27
10-28-77
25 DXTLS

K/CSD/TM-17

MASTER

COMPUTER SCIENCES DIVISION

SCOPE :
SYNERGISTIC COMPUTER OPTIMIZATION OF PLANNING
FOR ENRICHMENT
STATUS REPORT

R. C. DeLozier
D. M. Kelleher
K. E. Cross

UNION
CARBIDE

OAK RIDGE GASEOUS DIFFUSION PLANT
OAK RIDGE, TENNESSEE

prepared for the U.S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
under U.S. GOVERNMENT Contract W-7405 eng 26

DISTRIBUTION

DOCUMENT IS UNLIMITED

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

Contract No. W-7405 eng 26

COMPUTER SCIENCES DIVISION

SCOPE

SYNERGISTIC COMPUTER OPTIMIZATION OF PLANNING
FOR ENRICHMENT

STATUS REPORT

R. C. DeLozier
D. M. Kelleher
K. E. Cross

Computing Applications Department

July, 1977

— NOTICE —
This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Energy Research and Development Administration, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

UNION CARBIDE CORPORATION, NUCLEAR DIVISION
operating the
Oak Ridge Gaseous Diffusion Plant . Oak Ridge National Laboratory
Oak Ridge Y-12 Plant . Paducah Gaseous Diffusion Plant
for the
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

leg

TABLE OF CONTENTS

	Page
List of Figures	7
Abstract	9
1. Introduction	11
2. Description of the Code	15
2.1 The Main Program	15
2.2 The Order Auxiliary Program	20
2.3 The Inventory Auxiliary Program	20
3. Heuristic Methods	21
4. Output Reports	23
5. Future Work	38
6. Conclusions and Recommendations	39
References	41
Acknowledgments	43

LIST OF FIGURES

Figure		Page
1	Illustration of SCOPE Package	13
2	Cascade Model	17
3	Example of Separative Capacity Versus Power for Oak Ridge Gaseous Diffusion Plant	19
4	Example of Daily Output	25
5	Example of Tagged Inventory	27
6	Example of Unobligated Inventory	28
7	Example of Total Inventory	29
8	Example of Quarterly Output	31
9	Example of Assay Summary Output	32
10	Example of Operating Parameters Summary Output	33
11	Example of Important Calculational Summary	34
12	Example of Assay Plot	35
13	Example Plot of ERDA Feed Requirements	36
14	Example of Delay Plot	37

SCOPE
SYNERGISTIC COMPUTER OPTIMIZATION OF PLANNING
FOR ENRICHMENT
STATUS REPORT

R. C. DeLozier
D. M. Kelleher
K. E. Cross

ABSTRACT

The computer program SCOPE was developed to provide a schedule for filling orders for enriched uranium while constrained by: (1) the size and efficiency of the current and projected uranium enrichment complex; (2) the current levels of "yard inventory" of enriched uranium below 5%; and (3) variable conditions such as projected schedule of power availability, cascade tails assay, and the ERDA "Order Book" of firm and projected orders for enriched uranium. The program can be extended to include several more enrichment plants, such as a centrifuge plant. Output includes a detailed daily set of feed and withdrawal rates for each plant and a survey of all yard inventories at the end of each month.

The Phase I program does not contain cost tables; therefore, it cannot consider costs directly at this time. However, it does use heuristic procedures to establish preproduction schedules that will result in lower ERDA feed usage and, consequently, lower costs. The program currently relies on two files for data used in calculations. The first data set consists of all current UF_6 inventories at the plants; the second data set contains the ERDA enrichment requirements.

1. INTRODUCTION

The computer program package SCOPE is described briefly in this report. The program has been under development since June, 1973, by the Computer Sciences and Operations Analysis and Planning Divisions. The SCOPE program is being developed to aid in improving cascade complex production efficiency by refining scheduling procedures. Currently, the three gaseous diffusion plants operate on a short-term interactive scheduling philosophy which can be viewed as a batch process. In other words, when enrichment orders are received, a decision is made where and when the order will be pulled. Then the required staging, power, and feed alterations at each plant are optimized using the General Productivity Code¹ to process that plant's orders for the time period. It is hoped that by using SCOPE, the orders can be allocated such that the power schedules, feed alterations, and list of commitments can be considered over an extended period of time. Furthermore, the program, given certain constraints, will evaluate the preproduction assays that should be withdrawn over the campaign.

In the past, no real scheduling problems have occurred because of the relatively small demands. However, with the number of nuclear power plants increasing each year, the existing gaseous diffusion plants will be incapable of meeting orders in a very few years. Therefore, it is necessary that a comprehensive scheduling model be developed to determine the optimal or near-optimal method of operation that will fill the anticipated demands at a minimum cost.

The computer program SCOPE was developed to provide a schedule for filling orders for enriched uranium while constrained by: (1) the size and efficiency of the current and projected uranium enrichment complex; (2) the current levels of "yard inventory" of enriched uranium below 5%; and (3) variable conditions such as projected schedule of power availability, cascade tails assay, and the ERDA "Order Book" of firm and projected orders for enriched uranium. Variables considered include reactor returns, power schedules, design capacity as a function of time, feed alterations, and list of order commitments. Output includes a detailed daily set of feed and withdrawal rates for each plant and a survey of all yard inventories at the end of each month.

The program currently relies on two disk files for data used in calculations. The first disk consists of all yard inventories at existing plants; the second data set contains the future ERDA enrichment requirements.

The SCOPE package should provide a computer-based tool that can compare various philosophies associated with operating several enrichment plants. The package consists of one main program and two auxiliary codes. The SCOPE system is illustrated in Figure 1. The first auxiliary program is used to generate a cylinder inventory data set, disk 1. This information is selectively retrieved from uranium accountability data sources. The second auxiliary program is used to generate the future enrichment requirements data set, disk 2. This information is selectively retrieved from the Civilian Enrichment Requirements Program (CERP) data set. The two data sets (disks 1 and 2) can be updated as often as at

FIGURE 1

Illustration of SCOPE Package

one-month intervals. This data is used by the SCOPE main program to model an operating interval under an operating philosophy which is defined by the card input at execution time.

2. DESCRIPTION OF THE CODE

The SCOPE programs are designed to model the interaction of several uranium enrichment plants. As indicated in Figure 1, the package consists of a main program which models the plant operations and two auxiliary programs that convert order and yard inventory files to a form acceptable to the main program.

The current program requires about 5 minutes of CPU time to simulate 10 years of plant operation using the infinite cylinders option. The actual clock time from run request until the time when all output is received is approximately 24 hours. The run produces about 30,000 lines of print, uses 350K of core, and generates 15K of I/O. The I/O requirements are used in generating microfiche output for detailed reports.

2.1 The Main Program

The main program is designed to model the operation of the uranium enrichment facilities on a quarter-by-quarter basis over a long period of time. The program requires as input an order list, a yard inventory file, a power schedule, and operating assays. The program generates daily cascade operations reports, quarterly summary reports, and quarterly yard inventory reports.

Several options are available during program execution. The order list can be either read from a data file created by the order auxiliary programs or input on punched cards. The yard inventory can be handled as individual cylinders or modeled as a smaller group of very large cylinders consisting of the individual cylinders aggregated by assay

ranges. This feature is useful for multiple runs where the time required per run is greatly reduced. The program can be set to look ahead during execution to produce orders in the cascades ahead of the quarter in which they are due and store them in the yard for later retrieval. The pre-production assay can be changed during the run based on future order expectations and the inventory.

