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ANALYSTS' MANUAL FOR THE MULTIPLE-BID EVALUATION MODEL FOR PROC--ETC(U)
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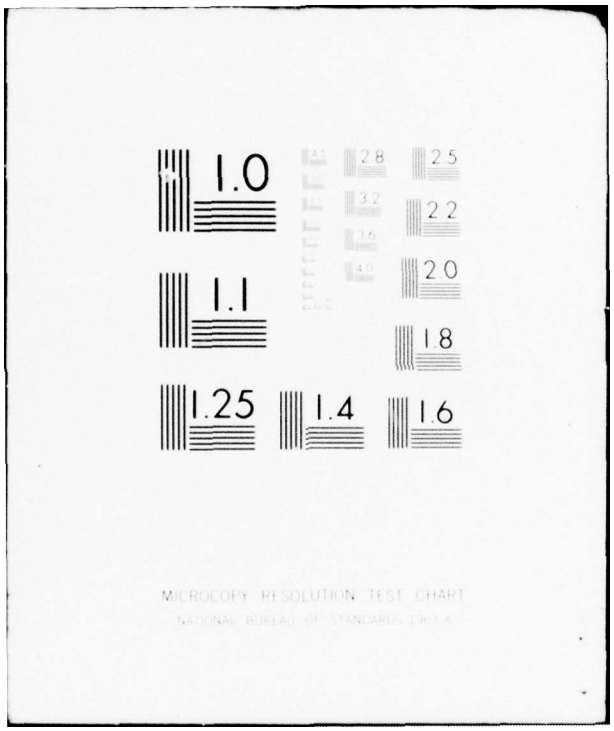
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ANALYSTS' MANUAL FOR THE MULTIPLE-BID EVALUATION MODEL FOR PROCUREMENT PLANNING & PLACEMENT

NOVEMBER 1977

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JOINT CONVENTIONAL
AMMUNITION PROGRAM COORDINATING GROUP

DECISION MODELS DIRECTORATE

ROCK ISLAND, ILLINOIS 61201

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This report provides useful information to ammunition managers on the Multiple-Bid Evaluation Model. The purpose of the Multiple-Bid Evaluation Model is to enable management to evaluate the economic and base protection impacts of available alternative solutions for complex procurement actions involving large numbers of multiple bidders, multiple bid levels, and multiple buy periods. The model can be used for single or multiple item buys. The sequence of steps by which the model achieves this objective is as follows:

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Input data for the model includes the procurement objectives (items, quantities, and time periods), bidder information (all costs associated with selecting a specific bidder), and base protection costs. These base protection costs are total costs of layaway and maintenance of Government-furnished equipment at those facilities which are not selected for a portion of the contract. The data conversion module accepts the verified input data and converts it into usable form for the main processing module.

The main processing module uses dynamic programming techniques to identify least-cost and alternative solutions. Dynamic programming is an efficient solution technique for multi-stage problems. In the model, the method used employs an approach in which any two bidders are considered. Then, only those bids made which can enter into the final solution are carried forward as a combination to compete against the next bidder. This procedure is repeated until a final combination is obtained. This final combination represents the least-cost solution. During the process, additional information is obtained which enables the model to identify the cost of all feasible solutions, to then rank order them by cost, and to supply additional breakout of information for management review and analysis.

The report generator module converts this information into the management-oriented output. This report provides management with complete cost-ranked sets of alternatives for meeting total or incremental procurement objectives. The latter is particularly useful if requirements are reduced after the bids have been submitted. The report also presents the least-cost solution for each possible total number of suppliers and the options available for various levels of base protection.

ANALYSTS' MANUAL
FOR THE
MULTIPLE-BID EVALUATION MODEL
FOR
PROCUREMENT PLANNING AND PLACEMENT

PREPARED BY
JOINT CONVENTIONAL AMMUNITION PROGRAM
DECISION MODELS DIRECTORATE
PRODUCTION AND MOBILIZATION PLANNING DIVISION

NOVEMBER 1977

JOINT CONVENTIONAL AMMUNITION PROGRAM
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ANALYSTS' MANUAL
FOR THE
MULTIPLE-BID EVALUATION MODEL
FOR
PROCUREMENT PLANNING AND PLACEMENT

FOREWORD

In the Department of Defense environment, there is a need for the capability of evaluating the cost of making one or more procurement awards for an item or component. The reasons range from distributing awards to maintain planned-producer capabilities as a part of assuring industrial preparedness to meet mobilization requirements to distributing procurement awards consistent with the capability limitations of competing planned-producer.

To meet these requirements specifications of the Military Services, a Multiple-Bid Evaluation Model was designed under the auspices of the Joint Conventional Ammunition Program Coordinating Group. The model has been successfully demonstrated and has been accepted by the Military Services.

This Analysts' Manual and a companion document, "The Users' Manual," comprise an export package which will permit the Military Services to install and use this Multiple-Bid Evaluation Model.

The Analysts' Manual consists of information about a given model and outlines the concept, purpose, and appropriate uses of the model along with (a) mathematical formulation of the problem, (b) conceptual flowcharts of the programs and subroutines used in the model, and (c) source listings of the actual program(s) including comments to assist in explanation of the logic used in the programs.

Configuration management of the model is retained by the Joint Conventional Ammunition Program Decision Models Directorate. Proposals for modification of the model and inquiries with respect to the model application and operation should be addressed to the Director, Joint Conventional Ammunition Program Decision Models Directorate, Rock Island Arsenal, IL 61201. Telephone inquiries should be addressed to the Chief, Production and Mobilization Planning Division of that Directorate, AUTOVON 793-5666.

