USER'S MANUAL
CASE NO. 1 TITLE CCNTOUR STRIPPING WITH DRAGLINES

1975 DOLLARS; FINANCIAL PARAMETERS AS PER MICRO MODEL ASSUMPTIONS

	EX	EY					
1	.00	.00					
2	200.00	23.46					
3	350.00	39.72					
4	650.00	47.48					
5	950.00	58.18					
6	1250.00	58.24					
7	1550.00	51.92					
8	1850.00	41.04					
	PXB	PXT	PY	PW	ASF	SA	AS
1	187.00	200.00	29.10	100.00	.9539	3747.1	3747.1
2	287.00	304.00	39.03	100.00	.9535	4978.4	5023.5
3	387.00	408.00	42.53	100.00	.9532	5373.0	5472.2
4	487.00	509.00	45.14	100.00	.9525	5703.3	5804.3
5	587.00	610.00	47.95	100.00	.9518	6003.2	6161.0
6	687.00	712.00	51.51	100.00	.9511	6512.2	6614.0
7	787.00	814.00	55.13	100.00	.9505	6943.8	7074.2
8	887.00	915.00	57.96	100.00	.9497	7386.2	7431.8
9	987.00	1016.00	58.20	100.00	.9490	7291.2	7456.6
10	1087.00	1116.00	58.22	100.00	.9481	7434.9	7452.1
11	1187.00	1216.00	57.79	100.00	.9472	7233.6	7389.4
12	1287.00	1315.00	55.83	100.00	.9462	7022.9	7131.0
13	1387.00	1414.00	53.74	100.00	.9451	6746.6	6856.8
14	1487.00	1513.00	51.36	100.00	.9440	6381.1	6545.1
15	1587.00	1612.00	47.89	100.00	.9429	5930.8	6096.3
16	1687.00	1710.00	44.34	100.00	.9416	5567.2	5636.1
17	1787.00	1808.00	.00	.00	.0000	.0	.0
	SX	SY					
1	14.97	.00					
2	-60.00	49.98					
3	-134.97	.00					
4	135.97	.00					
5	44.00	61.31					
6	-16.50	20.98					
7	247.96	.00					
8	148.00	66.64					
9	92.00	29.31					
10	355.46	.00					
11	249.00	70.97					
12	195.25	35.14					
13	461.46	.00					
14	350.00	74.30					
15	297.00	38.97					
16	569.45	.00					
17	452.00	78.30					
18	398.00	42.30					
19	677.45	.00					

20	554.00	82.30
21	500.00	46.30
22	784.94	.00
23	655.00	86.63
24	601.25	50.80
25	887.94	.00
26	756.00	87.56
27	704.50	53.63
28	990.44	.00
29	856.00	89.62
30	804.75	55.46
31	1089.93	.00
32	956.00	89.28
33	906.25	56.12
34	1187.43	.00
35	1055.00	88.28
36	1006.25	55.78
37	1283.42	.00
38	1154.00	86.28
39	1106.00	54.28
40	1377.92	.00
41	1253.00	83.28
42	1205.75	51.78
43	1470.92	.00
44	1352.00	79.27
45	1305.50	48.28
46	1563.41	.00
47	1450.00	75.60
48	1403.75	44.77

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RUN NO. 503 TITLE (CCMC0503) SAMPLE PROBLEM FOR USER'S MANUAL
 CASE NO. 1 TITLE CNTCUR STRIPPING WITH DRAGLINES

1975 DOLLARS; FINANCIAL PARAMETERS AS PER MICRO MODEL ASSUMPTIONS

***** WITH REHANDLE *****

NSEC	YS	NDL	ACRES	TOTC				
47.359	.633	1.000	4490.29	.259590E 08				
#	YRS	TCL	ACR	TCR	OAO	\$/A		\$/T
1.	30.000	.237502E 08	.137529E 07	.412587E 08	.650090E 08	14477.7		2.50430

DRAGLINE STATISTICS

SA	SB	SW	RMA	X	ST	PE
307.0	30.0	43.0	265.7	12.543	5011.0	3168.0
CA	CI	CM	CN	CD		
6132.	7533.	71.98	47.99	22.81		
CL	CR	TCL	ACR	TCR		
106.023	184.182	.237502E 08	.137529E 07	.412587E 08		

RUN NO. 503 TITLE (COMC0503) SAMPLE PROBLEM FOR USER'S MANUAL
CASE NO. 1 TITLE CNTCUR STRIPPING WITH DRAGLINES

1975 DOLLARS; FINANCIAL PARAMETERS AS PER MICRO MODEL ASSUMPTIONS

I IMOCH	1	INCLUDE COAL LOAD AND HAUL
I IMOGB	1	INCLUDE ROCK DRILL AND BLAST
I IMODL	1	INCLUDE OVERBURDEN REMOVAL W/ DRAGLINES
I IMOGA	1	INCLUDE GENERAL & ADMINISTRATIVE
I IMOLR	1	INCLUDE RECLAMATION
I IMOPP	1	INCLUDE PREP PLANT
I IMQGB	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	PPRINTS REGRESS. DATA FILE IF 1
I LOGSD	1	WRITES SPECIFICATION DATA IF 1
I LOGSM	1	WRITES ECONOMIC SUMMARY IF ONE
I ED2	260.000	EFFECTIVE DUMPING RADIUS
I GAMR	50.0000	GAA - MINERAL RIGHTS (\$/ACRE)
I GARA	.250000	GAA - ROYALTY AMOUNT (\$/TON)
I GASR	250.000	GAA - SURFACE RIGHTS (\$/ACRE)
I GAST	.000000	GAA - SEVERANCE TAX (\$/TON)
I GAUP	.110000	GAA - UNION PAYMENT (\$/TON)
I H3T	.500000	HEIGHT OF TOPSOIL - FEET
I HBX	58.2400	HEIGHT OF OVERBURDEN IN FEET (MAXIMUM)
I HC	4.00000	HEIGHT OF COAL IN FEET
I PPNED	.130000E 15	PP - COMPLEX ENERGY DEMAND BTU/YEAR
I PPNHV	12600.0	PP - CCAL HEAT VALUE BTU/LB
I RQC	900.000	RECLAMATION - OTHER COSTS - \$/ACRE
D ARHD	63.4350	ANGLE BURDEN HIGHWALL (DEGREES)
D A3SD	33.6890	ANGLE BURDEN SPOILS (DEGREES)
D ACFD	76.0000	ANGLE COAL FACE (DEGREES)
D CDRTYD	865000.	CCAL DEMAND ROM TONS/YEAR
D CHHDF	6600.00	CCAL HAUL DISTANCE IN FEET - AVERAGE
D DBBPY	4330.00	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	144.545	GAA - TCNS/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 SFB	.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

CDM MODEL ECONOMIC SUMMARY

RUN DATE 14:33 DEC 10, '76 PAGE NO. 1.6

RUN NO. 503 TITLE (CCM00503) SAMPLE PROBLEM FOR USER'S MANUAL
 CASE NO. 1 TITLE CONTOUR STRIPPING WITH DRAGLINES

1975 DOLLARS; FINANCIAL PARAMETERS AS PER MICRO MODEL ASSUMPTIONS

C NPITS	6	NC. OF PITS
C ACRES	449C.29	ACRES
C BPBY	.1C7277E 08	OVERBURDEN PRODUCTION YARDS/YEAR
C CDRTY	8653C0.	CCAL DEMAND RCM TONS/YEAR/PIT
C CDRTYX	.51918CE C7	CCMPLEX COAL DEMAND RCM TONS/YEAR
C CDRYY	801203.	COAL DEMAND FOR CLH IN REC. YARDS / YEAR
C COTA	.5C0CC1	COTANGENT ABHD
C COTB	.249230	COTANGENT ACFD
C COTT	1.50C06	CCTANGENT ABSD
C CRTAF	16C3.01	CCAL REC. TONS/ARCE-FOOT
C HBA	49.2734	HEIGHT OF OVERRURDEN IN FEET - AVERAGE
C PPFHV	12645.4	PP - FINAL HEAT VALUE
C PPFTY	.513988E C7	PP - FINISHED COAL TONS/YEAR
C PPHF	1.00360	PP - HEAT VALUE FACTOR FOR IPPT
C PPHV	1099C.0	PP - BASE HEAT VALUE FOR IPPT
C PPNS	20767.2	PP - CCMPLEX SIZE TONS/DAY
C PPSF	.99C0C0	PP - SIZE FACTOR FOR IPPT
C SRYT	12.3977	STRIPPING RATIO YARDS/TONS
C V8BY	.321832E 09	VOL. OVERRURDEN BANK YARDS
C VCBY	.261262E C8	VCL. CCAL BANK YARDS
C VCRT	.25955CE C8	VOL. COAL RCM TONS

CDM MODEL ECONOMIC SUMMARY RUN DATE 14:33 DEC 10, '76 PAGE NO. 1.7

RUN NO. 503 TITLE (CCM00503) SAMPLE PROBLEM FOR USER'S MANUAL
 CASE NO. 1 TITLE CCNTCUR STRIPPING WITH DRAGLINES

1975 DOLLARS; FINANCIAL PARAMETERS AS PER MICRO MODEL ASSUMPTIONS

OVERBURDEN DRILL AND BLAST STATISTICS

DRILL	QT	SH	CG	CP	CN	REF.#			
.598	1	15.000	440.8	33.04	46.55	16			
RD OWN	RD OPER	#SP	SP OWN	EX TOT	RD \$/T	EX \$/T			
.32343E 07	.27241E 07	0	.00000	.13808E 08	.22953	.53190			

CCAL DRILLING AND BLASTING STATISTICS

DRILL	QT	SH	CG	CP	CN	REF.#			
.260	1	3.000	37.3	3.30	17.46	23			
QD OWN	QC OPER	#SP	SP OWN	EX TOT	QD \$/T	EX \$/T			
.16157E 06	.22191E 06	0	.00000	.12979E 07	.14772E-01	.50000E-01			

COAL LOAD AND HAUL STATISTICS

SHOVEL	QT	ST	SW	CA	CG	CP	CN	REF.#	
.582	1	425	12.0	688.0	763.4	20.77	46.79	31	
TRUCK	QT	SC	SL	DT	CA	CG	CP	CN	REF.#
3.750	4	1000	300	E	317.6	292.6	21.94	55.01	53
SD OWN	SC OPER	TD OWN	TD OPER	SPARE OWN	#SP	\$/TON			
.10163E 07	.22854E 07	.42941E 07	.10093E 08	.32206E 07	3	.752			

LAND RECLAMATION STATISTICS

SCRAPER	QT	SA	SR	CG	CP	CN	REF.#			
.660	1	32	415	201.1	22.26	38.21	6			
DOZER	QT	SK	CG	CP	CN	REF.#				
1.694	2	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\$	
.11119E 07	.12597E 07	0	.00000	.21279E 07	.26391E 07	1	.10639E 07	.89806E 06	.44903E 06	

CDM MODEL ECONOMIC SUMMARY RUN DATE 14:33 DEC 10, '76 PAGE NO. 1.8

RUN NO. 503 TITLE (CDMC0503) SAMPLE PROBLEM FOR USER'S MANUAL
CASE NO. 1 TITLE CONTOUR STRIPPING WITH DRAGLINES

1975 DOLLARS; FINANCIAL PARAMETERS AS PER MICRC MODEL ASSUMPTIONS

PREPARATION PLANT STATISTICS

TYPE	SIZE TONS/DAY	DELIVERED COAL		
		BTU/LB	TCNS/YEAR	BTU/YEAR
1	20767.2	12645.4	.513988E 07	.130000E 15

		UNIT INVESTMENT	LABOR \$/HOUR	OWNERSHIP \$/HOUR	OPERATING \$/HOUR	O&O \$/TON
REC & BREAK	PREP. PLANT	.789216E 07	89.62	230.08	249.72	.335
BLEND-STOCK	PREP. PLANT	.300564E 08	137.50	584.03	409.00	1.040
COAL LOADOUT	PREP. PLANT	996824.	72.75	12.09	123.30	.251
CRUSH-SCREEN	PREP. PLANT	.423644E 07	103.25	82.32	204.31	.300
CS SUPPORT	PREP. PLANT	.738251E 07	187.13	390.04	541.64	.359
						.505653E 08
						2.285

GENERAL & ADMINISTRATIVE COSTS

		UNIT INVESTMENT	OWNERSHIP \$/HOUR	OPERATING \$/HOUR	O&O \$/TON
ROADS & SITE	ANC. FAC.	.300000E 07	155.16	.00	.064
BUILDINGS	ANC. FAC.	.489275E 07	253.10	32.60	.117
ELECT. SYS.	ANC. FAC.	.450000E 07	232.73	.00	.096
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	.026
EQUIP. SHDP	ANC. FAC.	.100000E 07	51.72	.00	.021
LAND RIGHTS	PREMINE	808251.	41.80	121.24	.067
EXPL. DRILL	PREMINE	673542.	34.83	.00	.014
CONT. ENG.	PREMINE	.600000E 07	310.31	.00	.128
E. I. S.	PREMINE	.100000E 07	51.72	.00	.021
SUPERV. PER.		.000000	.00	776.82	.319
ROY-SEV. TAX		.000000	.00	876.12	.360
		.234005E 08	1210.24	1806.77	1.240