The cascade operation shown in Figure 2 is simulated on a day-to-day basis. The feed and product streams shown in this figure are assigned an assay level, and the program determines the flow rates of each stream using a mathematical model. Each flow rate is calculated such that maximum and minimum flow constraints are satisfied. Therefore, there may be times when the power usage is less than that scheduled because some flow rate maximum would be exceeded under the schedule requested.

The cascade mathematical model is derived from the mass, isotopic, and separative work continuities:

$$\frac{\partial M}{\partial \theta} = \sum_{j=1}^{j_{\max}} P_j + \sum_{k=1}^{k_{\max}} W_k - \sum_{\ell=1}^{\ell_{\max}} F_{\ell} \quad (1)$$

$$\frac{\partial U}{\partial \theta} = \sum_{j=1}^{j_{\max}} (P_j x_{Pj}) + \sum_{k=1}^{k_{\max}} (W_k x_{wk}) - \sum_{\ell=1}^{\ell_{\max}} (F_{\ell} x_{F\ell}) \quad (2)$$

$$S = \sum_{j=1}^{j_{\max}} (P_j V_{Pj}) + \sum_{k=1}^{k_{\max}} (W V_{wk}) - \sum_{\ell=1}^{\ell_{\max}} (F V_{F\ell}) \quad (3)$$

SYMBOL

F_m

P_m

W_m

x_{Fm}

x_{Pm}

x_{wm}

DEFINITION

Feed, lb/day, at location m

Product, lb/day, at location m

Tails, lb/day, at location m

Feed assay of mth location

Product assay of mth location

Tails assay of mth location

FIGURE 2

Cascade Model

where the separative capacity,

$$S = SW - \frac{\partial M}{\partial \theta} V_a. \quad (4)$$

The value functions for product, waste, feed, and average cascade are denoted by V_{Pj} , V_{wk} , V_{Fl} , and V_a , respectively, where the assay of the appropriate stream is used in the function

$$V = \alpha + \beta X + (2X - 1) \ln \left(\frac{X}{X-1} \right). \quad (5)$$

The coefficients α and β are evaluated by setting equation (5) equal to zero at the transaction tails assay and normal feed assay (.711%).

The total mass of uranium in the plant is denoted by M , the total amount of the isotope U-235 is denoted by U , and the operator $\frac{\partial}{\partial \theta}$ indicates the partial with respect to time.

For the computer model describing the Oak Ridge and Portsmouth plants, one feed stream at each plant is assigned to use Paducah product, and one stream is assigned to the preproduction assay. The orders are received as a list each quarter and can be produced at any of the plants if within certain assay restrictions. They are allocated to the three plants based on the available separative work at each plant.

The separative work available at each plant denoted as SW in equation (4) is determined from the power schedule read in and the enrichment complex physical model stored as power versus separative work tables within the program. An example plot of these tables for ORGDP is shown in Figure 3. The program reads the power available from the input data and finds the separative work available by interpolating between entries on the table for that fiscal year. There is a different table

FIGURE 3

Example of Separative Capacity Versus Power
for Oak Ridge Gaseous Diffusion Plant

for each fiscal year from 1977 to 1987, and all subsequent years use the 1987 table. The program can receive separative work data along with the power data and use those values for separative work rather than the tables.

2.2 The Order Auxiliary Program

The order list can be entered manually into the program as card input or can be drawn from the Civilian Enrichment Requirements Program (CERP) files as indicated in Figure 1. A set of auxiliary programs reads, manipulates, and writes out the order file on another file. The program can pass on or reject orders based on the type of order. The program can also group the orders by assay range.

2.3 The Inventory Auxiliary Program

The uranium inventory is taken from the computerized uranium accountability files managed by the three plants. As shown in Figure 1, an auxiliary program searches the file and retrieves records on the cylinders of UF_6 . The cylinders are then classified according to type. The file created by this operation is then read directly into SCOPE and provides an initial yard inventory for each study.

3. HEURISTIC METHODS

The original operating schedules for SCOPE were determined using daily scheduling techniques which satisfied feed and power restriction of the plants while attempting to meet commitments for product. Many operating parameters such as preproduction assay were chosen as input data before a run was made. Many runs with different input data were made to find more desirable operating schedules. This approach required considerable machine time for multiple runs and a long delay in determining what cases to try. A desirable extension to a model like SCOPE is to assign values to parameters and then to automate the manipulation of input variables in a manner that yields an optimum solution.

With the many goals in the operation of an enrichment plant such as low feed requirements, minimum order delays, and smooth feed and withdrawal schedules, an optimum solution is at best difficult to even define. Also, with the many variables that could be changed and the infinite operations schedules possible, it may be impractical to find an optimum schedule. However, decision rules and calculations can be made to determine how to choose values of variables such that a very good, if not optimal, solution is obtained. A heuristic approach can often yield a near-optimal solution with a relatively small investment in increased running time for a model.

The initial variables to be manipulated automatically by the model are the yearly preproduction assays. The choice of a preproduction assay for each quarter is made by the model after a production schedule for all previous quarters has been determined. The available data such

as stockpiles and future demands is evaluated and a preproduction assay chosen for the next quarter. This procedure is repeated for each quarter of a campaign.

The first heuristic program looked ahead and chose a preproduction assay for which demand exceeded the current stockpile by the greatest amount. This procedure is a yard leveling scheme which attempts to avoid delaying orders and also yields great flexibility in case the order schedule is changed.

In addition to filling orders without delays, using less ERDA feed is a desirable goal which will reduce costs. In order to reduce feed usage, it is desirable to preproduce high assay material first. This is accomplished by modifying the heuristic calculations to continue producing the highest assay allowable until the stockpile of that material meets all future demands. Although this procedure uses less feed early, it does not have the ability to meet changes in orders as well as the yard leveling scheme. Other decision rules can be incorporated easily to consider other desirable operations goals.

4. OUTPUT REPORTS

Three types of reports are generated by the main program. The detail reports contain all of the information generated by the program. They are usually written on microfiche to save paper. Summary reports are generated for each quarter and are printed on paper. A temporary data set is written on disk file and analyzed by another program that generates graphical output of summary information presented in the summary reports.

The detail reports show all of the information generated by the main program. The three types of information shown are input data, intermediate results, and final results. The input data shown includes the flag options, run dates, and initial inventory. The order lists and operating assays for each quarter are also shown. The intermediate results shown include the list of orders sent to the cascade and the daily balances made by the cascade model. An example of daily balances made by the cascade is shown in Figure 4. The final results shown include orders delayed and an ending inventory. The ending inventory is separated into three groups of material. The first group, shown in Figure 5, is the orders produced that quarter to fill a total short-range demand. These orders are stored in the yard for later retrieval and are called "tagged" orders. The second group, shown in Figure 6, is the rest of the inventory. The third group, shown in Figure 7, represents the total inventory and is the sum of the first two groups.