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ANALYSTS' MANUAL

FOR THE

MULTIPLE-BID EVALUATION MODEL

FOR

PROCUREMENT PLANNING AND PLACEMENT

This Analysts' Manual for the Multiple-Bid Evaluation Model, designed, developed, and demonstrated by the Joint Conventional Ammunition Program Decision Models Directorate, is in response to requirements established by the Military Services, which have accepted the model for their uses as described herein.

Although the Multiple-Bid Evaluation Model was designed for procurement planning and placement of ammunition, it is capable of handling any commodity when the effects of multiple-buys and multiple-awards are evaluated by procurement directors.

EDWARD J. JORDAN
Executive Director
Joint Conventional Ammunition
Program Coordinating Group

ABSTRACT

This report documents the JCAP Multiple-Bid Evaluation Model (MBEM) as adapted and utilized by the JCAP Production and Mobilization Planning Division.

The model uses the principles of Dynamic Programming to conduct bid analyses for selection of a combination of suppliers to be awarded portions of a total contract. These analyses include the finding of least cost and next least cost solutions for the total requirement and for fractions of the total requirement. In the case of procuring a single item for a single buy period, the model can also find least and next least costs for each possible number of suppliers. This additional analysis enables Management to evaluate the costs of using additional suppliers in order to have a broader production base.

The model consists of four independent computer programs for several different situations. Program 1 is designed for a single buy period and a single type item; Program 2 can handle two buy periods, or two items for one buy period, Program 3 is designed for three buy periods, or three items for one buy period, Program 4 is a version of Program 1 which finds least cost and next least cost solutions for each possible number of bidders to be selected.

This volume contains:

(1) MBEM mathematical formulations and the computational methods used;

(2) Flowcharts for each program; and

(3) Computer listings complete with comments and identification of variables.

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SECTION I

INTRODUCTION

1. BACKGROUND.

The JCAP Multiple-Bid Evaluation Model (MBEM) is a computer program which analyzes bids submitted by potential suppliers for portions of a total contract requirement. The model identifies least cost solutions for selection of a combination of suppliers to provide the total production requirement over single or multiple buy periods.

The model can be used to analyze procurement of items when there is a mix of competition from privately-owned and Government-owned facilities.

The techniques and computer programs used in this application were developed initially in support of ORG Report 47 (reference 1). The model has since been modified and adopted as an integral member of the JCAP system of decision models.

2. APPROACH.

The principles of dynamic programming are utilized to provide the least cost solutions for each possible combination of production requirements and number of bidders, as well as "second best" solutions. Secondary solutions are provided as additional information to assist management in the decision process in the event that a decision cannot be made based on least cost solutions. The dynamic programming method employs an approach in which any two bidders are considered and only those bids which can be entered into the final solution are carried forward as a combination to compete against the next bidder. The final combination contains the least cost solution.

3. MODEL OPTIONS.

There are four different program versions of the model. Each program has unique capabilities and options available for the user.

Program one is designed for analyzing a contract procurement for one buy period and one type item. Production base protection, the cost of not selecting a particular bidder, can be assigned to any or all of the bidders prior to the analysis. The number of suppliers allowed in the solution is not included in the analysis. If an analysis for a specified number of suppliers to be selected is desired, then program four should be used. Program one has an option to determine least cost solutions for fractions of the total procurement contract. It is also capable of determining "second best" and other alternative solutions.

---

1. DeArmon, Ira A., Jr., and Fermaglich, David M., The Cost of Procuring Ammunition from Industry or from Government-Owned Plants, USAMUCOM ORG Report 47, USAMUCOM Operations Research Group, July 1972, UNCL.

Program two is designed for analyzing a contract procurement for two buy periods for one item or two items for one buy period. The other major difference between program two and program one is that program two can be used to analyze the problem in which there is competition among the bidders for assignment of production base protection responsibility.

Program three has all of the capabilities of the previously-described programs with the additional capability of analyzing a problem with up to three buy periods or up to three items for a single buy period.

Program four is similar to program one in that it is designed for one buy period and one type item. It has the additional capability, however, to identify the least cost solution for each possible number of suppliers which can be selected.

4. MODEL APPLICATION.

The Government issues Invitations for Bid (IFB's) to private industry as well as to its own plants. Each potential supplier submits several bids, each for a specified fraction of the procurement contract. These bids, along with other relevant cost factors, i.e., Government standby costs, transportation costs, equipment rental factors, and production-related costs are analyzed to determine the least cost and several near least cost solutions.

When developing the model for munitions procurement, each Government-owned contractor-operated (GOCO) source is considered as a separate supplier to allow for competition between GOCO facilities. In addition, the contract requirement for the period (or periods) in question must be known. Recognizing that the model derives the solutions for fractions of the total requirement, the decision maker can designate the maximum potential demand as his item requirement in his bid solicitations. Following this procedure, the analyst then defines the discrete bid levels that would be acceptable.

The bid levels selected do not have to be in percentage form, e.g., 0%, 25%, 50%, 75%, 100%. They can also be in actual production units form. For example, if the total requirement for the item to be procured were 100,000 items and the total number of bid levels were five, the bid levels could be entered as 0%, 25%, 50%, 75%, and 100% or as 0 units, 25,000 units, 50,000 units, 75,000 units, and 100,000 units.