TOTAL MM TONS/YEAR 144.545
TOTAL ACRES DISTURBED 26941.7

CDM MODEL ECCNOMIC SUMMARY

RUN DATE 14:33 DEC 10, '76 PAGE NO. 1.9

RUN NO. 503 TITLE (CDMCC503) SAMPLE PROBLEM FOR USER'S MANUAL
CASE NO. 1 TITLE CCNTOUR STRIPPING WITH DRAGLINES

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.	.367288E 07	.129592E 09	.832	.840
	SUPPORT EQUIP.	.124620E 07	374038.	879531.	.376070E 08	.241	.244
6	DRAGLINES	.451986E 08	.477598E 07	.825174E 07	.390831E 09	2.509	2.535
	SUPPORT EQUIP.	.154980E 07	534991.	.184891E 07	.715171E 08	.459	.464
6	COAL POTARY DRILLS	223800.	35206.4	430558.	.139729E 08	.090	.091
6	SHOVELS, 27 TRUCKS	.124806E 08	.169623E 07	.249879E 07	.125851E 09	.808	.816
	SUPPORT EQUIP.	.202620E 07	374591.	.115346E 07	.458414E 08	.294	.297
12	DOZERS, 4 SCRAPERS	.311440E 07	680379.	.114687E 07	.548175E 08	.352	.356
3	PR. PLANT TYPE 1	.505653E 08	.534306E 07	.639779E 07	.352226E 09	2.261	2.284
	GENERAL & ADMIN.	.234005E 08	.242049E 07	.361354E 07	.193089E 09	1.240	1.252
	PROJECT TOTALS	.142226E 09	.168466E 08	.294635E 08	.140137E 10		
	TONS DELIVERED =	.154156E 09	COST = 9.08822			\$/TON	
	BTUS DELIVERED =	.390000E 16	COST = .359326			\$/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 / 12600 * 75000
= 20767.2

CDRTYX = PPNS * PPODY = 20767.2 * 250 = .519180E7

PPFTY = CDRTYX * PPSF = .519180E7 * .99 = .513988E7

PPFHV = PPNHV * PPHF = 12600 * 1.0036 = 12645.4

PPCRCP = PPFTY / 1000 = .513988E4

TOTAL PROJECT TONS AND BTU'S

XRT = CDRTYX * TMY = .539139E7 * 30 = .155754E9

XTT = PPFTY * TMY = .539688E7 * 30 = .154196E9

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.

$$\begin{aligned} \text{NPITS} &= \text{INT}(\text{CDRTYX} / \text{CDRTYD} / 2 + .8) * 2 \\ &= \text{INT}(.519180\text{E}7 / .865\text{E}6 / 2 + .8) * 2 = 6 \end{aligned}$$

$$\text{CDRTY} = \text{CDRTYX} / \text{NPITS} = .519180\text{E}7 / 6 = .8653\text{E}6$$

$$\text{VCRT} = \text{CDRTY} * \text{TMY} = .8653\text{E}6 * 30 = .259590\text{E}8$$

$$\begin{aligned} \text{VCBY} &= \text{VCRT} / \text{ECR} / (\text{DCBPY} / 2000) \\ &= .259590\text{E}8 / .92 / (2160 / 2000) = .261262\text{E}8 \end{aligned}$$

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

3. OVERBURDEN REMOVAL WITH DRAGLINES

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

DLCRLC = TMY = 30
DLNP = NPITS = 6
DLPWF = PWF = 100
DLABHD = ABHD = 63.43
DLABSD = ABSD = 33.69
DLACFD = ACFD = 76.
DLCD = CDRTY = 865300
DLECR = ECR = .92
DLHBX = HBX = 58.24
DLHC = HC = 4
DLCOTA = COTA = .5
DLDB = DBBPY = 4330.
DLDC = DCBPY = 2160.
DLTANT = TANT = .6666
DLSFB = SFB = .35
IMODLC = IMODL = 1

IF THE USER WISHES TO SPECIFY THE DRAGLINE EFFECTIVE DUMPING RADIUS, HE SETS EDR = NON-ZERO VALUE. OTHERWISE, EDR IS CALCULATED AS FOLLOWS:

$$\begin{aligned} \text{EDR} &= 3. + \text{HC} * \text{CCTB} + \text{HBX} * (1. + \text{SFB}) * \text{COTT} \\ &\quad + \text{HBX} * \text{COTA} + .25 * \text{PWF} \\ &= 3. + 4. * .25 + 58.24 * (1. + .35) * 1.5 \\ &\quad + 58.24 * .5 + .25 * 100. \\ &= 176.06 \end{aligned}$$

FOR THIS PROBLEM EDR = 260.

BECAUSE OF THE COMPLEXITY OF THE ALGEBRAIC EQUATIONS IN THE DRAGLINE SUBROUTINE USED TO CALCULATE RADII, VOLUMES, AND CROSS-SECTIONAL DATA, NO ATTEMPT WILL BE MADE TO DOCUMENT THEM IN THIS FORMAT. A FAIRLY DETAILED DESCRIPTION OF THESE CALCULATIONS CAN BE FOUND IN THE TEXT OF THIS MANUAL. IF ADDITIONAL INFORMATION IS NEEDED, THE USER WILL BE FORCED TO REFER TO THE FORTRAN CODING FOR THIS PORTION OF THE SUBROUTINE.

THE MODEL PRINTS DETAIL INFORMATION ABOUT RADII, VOLUMES, CROSS-SECTION COORDINATES, AND A PANEL-BY-PANEL SUMMARY OF COAL AND OVERBURDEN VOLUMES, STRIPPING RATIOS,

AND DAYS TO STRIP EACH PANEL. THE MODEL PROCEEDS WITH
DRAGLINE SIZING.

AVERAGE OVERBURDEN HEIGHT AND OVERBURDEN PRODUCTION
DEMAND ARE CALCULATED BASED ON COAL DEMAND AND THE WEIGHTED
AVERAGE STRIPPING RATIO FOR PANELS. TOTAL OVERBURDEN VOLUME
IS CALCULATED.

$$\begin{aligned} \text{HBA} &= \text{SRYT} * \text{HC} * \text{ECR} * (\text{DCBPY} / 2000) \\ &= 12.4 * 4 * .92 * (2160 / 2000) \\ &= 49.27 \\ \text{BPBY} &= \text{DLCC} * \text{SRYT} = 865300 * 12.4 = .107277\text{E}8 \\ \text{VBBY} &= \text{BPBY} * \text{TMY} \end{aligned}$$

THE DRAGLINE BUCKET IS SIZED BASED ON THE OVERBURDEN
PRODUCTION DEMAND AND STRIPPING OPERATION EFFICIENCY
FACTORS.

$$\begin{aligned} \text{DLSW} &= \text{BPBY} / \text{FFP} / \text{CPH} / \text{PTF} / \text{ESD} * (1 + \text{DLSFB}) / \text{DLCROH} \\ &= .107277\text{E}8 / .95 / 60. / .95 / .8333 * 1.35 / 7467 \\ &= 43. \end{aligned}$$

THE NUMBER OF SECTIONS IN THE OPERATING PIT IS CAL-
CULATED USING THE TOTAL COAL RECOVERED FROM THE SECTION
AND THE COAL DEMAND.

$$\text{NSEC} = \text{DLCD} * \text{TMY} / \text{TUNC} = 865300 * 30 / 548127 = 47.359$$

TOTAL ACRES IN THE OPERATING PIT ARE CALCULATED USING
THE ARC LENGTHS OF EACH PANEL AND THE PANEL WIDTH.

$$\begin{aligned} \text{FOR } I &= 1, 16 \text{ WHERE } 16 \text{ IS THE LAST PANEL IN THE SECTION} \\ \text{ACRES} &= \text{SUMMATION} (\text{ARC}(I) * \text{PWF}) / 43560 * \text{NSEC} \\ &= 4130092 / 43560 * 47359 \\ &= 4490.29 \end{aligned}$$

THE OPERATING YEARS REQUIRED TO STRIP EACH SECTION
IS CALCULATED USING THE TOTAL DAYS IN THE PANELS AND THE
DRAGLINE SCHEDULE.

$$\text{YS} = \text{DAYS} / 365 = 231.2 / 365 = .633$$

THE REMAINING DRAGLINE DATA ARE CALCULATED USING
CORRELATION EQUATIONS. THE EQUATIONS WERE BASED ON THE
DRAGLINE DATA FILE ASSUMPTIONS FOR OVERBURDEN DENSITY

AND SWELL FACTOR. THE BUCKET SIZE, DLSW, IS ADJUSTED TO YIELD THE PROPER BUCKET SIZE, DBSW, TO MATCH THE DATA BOOK VALUE.

$$\begin{aligned} \text{DBSW} &= \text{DLSW} * (2000 + \text{DLDB} / (1 + \text{DLSFB})) / 4740.74 \\ &= 43. * (2000 + 4330 / 1.35) / 4740.74 \\ &= 47.23 \end{aligned}$$

THE VALUE EDR AS SPECIFIED BY THE USER, FOUND AS DEFAULT, OR CALCULATED IN THE MAIN PROGRAM ASSUMES THE BOOM FOOT IS A SAFE WORKING DISTANCE FROM THE HIGHWALL, WHEREAS, IN PRACTICE, THE OUTSIDE OF THE SHOES SHOULD BE A SAFE WORKING DISTANCE FROM THE EDGE OF THE HIGHWALL. THE MODEL USES AN ITERATIVE PROCEDURE TO FIND THE RMA FOR THE DRAGLINE THAT WILL HAVE THE REQUIRED EFFECTIVE RADIUS.

THE FOLLOWING RELATIONS ARE SOLVED IN THIS PROCEDURE.

$$\begin{aligned} \text{DLRMA} &= 1.2 * \text{EDR} \\ \text{DLX} &= \text{DLRMA} * \text{DBSW} / 1000 \\ \text{DLSH} &= 2.69 + 1.1156 * \text{DLRMA} \\ \text{DLSJ} &= 36.745 * \text{DLX} ** 0.3053 \\ \text{DLSE} &= \text{DLSH} - \text{DLRMA} \\ \text{CDR} &= \text{DLRMA} + \text{DLSE} - \text{DLSJ} / 2 \end{aligned}$$

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 EDR. AT THE END OF THE ITERATIONS,

$$\text{DLRMA} = 265.7$$

THE FOLLOWING REGRESSION EQUATIONS DETERMINE THE DRAGLINE SPECIFICATIONS AND COSTS.

$$\begin{aligned} \text{DLX} &= \text{DLRMA} * \text{DBSW} / 1000 = 265.7 * 47.23 / 1000 \\ &= 12.543 \end{aligned}$$

$$\begin{aligned} \text{DLSA} &= \text{INT}(\text{DLRMA} / \text{COS DLSB} + .9) = \text{INT}(265.7 / \text{COS } 30 + .9) \\ &= 307 \end{aligned}$$

$$\begin{aligned} \text{DLST} &= \text{INT}(729.5 + 341.44 * \text{DLX} + .9) \\ &= \text{INT}(729.5 + 341.44 * 12.543 + .9) \\ &= 5011. \end{aligned}$$

$$\begin{aligned} \text{DLPE} &= \text{INT}(642 + 201.4 * \text{DLX} + .9) \\ &= \text{INT}(642 + 201.4 * 12.543 + .9) \\ &= 3168. \end{aligned}$$

$$\begin{aligned} \text{DLCO} &= \text{DLPE} * \text{DLFDP} * \text{DLCEL} = 3168. * .72 * .01 \\ &= 22.81 \end{aligned}$$

$$\begin{aligned} \text{DLCA} &= 981.71 + 410.6 * \text{DLX} = 981.71 + 410.6 * 12.543 \\ &= 6132. \end{aligned}$$

$$\begin{aligned} \text{DLCI} &= -37.54 + 1.23468 * \text{DLCA} = -37.54 + 1.23468 * 12805.75 \\ &= 7533. \end{aligned}$$

$$\begin{aligned} \text{DLCM} &= 14.5 + 4.583 * \text{DLX} = 14.5 + 4.583 * 12.543 \\ &= 71.98 \end{aligned}$$

$$\begin{aligned} \text{DLCN} &= 9.67 + 3.055 * \text{DLX} = 9.67 + 3.055 * 12.543 \\ &= 47.99 \end{aligned}$$

$$\begin{aligned} \text{DLCL} &= 17.695 + 7.0423 * \text{DLX} = 17.695 + 7.0423 * 12.543 \\ &= 106.02 \end{aligned}$$

$$\begin{aligned} \text{DLCR} &= 61.962 + 9.7445 * \text{DLX} = 61.962 + 9.7445 * 12.543 \\ &= 184.18 \end{aligned}$$

$$\begin{aligned} \text{DLTCL} &= \text{DLCL} * \text{DLCRCH} * \text{DLCRLO} \\ &= 106.02 * 7467 * 30 \\ &= .237502\text{E}8 \end{aligned}$$

$$\begin{aligned} \text{DLACR} &= \text{DLCR} * \text{DLCROH} = 184.18 * 7467 \\ &= .137529\text{E}7 \end{aligned}$$

$$\begin{aligned} \text{DLTCR} &= \text{DLACR} * \text{DLCRLO} = .137529\text{E}7 * 30 \\ &= .412587\text{E}8 \end{aligned}$$

$$\begin{aligned} \text{DLQAO} &= \text{DLTCL} + \text{DLTCR} = .237502\text{E}8 + .412587\text{E}8 \\ &= .650090\text{E}8 \end{aligned}$$

$$\text{DLDA} = \text{DLQAO} / \text{ACRES} = .650090\text{E}8 / 4490.29 = 14477.7$$

$$\text{DLDT} = \text{DLQAO} / \text{TUNC} = .650090\text{E}8 / .259590\text{E}8 = 2.50430$$

THE MODEL PRINTS A COST SUMMARY FOR THE OPERATING PIT. THE FIRST LINE PRINTS,

NSEC, YS, "1", ACRES, TOTC

THE SECOND LINE PRINTS,

"1", TMY, DLTCL, DLACR, DLTCR, DLQAO, DLDA, DLDT

THE MODEL PRINT THE DRAGLINE SPECIFICATION DATA. THE FIRST DETAIL LINE PRINTS,

DLSA, DLSB, CLSW, DLRMA, DLX, DLST, DLPE

THE SECOND DETAIL LINE PRINTS,

DLCA, DLCI, DCLM, DLCN, DLCO

THE THIRD DETAIL LINE PRINTS,

DLCL, DLGR, DLTCL, DLACR, DLTCR

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

$DLGRQT = DLNP = 6$

$DLGRCP = BPEY * DLNP / 1000 = .107277E8 * 6 / 1000$
 $= 64366.4$

$DLGRNY = DLNP / 2 = 6 / 2 = 3$

$DLD2UI = DLCI = 7533.09$

$DLD2DH = DLCROH * DLDY = 7467 * 30 = 224010$

$DLD3ML = DLCN = 47.99$

$DLD3MM = DCLM = 71.98$

$DLD3EL = DLCO = 22.81$

DLOIQ2 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.