The summary reports show a page of operating information and the ending inventory for each quarter. The operating information shown includes the operating assays, plant power and separative work, orders

OPERATING REPORT
FOR MONTH 1/ 77

* DATE *	* FEED *	* PRODD. *	* TAILS *	* SEP WORK *	* POWER *	* COMMENTS *
* NO. *	* ASSAY *	* AMOUNT*NO. *	* ASSAY *	* AMOUNT*NO. *	* ASSAY *	* AMOUNT*NO. *
* (10-3) *	* (10-3) *					
* 1/ 2/77 *	1.* 0.711*	67809.50* 1.*	2.700*	17935.86* 1.*	0.250*	62962.23*
* 1/ 2/77 *	2.* 1.750*	17572.41* 2.*	3.300*	4483.96* 2.*	0.250*	0.0 *
* TOTALS *		85382. *	22420. *			62962. *
* 1/ 3/77 *	1.* 0.711*	67809.50* 1.*	2.700*	12799.35* 1.*	0.250*	62962.23*
* 1/ 3/77 *	2.* 1.750*	17572.41* 2.*	3.300*	4483.96* 2.*	0.250*	0.0 *
* TOTALS *		85382. *	21044. *			62962. *
* 1/ 4/77 *	1.* 0.711*	64110.66* 1.*	3.000*	15509.16* 1.*	0.250*	61338.14*
* 1/ 4/77 *	2.* 1.750*	16613.86* 2.*	3.300*	3877.29* 2.*	0.250*	0.0 *
* TOTALS *		80725. *	19386. *			61338. *
* 1/ 5/77 *	1.* 0.711*	64110.66* 1.*	3.000*	15509.16* 1.*	0.250*	61338.14*
* 1/ 5/77 *	2.* 1.750*	16613.86* 2.*	3.300*	3877.29* 2.*	0.250*	0.0 *
* TOTALS *		80725. *	19386. *			61338. *
* 1/ 6/77 *	1.* 0.711*	64110.66* 1.*	3.000*	15509.16* 1.*	0.250*	61338.14*
* 1/ 6/77 *	2.* 1.750*	16613.86* 2.*	3.300*	3877.29* 2.*	0.250*	0.0 *
* TOTALS *		80725. *	19386. *			61338. *
* 1/ 7/77 *	1.* 0.711*	64110.66* 1.*	3.000*	15509.16* 1.*	0.250*	61338.14*
* 1/ 7/77 *	2.* 1.750*	16613.86* 2.*	3.300*	3877.29* 2.*	0.250*	0.0 *
* TOTALS *		80725. *	19386. *			61338. *
* 1/ 8/77 *	1.* 0.711*	64110.66* 1.*	3.000*	15509.16* 1.*	0.250*	61338.14*
* 1/ 8/77 *	2.* 1.750*	16613.86* 2.*	3.300*	3877.29* 2.*	0.250*	0.0 *
* TOTALS *		80725. *	19386. *			61338. *
* 1/ 9/77 *	1.* 0.711*	64110.66* 1.*	3.000*	15509.16* 1.*	0.250*	61338.14*
* 1/ 9/77 *	2.* 1.750*	16613.86* 2.*	3.300*	3877.29* 2.*	0.250*	0.0 *
* TOTALS *		80725. *	19386. *			61338. *
* 1/10/77 *	1.* 0.711*	64110.66* 1.*	3.000*	15509.16* 1.*	0.250*	61338.14*
* 1/10/77 *	2.* 1.750*	16613.86* 2.*	3.300*	3877.29* 2.*	0.250*	0.0 *
* TOTALS *		80725. *	19386. *			61338. *
* 1/11/77 *	1.* 0.711*	64110.66* 1.*	3.000*	15509.16* 1.*	0.250*	61338.14*
* 1/11/77 *	2.* 1.750*	16613.86* 2.*	3.300*	3877.29* 2.*	0.250*	0.0 *
* TOTALS *		80725. *	19386. *			61338. *
* 1/12/77 *	1.* 0.711*	64110.66* 1.*	3.000*	15509.16* 1.*	0.250*	61338.14*
* 1/12/77 *	2.* 1.750*	16613.86* 2.*	3.300*	3877.29* 2.*	0.250*	0.0 *
* TOTALS *		80725. *	19386. *			61338. *
* 1/13/77 *	1.* 0.711*	64110.66* 1.*	3.000*	15509.16* 1.*	0.250*	61338.14*
* 1/13/77 *	2.* 1.750*	16613.86* 2.*	3.300*	3877.29* 2.*	0.250*	0.0 *
* TOTALS *		80725. *	19386. *			61338. *
* 1/14/77 *	1.* 0.711*	64110.66* 1.*	3.000*	15509.16* 1.*	0.250*	61338.14*
* 1/14/77 *	2.* 1.750*	16613.86* 2.*	3.300*	3877.29* 2.*	0.250*	0.0 *
* TOTALS *		80725. *	19386. *			61338. *
* 1/15/77 *	1.* 0.711*	64110.66* 1.*	3.000*	15509.16* 1.*	0.250*	61338.14*
* 1/15/77 *	2.* 1.750*	16613.86* 2.*	3.300*	3877.29* 2.*	0.250*	0.0 *
* TOTALS *		80725. *	19386. *			61338. *
* 1/16/77 *	1.* 0.711*	64110.66* 1.*	3.000*	15509.16* 1.*	0.250*	61338.14*
* 1/16/77 *	2.* 1.750*	16613.86* 2.*	3.300*	3877.29* 2.*	0.250*	0.0 *
* TOTALS *		80725. *	19386. *			61338. *
* 1/17/77 *	1.* 0.711*	64110.66* 1.*	3.000*	15509.16* 1.*	0.250*	61338.14*
* 1/17/77 *	2.* 1.750*	16613.86* 2.*	3.300*	3877.29* 2.*	0.250*	0.0 *
* TOTALS *		80725. *	19386. *			61338. *
* 1/18/77 *	1.* 0.711*	64110.66* 1.*	3.000*	15509.16* 1.*	0.250*	61338.14*
* 1/18/77 *	2.* 1.750*	16613.86* 2.*	3.300*	3877.29* 2.*	0.250*	0.0 *
* TOTALS *		80725. *	19386. *			61338. *
* 1/19/77 *	1.* 0.711*	64110.66* 1.*	3.000*	15509.16* 1.*	0.250*	61338.14*
* 1/19/77 *	2.* 1.750*	16613.86* 2.*	3.300*	3877.29* 2.*	0.250*	0.0 *
* TOTALS *		80725. *	19386. *			61338. *
* 1/20/77 *	1.* 0.711*	64110.66* 1.*	3.000*	15509.16* 1.*	0.250*	61338.14*
* 1/20/77 *	2.* 1.750*	16613.86* 2.*	3.300*	3877.29* 2.*	0.250*	0.0 *
* TOTALS *		80725. *	19386. *			61338. *
* 1/21/77 *	1.* 0.711*	64110.66* 1.*	3.000*	15509.16* 1.*	0.250*	61338.14*
* 1/21/77 *	2.* 1.750*	16613.86* 2.*	3.300*	3877.29* 2.*	0.250*	0.0 *
* TOTALS *		80725. *	19386. *			61338. *
* 1/22/77 *	1.* 0.711*	62051.48* 1.*	3.200*	14202.32* 1.*	0.250*	60378.80*
* 1/22/77 *	2.* 1.750*	16080.23* 2.*	3.300*	3550.58* 2.*	0.250*	0.0 *
* TOTALS *		78132. *	17753. *			60379. *
* 1/23/77 *	1.* 0.711*	62051.48* 1.*	3.200*	14202.32* 1.*	0.250*	60378.80*
* 1/23/77 *	2.* 1.750*	16080.23* 2.*	3.300*	3550.58* 2.*	0.250*	0.0 *
* TOTALS *		78132. *	17753. *			60379. *
* 1/24/77 *	1.* 0.711*	62051.48* 1.*	3.200*	14202.32* 1.*	0.250*	60378.80*
* 1/24/77 *	2.* 1.750*	16080.23* 2.*	3.300*	3550.58* 2.*	0.250*	0.0 *
* TOTALS *		78132. *	17753. *			60379. *
* 1/25/77 *	1.* 0.711*	62051.48* 1.*	3.200*	14202.32* 1.*	0.250*	60378.80*
* 1/25/77 *	2.* 1.750*	16080.23* 2.*	3.300*	3550.58* 2.*	0.250*	0.0 *
* TOTALS *		78132. *	17753. *			60379. *
* 1/26/77 *	1.* 0.711*	62051.48* 1.*	3.200*	14202.32* 1.*	0.250*	60378.80*
* 1/26/77 *	2.* 1.750*	16080.23* 2.*	3.300*	3550.58* 2.*	0.250*	0.0 *
* TOTALS *		78132. *	17753. *			60379. *
* 1/27/77 *	1.* 0.711*	62051.48* 1.*	3.200*	14202.32* 1.*	0.250*	60378.80*
* 1/27/77 *	2.* 1.750*	16080.23* 2.*	3.300*	3550.58* 2.*	0.250*	0.0 *
* TOTALS *		78132. *	17753. *			60379. *
* 1/28/77 *	1.* 0.711*	62051.48* 1.*	3.200*	14202.32* 1.*	0.250*	60378.80*
* 1/28/77 *	2.* 1.750*	16080.23* 2.*	3.300*	3550.58* 2.*	0.250*	0.0 *
* TOTALS *		78132. *	17753. *			60379. *
* 1/29/77 *	1.* 0.711*	62051.48* 1.*	3.200*	14202.32* 1.*	0.250*	60378.80*
* 1/29/77 *	2.* 1.750*	16080.23* 2.*	3.300*	3550.58* 2.*	0.250*	0.0 *
* TOTALS *		78132. *	17753. *			60379. *
* 1/30/77 *	1.* 0.711*	62051.48* 1.*	3.200*	14202.32* 1.*	0.250*	60378.80*
* 1/30/77 *	2.* 1.750*	16080.23* 2.*	3.300*	3550.58* 2.*	0.250*	0.0 *
* TOTALS *		78132. *	17753. *			60379. *
* 1/31/77 *	1.* 0.711*	62051.48* 1.*	3.200*	14202.32* 1.*	0.250*	60378.80*
* 1/31/77 *	2.* 1.750*	16080.23* 2.*	3.300*	3550.58* 2.*	0.250*	0.0 *
* TOTALS *		78132. *	17753. *			60379. *
* TOTALS *		2405111. *	570016. *			1833790. *