In theory, the model can accommodate a large number of discrete bidding levels. In practice, the problem of expected item demand levels and the practicality of developing suitable cost data will be the limiting factors for choosing the number of bid levels for the analysis. Once the procurement requirement, the suppliers, and the feasible bid levels have been defined, the last ingredient to the analysis, i.e., the input cost data, must be developed for each bid level. This data set should include all relevant cost information for the procurement decision.

It is not necessary for model operation that each bidder submit a bid for each level. This facet of the model allows a smaller company, with an insufficient capacity for meeting the entire requirement, to compete for part of the contract. It also gives a supplier the option of not bidding for a lower bid level when he feels it is not in his self-interest.

SECTION II

MULTIPLE-BID EVALUATION MODEL MATHEMATICAL FORMULATIONS

1. GENERAL.

The objective of the model is to find the solution which meets the bid requirements at the least cost. The following paragraphs describe each individual program in English and in mathematical language.

2. PROGRAM 1.

Program 1 finds least cost and next least cost solutions at all bid levels for one time period and one item. The mathematical statement follows:

$$\text{Minimize:} \quad \sum_{i=1}^{B} \sum_{j=1}^{L} C_{ij} X_{ij}$$

$$\text{Subject to:} \quad X_{ij} = 0 \text{ or } 1$$

$$\sum_{j=1}^{L} X_{ij} = 1$$

$$\sum_{i=1}^{B} \sum_{j=1}^{L} q_j X_{ij} \geqq R$$

Where i is the bidder subscript,

j is the bid level subscript,

B is the number of bidders,

L is the number of bid levels,

$X_{ij} = 1$ if bidder i is selected at bid level j,

$= 0$ otherwise,

C_{ij} is the cost of bidder i's bid at level j,

q_j is the quantity of bid level j, and

R is the total requirement or any of the lower requirements desired.

3. PROGRAM 2.

Program 2 finds least cost solutions at each possible set of bid levels for two periods or two items. The mathematical statement follows:

$$\text{Minimize:} \quad \sum_{i=1}^{B} \sum_{j=1}^{L1} \sum_{k=1}^{L2} C_{ijk} X_{ijk}$$

$$\text{Subject to:} \quad X_{ijk} = 0 \text{ or } 1$$

$$\sum_{j=1}^{L1} \sum_{k=1}^{L2} X_{ijk} = 1$$

$$\sum_{i=1}^{B} \sum_{j=1}^{L1} \sum_{k=1}^{L2} q_{1j} X_{ijk} \geqq R1$$

$$\sum_{i=1}^{B} \sum_{j=1}^{L1} \sum_{k=1}^{L2} q_{2k} X_{ijk} \geqq R2$$

Where

i is the bidder subscript,

j is the subscript for the first period/item bid level,

k is the subscript of the second period/item bid level,

B is the number of bidders,

$L1$ is the number of first period/item bid levels,

$L2$ is the number of second period/item bid levels,

X_{ijk} = 1 if bidder i is selected at first period/item bid level j and second period/item bid level k

= 0 otherwise,

C_{ijk} is the cost of bidder i's bid at first period/item bid level j and second period/item bid level k,

q_{1j} is the quantity of first period/item bid level j,

q_{2k} is the quantity of second period/item bid level k,

R1 is the first period/item requirement to be met, and

R2 is the second period/item requirement.

4. PROGRAM 3.

Program 3 finds least cost solutions at each possible set of bid levels for two periods or two items. It also finds next least cost solutions at the total requirement bid levels. The mathematical statement of this problem follows:

$$\text{Minimize:} \quad \sum_{i=1}^{B} \sum_{j=1}^{L1} \sum_{k=1}^{L2} \sum_{l=1}^{L3} C_{ijkl} X_{ijkl}$$

$$\text{Subject to:} \quad X_{ijkl} = 0 \text{ or } 1$$

$$\sum_{j=1}^{L1} \sum_{k=1}^{L2} \sum_{l=1}^{L3} X_{ijkl} = 1$$

$$\sum_{i=1}^{B} \sum_{j=1}^{L1} \sum_{k=1}^{L2} \sum_{l=1}^{L3} q_{1j} X_{ijkl} \geqq R1$$

$$\sum_{i=1}^{B} \sum_{j=1}^{L1} \sum_{k=1}^{L2} \sum_{l=1}^{L3} q_{2k} X_{ijkl} \geqq R2$$

$$\sum_{i=1}^{B} \sum_{j=1}^{L1} \sum_{k=1}^{L2} \sum_{l=1}^{L3} q_{3l} X_{ijkl} \geqq R3$$

Where i is the bidder subscript,

j is the subscript of the first period/item bid level,

k is the subscript of the second period/item bid level,

l is the subscript of the third period/item bid level,

B is the number of bidders,

L1 is the number of first period/item bid levels,

L2 is the number of second period/item bid levels,

L3 is the number of third period/item bid levels,

X_{ijkl} = 1 if bidder is selected at first period/item bid level j, second period/item bid level k, and third period/item bid level l,

= 0 otherwise,

C_{ijkl} is the cost of bidder i's bid at first period/item bid level j, second period/item bid level k, and third period/item bid level l,

q_{1j} is the quantity of first period/item bid level j,

q_{2k} is the quantity of second period/item bid level k,

q_{3l} is the quantity of third period/item bid level l,

R1 is the first period/item requirement to be met,

R2 is the second period/item requirement, and

R3 is the third period/item requirement.