$O2CRQT = DLNP = 6$

$O2CROH = DLCROH = 7467$

$O2CRSY = DLCSY = 7$

$O2CRNY = DLGRNY = 3$

$O2CRSH = DLGRSH = 8297$

$O6CRQT = DLNP = 3$

$O3CROH = DLCROH * .318 = 2374$

$O3CRSY = DLCSY = 7$

$O3CRNY = DLGRNY = 3$

$O3CRSH = DLGRSH * .318 = 2638$

THE DRAGLINE SUMMARY COST ELEMENTS ARE CALCULATED
AND PRINTED.

$DLII = DLGRQT * DLD2UI * 1000 = 6 * 7533.09 * 1000$
 $= .451986E8$

$DLAIC = DLII * (1 + .07 * (1 + DLDY)) / DLDY$

$$= .451986E8 * (1 + .07 * (1 + 30)) / 30$$
$$= .477598E7$$

$$DLAOC = DLCRGT * DLACR = 6 * .137529E7$$
$$= .825174E7$$

$$DLPT = (DLAIC + DLAOC) * DLCRLO$$
$$= (.477598E7 + .825174E7) * 30$$
$$= .390831E9$$

$$DRT = DLPT / XRT = .390831E9 / .155754E9$$
$$= 2.509$$

$$DFT = DLPT / XTT = .390831E9 / .154196E9$$
$$= 2.535$$

THE SUMMARY LINE PRINTS,
DLNP, DL11, DLAIC, DLAOC, DLPT, DRT, DFT

THE SUPPORT EQUIPMENT SUMMARY DATA ARE CALCULATED AND
PRINTED USING THE ABOVE EQUATIONS.

4. OVERBURDEN DRILLING AND BLASTING

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

BLCRLC = TMY = 30
 RDCRLO = TMY = 30
 DBNP = NPITS = 6
 DBCD = CDRTY = .8653E6
 DBHB = HBA = 49.27
 DBCR = CRSMFH = 100
 DBBD = BPBY = .107277E8
 DBPRPY = PRPY = .3
 DBHC = HC = 4

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

	PARAMETER VALUES
RNORD = 5.60855 / HC	4
* DBCD / 1E6	.8653E6
* DBHB	49.27
/ DBCR	100
= .598	
INORD = INT(RNORD + .9) = INT(.598 + .9)	
= 1	
INOSRD = 0	
DBRDTI = INCRD * RDCRLO * KDCROH * RDCP	
= 1 * 30 * 3263 * 33.04	
= .32343E7	
DBRDTO = RNORD * RDCRLO * KDCROH * RDCN	
= .598 * 30 * 3263 * 46.55	
= .27241E7	
DBRDFI = INOSRD * RDCRLO * KDCROH * RDCP	
= 0	
RDDT = (DBRDTI + DBRDTO + DBRDFI) / (DBCD * RDCRLO)	
= (.32343E7 + .27241E7 + 0) / (.8653E6 * 30)	
= .2486	

A REGRESSION EQUATION DETERMINES EXPLOSIVES COSTS.

PARAMETER VALUES

DBTEC = 111 * 109.22 / HC 4
 * DBCD / 1E6 .8653E6
 * DBHB 49.27
 * DBPRPY .3
 = 460.11

DBTEC = DBTEC * BLCRLO * 1000 = 460.11 * 30 * 1000
 = .13808E8

ECDT = DBTEC / DBCD / BLCRLO = .13808E8 / .8653E6 / 30
 = .5319

CFA EQUIPMENT DATA CARD FIELDS ARE SETUP FOR PRIMARY EQUIPMENT.

RDCRQT = INGRD * DBNP = 1 * 6 = 6
 RDCRFS = INC SRD = 0
 RDCRCP = BPBY * DBNP / 1000 = .107277E8 * 6 / 1000
 = 64366.4
 RDCRNY = CBNP / 2 = 6 / 2 = 3
 RDD2UI = RDCG = 440.8
 RDD2DH = RDP7 = 20000
 RDD3MM = RDCR = 10.14
 RDD3ML = RDCJ = 6.76
 RDD3EL = RDCCK = 2.87
 RDD3OT = RDCM = 7.04
 BLCRCP = RDCRCP = 64366.4
 BLCRNY = CBNP / 2 = 6 / 2 = 3
 BLCROH = RDCROH / 2 = 3263 / 2 = 1631
 BLCRSH = RDCRSH / 2 = 3625 / 2 = 1813
 BLD3OT = DBTEC / BLCRCH / BLCRLO
 = .13808E8 / 1631 / 30
 = 282.19

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

D3CRQT = DBNP = 3
 D3CROH = RDCROH = 3263
 D3CRSY = RDCRSY = 7
 D3CRNY = DBNP / 2 = 6 / 2 = 3
 D3CRSH = RDCRSH = 3625

 D4CRQT = DBNP = 6
 D4CROH = BLCROH = 1631
 D4CRSY = RDCRSY = 7
 D4CRNY = DBNP / 2 = 6 / 2 = 3

D4CRSH = BLCRSH = 1813

D5CRQT = DBNP = 6

D5CROH = BLCROH = 1631

D5CRSY = RDCRSY = 7

D5CRNY = DBNP / 2 = 6 / 2 = 3

D5CRSH = BLCRSH = 1813

FIRST DETAIL LINE PRINTS,
RNURD, INCRD, RDSH, RDCG, RDCP, RDCN, RDRN

SECCND DETAIL LINE PRINTS,
DBRDTI, DBRCTD, INUSRD, 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

DBAUC = RDCN * RDCROH * RDCRQT + BLD3OT * BLCROH * BLCRQT
= 46.55 * 3263 * 6 + 282.19 * 1631 * 6
= .367288E7

DBPT = (DBAIC + DBAUC) * RDCRLO = (.646839E6 + .367288E7) * 30
= .129592E9

DRT = DBPT / XRT = .129592E9 / .155754E9
= .832

DFT = DBPT / XTT = .129592E9 / .154196E9
= .840

RDTNC = RDCRQT + RDCRFS = 6 + 0 = 6

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

SUPPORT EQUIPMENT SUMMARY DATA ARE CALCULATED AND

PRINTED.

$$\begin{aligned} DSECI1 &= (D3CRQT * D3D2UI + D4CRQT * D4D2UI + D5CRQT * D5D2UI) \\ &\quad * 1000 \\ &= (6 * 135.3 + 6 * 36.4 + 6 * 39) * 1000 \\ &= .124620E7 \end{aligned}$$

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

$$\begin{aligned} D3AIC &= D3D2UI * 1000 * (1 + .07 * (1 + D3DY)) / D3DY * D3CRQT \\ &= 135.3 * 1000 * (1 + .07 * (1 + 3.678)) / 3.678 * 6 \\ &= 293019.8 \end{aligned}$$

$$\begin{aligned} D3AOC &= D3CN * D3CROH * D3CRQT = 26.86 * 3263 * 6 \\ &= .525865E6 \end{aligned}$$

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

$$\begin{aligned} D4AIC &= D4D2UI * 1000 * (1 + .07 * (1 + D4DY)) / D4DY * D4CRQT \\ &= 36.4 * 1000 * (1 + .07 * (1 + 7.357)) / 7.357 * 6 \\ &= 47050 \end{aligned}$$

$$\begin{aligned} D4AOC &= D4CN * D4CROH * D4CRQT \\ &= 21.51 * 1631 * 6 \\ &= .210496E6 \end{aligned}$$

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

$$\begin{aligned} D5AIC &= D5D2UI * 1000 * (1 + .07 * (1 + D5DY)) / D5DY * D5CRQT \\ &= 36 * 1000 * (1 + .07 * (1 + 12.262)) / 12.262 * 6 \\ &= 33967.8 \end{aligned}$$

$$\begin{aligned} D5AOC &= D5CN * D5CROH * D5CRQT = 14.63 * 1631 * 6 \\ &= .143169E6 \end{aligned}$$

$$\begin{aligned} DSEAIC &= D3AIC + D4AIC + D5AIC \\ &= 293019.8 + 47050 + 33967.8 \\ &= 374037.6 \end{aligned}$$

$$\begin{aligned} DSEAOC &= D3AOC + D4AOC + D5AOC \\ &= 525865 + 210496 + 143169 \\ &= 879531 \end{aligned}$$

$$\begin{aligned} DSEPT &= (DSEAIC + DSEAOC) * RDCRLG \\ &= (374037.6 + 879531) * 30 \\ &= .376070E8 \end{aligned}$$

$$\begin{aligned} DRT &= DSEPT / XRT = .376070E8 / .155754E9 \\ &= .241 \end{aligned}$$

DFT = DSEPT / XTT = .376070E8 / .154196E9
= .244

SUPPORT SUMMARY LINE PRINTS,
DSEC11, DSEAIC, DSEAOC, DSEPT, DRT, DFT

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 = 6
QBCD = CURTY = .8653E6
QBHB = HBX = 58.24
QBDR = DRSMFH = 100
QDCRCP = CDRTY / DCBPY / 2000 / ECR / 1000. * NPITS
        = 865300 / 2160 * 2000 / .92 / 1000. * 6
        = 5225.24
QBHC = HC = 4
```

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

```
RNCQD = .3 * QBCD / 1E6 * 1632 / QDCRQH
      = .3 * .8653E6 / 1E6 * 1632 / 1632
      = .260
```

```
INOQD = INT(RNCQD + .9) = INT(.260 + .9)
      = 1
```

```
INCSQD = 0
```

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

```
QBQDTC = RNCQD * QDCRLO * QDCRQH * QDCN
      = .260 * 30 * 1632 * 46.55
      = .22191E6
```

```
QBQDFI = INCSQD * QDCRLO * QDCRQH * QDCP
      = 0
```

```
QDDT = (QBQDTI + QBQDTC + QBQDFI) / (QBCD * QDCRLO)
      = (.161568E6 + .22191E6 + 0) / (.8653E6 * 30)
      = .0148
```

A REGRESSION EQUATION DETERMINES EXPLOSIVES COSTS.

```
QBTEC = .05 * QBCD * QLCRLO
      = .05 * .8653E6 * 30
```

$$= .12979E7$$

$$\begin{aligned} \text{ECDT} &= \text{QBTEC} / \text{QBOD} / \text{QLCRLO} = .12979E6 / .8653E6 / 30 \\ &= .05 \end{aligned}$$

CFA EQUIPMENT DATA CARD FIELDS ARE SETUP FOR PRIMARY EQUIPMENT.

$$\begin{aligned} \text{QDCRQT} &= \text{INGCD} * \text{QBNP} = 1 * 6 = 6 \\ \text{QDCRFS} &= \text{INOSQD} = 0 \\ \text{QDCRNY} &= \text{QBNP} / 2 = 6 / 2 = 3 \\ \text{QDD2UI} &= \text{QDCG} = 37.3 \\ \text{QDD2DH} &= \text{QDP7} = 20000 \\ \text{QDD3MM} &= \text{QDCR} = 1.02 \\ \text{QDD3ML} &= \text{QDCJ} = .68 \\ \text{QDD3EL} &= \text{QDCK} = .90 \\ \text{QDD3OT} &= \text{QDCM} = 3.60 \\ \text{QLCRCP} &= \text{QDCRCP} = 5225.24 \\ \text{QLCRNY} &= \text{QBNP} = 3 \\ \text{QLD3OT} &= \text{QBTEC} / \text{QLCRCH} / \text{QLCRLO} \\ &= .12979E6 / 1632 / 30 \\ &= 26.51 \end{aligned}$$

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

$$\begin{aligned} \text{Q5CRQT} &= \text{QBNP} = 6 \\ \text{Q5CROH} &= \text{QDCROH} = 1632 \\ \text{Q5CRSY} &= \text{QDCRSY} = 7 \\ \text{Q5CRNY} &= \text{QBNP} / 2 = 6 / 2 = 3 \\ \text{Q5CRSH} &= \text{QDCRSH} = 1813 \end{aligned}$$

Q5 SUPPORT CARDS (PRILL TRUCK) ARE GENERATED ONLY WHEN $\text{IMGCB} = 0$.

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

SECOND DETAIL LINE PRINTS,
QBQDTI, QBQCTO, INUSQD, QBQDTI, QBTEC, QDDT, ECDT

PRIMARY EQUIPMENT SUMMARY DATA ARE CALCULATED AND PRINTED.

$$\begin{aligned} \text{QBII} &= \text{QDD2UI} * (\text{QDCRQT} + \text{QDCRFS}) * 1000 \\ &= 37.3 * (6 + 0) * 1000 \end{aligned}$$

$$= 223800$$

$$\begin{aligned} QDDY &= QDD2CH / QDCROH = 20000 / 1632 \\ &= 6.129 \end{aligned}$$

$$\begin{aligned} QBAIC &= QBII * (1 + .07 * (1 + QDDY)) / QDDY \\ &= 223800 * (1 + .07 * (1 + 6.129)) / 6.129 \\ &= 35206.4 \end{aligned}$$

$$\begin{aligned} QBAOC &= QDCN * QDCROH * QDCRQT + QLD30T * QLCRCH * QLCRQT \\ &= 17.46 * 1632 * 6 + 26.51 * 1632 * 6 \\ &= 430558 \end{aligned}$$

$$\begin{aligned} QBPT &= (QBAIC + QBAOC) * QDCRLO = (35206.4 + 430558) * 30 \\ &= .139729E8 \end{aligned}$$

$$\begin{aligned} DRT &= QBPT / XRT = .139729E8 / .155754E9 \\ &= .090 \end{aligned}$$

$$\begin{aligned} DFT &= QBPT / XTT = .139729E8 / .154196E9 \\ &= .091 \end{aligned}$$

$$QDTNO = QDCRQT + QDCRFS = 6 + 0 = 6$$

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

SUPPORT EQUIPMENT SUMMARY DATA ARE CALCULATED AND
PRINTED.

$$\begin{aligned} Q5CII &= Q5CRQT * Q5D2UI * 1000 \\ &= 6 * 39 * 1000 \\ &= 216000 \end{aligned}$$

$$Q5DY = Q5D2DH / Q5CROH = 20000 / 1632 = 12.255$$

$$\begin{aligned} Q5AIC &= Q5D2LI * 1000 * (1 + .07 * (1 + Q5DY)) / Q5DY * Q5CRQT \\ &= 36 * 1000 * (1 + .07 * (1 + 12.255)) / 12.255 * 6 \\ &= 33979.4 \end{aligned}$$

$$\begin{aligned} Q5AOC &= Q5CN * Q5CROH * Q5CRQT = 14.63 * 1632 * 6 \\ &= 143257. \end{aligned}$$

$$\begin{aligned} Q5PT &= (Q5AIC + Q5AOC) * QDCRLO \\ &= (33979.4 + 143257) * 30 \\ &= .531709E7 \end{aligned}$$

$$DRT = Q5PT / XRT = .531709E7 / .155754E9$$

= .034

DFT = Q5PT / XTT = .531709E7 / .154196E9
= .034

SUPPORT SUMMARY LINE PRINTS,
Q5CII, Q5AIC, Q5ACC, 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.