NOTE MONTHLY REPORT AND INVENTORY
INCLUDES FIRST DAY OF NEXT MONTH

* NO. *	* TOTAL FEED *	* TOTAL PRODD. *	* TOTAL WAST *	* PRODD. CYLD *	* WAST CYLD *
* 1 *	0.0	0.0	1894046.0	0	68
* 2 *	0.0	0.0	0.0	0	0
* 3 *	0.0	0.0	0.0	0	0
* 4 *	0.0	0.0	0.0	0	0
* 5 *	0.0	0.0	0.0	0	0
* 6 *	0.0	0.0	0.0	0	0
* 7 *	0.0	0.0	0.0	0	0
* 8 *	0.0	0.0	0.0	0	0
* 9 *	199729.8	30735.2	0.0	0	0
* 10 *	1710390.0	277783.9	0.0	0	0
* 11 *	61796.0	153948.9	0.0	0	0
* 12 *	0.0	2662.5	0.0	1	0
* 13 *	0.0	0.0	0.0	0	0
* 14 *	0.0	0.0	0.0	0	0
* 15 *	0.0	0.0	0.0	0	0
* 16 *	0.0	0.0	0.0	0	0
* 17 *	0.0	0.0	0.0	0	0
* 18 *	0.0	0.0	0.0	0	0
* 19 *	0.0	0.0	0.0	0	0
* 20 *	0.0	0.0	0.0	0	0
* 21 *	511009.4	0.0	0.0	0	0
* 22 *	0.0	121513.4	0.0	7	0
* TOTAL *	2482924.0	586583.9	1894046.0	8	68

OAK RIDGE TAGGED CYLINDER INVENTORY
AS OF 10/ 1/82

ASSAY	14-TON CYLINDERS			10-TON CYLINDERS			2.5-TON CYLINDERS			AMOUNT (MTU)
	SHIP.	UNSHIP.	THIN WALL	SHIP.	UNSHIP.	THIN WALL	SHIP.	UNSHIP.	THIN WALL	
0.001000	0	0	0	0	0	0	0	0	0	0.0
0.002000	0	0	0	0	0	0	0	0	0	0.0
0.003000	0	0	0	0	0	0	0	0	0	0.0
0.004000	0	0	0	0	0	0	0	0	0	0.0
0.005000	0	0	0	0	0	0	0	0	0	0.0
0.006000	0	0	0	0	0	0	0	0	0	0.0
0.007000	0	0	0	0	0	0	0	0	0	0.0
0.008000	0	0	0	0	0	0	0	0	0	0.0
0.009000	0	0	0	0	0	0	0	0	0	0.0
0.010000	0	0	0	0	0	0	0	0	0	0.0
0.011000	0	0	0	0	0	0	0	0	0	0.0
0.012000	0	0	0	0	0	0	0	0	0	0.0
0.013000	0	0	0	0	0	0	0	0	0	0.0
0.014000	0	0	0	0	0	0	0	0	0	0.0
0.015000	0	0	0	0	0	0	0	0	0	0.0
0.016000	0	0	0	0	0	0	0	0	0	0.0
0.017000	0	0	0	0	0	0	0	0	0	0.0
0.018000	0	0	0	0	0	0	0	0	0	0.0
0.019000	0	0	0	0	0	0	0	0	0	0.0
0.020000	0	0	0	0	0	0	0	0	0	0.0
0.021000	1	0	0	0	0	0	0	0	0	114.4469
0.022000	0	0	0	0	0	0	0	0	0	0.0
0.023000	1	0	0	0	0	0	0	0	0	21.9140
0.024000	1	0	0	0	0	0	0	0	0	8.2800
0.025000	1	0	0	0	0	0	0	0	0	11.8570
0.026000	1	0	0	0	0	0	0	0	0	144.2899
0.027000	0	0	0	0	0	0	0	0	0	0.0
0.028000	1	0	0	0	0	0	0	0	0	163.2856
0.029000	0	0	0	0	0	0	0	0	0	0.0
0.030000	0	0	0	0	0	0	0	0	0	515.9863
0.031000	0	0	0	0	0	0	0	0	0	0.0
0.032000	0	0	0	0	0	0	0	0	0	0.0
0.033000	0	0	0	0	0	0	0	0	0	0.0
0.034000	0	0	0	0	0	0	0	0	0	0.0
0.035000	0	0	0	0	0	0	0	0	0	0.0
0.036000	0	0	0	0	0	0	0	0	0	0.0
0.037000	0	0	0	0	0	0	0	0	0	0.0
0.038000	0	0	0	0	0	0	0	0	0	0.0
0.039000	0	0	0	0	0	0	0	0	0	0.0
0.040000	0	0	0	0	0	0	0	0	0	0.0
0.041000	0	0	0	0	0	0	0	0	0	0.0
0.042000	0	0	0	0	0	0	0	0	0	0.0
0.043000	0	0	0	0	0	0	0	0	0	0.0
0.044000	0	0	0	0	0	0	0	0	0	0.0
0.045000	0	0	0	0	0	0	0	0	0	0.0
0.046000	0	0	0	0	0	0	0	0	0	0.0
0.047000	0	0	0	0	0	0	0	0	0	0.0
0.048000	0	0	0	0	0	0	0	0	0	0.0
0.049000	0	0	0	0	0	0	0	0	0	0.0
0.050000	0	0	0	0	0	0	0	0	0	0.0
TOTALS	8	0	0	0	0	0	0	0	0	980.