5. PROGRAM 4.

Program 4 finds least cost and next least cost solutions at each bid level for each possible number of suppliers. It considers one time period and one item. The mathematical statement follows:

$$\text{Minimize:} \quad \sum_{i=1}^{B} \sum_{j=1}^{L} C_{ij} X_{ij}$$

$$\text{Subject to:} \quad X_{ij} = 0 \text{ or } 1$$

$$\sum_{j=1}^{L} X_{ij} = 1$$

$$\sum_{i=1}^{B} \sum_{j=1}^{L} q_j X_{ij} \geqq R$$

$$\sum_{i=1}^{B} \sum_{\{j:q_j > 0\}} X_{ij} = N$$

Where i is the bidder subscript,

j is the bid level subscript,

N is the number of bidders in the solution,

B is the total number of bidders,

L is the number of bid levels,

X_{ij} = 1 if bidder i is selected at bid level j,

= 0 otherwise,

C_{ij} is the cost of bidder i's bid at level j,

q_j is the quantity of bid level j, and

R is the total requirement or any of the lower requirements desired.

SECTION III

COMPUTATIONAL METHODS

1. GENERAL METHOD.

The model consists of several computer programs. Each program considers bidders sequentially, finding all least cost combinations of the first two bidders, of the first three bidders, and so on until it has found the least cost combinations of all bidders. Then each program works backwards to assemble each bidder's share of the least cost solution.

2. EXAMPLE.

Consider the following problem: Three bidders are bidding at three bid levels: 0%, 50%, and 100%. Their bids at each level are:

LEVEL	BIDDER 1's BIDS	BIDDER 2's BIDS	BIDDER 3's BIDS
0%	100	0	0
50%	600	350	400
100%	900	900	850

Find the combinations of bids which meet the 0%, 50%, and 100% requirements at least cost.

The first step is to combine bids for Bidders 1 and 2 to find least costs at each bid level using these two bidders. This is depicted in Table 1.

The second step is to treat the combined bids for Bidders 1 and 2 as bids by a single bidder and combine them with Bidder 3's bids in the same way as before. This is depicted in Table 2.

If there were more bidders, their bids would be combined with the above bids one at a time until all had been considered.

At this stage, the least costs are known but not each individual bidder's bids. To find these bids, the programs work backwards through the bid levels noted for each bidder during the earlier steps. At each step, the programs find a bidder's bid level and subtract that level from the old balance to get the new balance. Repeating this step, the programs find the bid levels for all bidders, as shown below.

TABLE 1 - COMBINATION OF BIDDERS 1 AND 2

0% TOTAL PRODUCTION ALTERNATIVES:	COST
a. 1 at 0% and 2 at 0%	100 min
50% TOTAL PRODUCTION ALTERNATIVES:	**COST**
a. 1 at 0% and 2 at 50%	450 min
b. 1 at 50% and 2 at 0%	600
100% TOTAL PRODUCTION ALTERNATIVES:	**COST**
a. 1 at 0% and 2 at 100%	1000
b. 1 at 50% and 2 at 50%	950
c. 1 at 100% and 2 at 0%	900 min

BIDS

LEVEL	BIDDER 1	BIDDER 2	COMBINED BIDDERS 1 & 2
0%	100	0	100
50%	600	350	450
100%	900	900	900

BIDDER 2's BID LEVELS
IN SOLUTION FOR FIRST 2 BIDDERS

LEVEL	BIDDER 2's SHARE
0%	0%
50%	50%
100%	0%

TABLE 2 - COMBINATION OF FIRST TWO BIDDERS WITH BIDDER 3

0% TOTAL PRODUCTION ALTERNATIVES:	COST
a. 1-2 at 0% and 3 at 0%	100 min
50% TOTAL PRODUCTION ALTERNATIVES:	**COST**
a. 1-2 at 0% and 3 at 50%	500
b. 1-2 at 50% and 3 at 0%	450 min
100% TOTAL PRODUCTION ALTERNATIVES:	**COST**
a. 1-2 at 0% and 3 at 100%	950
b. 1-2 at 50% and 3 at 50%	850 min
c. 1-2 at 100% and 3 at 0%	900

BIDS

LEVEL	BIDDERS 1-2	BIDDER 3	COMBINED BIDDERS 1-3
0%	100	0	100
50%	450	400	450
100%	900	850	850

BIDDER 3's BID LEVELS IN SOLUTION FOR FIRST 3 BIDDERS

LEVEL	BIDDER 3's SHARE
0%	0%
50%	0%
100%	50%

First, recall the bid levels of Bidders 3 and 2 in the solutions for Bidders 1 - 3 and 1 - 2, respectively.

BID LEVEL	LEVELS OF BIDDER 3 IN SOLUTIONS FOR 1 - 3	LEVELS OF BIDDER 2 IN SOLUTIONS FOR 1 - 2
0%	0%	0%
50%	0%	50%
100%	50%	0%

The computations follow:

Bid Level	0%	50%	100%
3rd Bidder	0%	0%	50%
Balance	0%	50%	50%
2nd Bidder	0%	50%	50%
Balance	0%	0%	0%
1st Bidder	0%	0%	0%

The solutions, then, are these:

Bid Level	0%	50%	100%
1st Bidder	0%	0%	0%
2nd Bidder	0%	50%	50%
3rd Bidder	0%	0%	50%
Cost	100	450	850

SECTION IV

MULTIPLE-BID EVALUATION MODEL FLOWCHARTS

This section contains Multiple-Bid Evaluation Model flowcharts which show major logical steps in the programs. There are flowcharts for each program. Programs with a main routine and subroutine have individual flowcharts.