```
SDCRLC = TMY = 30
TDCRLO = TMY = 30
CHHD = CHHDF + 27720 * 4 / HC * CDRTY / 865300
      = 6600 + 27720 * 4 / 4 * 865300 / 865300
      = 34320.
SFC1 = 1 + SFC = 1 + .35 = 1.35
DCBTY = DCBPY / 2000 = 2160 / 2000 = 1.08
CDRYT = CDRTY / DCBTY = .8653E6 / 1.08 = .801203
CHNP = NPITS = 6
CHAC = ACRES = 4490.25
CHHC = HC = 4
```

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

```
EBWT = SDSW * (1 + CHSO) * CHFF * DCBTY / SFC1
      = 12 * (1 + 0) * .95 * 1.08 / 1.35
      = 9.12
```

```
SPL = INT(TDSL / 2 * (1 + CHTD) / EBWT)
      = INT(300 / 2 * (1 + .1) / 9.12)
      = 18
```

```
TTL = SPL * CHCT + CHSW = 18 * .5 + 0 = 9
TRHR = 50 / TTL = 50 / 9 = 5.56
STCAP = SPL * EBWT * TRHR / DCBTY = 18 * 9.12 * 5.56 / 1.08
      = 845.12
```

```
CAPAC = CDRYT / SDCROH = 801203 / 1631
      = 491.23
SDNO = CAPAC / STCAP = 491.23 / 845.12
      = .5819
ISDNO = INT(SDNO + .9) = INT(.5819 + .9) = 1
```

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

```
CHHDM = CHHD / 5280 = 34320 / 5280 = 6.5
```

$$\begin{aligned}
TDCT &= 7.41 + CHCT * SPL \\
&\quad + .26673 * CHDM \\
&\quad + 20.434 * TDSL * CHDM / TDSC \\
&= 7.41 + .5 * 18 \\
&\quad + .026673 * 6.5 \\
&\quad + 20.434 * 300 * 0.5 / 1000 \\
&= 56.429
\end{aligned}$$

$$\begin{aligned}
TDNO &= STCAP * DCBTY * SDNO / (50 / TDCT * SPL * EBWT) \\
&= 845.12 * 1.08 * .5819 / (50 / 56.43 * 18 * 9.12) \\
&= 3.75
\end{aligned}$$

$$ITDNC = INT(TDNO + .9) = INT(1.723 + .9) = 4$$

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

$$\begin{aligned}
STOAO &= ISDNC * SDCP + SDNC * SDCN + ITDNO * TDCP + TDNO * TDCN \\
&= 1 * 20.77 + .5819 * 46.79 + 4 * 21.94 + 3.75 * 55.01 \\
&= 342.04
\end{aligned}$$

$$\begin{aligned}
SDTCP &= ISDNO * SDCP * SDCRDH * SDCRLO \\
&= 1 * 20.77 * 1631 * 30 \\
&= .10163E7
\end{aligned}$$

$$\begin{aligned}
SDTCN &= ISDNC * SDCN * SDCRDH * SDCRLO \\
&= 1 * 46.79 * 1631 * 30 \\
&= .22894E7
\end{aligned}$$

$$\begin{aligned}
TDTCP &= ITDNO * TDCP * TDCRDH * TDCRLO \\
&= 4 * 21.94 * 1631 * 30 \\
&= .42941E7
\end{aligned}$$

$$\begin{aligned}
TDTCN &= TDNO * TDCN * TDCRDH * TDCRLO \\
&= 3.75 * 55.01 * 1631 * 30 \\
&= .10093E8
\end{aligned}$$

$$\begin{aligned}
SDII &= SDCG = 763.4 \\
TDII &= TDCG = 292.6
\end{aligned}$$

$$\begin{aligned}
TDCRFS &= INT(TDNO * CHNP * .10 + .9) \\
&= INT(3.75 * 6 * .10 + .9) \\
&= 3
\end{aligned}$$

$$\begin{aligned}
TDSCP &= TDCRFS * TDCP * TDCRDH * TDCRLO \\
&= 3 * 21.94 * 1631 * 30 \\
&= .32206E7
\end{aligned}$$

$$\begin{aligned} \text{STDT} &= \text{STOAC} * \text{DCBTY} / (\text{CDRY} / \text{SDCROH}) \\ &= 342.04 * 1.08 / (801203 / 1631) \\ &= .7519 \end{aligned}$$

THE FIRST DETAIL LINE PRINTS,
SDNO, ISDNC, SDST, SDSW, SECA, SDCG, SDCP, SDCN, SDRN

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

THE THIRD DETAIL LINE PRINTS,
SDTCP, SDTCN, TDTCP, TOTCN, TGSCP, TDCRFS, STDT

CFA EQUIPMENT DATA CARD FIELDS ARE SET UP.

$$\begin{aligned} \text{SDCRQT} &= \text{ISDNC} * \text{CHNP} = 1 * 6 = 6 \\ \text{SDCRCP} &= \text{CDRY} * \text{DCBTY} * \text{CHNP} / 1000 \\ &= 801203 * 1.08 * 6 / 1000 \\ &= 5191.7 \\ \text{SDCRNY} &= \text{CHNP} / 2 = 6 / 2 = 3 \\ \text{SDD2UI} &= \text{SCCG} = 763.4 \\ \text{SDD2DH} &= \text{SDP7} = 60000 \\ \text{SDD3ML} &= \text{SDCR} = 5.01 \\ \text{SDD3MM} &= \text{SCCJ} = 15.03 \\ \text{SDD2EL} &= \text{SDCK} = 2.30 \\ \text{TDCRQT} &= \text{ITDNO} * \text{CHNP} = 4 * 6 = 24 \\ \text{TDCRCP} &= \text{SDCRCP} = 5191.7 \\ \text{TDCRNY} &= \text{CHNP} / 2 = 6 / 2 = 3 \\ \text{TDD2UI} &= \text{TDCG} = 292.6 \\ \text{TDD2DH} &= \text{TDP7} = 20000 \\ \text{TDD3ML} &= \text{TDCR} = 8.26 \\ \text{TDD3MM} &= \text{TCCJ} = 12.39 \\ \text{TDD3FU} &= \text{TDCCK} = 9.36 \\ \text{TDD3TI} &= \text{TDCM} = 13.75 \end{aligned}$$

SUPPORT EQUIPMENT

$$\begin{aligned} \text{C6CRQT} &= \text{CHNP} = 3 \\ \text{C3CROH} &= \text{SDCROH} = 1631 \\ \text{C3CRNY} &= \text{CHNP} / 2 = 6 / 2 = 3 \\ \text{C3CRSY} &= \text{SDCRSY} = 7 \\ \text{C3CRSH} &= \text{SDCRSH} = 1813 \\ \\ \text{C4CRQT} &= \text{CHNP} = 6 \\ \text{C4CROH} &= \text{SDCROH} = 1631 \\ \text{C4CRNY} &= \text{CHNP} / 2 = 6 / 2 = 3 \\ \text{C4CRSY} &= \text{SDCRSY} = 7 \\ \text{C4CRSH} &= \text{SDCRSH} = 1813 \end{aligned}$$

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

C6CRQT = CHNP = 6
C6CROH = SDCROH = 1631
C6CRNY = CHNP / 2 = 6 / 2 = 3
C6CRSY = SDCRSY = 7
C6CRSH = SDCRSH = 1813

THE SUMMARY COST ELEMENTS ARE CALCULATED AND PRINTED FOR BOTH PRIMARY AND SUPPORT EQUIPMENT. SINCE THE FORM OF THE EQUATIONS IS DEMONSTRATED IN DRILLING AND BLASTING AND OVERBURDEN REMOVAL, IT SHOULD NOT BE NECESSARY TO REPEAT THEM FOR CCAL 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
RVCRLC = TMY = 30
RCNP = NPITS = 6
RCCG = ROC * 6 / 9 = 900 * 6 / 9 = 600
RCCLM = RCC / 9 = 900 / 9 = 100
RCCRIV = ROC * 2 / 9 = 900 * 2 / 9 = 200
RCTT = 1 / CCTT = 1 / 1.5 = .666
RCHC = HC = 4
RCHBT = HBT = .5
RCCD = CDRTY = 865300
RCPWF = PWF = 100
RCTRF = TRF = .06
RCAC = ACRES = 4490.29
```

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

```
RNOSC = .66 * 4 / RCHC * RCHBT / .5 * RCCD / 865300
       = .66 * 4 / 4 * .5 / .5 * 865300 / 865300
       = .66
```

```
INOSC = INT(RNOSC + .9) = INT(.66 + .9) = 1
```

```
INOSSC = 0
```

```
RCSCFI = INOSC * SCCP * SCCRDH * SCCRLO
       = 1 * 22.26 * 1665 * 30
       = .11119E7
```

```
RCSCFO = RNOSC * SCCN * SCCRDH * SCCRLO
       = .66 * 38.21 * 1665 * 30
       = .12597E7
```

```
RCSCFI = INOSSC * SCCP * SCCRDH * SCCRLO
       = 0
```

```
SCDT = (RCSCFI + RCSCFO + RCSCFI) / CDRTY / SCCRLO
       = (.11119E7 + .12597E7 + 0.) / .8653E6 / 30
       = .0913
```

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

$$\begin{aligned} X &= \text{CDRTY} / 1\text{E}6 / \text{HC} = 865300 / 1\text{E}6 / 4 = .21633 \\ \text{RNCCD} &= -.00384704 * X * \text{RCTT} * \text{RCPWF} \\ &\quad + .000618961 * X * \text{RCTT} * \text{RCPWF}^2 \\ &\quad + .00660504 * X * \text{RCCG} \\ &= -.00384704 * .21633 * .666 * 100 \\ &\quad + .000618961 * .21633 * .666 * 100^2 \\ &\quad + .00660504 * .21633 * 600. \\ &= 1.694 \end{aligned}$$

$$\text{INOCD} = \text{INT}(\text{RNCCD} + .9) = \text{INT}(1.694 + .9) = 2$$

$$\begin{aligned} \text{INOSCD} &= \text{INT}(\text{RNCCD} * \text{RCNP} * .10 + .9) \\ &= \text{INT}(1.694 * 6 * .10 + .9) \\ &= 1 \end{aligned}$$

$$\begin{aligned} \text{RCCDTI} &= \text{INOCD} * \text{CDCP} * \text{CDCRCH} * \text{CDCRLO} \\ &= 2 * 21.30 * 1665 * 30 \\ &= .21279\text{E}7 \end{aligned}$$

$$\begin{aligned} \text{RCCDTO} &= \text{RNCCD} * \text{CCCN} * \text{CDCRCH} * \text{CDCRLO} \\ &= 1.694 * 31.18 * 1665 * 30 \\ &= .26391\text{E}7 \end{aligned}$$

$$\begin{aligned} \text{RCCDFI} &= \text{INOSCD} * \text{CDCP} * \text{CDCRCH} * \text{CDCRLO} \\ &= 1 * 21.30 * 1665 * 30 \\ &= .10639\text{E}7 \end{aligned}$$

$$\begin{aligned} \text{CDDT} &= (\text{RCCDTI} + \text{RCCDTO} + \text{RCCDFI}) / \text{CDRTY} / \text{CDCRLO} \\ &= (.21279\text{E}7 + .26391\text{E}7 + .10639\text{E}7) / .8653\text{E}6 / 30 \\ &= .2246 \end{aligned}$$