FIGURE 5

Example of Tagged Inventory

OAK RIDGE FREE CYLINDER INVENTORY
AS OF 10/ 1/82

ASSAY	14-TON CYLINDERS			10-TON CYLINDERS			2.5-TON CYLINDERS			AMOUNT (MTU)
	SHIP.	UNSHIP.	THIN WALL	SHIP.	UNSHIP.	THIN WALL	SHIP.	UNSHIP.	THIN WALL	
0.001000	1	0	0	0	0	0	0	0	0	1.0646
0.002000	1	0	0	0	0	0	0	0	0	25620.4375
0.003000	2	0	0	0	0	0	0	0	0	47855.9023
0.004000	1	0	0	0	0	0	0	0	0	12.0410
0.005000	1	0	0	0	0	0	0	0	0	0.1830
0.006000	1	0	0	0	0	0	0	0	0	0.0310
0.007000	1	0	0	0	0	0	0	0	0	0.0
0.008000	1	0	0	0	0	0	0	0	0	0.0105
0.009000	1	0	0	0	0	0	0	0	0	0.0049
0.010000	1	0	0	0	0	0	0	0	0	0.0068
0.011000	1	0	0	0	0	0	0	0	0	0.0021
0.012000	1	0	0	0	0	0	0	0	0	0.0481
0.013000	1	0	0	0	0	0	0	0	0	0.3976
0.014000	1	0	0	0	0	0	0	0	0	111.5488
0.015000	1	0	0	0	0	0	0	0	0	0.0096
0.016000	1	0	0	0	0	0	0	0	0	0.0033
0.017000	1	0	0	0	0	0	0	0	0	0.2028
0.018000	2	0	0	0	0	0	0	0	0	734.3218
0.019000	2	0	0	0	0	0	0	0	0	0.0
0.020000	2	0	0	0	0	0	0	0	0	555.3611
0.021000	14	0	0	0	0	0	0	0	0	0.0000
0.022000	7	0	0	0	0	0	0	0	0	35.3413
0.023000	9	0	0	0	0	0	0	0	0	232.2513
0.024000	8	0	0	0	0	0	0	0	0	106.2970
0.025000	11	0	0	0	0	0	0	0	0	164.5862
0.026000	12	0	0	0	0	0	0	0	0	68.7006
0.027000	14	0	0	0	0	0	0	0	0	0.0001
0.028000	15	0	0	0	0	0	0	0	0	112.0903
0.029000	8	0	0	0	0	0	0	0	0	387.7852
0.030000	12	0	0	0	0	0	0	0	0	212.4202
0.031000	14	0	0	0	0	0	0	0	0	1044.1409
0.032000	9	0	0	0	0	0	0	0	0	1258.4939
0.033000	1	0	0	0	0	0	0	0	0	0.0
0.034000	1	0	0	0	0	0	0	0	0	147.2327
0.035000	1	0	0	0	0	0	0	0	0	17.2783
0.036000	1	0	0	0	0	0	0	0	0	0.0
0.037000	0	0	0	0	0	0	0	0	0	0.0
0.038000	0	0	0	0	0	0	0	0	0	0.0
0.039000	0	0	0	0	0	0	0	0	0	0.0
0.040000	1	0	0	0	0	0	0	0	0	0.0
0.041000	1	0	0	0	0	0	0	0	0	0.0083
0.042000	0	0	0	0	0	0	0	0	0	0.0
0.043000	0	0	0	0	0	0	0	0	0	0.0
0.044000	1	0	0	0	0	0	0	0	0	0.3972
0.045000	1	0	0	0	0	0	0	0	0	0.0000
0.046000	0	0	0	0	0	0	0	0	0	0.0
0.047000	0	0	0	0	0	0	0	0	0	0.0
0.048000	1	0	0	0	0	0	0	0	0	0.0777
0.049000	0	0	0	0	0	0	0	0	0	0.0
0.050000	0	0	0	0	0	0	0	0	0	0.0
TOTALS	166	0	0	0	0	0	0	0	0	78684.

FIGURE 6

Example of Unobligated Inventory

OAK RIDGE TOTAL CYLINDER INVENTORY
AS OF 10/ 1/82

ASSAY	14-TON CYLINDERS			10-TON CYLINDERS			2.5-TON CYLINDERS			AMOUNT (MTU)
	SHIP.	UNSHIP.	THIN WALL	SHIP.	UNSHIP.	THIN WALL	SHIP.	UNSHIP.	THIN WALL	
0.001000	1	0	0	0	0	0	0	0	0	1.0040
0.002000	1	0	0	0	0	0	0	0	0	25620.4375
0.003000	2	0	0	0	0	0	0	0	0	47855.9023
0.004000	1	0	0	0	0	0	0	0	0	12.0410
0.005000	1	0	0	0	0	0	0	0	0	0.1830
0.006000	1	0	0	0	0	0	0	0	0	0.0310
0.007000	1	0	0	0	0	0	0	0	0	0.0
0.008000	1	0	0	0	0	0	0	0	0	0.0105
0.009000	1	0	0	0	0	0	0	0	0	0.0049
0.010000	1	0	0	0	0	0	0	0	0	0.0068
0.011000	1	0	0	0	0	0	0	0	0	0.0021
0.012000	1	0	0	0	0	0	0	0	0	0.0481
0.013000	1	0	0	0	0	0	0	0	0	6.3976
0.014000	1	0	0	0	0	0	0	0	0	111.5488
0.015000	1	0	0	0	0	0	0	0	0	0.0096
0.016000	1	0	0	0	0	0	0	0	0	0.0033
0.017000	1	0	0	0	0	0	0	0	0	0.2028
0.018000	2	0	0	0	0	0	0	0	0	734.3218
0.019000	2	0	0	0	0	0	0	0	0	0.0
0.020000	2	0	0	0	0	0	0	0	0	555.3611
0.021000	15	0	0	0	0	0	0	0	0	114.4469
0.022000	7	0	0	0	0	0	0	0	0	35.3413
0.023000	10	0	0	0	0	0	0	0	0	254.1653
0.024000	9	0	0	0	0	0	0	0	0	114.5770
0.025000	12	0	0	0	0	0	0	0	0	176.4432
0.026000	13	0	0	0	0	0	0	0	0	212.9905
0.027000	14	0	0	0	0	0	0	0	0	0.0001
0.028000	16	0	0	0	0	0	0	0	0	275.3757
0.029000	8	0	0	0	0	0	0	0	0	387.7852
0.030000	14	0	0	0	0	0	0	0	0	728.4065
0.031000	14	0	0	0	0	0	0	0	0	1044.1409
0.032000	9	0	0	0	0	0	0	0	0	1258.4939
0.033000	1	0	0	0	0	0	0	0	0	0.0
0.034000	1	0	0	0	0	0	0	0	0	147.2327
0.035000	1	0	0	0	0	0	0	0	0	17.2783
0.036000	1	0	0	0	0	0	0	0	0	0.0
0.037000	0	0	0	0	0	0	0	0	0	0.0
0.038000	0	0	0	0	0	0	0	0	0	0.0
0.039000	0	0	0	0	0	0	0	0	0	0.0
0.040000	1	0	0	0	0	0	0	0	0	0.0
0.041000	1	0	0	0	0	0	0	0	0	0.0083
0.042000	0	0	0	0	0	0	0	0	0	0.0
0.043000	0	0	0	0	0	0	0	0	0	0.0
0.044000	1	0	0	0	0	0	0	0	0	0.3972
0.045000	1	0	0	0	0	0	0	0	0	0.0000
0.046000	0	0	0	0	0	0	0	0	0	0.0
0.047000	0	0	0	0	0	0	0	0	0	0.0
0.048000	1	0	0	0	0	0	0	0	0	0.0777
0.049000	0	0	0	0	0	0	0	0	0	0.0
0.050000	0	0	0	0	0	0	0	0	0	0.0
TOTALS	174	0	0	0	0	0	0	0	0	79660.