Throughout the flowcharts, the four major steps which the program performs are shown by the symbols ⟨1⟩, ⟨2⟩, ⟨3⟩, and ⟨4⟩. These steps are:

Step ⟨1⟩: Input.

Initialize the arrays and read the data.

Step ⟨2⟩: Combining.

For each I'th bidder, find his share of the solutions for bidders 1 through I.

Step ⟨3⟩: Assembly and Printing.

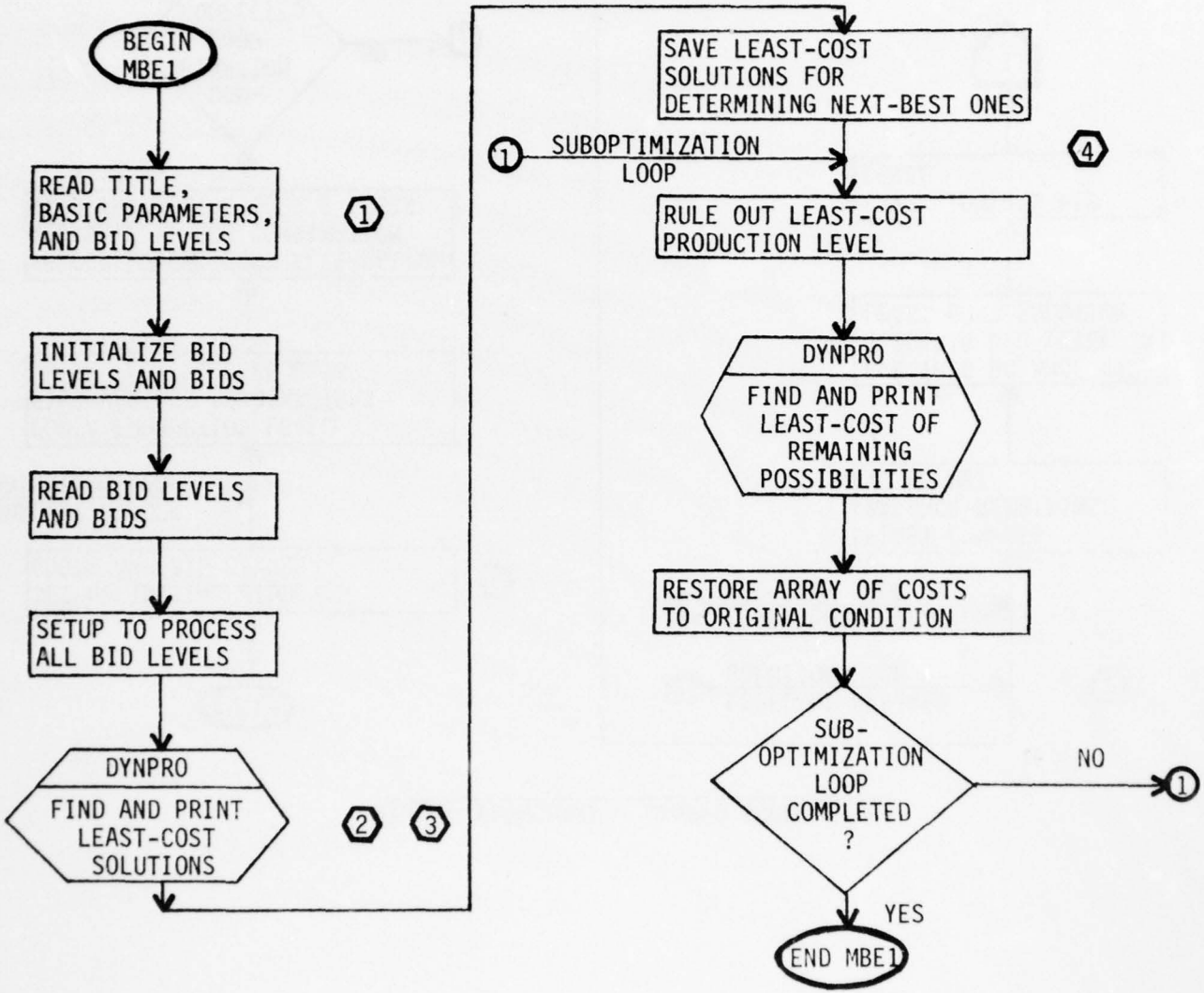
Assemble and print least cost solutions by working backwards bidder by bidder.

Step ⟨4⟩: Suboptimization.