REVEGETATION AND LAND MANAGEMENT COSTS ARE CALCULATED.

$$\text{RCRVTD} = \text{RCCRV} * \text{ACRES} = 200 * 4490.29 = .89806\text{E}6$$

$$\text{RCLMTD} = \text{RCCLM} * \text{ACRES} = 100 * 4490.29 = .44903\text{E}6$$

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

SECOND DETAIL LINE PRINTS,
RNCCD, INOCD, CDSK, CDCG, CDCP, CDCN, CDRN

THIRD DETAIL LINE PRINTS,
RCSCTI, RCSCTG, INCSSC, RCSCFI, RCCDTI, RCCDIO, INOSCD,
RCCDFI, RCRVTD, RCLMTD

CFA EQUIPMENT DATA CARD FIELDS ARE SET UP.

$$\text{CDCRQT} = \text{INT}(\text{RNQCD} * \text{RCNP} + .9) = \text{INT}(1.694 * 6 + .9) = 10$$

$$\text{CDCRFS} = \text{INOSCD} = 1$$

$$\begin{aligned}\text{CDCRCP} &= \text{ACRES} / \text{CDCRLO} * \text{RCNP} / 1000 \\ &= 4490.29 / 30 * 6 / 1000 \\ &= .898\end{aligned}$$

$$\text{CDCRNY} = \text{RCNP} / 2 = 6 / 2 = 3$$

$$\text{CDD2UI} = \text{CDCG} = 192.5$$

$$\text{CDD2DH} = \text{CDF7} = 12000$$

$$\text{CDD3ML} = \text{CDCR} = 5.64$$

$$\text{CDD3MM} = \text{CCCJ} = 10.32$$

$$\text{CDD3FU} = \text{CDCK} = 5.35$$

$$\text{SCCRQT} = \text{INT}(\text{RNOSC} * \text{RCNP} + .9) = \text{INT}(1.66 * 6 + .9) = 4$$

$$\text{SCCRFS} = \text{INOSSC} = 0$$

$$\text{SCCRCP} = \text{CDCRCP} = .898$$

$$\text{SCCRNY} = \text{RCNP} / 2 = 6 / 2 = 3$$

$$\text{SCD2UI} = \text{SCCG} = 201.1$$

$$\text{SCD2DH} = \text{SCF7} = 12000$$

$$\text{SCD3ML} = \text{SCCR} = 9.19$$

$$\text{SCD3MM} = \text{SCCJ} = 9.19$$

$$\text{SCD3FU} = \text{SCCK} = 5.13$$

$$\text{SCD3TI} = \text{SCCM} = 3.55$$

$$\text{RVCRCP} = \text{CDCRCP} = .898$$

$$\text{RVCRNY} = \text{RCNP} / 2 = 6 / 2 = 3$$

$$\begin{aligned}\text{RVD3OT} &= \text{ACRES} / \text{CDCRLO} * \text{RCCR} / \text{RVCROH} * \text{RCNP} \\ &= 4490.29 / 30 * 200 / 1665 * 6 \\ &= 107.87\end{aligned}$$

$$\text{LMCRCP} = \text{CDCRCP} = .898$$

$$\text{LMCRNY} = \text{RCNP} / 2 = 6 / 2 = 3$$

$$\begin{aligned}\text{LMD3OT} &= \text{ACRES} / \text{LMCRLO} * \text{RCCLM} / \text{LMCROH} * \text{RCNP} \\ &= 4490.29 / 30 * 100 / 1665 * 6 \\ &= 53.94\end{aligned}$$

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.

PPCRLC = 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
= 20767.2 / 3 / 75000
= .09230

PPCRNY = PPEQTY(I) = 3

PPCC = PPCCF(I) * PSF**PPCCX(I)
= 17700 * .09230**0.8
= 2631.05

PPDY = PPCRLC = 30
PPD2DH = PPCCF(I) * PPDY = 3625 * 30 = 108750

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

PPPS(J,2) = PPPSF(I,J) * PSF**PPPSX(I)
PPPS(J,1) = PPCS(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)
= 71.52 * .09230**0.35 = 31.06

PPMM = PPMMF(I) * PSF**PPMMX(I)
= 122.07 * .09230**0.8 = 18.15

$$\begin{aligned} \text{PPFC} &= \text{PPFCF}(1) * \text{PSF} ** \text{PPFCX}(1) \\ &= 0 * .09230 ** 0 = 0 \end{aligned}$$

$$\begin{aligned} \text{FOR I} &= 4, \\ &= 12.41 * .09230 ** 0.8 = 1.84 \end{aligned}$$

$$\text{PPWC} = \text{PPWCF}(1) * \text{PSF} ** \text{PPWCX}(1)$$

$$\begin{aligned} \text{FOR I} &= 6, \\ &= 2.40 * .09230 ** 1 = .2215 \end{aligned}$$

$$\begin{aligned} \text{PPEP} &= \text{PPEPF}(1) * \text{PSF} ** \text{PPEPX}(1) \\ &= 45.05 * .09230 ** 1 = 4.16 \end{aligned}$$

$$\begin{aligned} \text{PPLC} &= \text{PPLCF}(1) * \text{PSF} ** \text{PPLCX}(1) \\ &= 68.78 * .09230 ** 0.35 = 29.87 \end{aligned}$$

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

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.

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

ALL COST ARE ADJUSTED TO REFLECT THE PROPER NUMBER OF PREPARATION PLANTS, PPEQTY(IC).

$$\begin{aligned} \text{PPCC} &= \text{PPCC} * 1000 * \text{PPEQTY}(1\text{C}) = 2631.05 * 1000 * 3 = .789316\text{E} \\ \text{PPML} &= \text{PPML} * \text{PPEQTY}(1\text{C}) = 31.06 * 3 = 93.18 \\ \text{PPMM} &= \text{PPMM} * \text{PPEQTY}(1\text{C}) = 18.15 * 3 = 54.45 \\ \text{PPFC} &= \text{PPFC} * \text{PPEQTY}(1\text{C}) = 0 * 3 = 0 \\ \text{PPWC} &= \text{PPWC} * \text{PPEQTY}(1\text{C}) = 0 * 3 = 0 \\ \text{PPEP} &= \text{PPEP} * \text{PPEQTY}(1\text{C}) = 4.16 * 3 = 12.48 \\ \text{PPLC} &= \text{PPLC} * \text{PPEQTY}(1\text{C}) = 29.87 * 3 = 89.62 \end{aligned}$$

$$\begin{aligned} \text{PPOWC} &= \text{PPCC} * (1 + .07 * (1 + \text{PPDY})) / \text{PPDY} / \text{PPOWCF}(1) \\ &= (.789316\text{E} * (1 + .07 * (1 + 30)) / 30 / 3625) * 3 \\ &= 230.08 \end{aligned}$$

$$\begin{aligned} \text{PPUPC} &= \text{PPML} + \text{PPMM} + \text{PPFC} + \text{PPWC} + \text{PPEP} + \text{PPLC} \\ &= 93.18 + 54.45 + 0 + 0 + 12.48 + 89.62 \\ &= 249.72 \end{aligned}$$

$$\begin{aligned} \text{PPDT} &= (\text{PPOWC} + \text{PPUPC}) * \text{PPDTF}(1) / \text{PPNS} \\ &= (230.08 + 249.72) * 14.5 / 20767.2 \\ &= .335 \end{aligned}$$

SUMMARY DATA ARE CALCULATED AND PRINTED.

SPPDT = SUMMATION OF ALL PPDT = 2.285
PPII = SUMMATION OF ALL PPCC = .505653E8
PPACC = SUMMATION OF ALL PPOWC TIMES PPOWCF = .534306E7
PPAOC = SUMMATION OF ALL PPOPC TIMES PPOWCF = .639779E7

PPPT = (PPACC + PPAOC) * PPCRLO
= (.534306E7 + .639779E7) * 30
= .352226E9

DRT = PPPT / XRT = .352226E9 / .155754E9 = 2.261

DFT = PPPT / XTT = .352226E9 / .154196E9 = 2.284

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. CCM COMMUN. SYS. ANC. FAC.
6. MBEQ MOBILE SUP. ANC. FAC.
7. SPEC EQUIP. SHOP ANC. FAC.
8. LAND LAND RIGHTS PREMINE
9. XERL EXPL. DRILL. PREMINE
10. ENG CCNT. ENG. PREMINE
11. EIS E. I. S. PREMINE
12. STF SUPERV. PER.
13. RLTX RCY-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.

$$GTAD = ACRES * NPITS = 4490.29 * 6 = 26941.7$$

$$\begin{aligned} GTTY &= (CDRTYX + BPBY * LBBPY / 2000 * NPITS) / 1E6 \\ &= (1.519180E7 + .107277E8 * 4330 / 2000 * 6) / 1E6 \\ &= 144.545 \end{aligned}$$

$$GSR = GTTY / GATYB = 144.545 / 144.545 = 1$$

$$\begin{aligned} GBMR &= GAMR = 50 \\ GBRS &= GASR = 250 \\ GBYRS &= TMY = 30 \\ G15ROY &= GARA = .25 \\ G15STX &= GAST = 0 \\ G15UNI &= GAUF = .11 \end{aligned}$$

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:

$$GACRLO = TMY + NPITS / 2 - 1 = 30 + 6 / 2 - 1 = 32$$

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

$$GCDRTY = XRT / GACRLO = .155754E9 / 32 \\ = .486731E7$$

1) ROADS & SITE WORK

$$GAD2UI = G1CCF * GSR**G1EXP / 1000 \\ = 3E6 * 1**0.35 / 1000 = 3000$$

2) BUILDINGS

$$GAD2UI = G2SQF * GSR**G2EXP1 * G2DSQF / 1000 \\ = 135E3 * 1**0.85 * 36.25 / 1000 \\ = 4893.75$$

$$FUEL = G2MSFF * GSR**G2EXP2 / GACRHO(2) \\ = 65E3 * 1**0.9 / 2000 = 32.50$$

$$WATER = G2MSFW * GSR**G2EXP3 / GACRHO(2) \\ = 200 * 1**0.75 / 2000 = .1$$

$$GTOPRC = FUEL + WATER = 32.50 + .10 = 32.60 \\ GTOPRC IS OPERATING COST IN $/HOUR.$$

3) ELECTRIC POWER SYSTEM.

$$GAD2UI = G3CCF * GSR**G3EXP / 1000 \\ = 45E5 * 1**0.7 / 1000 = 4500$$

4) WATER SYSTEM - DEPENDS IN IPPT

$$GAD2UI = G4ACCF * GSR**G4EXP / 1000 \\ = 2E5 * 1**0.45 / 1000 = 200 (FOR IPPT = 1)$$

$$GAD2UI = G4BCCF * GSR**G4EXP / 1000 \\ = 4.5E5 * 1**0.45 / 1000 = 450 (FOR IPPT = 2)$$

$$GAD2UI = G4CCCF * GSR**G4EXP / 1000 \\ = 5.5E5 * 1**0.45 / 1000 = 550 (FOR IPPT = 3)$$

5) COMMUNICATIONS SYSTEM

$$GAD2UI = G5CCF * GSR**G5EXP / 1000 \\ = 125E3 * 1**0.4 / 1000 = 125$$

6) MOBILE SUPPORT

$$GAD2UI = G6CCF * GSR**G6EXP / 1000 \\ = 12E5 * 1**0.85 / 1000 = 1200$$

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

$$\begin{aligned} \text{GAD2UI} &= \text{G8PERC} * (\text{G8SR} + \text{G8MR}) * \text{GTAD} / 1000 \\ &= .1 * (250 + 50) * 26941.7 / 1000 = 808.3 \end{aligned}$$

$$\begin{aligned} \text{GTOPRC} &= (1 - \text{G8PERC}) * (\text{G8SR} + \text{G8MR}) * \text{GTAD} / 30 / \text{GACRDH}(8) \\ &= (1 - .1) * (250 + 50) * 26941.7 / 30 / 2000 = 121.24 \end{aligned}$$

9) EXPLORATION DRILLING

$$\begin{aligned} \text{GAD2UI} &= \text{G9CCF} * \text{GTAD} / \text{G9AHOL} / 1000 \\ &= 1000 * 26941.7 / 40 / 1000 = 673.54 \end{aligned}$$

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

$$\begin{aligned} \text{GAD3MM} &= \text{G13PRC} * \text{G13MPW} * \text{GSR} ** \text{G13EXP} * \text{G13FCT} / \text{GACROH} \\ &= .16 * 492 * 1 ** 0.9 * 2000 / 2000 = 78.72 \end{aligned}$$

$$\begin{aligned} \text{GAU1Q1} &= \text{INT}(\text{G13PRC} * \text{G13MPW} * \text{GSR} ** \text{G13EXP}) \\ &= \text{INT}(.16 * 492 * 1 ** 0.9) = 78 \end{aligned}$$

$$\begin{aligned} \text{GTOPRC} &= \text{GAD3MM} + \text{G13AWK} * \text{GAU1Q1} / \text{GACROH} \\ &= 78.72 + 17900 * 78 / 2000 = 776.82 \end{aligned}$$

13) ROYALTY, SEVERANCE TAX AND UNION WELFARE

$$\begin{aligned} \text{GTOPRC} &= (\text{G15ROY} + \text{G15STX} + \text{G15UNI}) * \text{GCDRTY} / \text{GACROH} \\ &= (.25 + 0 + .11) * .486731\text{E}7 / 2000 = 876.12 \end{aligned}$$

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.)