FIGURE 7

Example of Total Inventory

received and delayed, uranium normal feed requirements, and an inventory summary. The ending information shown is the same as the detail report described above. Examples of the ending inventory reports are shown in Figures 5, 6, and 7; and an example of an operating information report is shown in Figure 8.

The tables shown in Figures 9, 10, and 11 are generated by another program that reads a temporary data set created by the main program. The information presented is the same as that shown on the operating information summary report. The tables are organized on a quarter-by-quarter basis. The temporary data set can also be read and analyzed by a plotting program. Figures 12, 13, and 14 are examples of plots that can be produced from the information on the data set. In these last three example plots, the type of lettering was varied to illustrate some of the options available using the DISSPLA software.²

SUMMARY REPORT FOR PERIOD NUMBER 23

PERIOD DATES: 7/ 1/82 TO 10/ 1/82

ASSAY VALUES:

PRE-PRODUCTION:	.03000
PADUCAH PRODUCT:	.01900
NORMAL FEED:	.00711
CASCADE TAILS:	.00235
TRANSACTION TAILS:	.00200

POWER AND SEPARATIVE WORK AVAILABLE:

OAK RIDGE POWER (MW):	1746.
OAK RIDGE SEPARATIVE WORK:	18837.
PADUCAH POWER (MW):	2572.
PADUCAH SEPARATIVE WORK:	27724.
PORTSMOUTH POWER (MW):	2260.
PORTSMOUTH SEPARATIVE WORK:	23008.

ORDER INFORMATION:

NUMBER RECEIVED:	21
NUMBER DELAYED:	0
NUMBER OF DELAYS TO DATE:	0
SEPARATIVE WORK VALUE OF DELAYED ORDERS (*):	0.

COMBINED PLANT URANIUM NORMAL FEED REQUIREMENTS (MTU):

THIS PERIOD:

TOTAL URANIUM FED TO CASCADES:	9736.
TOTAL URANIUM RECEIVED FROM CUSTOMERS:	17826.
TOTAL ERDA-OWNED URANIUM REQUIRED:	-8090.

SINCE START OF RUN:

TOTAL URANIUM FED TO CASCADES:	193381.
TOTAL URANIUM RECEIVED FROM CUSTOMERS:	164671.
TOTAL ERDA-OWNED URANIUM REQUIRED:	28711.

COMBINED PLANT STOCKPILE:

METRIC TONS URANIUM:	17868.
SEPARATIVE WORK UNITS (*):	71032.
AVERAGE ASSAY:	.02836

* IN THOUSANDS OF KG-SWU, BASED ON SEPARATIVE WORK VALUES OF ZERO FOR ASSAYS OF .00711 AND .00200.

FIGURE 8

Example of Quarterly Output

S C O P E - P W E R A N D S E P A R A T I V E W O R K

FISCAL YR-QTR	CALENDAR START	DATES END	OAK POWER	RIDGE SEP WK	PADUCAH POWER	SEP WK	PORTSMOUTH POWER	SEP WK	POWER	TOTAL SEP WK
1977-2	1/ 1/77	4/ 1/77	900.	7983.	1320.	12859.	1194.	11013.	3414.	31855.
1977-3	4/ 1/77	7/ 1/77	612.	5275.	948.	9836.	1194.	11013.	2754.	26124.
1977-4	7/ 1/77	10/ 1/77	990.	9341.	1380.	14534.	1194.	11642.	3564.	35517.
1977	1/ 1/77	10/ 1/77		22599.		37229.		33668.		93496.
1978-1	10/ 1/77	1/ 1/78	795.	7589.	1380.	14534.	1194.	11642.	3369.	33765.
1978-2	1/ 1/78	4/ 1/78	789.	7533.	1386.	14534.	1194.	11642.	3369.	33709.
1978-3	4/ 1/78	7/ 1/78	615.	5893.	1245.	14534.	1194.	11642.	3054.	32069.
1978-4	7/ 1/78	10/ 1/78	921.	9148.	1494.	17378.	1194.	12037.	3609.	38563.
1978	10/ 1/77	10/ 1/78		30163.		60940.		45963.		138106.
1979-1	10/ 1/78	1/ 1/79	921.	9148.	1494.	17378.	1194.	12037.	3609.	38563.
1979-2	1/ 1/79	4/ 1/79	942.	9356.	1545.	17378.	1194.	12037.	3681.	38771.
1979-3	4/ 1/79	7/ 1/79	942.	9356.	1545.	17378.	1194.	12037.	3681.	38771.
1979-4	7/ 1/79	10/ 1/79	939.	10061.	1572.	19036.	1194.	12503.	3705.	41597.
1979	10/ 1/78	10/ 1/79		37921.		71170.		48511.		157702.
1980-1	10/ 1/79	1/ 1/80	972.	10398.	1611.	19036.	1194.	12500.	3777.	41934.
1980-2	1/ 1/80	4/ 1/80	972.	10398.	1611.	19036.	1194.	12500.	3777.	41934.
1980-3	4/ 1/80	7/ 1/80	984.	10521.	1629.	19036.	1194.	12500.	3807.	42057.
1980-4	7/ 1/80	10/ 1/80	1041.	11250.	1572.	20140.	1194.	12752.	3807.	44142.
1980	10/ 1/79	10/ 1/80		42567.		77248.		50252.		170067.
1981-1	10/ 1/80	1/ 1/81	1041.	11250.	1572.	20140.	1194.	12752.	3807.	44142.
1981-2	1/ 1/81	4/ 1/81	1041.	11250.	1572.	20140.	1194.	12752.	3807.	44142.
1981-3	4/ 1/81	7/ 1/81	1041.	11250.	1572.	20140.	1194.	12752.	3807.	44142.
1981-4	7/ 1/81	10/ 1/81	1071.	11793.	1536.	21159.	1194.	15091.	3801.	49043.
1981	10/ 1/80	10/ 1/81		45543.		81579.		54347.		181469.
1982-1	10/ 1/81	1/ 1/82	1071.	11793.	1536.	21159.	1194.	16091.	3801.	49043.
1982-2	1/ 1/82	4/ 1/82	1071.	11793.	1536.	21159.	1194.	16091.	3801.	49043.
1982-3	4/ 1/82	7/ 1/82	1071.	11793.	1536.	21159.	1194.	16091.	3801.	49043.
1982-4	7/ 1/82	10/ 1/82	1071.	11793.	1536.	21159.	1194.	16091.	3801.	49043.
1982	10/ 1/81	10/ 1/82		47172.		84636.		64364.		196172.
1983-1	10/ 1/82	1/ 1/83	1071.	11793.	1536.	21159.	1194.	16091.	3801.	49043.
1983-2	1/ 1/83	4/ 1/83	1071.	11793.	1536.	21159.	1194.	16091.	3801.	49043.
1983-3	4/ 1/83	7/ 1/83	1071.	11793.	1536.	21159.	1194.	16091.	3801.	49043.
1983-4	7/ 1/83	10/ 1/83	1065.	11724.	1542.	21159.	1194.	16091.	3801.	48974.
1983	10/ 1/82	10/ 1/83		47103.		84636.		64364.		196103.
1984-1	10/ 1/83	1/ 1/84	1113.	12275.	1617.	21159.	1194.	15091.	3924.	49525.
1984-2	1/ 1/84	4/ 1/84	1113.	12275.	1617.	21159.	1194.	15091.	3924.	49525.
1984-3	4/ 1/84	7/ 1/84	1170.	12918.	1713.	21159.	1194.	15091.	4077.	50168.
1984-4	7/ 1/84	10/ 1/84	1263.	13950.	1824.	21159.	1194.	15091.	4281.	51200.
1984	10/ 1/83	10/ 1/84		51418.		84636.		64364.		200418.
1985-1	10/ 1/84	1/ 1/85	1263.	13950.	1824.	21159.	1194.	15091.	4281.	51200.
1985-2	1/ 1/85	4/ 1/85	1263.	13950.	1824.	21159.	1194.	15091.	4281.	51200.
1985-3	4/ 1/85	7/ 1/85	1263.	13950.	1824.	21159.	1194.	15091.	4281.	51200.
1985	10/ 1/84	7/ 1/85		41850.		63477.		49273.		153600.
TOTAL	1/ 1/77	7/ 1/85		366336.		645591.		475206.		1487133.