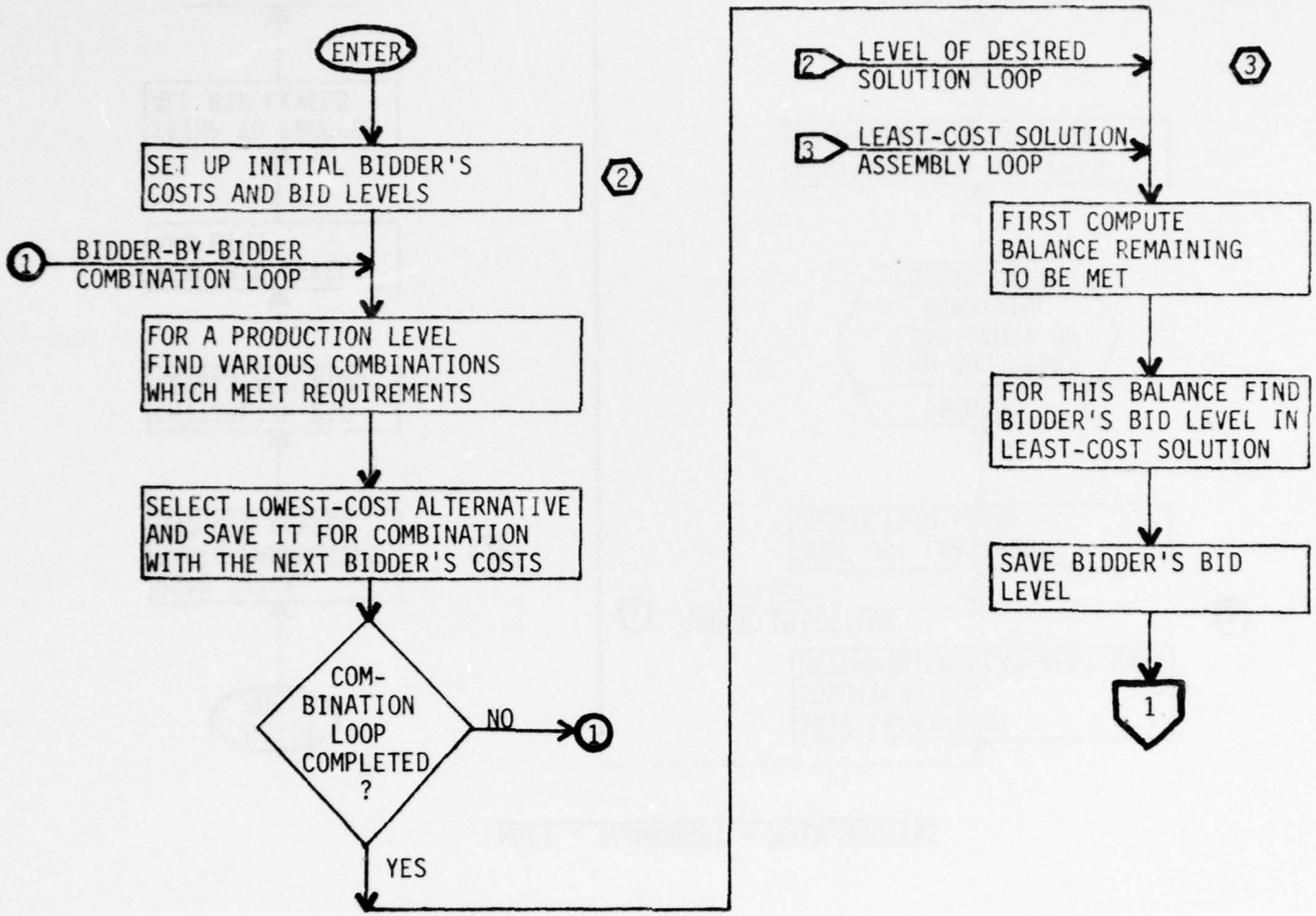
Compute, assemble and print next least cost solutions.

The programs differ somewhat in structure. Programs 1 and 3 have a subroutine for finding least costs, while the other programs find least costs in the main routine.