$$\begin{aligned} \text{GTOWNC} &= \text{GAE2UI} * 1000 * (1 + .07 * (1 + \text{GACRLO})) \\ &\quad / \text{GACRLE} / \text{GACRCH} \\ &= 3000 * 1000 * (1 + .07 * (1 + 32)) / 32 / 2000 \\ &= 155.156 \end{aligned}$$

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

$$\begin{aligned} \text{GOOTON} &= (\text{GTOWNC} + \text{GTCPRC}) * \text{GACRCH} / \text{GCDRTY} \\ &= (155.156 + 0) * 2000 / .486731E7 = .0637 \end{aligned}$$

DETAIL FOR EACH ELEMENT PRINTS,
GAE2UI, GTOWNC, GTCPRC, GOOTON

SUMMARY COSTS ARE CALCULATED AND PRINTED.

$$\begin{aligned} \text{GAI1} &= \text{SUMMATION OF ALL GAE2UI TIMES 1000} = .234005E8 \\ \text{GAOWC} &= \text{SUMMATION OF ALL GTOWNC TIMES HOURS/YEAR} = .242049E7 \\ \text{GAOPC} &= \text{SUMMATION OF ALL GTCPRC TIMES HOURS/YEAR} = .361354E7 \\ \text{GADT} &= \text{SUMMATION OF ALL GADT} = 1.240 \end{aligned}$$

$$\begin{aligned} \text{GAPT} &= (\text{GACWC} + \text{GACPC}) * \text{GACRLO} \\ &= (.234005E7 + .361254E7) * 32 \\ &= .193089E9 \end{aligned}$$

$$\text{DRT} = \text{GAPT} / \text{XRT} = .193089E9 / .155754E9 = 1.240$$

$$\text{DFT} = \text{GAPT} / \text{XTT} = .193089E9 / .154196E9 = 1.252$$

THE SUMMARY LINE PRINTS,
GAI1, GAOWC, GAOPC, 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 VARIABLES LISTING

ABHD	A	ANGLE BURDEN HIGHWALL (DEGREES)
ABSD	A	ANGLE BURDEN SPOILS (DEGREES)
ACFD	A	ANGLE COAL FACE (DEGREES)
ACRES	A	ACRES
ANGLE	O	INTERIOR ANGLE (O FOR STRAIGHT SEGMENT)
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
BLD1F(3)	D	BLASTING DATA FILE CODE
BLD1ID	D	EQUIPMENT ID
BLD1MO	D	MINING OPERATION
BLD1S(4)	D	BLASTING EQUIPMENT SIZE
BLD1T(3)	D	BLASTING EQUIPMENT TYPE
BLD3ID	D	EQUIPMENT ID
BLD3MO	D	MINING OPERATION
BLD3OT	D	BLASTING HOURLY OTHER COST - \$/HR
BLO1CI	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 MAINTENANCE LABOR COST - \$/HR
CDCK	L	DOZER HOURLY FUEL COST - \$/HR
CDCN	L	DOZER HOURLY OPERATING COST - \$/HR
CDCP	L	DOZER HOURLY OWNERSHIP 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 CCST CF DOZERS - \$/TON
CDD1F(3)	L DOZER FILE CODE
CDD1ID	L EQUIPMENT ID
CDD1MO	L MINING OPERATION
CDD1S(4)	L DOZER EQUIPMENT SIZE
CDD1T(3)	L DOZER EQUIPMENT TYPE
CDD2BY	L DOZER BASE YEAR
CDD2CO	L DOZER CONSTRUCTION CODE
CDD2DL	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 MAINTENANCE LABOR - \$/HR
CDD3MM	L DOZER HOURLY MAINTENANCE MATERIALS - \$/HR
CDD3MO	L MINING OPERATION
CDMN(3)	L DOZER DATA FILE MODEL NAME
CDM1C1	L DOZER MAINTENANCE LABOR CLASS 1
CDM1F1	L DOZER MAINTENANCE LABOR FRACTION 1
CDM1ID	L EQUIPMENT ID
CDM1MO	L MINING OPERATION
CDM1S1	L DOZER MAINTENANCE 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/YEAR
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 - AVERAGE
CHNP	C CH - NUMBER OF PITS
CHRYR	C CH - COAL DEMAND (REC. YARDS/YEAR)
CHS	C SUBROUTINE NAME FOR COAL LOAD AND HAUL
CHSDRR	C CH - SUM OF DISTANCE 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
CPH	D	CYCLES PER HOUR
CRTAF	A	COAL REC. TONS/ARCE-FOOT
DBBD	D	BURDEN DEMAND - BANK CU YD / YR
DBBPY	A	DENSITY OF OVERBURDEN BANK LBS/YARD
DBCDD	D	COAL DEMAND - REC. 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
DCRTY	C	DENSITY OF COAL (BANK TONS/YARD)
DLABHD	O	ANGLE OF OVERBURDEN HIGHWALL IN DEGREES
DLABSD	O	ANGLE SPOIL IN DEGREES
DLACFD	O	ANGLE OF COAL FACE IN DEGREES
DLACR	O	ANNUAL OPERATING COSTS
DLACL	O	TOTAL ACRES PER PIT
DLBP	O	BURDEN PRODN. BANK YARDS/YEAR
DLCA	O	DL - PURCHASE PRICE IN M \$
DLCD	O	COAL DEMAND RECOVERABLE TONS/YEAR
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
DLCOTA	O	SLOPE OF HIGHWALL - HORIZONTAL/VERTICAL
DLCR	O	HOURLY OPERATING COST
DLCRCP	O	EC - COMPLEX PRODUCTION CDRTY*1000
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
DLCRCH	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	O	EC - STARTING YEAR
DLDB	O	DENSITY OF BURDEN - BANK POUNDS/YARD
DLDC	O	DENSITY OF COAL - BANK POUNDS/YARD
DLOY	O	DL - DEPRECIATION YEARS
OLDIF1	O	ED1 - EQUIP. FILE ID

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DLD1F2	0	2
DLD1F3	0	3
DLD1ID	0 ED1 - ECID	
DLD1S1	0 ED1 - EQUIP. SIZE	1
DLD1S2	0	2
DLD1S3	0	3
DLD1S4	0	4
DLD1T1	0 ED1 - EQUIP. TYPE	1
DLD1T2	0	2
DLD1T3	0	3
DLD2BY	0 ED2 - BASE YEAR	
DLD2CO	0 ED2 - CONSTANT	
DLD2DH	0 ED2 - DEPRECIATION HOURS	
DLD2DM	0 ED2 - DEPRECIATION METHOD	
DLD2EF	0 ED2 - ESCALATION FACTOR	
DLD2ID	0 ED2 - ECID	
DLD2PC	0 ED2 - PURCHASE CODE	
DLD2RA	0 ED2 - REGIONAL ADJUSTMENT	
DLD2SF	0 ED2 - SALVAGE FACTOR	
DLD2UI	0 ED2 - UNIT INVESTMENT	
DLD3EL	0 ED3 - ELECTRIC POWER COST	
DLD3FU	0 ED3 - FUELS	
DLD3ID	0 ED3 - ECID	
DLD3ML	0 ED3 - MAINTENANCE LABOR	
DLD3MM	0 ED3 - MAINTENANCE MATERIALS	
DLD3OT	0 ED3 - OTHER	
DLD3TI	0 ED3 - TIRES	
DLD3WA	0 ED3 - WATER	
DLECR	0 EXPECTED COAL RECOVERY	
DLFDP	0 DL - DIGGING POWER FACTOR	
DLHBM	0 MAXIMUM HEIGHT OF BURDEN	
DLHC	0 HEIGHT OF COAL	
DLNP	0 DL - NO. OF PITS	
DLOHD	0 DRAGLINE OPERATING HOURS PER DAY	
DLO1C1	0 EPC1 - OPERATOR CLASS CODE	
DLO1C2	0 EPC1 - OILER CLASS CODE	
DLO1C3	0 EPO1 - GROUNDMAN CLASS CODE	
DLO1ID	0 EPO1 - ECID	
DLO1Q1	0 EPO1 - OPERATOR QUANT.	
DLO1Q2	0 EPO1 - OILER QUANT.	
DLO1Q3	0 EPO1 - GROUNDMAN QUANT.	
DLO1S1	0 EPC1 - OPERATOR SCHED CODE	
DLO1S2	0 EPO1 - OILER SCHED CODE	
DLO1S3	0 EPO1 - GROUNDMAN SCHED CODE	
DLPE	0 DL - PEAK 15-MINUTE DEMAND	
DLRMA	0 DL - RMA	
DLSA	0 DL - BOOM LENGTH IN FEET	
DLSB	0 DL - BOOM ANGLE	
DLSFB	0 SWELL FACTOR FOR OVERBURDEN	
DLSH	0 DRAGLINE DUMPING RADIUS	
DLSHY	0 DL - SCHEDULED HOURS/YEAR	

DLSJ	O DRAGLINE WIDTH OVER BOTH SHOES
DLSRYT	O STRIPPING RATIO - CUBIC YARDS / TON
DLST	O CL - WEIGHT IN M LBS
DLSW	O DL - BUCKET SIZE
DLS6	O DL - PRODUCTION BANK YARDS/YEAR
DLTANT	O SLOPE OF SPOIL VERTICAL/HORIZONTAL
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
EBWT	C EFFECTIVE SHOVEL BUCKET WEIGHT IN TONS
ECDT	D EXPLOSIVE COST - \$/TON
ECDT	Q EXPLOSIVE COST - \$/TON
ECR	A EXPECTED COAL RECOVERY FACTOR
EDR	A EFFECTIVE DUMPING RADIUS
EDR	O EFFECTIVE DUMPING RADIUS
EFH	O ELEVATION OF FIRST HIGHWALL
EMAX	O DIMENSION OF EX AND EY ARRAYS
ESO	O EFFICIENCY OF STRIPPING OPERATION
EYX	O MAX. VALUE IN EY ADATA
FFP	O FILL FACTOR
GAAOC	G ANNUAL OPERATING COST
GACRLO (13)	G LIFE OF OPERATION
GACRNY (13)	G NO. OF START-UP YEARS
GACROH (13)	G 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
GAI I	G INITIAL INVESTMENT
GAMR	A GAA - MINERAL RIGHTS (\$/ACRE)
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 RCM TONS/YEAR
GMAX	O DIMENSION OF EG ARRAY
GTAD	G TOTAL ACRES DISTURBED
GTTY	G COMPLEX SIZE IN TOTAL TONS PER YEAR
GTTYB	G COMPLEX SIZE IN TOTAL TONS PER YEAR (BASELINE C
GICCF	G CAPITAL COST FACTOR FOR ROADS & SITE WORK

G1EXP	G EXPONENT FOR ROADS & SITE WORK CAPITAL COST CAL
G10CCF	G CAPITAL COST FACTOR FOR CONTRACT ENGINEERING
G10EXP	G EXPONENT FOR CONTR. ENG. CAPITAL COST CALC.
G11CCF	G CAPITAL COST FACTOR FOR E. I. S.
G11EXP	G EXPONENT FOR E.I.S. CAPITAL COST CALCULATION
G13AWR	G ANNUAL AVERAGE WAGE RATE
G13EXP	G EXPONENT FOR STAFF OPER. MANPOWER CALCULATION
G13FCT	G MATERIALS & SERVICES FACTOR FOR STAFF MAT.& SER
G13MPW	G MANPOWER FACTOR FOR STAFF OPER. MANPOWER CALC.
G13OCL	G OPERATOR CLASS FOR STAFF MATERIAL & SERVICES
G13OSC	G OPERATOR SCHEDULE FOR STAFF MAT. & SERVICES
G13PRC	G PERCENTAGE FOR STAFF OPER. MANPOWER CALC.
G15ROY	G ROYALTY FOR ROYALTY & SEV. TAX AND UNION WELFA
G15STX	G SEV. TAX FOR ROYALTY & SEV. TAX AND UNION WELFA
G15UNI	G UNION WELF. FOR ROYALTY & SEV. TAX AND UNION WELF
G2DSQF	G \$ / SQUARE FEET FOR BUILDINGS CAP. COST CALC.
G2EXP1	G EXPONENT FOR BUILDINGS FUEL CALCULATION
G2EXP2	G EXPONENT FOR FUEL (BUILDG) MAT. & SERV. CALC.
G2EXP3	G EXPONENT FOR WATER (BUILDG) MAT. & SERV. CALC.
G2MSFF	G MATERIAL & SERVICES FACTOR FOR FUEL (BUILDINGS)
G2MSFW	G MATERIAL & SERVICES FACTOR FOR WATER (BUILDINGS)
G2SQF	G SQUARE FEET FOR BUILDINGS CAPITAL COST CALCULAT
G3CCF	G CAPITAL COST FACTOR FOR ELECTR. POWER SYST.
G3EXP	G EXPONENT FOR ELECTR. POWER SYST. CAP. COST CALC
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 CALC.
G5CCF	G CAPITAL COST FACTOR FOR COMMUNICATION SYSTEM
G5EXP	G EXPONENT FOR COMMUN. SYSTEM CAPITAL COST CALC.
G6CCF	G CAPITAL COST FACTOR FOR MOBILE SUPPORT
G6EXP	G EXPONENT FOR MOBILE SUPPORT CAPITAL COST CALC.
G7CCF	G CAPITAL COST FACTOR FOR SHOP
G7EXP	G EXPONENT FOR SHOP CAPITAL COST CALCULATION
G8MR	G MINERAL RIGHT COST \$/ACRE FOR LAND RIGHT COST C
G8PERC	G PERCENTAGE FOR LAND RIGHTS CAPITAL COST CALC.
G8SR	G SURFACE RIGHT COST \$/ACRE FOR LAND RIGHT COST C
G8YRS	G NUMBER OF YEARS FOR LAND RIGHT MAT. & SERV. CAL
G9AHL	G ACRES / HOLE FOR EXPL. DRILLING CAPITAL COST CA
G9CCF	G CAPITAL COST FACTOR FOR EXPL. DRILLING
HBT	A HEIGHT OF TOPSOIL - FEET
HBX	A HEIGHT OF OVERBURDEN IN FEET (MAXIMUM)
HC	A HEIGHT OF COAL IN FEET
IGPT	G PLANT SWITCH
IMCH	A INCLUDE COAL LOAD AND HAUL
IMDB	A INCLUDE ROCK DRILL AND BLAST
IMDL	A INCLUDE OVERBURDEN REMOVAL W/ DRAGLINES
IMDLC	O INCLUDE DRAGLINE OPERATION
IMGA	A INCLUDE GENERAL & ADMINISTRATIVE
IMLR	A INCLUDE RECLAMATION
IMOPP	A INCLUDE PREP PLANT