FIGURE 9

Example of Assay Summary Output

A S S A Y S							
FISCAL YR-QTR	CALENDAR START	DATES END	PRE-PRO- DUCTION	PADUCAH PRODUCT	NORMAL FEED	CASCADE TAILS	TRANS. TAILS
1977-2	1/ 1/77	4/ 1/77	.03000	.01750	.00711	.00250	.00200
1977-3	4/ 1/77	7/ 1/77	.03000	.01750	.00711	.00250	.00200
1977-4	7/ 1/77	10/ 1/77	.03000	.01750	.00711	.00250	.00200
1978-1	10/ 1/77	1/ 1/78	.03000	.02000	.00711	.00250	.00200
1978-2	1/ 1/78	4/ 1/78	.03000	.02000	.00711	.00250	.00200
1978-3	4/ 1/78	7/ 1/78	.03000	.02000	.00711	.00250	.00200
1978-4	7/ 1/78	10/ 1/78	.03000	.02000	.00711	.00235	.00200
1979-1	10/ 1/78	1/ 1/79	.03000	.02000	.00711	.00235	.00200
1979-2	1/ 1/79	4/ 1/79	.03000	.02000	.00711	.00235	.00200
1979-3	4/ 1/79	7/ 1/79	.03000	.02000	.00711	.00235	.00200
1979-4	7/ 1/79	10/ 1/79	.03000	.02000	.00711	.00235	.00200
1980-1	10/ 1/79	1/ 1/80	.03000	.02000	.00711	.00235	.00200
1980-2	1/ 1/80	4/ 1/80	.03000	.01900	.00711	.00235	.00200
1980-3	4/ 1/80	7/ 1/80	.03000	.01900	.00711	.00235	.00200
1980-4	7/ 1/80	10/ 1/80	.03000	.01900	.00711	.00235	.00200
1981-1	10/ 1/80	1/ 1/81	.03000	.01900	.00711	.00235	.00200
1981-2	1/ 1/81	4/ 1/81	.03000	.01900	.00711	.00235	.00200
1981-3	4/ 1/81	7/ 1/81	.03000	.01900	.00711	.00235	.00200
1981-4	7/ 1/81	10/ 1/81	.03000	.01900	.00711	.00235	.00200
1982-1	10/ 1/81	1/ 1/82	.03000	.01900	.00711	.00235	.00200
1982-2	1/ 1/82	4/ 1/82	.03000	.01900	.00711	.00235	.00200
1982-3	4/ 1/82	7/ 1/82	.03000	.01900	.00711	.00235	.00200
1982-4	7/ 1/82	10/ 1/82	.03000	.01900	.00711	.00235	.00200
1983-1	10/ 1/82	1/ 1/83	.03000	.01900	.00711	.00235	.00200
1983-2	1/ 1/83	4/ 1/83	.02900	.01900	.00711	.00235	.00200
1983-3	4/ 1/83	7/ 1/83	.02900	.01900	.00711	.00235	.00200
1983-4	7/ 1/83	10/ 1/83	.02900	.01900	.00711	.00235	.00200
1984-1	10/ 1/83	1/ 1/84	.02900	.01900	.00711	.00235	.00200
1984-2	1/ 1/84	4/ 1/84	.02900	.01900	.00711	.00235	.00200
1984-3	4/ 1/84	7/ 1/84	.02900	.01900	.00711	.00235	.00200
1984-4	7/ 1/84	10/ 1/84	.02900	.01900	.00711	.00220	.00200
1985-1	10/ 1/84	1/ 1/85	.02900	.01900	.00711	.00220	.00200
1985-2	1/ 1/85	4/ 1/85	.02800	.01900	.00711	.00220	.00200
1985-3	4/ 1/85	7/ 1/85	.02900	.01900	.00711	.00220	.00200