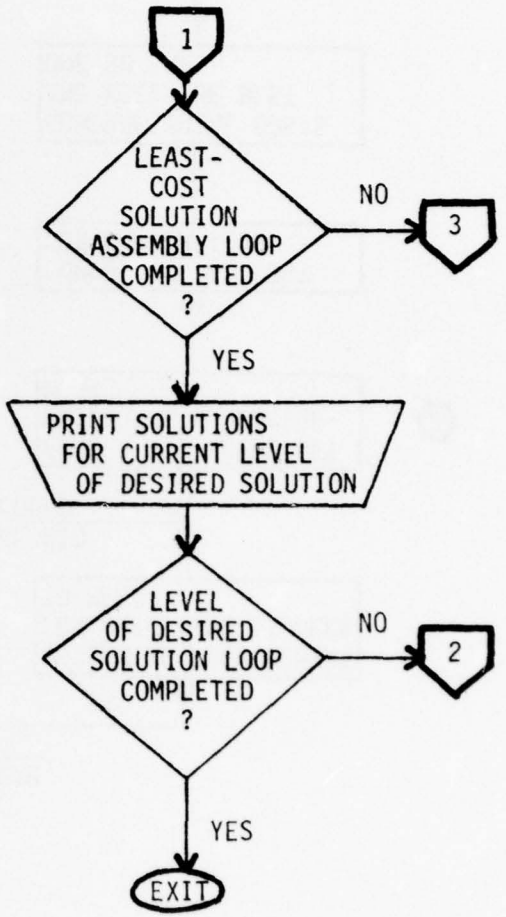
MBE1 - FLOWCHART - MAIN ROUTINE



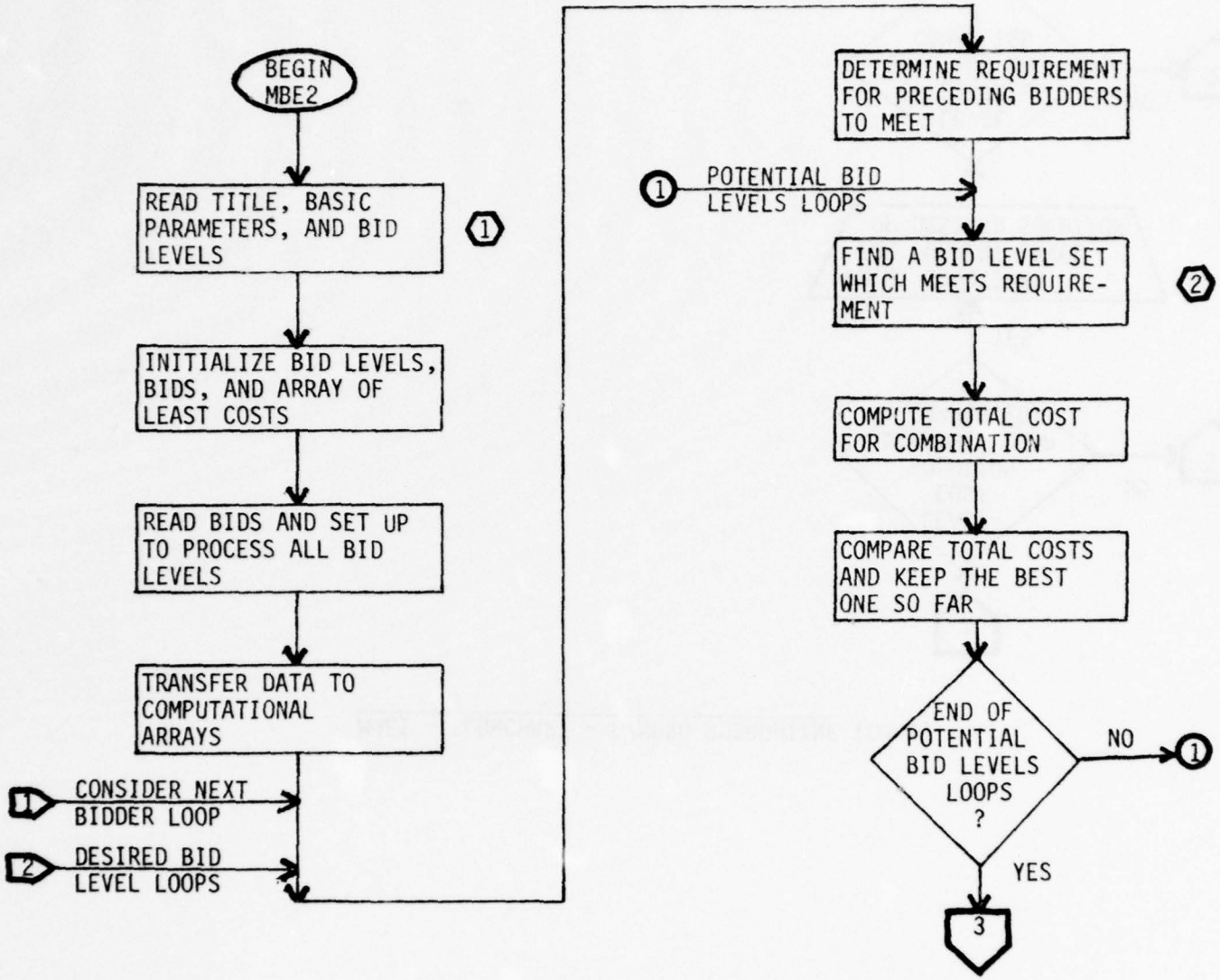
MBE1 - FLOWCHART - DYNPRO SUBROUTINE



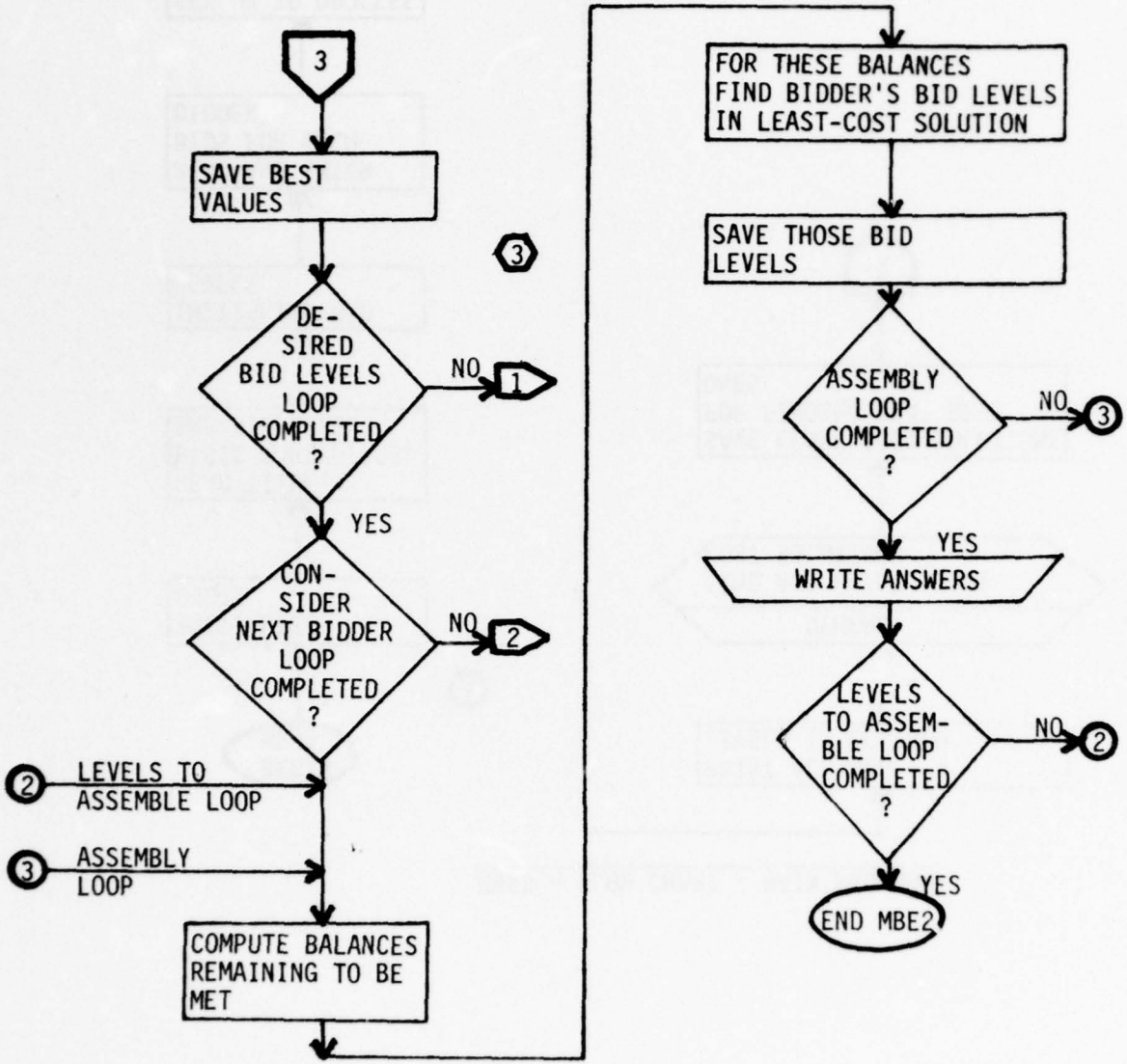
MBE1 - FLOWCHART - DYNPRO SUBROUTINE (Cont)