IMOQB	A	INCLUDE COAL DRILL AND BLAST
INOCB	L	NUMBER OF DOZERS PER PIT - INTEGER
INOQD	Q	NUMBER OF DRILLS - INTEGER
INORD	D	NUMBER OF DRILLS - INTEGER
INOSC	L	NUMBER OF SCRAPERS PER PIT - INTEGER
INOSCD	L	NUMBER OF SPARE DOZERS PER PIT - INTEGER
INOSQD	Q	NUMBER OF SPARE DRILLS - INTEGER
INOSRD	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
KABORT	O	ABNORMAL CONDITION IN CDM - ABORT JOB IF 1
LFCDL	A	LF - CDC FILE FOR CASH FLOW
LFCDL	A	LF - ECRG CARDS
LFEC	G	LOGICAL UNIT OF OUTPUT FILE
LFEC	P	LOGICAL UNIT OF OUTPUT FILE
LFIN	A	LF - CARD READER
LFLP	A	LF - PRINTER
LFLP	G	LOGICAL UNIT OF LINE PRINTER
LFLP	P	LOGICAL UNIT OF LINE PRINTER
LFRD	A	REGRESS. DATA FILE NO.
LMCRCP	L	LAND MGT. COMPLEX PRODUCTION - M ACRES/YEAR
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
LMCRM0	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
LMD1T(3)	L	LAND MGT. EQUIPMENT TYPE
LMD3ID	L	EQUIPMENT ID
LMD3MO	L	MINING OPERATION
LMD3OT	L	LAND MGT. HOURLY OTHER - \$/HR
LOGCA	A	PRINTS COMMON ARRAYS IF 1 (FOR DEBUG)
LOGCF	A	WRITES CFA CONTROL FILE IF 1
LOGDL	O	LOG DRAGLINE STATISTICS IF 1
LOGDV	A	PRINTS DEFAULT VARIABLES IF 1
LOGEC	A	WRITES CFA EQUIPMENT FILE IF 1
LOGEC	P	WRITE ECRG FILE IF 1
LOGPA	A	PRINTS PARAMETERS IF 1
LOGPD	G	LOG SWITCH FOR PP STATISTICS
LOGPE	G	LOG SWITCH FOR ECRG CARDS
LOGRD	A	PRINTS REGRESS. DATA FILE IF 1
LOGSD	A	WRITES SPECIFICATION DATA IF 1

LOGSD	P LOGSWITCH FOR INPUT PARAMETERS
LOGSM	A WRITES ECONOMIC SUMMARY IF ONE
NEX	C NO. OF EX, EY POINTS
NPITS	A NO. OF PITS
NSEC	O NUMBER OF SECTIONS PER PIT
OAOL	C LEAST COST O AND O FOR SHOVEL/TRACK COMB.
OSEAIC	O SUPPORT EQUIPMENT ANNUAL INVESTMENT COST
OSEAOC	O SUPPORT EQUIPMENT ANNUAL OPERATING COST
OSECII	O SUPPORT EQUIPMENT INITIAL INVESTMENT
OSEPT	O SUPPORT EQUIPMENT PROJECT TOTAL COST
PL	C TRUCK PAYLOAD IN TONS
PLH	C PROJECT LIFE IN HOURS
PMAX	O DIMENSION OF P ARRAY
PNPS	P NEW PLANT SIZE
PO	O ALLOWABLE OVERLAP
PPACC	P ANNUAL CAPITAL COST
PPAOC	P ANNUAL OPERATING COST
PPBED	A PP - BASE ENERGY BTU/YEAR
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
PPCRPL	P PURCHASE LEAD TIME
PPCRQT	P EQUIPMENT QUANTITY
PPCRSE	P START-UP EFFICIENCY
PPCRSY	P START YEAR
PPDT	P C & O CENTS PER TON
PPDTF (9)	P O & O CENTS PER 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
PPECF (9)	P ELECTRIC POWER PER SCHED. HR. FACTOR
PPECX (9)	P ELECTRIC POWER PER SCHED. HR. EXPONENT
PPEP	P ELECTRIC POWER PER SCHED. HR.
PPEQTY (9)	P EQUIPMENT QUANTITY
PPFC	P FUEL COST PER SCHED. HR.
PPFCF (9)	P FUEL COST PER SCHED. HR. FACTOR
PPFCX (9)	P FUEL COST PER 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 - BASE HEAT VALUE FOR IPPT

PPII		P INITIAL INVESTMENT
PPLC		P OPER. LABOR COST PER SCHED. HR.
PPLCF	(9)	P OPER. LABOR COST PER SCHED. HR. FACTOR
PPLCX	(9)	P OPER. LABOR COST PER SCHED. HR. EXPONENT
PPML		P MAINT. LABOR COST PER SCHED. HR.
PPMLF	(9)	P MAINT. LABOR COST PER SCHED. HR. FACTOR
PPMLX	(9)	P MAINT. LABOR COST PER SCHED. HR. EXPONENT
PPMM		P MAINT. MATERIALS & SERVICES PER SCHED. HR.
PPMMF	(9)	P MAINT. MATERIALS & SERVICES PER SCHED. HR. FACT
PPMMX	(9)	P MAINT. MATERIALS & SERV. PER SCHED. HR. EXPONEN
PPMS		P PPMS1 - PPMS9 MAINTENANCE SCHEDULES
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 TCTAL OPERATING COST PER SCHED. HR.
PPOS	(9)	P OPERATING SCHEDULES
PPOWC		P TOTAL OWNERSHIP COST PER SCHED. HR.
PPOWCF	(9)	P TOTAL OWNERSHIP COST PER SCHED. HR. FACTOR
PPPS	(8,2)	P OPERATING PERSONNEL SCHED. HR.
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 PER SCHED. HR.
PPWCF	(9)	P WATER COST PER SCHED. HR. FACTOR
PPWCX	(9)	P WATER COST PER SCHED. HR. EXPONENT
PRPY		A POWDER RATIO - POUNDS / CU. YD.
PTF		O PROPEL TIME FACTOR
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
QBQDIO		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 RCT 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 DEFFERED PURCHASE
QDCRFS		Q DRILL FLEET SPARES
QDCRID		Q DRILL EQUIPMENT ID

QDCRLO	Q DRILL LIFE OF OPERATION
QDCRMO	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
QDO1C1	Q DRILL OPERATOR CLASS 1
QDO1C2	Q DRILL OPERATOR CLASS 2
QDO1ID	Q EQUIPMENT ID
QDO1MO	Q MINING OPERATION
QDO1Q1	Q DRILL OPERATOR QUANTITY 1
QDO1Q2	Q DRILL OPERATOR QUANTITY 2
QDO1S1	Q DRILL OPERATOR SCHEDULE 1
QDO1S2	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
QLCROH	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
QLD1MO	Q MINING OPERATION
QLD3ID	Q EQUIPMENT ID
QLD3MO	Q MINING OPERATION
QLD3OT	Q BLASTING HOURLY OTHER COST - \$/HR
QLO1C1	Q BLASTING OPERATOR CLASS 1
QLO1ID	Q EQUIPMENT ID
QLO1MO	Q MINING OPERATION
QLO1Q1	Q BLASTING OPERATOR QUANTITY 1
QLO1S1	Q BLASTING OPERATOR SCHEDULE 1
RADIUS	O RADIUS OR LENGTH OF SEGMENT
RCAC	L RECLAMATION TOTAL ACRES
RCCD	L COAL DEMAND - REC. 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
RCHBT	L HEIGHT OF TOPSOIL - FEET
RCHC	L HEIGHT OF COAL - FEET
RCLMDA	L LAND MANAGEMENT COST - \$/ACRE
RCNP	L NUMBER OF PITS
RCPLH	L PROJECT LIFE IN HOURS
RCPWF	L PANEL WIDTH - FEET
RCRVDA	L REVEGETATION COST - \$/ACRE
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 - FRACTIO
RDCG	D ROTARY DRILL TOTAL INVESTMENT
RDCJ	D ROTARY DRILL HOURLY MAINT. MATERIAL COST - \$/HR
RDCK	D ROTARY DRILL HOURLY UTILITIES COST - \$/HR
RDCM	D ROTARY DRILL HOURLY BIT & PIPE COST - \$/HR
RDCN	D ROTARY DRILL HOURLY OPERATING COST - \$/HR
RDCP	D ROTARY DRILL HOURLY OWNERSHIP COST - \$/HR
RDCR	D ROTARY DRILL HOURLY MAINT. LABOR COST - \$/HR
RDCRCP	D DRILL COMPLEX PRODUCTION - M YDS/YEAR
RDCRDP	D DRILL DEFERRED PURCHASE
RDCRF5	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
RDD1F(3)	D DRILL DATA FILE CODE
RDD1ID	D EQUIPMENT ID
RDD1MO	D MINING OPERATION
RDD1S(4)	D DRILL EQUIPMENT SIZE
RDD1T(3)	D DRILL EQUIPMENT TYPE
RDD2BY	D DRILL INVESTMENT BASE YEAR
RDD2CO	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 MAINTENANCE LABOR COST - \$/HR
RDD3MM	D DRILL HOURLY MAINTENANCE MATERIAL COST - \$/HR
RDD3MO	D MINING OPERATION
RDD3OT	D DRILL HOURLY OTHER COST - \$/HR
RDMN(3)	D ROTARY DRILL DATA FILE MODEL NAME
RDM1C1	D DRILL MAINTENANCE LABOR CLASS 1
RDM1F1	D DRILL MAINTENANCE LABOR FRACTION 1
RDM1ID	D EQUIPMENT ID
RDM1MO	D MINING OPERATION
RDM1S1	D DRILL MAINTENANCE LABOR SCHEDULE 1
RDO1C1	D DRILL OPERATOR CLASS 1
RDO1C2	D DRILL OPERATOR CLASS 2
RDO1ID	D EQUIPMENT ID
RDO1MO	D MINING OPERATION
RDO1Q1	D DRILL OPERATOR QUANTITY 1
RDO1Q2	D DRILL OPERATOR QUANTITY 2
RDO1S1	D DRILL OPERATOR SCHEDULE 1
RDO1S2	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 REQUIRED NUMBER 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 REVEGETATION COMPLEX PRODUCTION - M ACRES/YEAR
RVCRDP	L REVEGETATION DEFERRED PURCHASE
RVCRFS	L REVEGETATION FLEET SPARES
RVCRID	L REVEGETATION EQUIPMENT ID
RVCRLO	L REVEGETATION LIFE OF OPERATION
RVCRMO	L REVEGETATION MINING OPERATION
RVCRNY	L REVEGETATION NO. OF YEARS STARTUP
RVCRQH	L REVEGETATION OPERATING HOURS/YEAR
RVCRPL	L REVEGETATION PURCHASE LEAD TIME
RVCRQT	L REVEGETATION EQUIPMENT QUANTITY
RVCRSE	L REVEGETATION STARTUP EFFICIENCY
RVCRSH	L REVEGETATION SCHEDULED HOURS/YEAR
RVCRSY	L REVEGETATION START YEAR
RVD1ID	L EQUIPMENT ID
RVD1MO	L MINING OPERATION
RVD1T(3)	L REVEGETATION EQUIPMENT TYPE
RVD3ID	L EQUIPMENT ID
RVD3MO	L MINING OPERATION
RVD3OT	L REVEGETATION HOURLY OTHER - \$/HR
SCCG	L SCRAPER UNIT INVESTMENT - M\$
SCCJ	L SCRAPER HOURLY MAINTENANCE LABOR 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
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
SCCRQH	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 CCST OF SCRAPERS - \$/TON
SCD1F(3)	L SCRAPER FILE CODE
SCD1ID	L EQUIPMENT ID
SCD1MO	L MINING OPERATION
SCD1S(4)	L SCRAPER EQUIPMENT SIZE
SCD1T(3)	L SCRAPER EQUIPMENT TYPE
SCD2BY	L SCRAPER BASE YEAR
SCD2CO	L SCRAPER CONSTRUCTION CODE
SCD2DL	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
SCD2UT	L SCRAPER UNIT INVESTMENT - M\$
SCD3FU	L SCRAPER HOURLY FUEL COST - \$/HR
SCD3ID	L EQUIPMENT ID
SCD3ML	L SCRAPER HOURLY MAINTENANCE LABOR - \$/HR
SCD3MM	L SCRAPER HOURLY MAINTENANCE MATERIALS - \$/HR
SCD3MO	L MINING OPERATION
SCD3TI	L SCRAPER HOURLY TIRE COST - \$/HR
SCMN(3)	L SCRAPER DATA FILE MODEL NAME
SCM1C1	L SCRAPER MAINTENANCE LABOR CLASS 1
SCM1F1	L SCRAPER MAINTENANCE LABOR FRACTION 1
SCM1ID	L EQUIPMENT ID
SCM1MO	L MINING OPERATION
SCM1S1	L SCRAPER MAINTENANCE LABOR SCHEDULE 1
SCO1C1	L SCRAPER OPERATOR CLASS 1
SCO1ID	L EQUIPMENT ID
SCO1MO	L MINING OPERATION
SCO1Q1	L SCRAPER OPERATOR QUANTITY 1
SCO1S1	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 MAINTENANCE MATERIALS 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 MAINTENANCE LABOR COST - \$/HR
SDCRCP	C SHOVEL COMPLEX PRODUCTION CDRTY*1000
SDCRDP	C SHOVEL DEFERRED PURCHASE
SDCRFS	C SHOVEL FLEET SPARES
SDCRID	C EQUIPMENT ID
SDCRLO	C SHOVEL LIFE OF OPERATION
SDCRMO	C MINING OPERATION
SDCRNY	C SHOVEL NO. YEARS STARTUP
SDCROH	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
SDD1F(3)	C SHOVEL FILE CODE
SDD1ID	C EQUIPMENT ID
SDD1MO	C MINING OPERATION
SDD1S(4)	C SHOVEL EQUIPMENT SIZE
SDD1T(3)	C SHOVEL EQUIPMENT TYPE
SDD2BY	C SHOVEL BUY YEAR