FIGURE 10

Example of Operating Parameters Summary Output

SUMMARY

FISCAL YR-QTR	CALENDAR START	DATES END	ORDER INFORMATION NUMBER RECEIVED	NUMBER DELAYED	SW UNITS DELAYED	ERDA URANIUM USED DURING PERIOD	TOTAL TO DATE	MET TONS URANIUM	STOCKPILE SEP WORK UNITS	AVERAGE ASSAY
1977-2	1/ 1/77	4/ 1/77	19	0	0.0	2196.	2196.	11307.3	44229.3	.02807
1977-3	4/ 1/77	7/ 1/77	17	0	0.0	-244.	1952.	11721.4	45220.3	.02781
1977-4	7/ 1/77	10/ 1/77	22	0	0.0	-1052.	900.	11682.3	44793.6	.02770
1978-1	10/ 1/77	1/ 1/78	18	0	0.0	1144.	2044.	11955.0	45335.2	.02750
1978-2	1/ 1/78	4/ 1/78	19	0	0.0	-1279.	765.	12166.4	45742.5	.02735
1978-3	4/ 1/78	7/ 1/78	18	0	0.0	-553.	212.	12485.0	46699.9	.02726
1978-4	7/ 1/78	10/ 1/78	21	0	0.0	-1534.	-1322.	12475.1	45743.3	.02691
1979-1	10/ 1/78	1/ 1/79	16	0	0.0	-864.	-2186.	12869.3	46245.6	.02656
1979-2	1/ 1/79	4/ 1/79	21	0	0.0	-3556.	-5742.	12750.3	45823.7	.02656
1979-3	4/ 1/79	7/ 1/79	24	0	0.0	-377.	-6119.	12600.4	45216.1	.02654
1979-4	7/ 1/79	10/ 1/79	23	0	0.0	-2255.	-8374.	12266.0	42940.7	.02612
1980-1	10/ 1/79	1/ 1/80	20	0	0.0	-2636.	-11010.	12453.8	43368.3	.02604
1980-2	1/ 1/80	4/ 1/80	23	0	0.0	-1634.	-12644.	12267.6	42106.6	.02580
1980-3	4/ 1/80	7/ 1/80	22	0	0.0	-2108.	-14752.	11922.8	40438.8	.02560
1980-4	7/ 1/80	10/ 1/80	21	0	0.0	-6069.	-20821.	12187.6	39384.1	.02485
1981-1	10/ 1/80	1/ 1/81	20	2	188.1	-832.	-21653.	12328.4	38871.2	.02447
1981-2	1/ 1/81	4/ 1/81	28	6	1552.5	-67.	-21720.	11623.2	36085.6	.02424
1981-3	4/ 1/81	7/ 1/81	30	7	1339.8	-727.	-22447.	11386.2	35061.5	.02413
1981-4	7/ 1/81	10/ 1/81	30	7	1451.3	-6684.	-29131.	11267.1	33415.6	.02359
1982-1	10/ 1/81	1/ 1/82	27	2	591.0	-3656.	-32797.	11379.5	33055.5	.02330
1982-2	1/ 1/82	4/ 1/82	27	7	2843.9	1974.	-30813.	10924.0	30788.4	.02289
1982-3	4/ 1/82	7/ 1/82	32	15	4125.9	2138.	-28675.	10837.1	29976.8	.02265
1982-4	7/ 1/82	10/ 1/82	36	16	4633.2	-10690.	-39365.	11037.4	29741.7	.02231
1983-1	10/ 1/82	1/ 1/83	37	18	4411.4	-4841.	-44206.	11280.8	29850.4	.02208
1983-2	1/ 1/83	4/ 1/83	45	22	9806.3	7094.	-37112.	10520.0	26426.2	.02144
1983-3	4/ 1/83	7/ 1/83	45	26	13068.9	5638.	-31474.	10512.7	26149.8	.02133
1983-4	7/ 1/83	10/ 1/83	50	36	14126.4	-11562.	-43036.	10979.9	26975.4	.02118
1984-1	10/ 1/83	1/ 1/84	59	42	13611.7	-5152.	-48199.	11184.8	27620.1	.02124
1984-2	1/ 1/84	4/ 1/84	69	52	20851.5	7936.	-40252.	10454.8	24888.6	.02082
1984-3	4/ 1/84	7/ 1/84	75	57	24078.1	5616.	-34636.	10507.4	24646.1	.02066
1984-4	7/ 1/84	10/ 1/84	81	65	26234.6	-13847.	-48483.	10992.9	25446.4	.02051
1985-1	10/ 1/84	1/ 1/85	86	69	26134.6	-5421.	-53904.	11483.9	26641.8	.02053
1985-2	1/ 1/85	4/ 1/85	95	72	36735.9	10144.	-43760.	10899.4	24147.4	.02004
1985-3	4/ 1/85	7/ 1/85	97	72	40446.8	6042.	-37713.	10933.1	23777.8	.01984
TOTALS	1/ 1/77	7/ 1/85	1273	593	246231.7		-37718.			

FIGURE 11

Example of Important Computational Summary

FIGURE 12

Example of Assay Plot

FIGURE 13

Example Plot of ERDA Feed Requirements

FIGURE 14

Example of Delay Plot

5. FUTURE WORK

This report is a summary of the current status of the set of programs referred to as SCOPE. Work is planned and continuing in the following areas:

- 1) A user's manual for SCOPE (Phase I) is being prepared;
- 2) The scheduling algorithms area is being improved to reduce the time required per calculation, thus allowing more heuristic calculations and possibly some optimization;
- 3) The number and type of plants that can be handled are being increased; and
- 4) More graphical capabilities are being included to simplify data presentation.

6. CONCLUSIONS AND RECOMMENDATIONS

A summary description of the current status of the package of computer programs, SCOPE, which is being developed to provide an aid in improving cascade complex production efficiency by refining, operating, and scheduling procedures, has been presented in this report. One major scheduling decision is concerned with the sequence and timing of preproduction assays which will minimize use of ERDA feed and assure the maximum contingency for filling orders. This program can be used to determine the appropriate operating schedule to provide one solution to this problem.

The SCOPE programs can now compare various approaches to running a complex (three or more plants). Using these calculations, the user can select a preproduction schedule that will minimize the chance of delays under a low power contingency case over several years. The selection of the contingency plan must be given some thought. For example, is a 60% power case the one that should be used for planning purposes?

At this time, some attention should be given to standardizing the labeling of the requirements data files. The authors recommend that the data sets be given alphabetic titles plus dates of creation. With this type of identification, a user could simply request an order tape created 7/10/77 and that data can be acquired with minimum effort. Presently, no formal nomenclature exists and communications are hampered. We further suggest, at this time, that recipients of this report review the example program output and provide any comments about its completeness, content, or format.

REFERENCES

1. Tunstall, J. N., "The General Productivity Code: Productivity Optimization of Gaseous Diffusion Cascades, The Programmer's Guide," UCCND/CSD-11, Union Carbide Corporation, Oak Ridge, TN (May 1975).
2. "DISSPLA - Display Integrated Software System and Plotting Language," Integrated Software Systems Corporation, San Diego, California (Copyrighted 1970).

ACKNOWLEDGMENTS

This work was requested by the Interplant Operating Committee and funded by the Operations Analysis and Planning Division.

The authors would like to express their appreciation to M. S. Ginsburg who provided valuable counsel in the course of this work. The authors would also like to thank Teri Stanton and Normel Hodges for their assistance in grammatical editing and typing.

DISTRIBUTION

<p>1-46. <u>Computer Sciences</u></p> <p>A. A. Brooks
H. P. Carter
K. E. Cross (10)
R. C. DeLozier (20)
R. W. Henderson
D. M. Kelleher (10)
N. H. Van Wie
CSD Library, K-1007
CSD Library, ORNL</p> <p>47-52. <u>Operations Anal. & Planning</u></p> <p>J. T. Bradbury III
A. de la Garza
M. S. Ginsburg
T. R. Lemons
S. A. Levin
L. P. Pasquier</p> <p>53-57. <u>Operations</u></p> <p>M. P. DeLozier
E. L. Hannahs
J. F. Hudson
K. W. Sommerfeld
L. E. Wheeler</p> | <p>58-60. <u>ORGDP Technical Services</u></p> <p>D. S. Napolitan</p> <p>61-64. <u>ORGDP Library</u></p> <p>65. <u>ORGDP Records - RC</u></p> <p>66-67. <u>Paducah Plant</u></p> <p>R. A. Green
C. W. Walter</p> |
|--|---|

EXTERNAL DISTRIBUTION

- 68-73. M. M. Dare, United States Energy Research and Development Administration, P. O. Box E, Oak Ridge, Tennessee 37830
74. J. S. Murrell, Goodyear Atomic Corporation, P. O. Box 628, Piketon, Ohio 45661
75. L. D. Reynolds, International Atomic Energy Agency, Karntner Ring 11, P. O. Box 645, A-1011 Vienna, Austria, Europe
- 76-102. Technical Information Center, United States Energy Research and Development Administration, P. O. Box 62, Oak Ridge, Tennessee 37830
103. F. E. Woltz, Goodyear Atomic Corporation, P. O. Box 628, Piketon, Ohio 45661