SDD2CO	C SHOVEL CONSTRUCTION CODE
SDD2DH	C SHOVEL DEPRECIATION HOURS
SDD2DM	C SHOVEL DEPRECIATION METHOD
SDD2EF	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 MAINTENANCE LABOR COST - \$/HR
SDD3MM	C SHOVEL HOURLY MAINTENANCE MATERIALS COST \$/HR
SDD3MO	C MINING OPERATION
SDII	C LEAST COST SHOVEL INVESTMENT COST
SDI1ID	C EQUIPMENT ID
SDMN(3)	C SHOVEL MODEL NUMBER
SDM1C1	C SHOVEL MAINTENANCE LABOR CLASS 1
SDM1F1	C SHOVEL MAINTENANCE LABOR FRACTION 1
SDM1ID	C EQUIPMENT ID
SDM1MO	C MINING OPERATION
SDM1S1	C SHOVEL MAINTENANCE 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
SDO1MO	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 CAPACITY - CU. YDS. / H
STDT	C COMBINATION COST PER TON - \$/TON
STKY	C SHOVEL - TRUCK COMBINATION KEY
STLC(6)	C LEAST COST SHOVEL/TRUCK DATA
STGAD	C OWNERSHIP AND OPERATING COST - \$/HR/PIT
SWDH	O SAFE WORKING DISTANCE FROM EDGE OF HIGHWALL
TDCA	C TRUCK PURCHASE PRICE - M\$
TDCG	C TRUCK INVESTMENT COST - M\$
TDCJ	C TRUCK HOURLY MAINTENANCE 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 MAINTENANCE LABOR COST - \$/HR
TDCRCP	C TRUCK COMPLEX PRODUCTION CDRTY*1000
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
TDD1F(3)	C TRUCK FILE CODE
TDD1ID	C EQUIPMENT ID
TDD1MO	C MINING OPERATION
TDD1S(4)	C TRUCK EQUIPMENT SIZE
TDD1T(3)	C TRUCK EQUIPMENT TYPE
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 MAINTENANCE LABOR COST - \$/HR
TDD3MM	C TRUCK HOURLY MAINTENANCE MATERIALS COST - \$/HR
TDD3MO	C MINING OPERATION
TDD3TI	C TRUCK HOURLY TIRE COST - \$/HR
TDII	C LEAST COST TRUCK INVESTMENT COST
TDMN(3)	C TRUCK DATA FILE MODEL NUMBER
TDM1C1	C TRUCK MAINTENANCE LABOR CLASS 1
TDM1F1	C TRUCK MAINTENANCE LABOR FRACTION 1
TDM1ID	C EQUIPMENT ID
TDM1MO	C MINING OPERATION
TDM1S1	C TRUCK MAINTENANCE LABOR SCHEDULE 1
TDNO	C INTEGER NUMBER OF TRUCKS REQUIRED / PIT
TDO1C1	C TRUCK OPERATOR CLASS 1
TDO1ID	C EQUIPMENT ID

TDO1M0	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
TODF	D TOTAL OUTCROP DIST. - FEET
TRF	A TOTAL RESISTANCE ON TOPSOIL HAUL ROAD
TRHR	C NUMBER OF TRUCKS SHOVEL CAN LOAD IN ONE HOUR
TTL	C TIME FOR SHOVEL TO LOAD TRUCK
VBBY	A VOL. OVERBURDEN BANK YARDS
VCBY	A VOL. COAL BANK YARDS
VCRT	A VOL. COAL RCM TONS
XNS	C FRACTIONAL NUMBER OF SHOVELS REQUIRED
XNT	C FRACTIONAL NUMBER OF TRUCKS REQUIRED

APPENDIX D
DEFAULT VALUES LISTING

ANGLE	O	23.97
BEFH	O	23.46
BEX	O	0,200,350,650,950,1250,1550,1850,0,0
BEY	O	0,23.46,39.72,47.48,58.18,58.24,51.92,
BEY	O	41.04,0,0
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	1665.
CDCRPL	L	1.
CDCRSE	L	.8
CDCRSH	L	1850.
CDCRSY	L	7.
CDD2BY	L	0.
CDD2CO	L	0.
CDD2DM	L	1.
CDD2EF	L	0.0
CDD2PC	L	2.
CDD2RA	L	1.
CDD2SF	L	0.0
CDM1C1	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.
CDSK	L	410.
CHCT	C	.5
CHFF	C	0.95
CHHD	C	29645.
CHSD	C	.0
CHSW	C	0.
CHTD	C	.1
CPH	O	60.

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
DLAC	0	0.
DLCEL	0	.100000E-01
DLCRDP	0	.000000
DLCRFS	0	.000000
DLCROH	0	7467.00
DLCRPL	0	4.00000
DLCRSE	0	.800000
DLCRSH	0	8297.00
DLCRSY	0	7.00000
DLDY	0	30.0000
DLD1F1	0	.000000
DLD1F2	0	.000000
DLD1F3	0	.000000
DLD1I0	0	.000000
DLD1S1	0	70.0000
DLD1S2	0	.000000
DLD1S3	0	.000000
DLD1S4	0	.000000
DLD1T1	0	.000000
DLD1T2	0	.000000
DLD1T3	0	.000000
DLD2BY	0	0.00000
DLD2CO	0	.000000
DLD2DM	0	1.00000
DLD2EF	0	.000000
DLD2PC	0	5.00000
DLD2RA	0	1.00000
DLD2SF	0	.000000
DLD3FU	0	.000000
DLD3OT	0	.000000
DLD3TI	0	.000000
DLD3WA	0	.000000
DLEDR	0	260.
DLFDP	0	.720000
DLMIC1	0	6
DLM1Q1	0	1
DLM1S1	0	10
DLO1C1	0	2.00000
DLO1C2	0	8.00000

DLO1C3	O	9.00000
DLO1D	O	.000000
DLO1Q1	O	1.00000
DLO1Q2	O	1.00000
DLO1Q3	O	1.00000
DLO1S1	O	12.0000
DLO1S2	O	12.0000
DLO1S3	O	12.0000
DLSB	O	30.0000
DLSHY	O	8297.00
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
EMAX	O	50.
ESD	O	.8333
FFP	O	.95
GACRLO	G	32,32,32,32,32,32,32,32,32,32,32,32,32,32
GACRNY	G	1,1,1,1,1,1,1,1,1,1,1,9,1
GACROH	G	2000., 2000., 2000., 2000., 2000., 2000., 20
GACROH	G	2000., 2000., 2000., 2000., 2000., 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.,1.
GACRSY	G	7,7,7,7,7,7,7,7,7,7,7,7,1,7
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	1,1,1,1,1,1,1,1,1,1,1,1
GAD2EF	G	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.,1.
GMAX	O	3000.
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	492.
G13OCL	G	24
G13OSC	G	3
G13PRC	G	.16

G15ROY	G	.25
G15STX	G	0.
G15UNI	G	.11
G2DSQF	G	36.25
G2EXPI	G	.85
G2EXP2	G	.9
G2EXP3	G	.75
G2MSFF	G	65000.
G2MSFW	G	200.
G2SQF	G	135000.
G3CCF	G	4500000.
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
G8MR	G	50.
G8PERC	G	.1
G8SR	G	250.
G8YRS	G	30.
G9AHOL	G	40.
G9CCF	G	1000.
ISX	O	98
KOUNT	O	0
LFCC	A	1.
LFCCF	A	3
LMCRDP	L	0.
LMCRFS	L	0.
LMCROH	L	1665.
LMCRPL	L	0.
LMCRQT	L	1.
LMCRSE	L	0.0
LMCRSH	L	1850.
LMCRSY	L	8.
LOGDL	O	1.
NEX	O	8.
NP	O	0
NPX	O	0
NS	O	1
O2CN	O	26.86
O2D2DH	O	24000
O2D2UI	O	135.3
O3CN	O	45.31
O3D2DH	O	12000
O3D2UI	O	123.0

PMAX	O	50.
PNPS	P	0.
PO	O	2.
PPBHF	A	1.0036, 1.0373, 1.06
PPBHV	A	10990., 12760., 13084
PPBSF	A	0.99, 0.825, 0.787
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.
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
PPD2DM	P	1.
PPD2EF	P	0.
PPD2PC	P	5.
PPD2RA	P	1.
PPD2SF	P	0.
PPECF	P	45.05, 99.87, 22.12, 19.08, 128.12, 185.,
PPECF	P	128.12, 314.65, 128.12
PPECX	P	1., 1., 1., 1., 1., 1., 1., 1., 1.
PPEQTY	P	3., 3., 3., 3., 3., 3., 3., 3., 3.
PPFCF	P	0., 0., 0., 12.41, 0., 15.45, 0., 17.93,
PPFCX	P	0., 0., 0., .8, 0., .75, 0., .7, 0.
PPLCF	P	68.78, 105.53, 55.83, 79.24, 143.62, 161.0
PPLCF	P	166.80, 220.21, 189.99
PPLCX	P	.35, .35, .35, .35, .35, .35, .35, .35, .35, .3
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

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, .3
PPMMF	P	122.07, 309.86, 10.33, 43.67, 101.25, 287
PPMMF	P	101.25, 516.37, 101.25
PPMMX	P	.8, .8, .8, .8, .5, .75, .5, .7, .5
PPMS	P	9*5
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
PPDS	P	5, 9, 12, 9, 5, 9, 5, 9, 5
PPOWCF	P	3625., 5438., 8712., 5438., 2000., 5438.,
PPOWCF	P	2000., 5438., 2000.
PPPSF-1	P	2, 2, 3, 0, 0, 0, 0, 0
PPPSF-2	P	8.5, 2, 0, 0, 0, 0, 0, 0
PPPSF-3	P	2, 2, 1, 0, 0, 0, 0, 0
PPPSF-4	P	2, 2, 3, 1, 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
PPPSX	P	.35, .35, .35, .35, .35, .35, .35, .35, .
PPSDY	P	250.
PPWCF	P	0., 0., 0., 0., 0., 2.40, 0., 4.20, 0.
PPWCX	P	0., 0., 0., 0., 0., 1., 0., 1., 0.
PTF	Q	.95
QDCG	Q	37.3
QDCJ	Q	.68
QDCK	Q	.90
QDCM	Q	3.6
QDCN	Q	17.46
QDCP	Q	3.30
QDCR	Q	1.02
QDCRDP	Q	0.
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.
QDO1Q1	Q	1.
QDO1S1	Q	1.
QDP7	Q	20000.
QDRN	Q	23.
QLCRDP	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
RADIUS	O	6550.
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.
RVCRDP	L	0.
RVCRFS	L	0.
RVCROH	L	1665.
RVCRPL	L	0.
RVCRQT	L	1.
RVCRSE	L	0.0
RVCRSH	L	1850.
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.
SCCROH	L	1665.
SCCRPL	L	1.
SCCRSE	L	0.0
SCCRSH	L	1850.
SCCRSY	L	7.
SCD2BY	L	0.
SCD2CD	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	688.
SDCG	C	763.4
SDCJ	C	15.03
SDCK	C	2.30
SDCN	C	46.79

SDCP	C	20.77
SDCR	C	5.01
SDCRCP	C	0.
SDCRDP	C	0.
SDCRFS	C	0.
SDCRID	C	0.
SDCRLO	C	30.
SDCRMO	C	0.
SDCRNY	C	0.
SDCROH	C	1631
SDCRPL	C	2.
SDCRQT	C	0.
SDCRSE	C	.8
SDCRSH	C	1813.
SDCRSY	C	7.
SDD2BY	C	0.
SDD2CO	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	1.
SDO1S2	C	1.
SDP7	C	60000.
SDRN	C	31.
SDST	C	425.
SDSW	C	12.
SWDH	0	3.
TDCA	C	317.6
TDCG	C	292.6
TDCJ	C	12.39
TDCK	C	9.36
TDCM	C	13.75
TDCN	C	55.01
TDCP	C	21.94
TDCR	C	8.26
TDCRCP	C	0.
TDCRDP	C	0.
TDCRFS	C	0.
TDCRID	C	0.
TDCRLO	C	30.
TDCRMO	C	0.
TDCRNY	C	0.

TDCROH	C	1631.
TDCRPL	C	1.
TDCRQT	C	0.
TDCRSE	C	.8
TDCRSH	C	1813.
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.
TDD1C1	C	11.
TDD1Q1	C	1.
TDD1S1	C	1.
TDP7	C	20000.
TDRN	C	53
TDSC	C	1000.
TDSL	C	300.