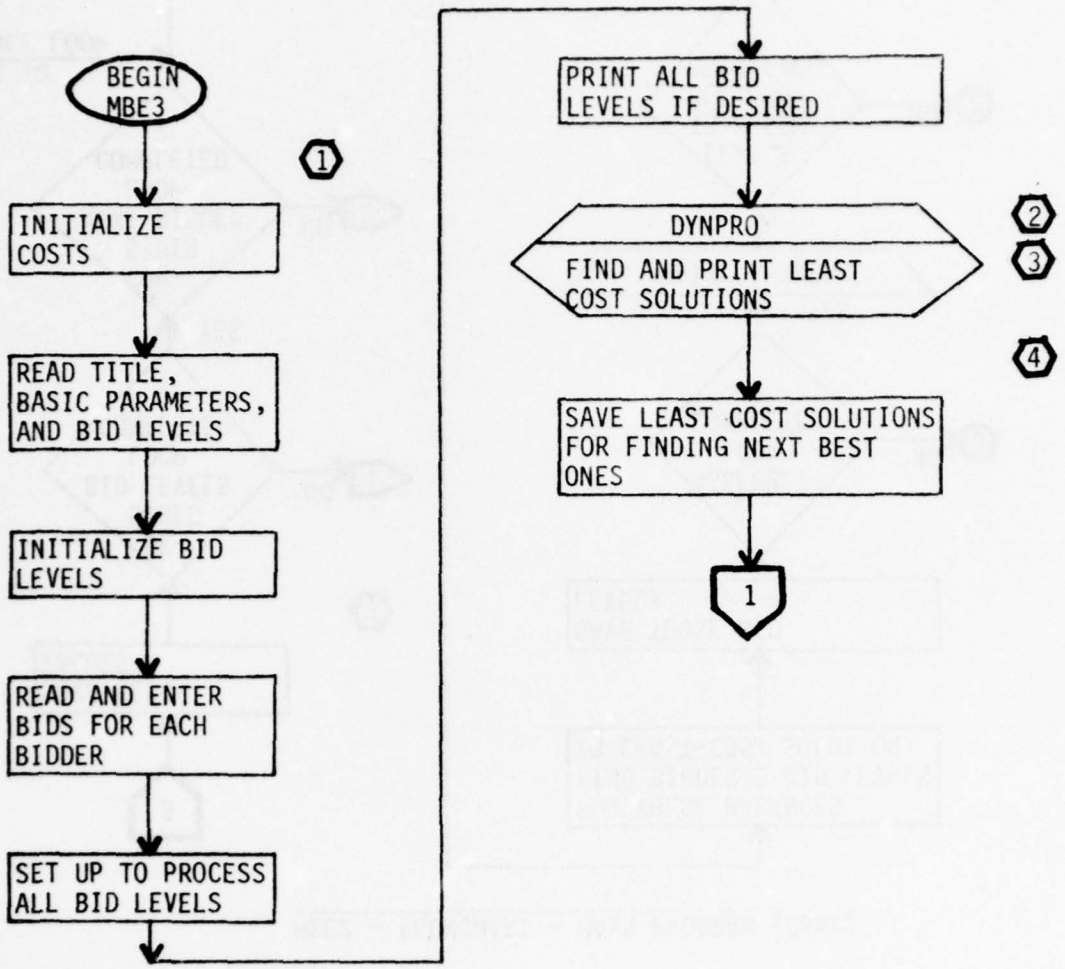
MBE2 - FLOWCHART - MAIN PROGRAM



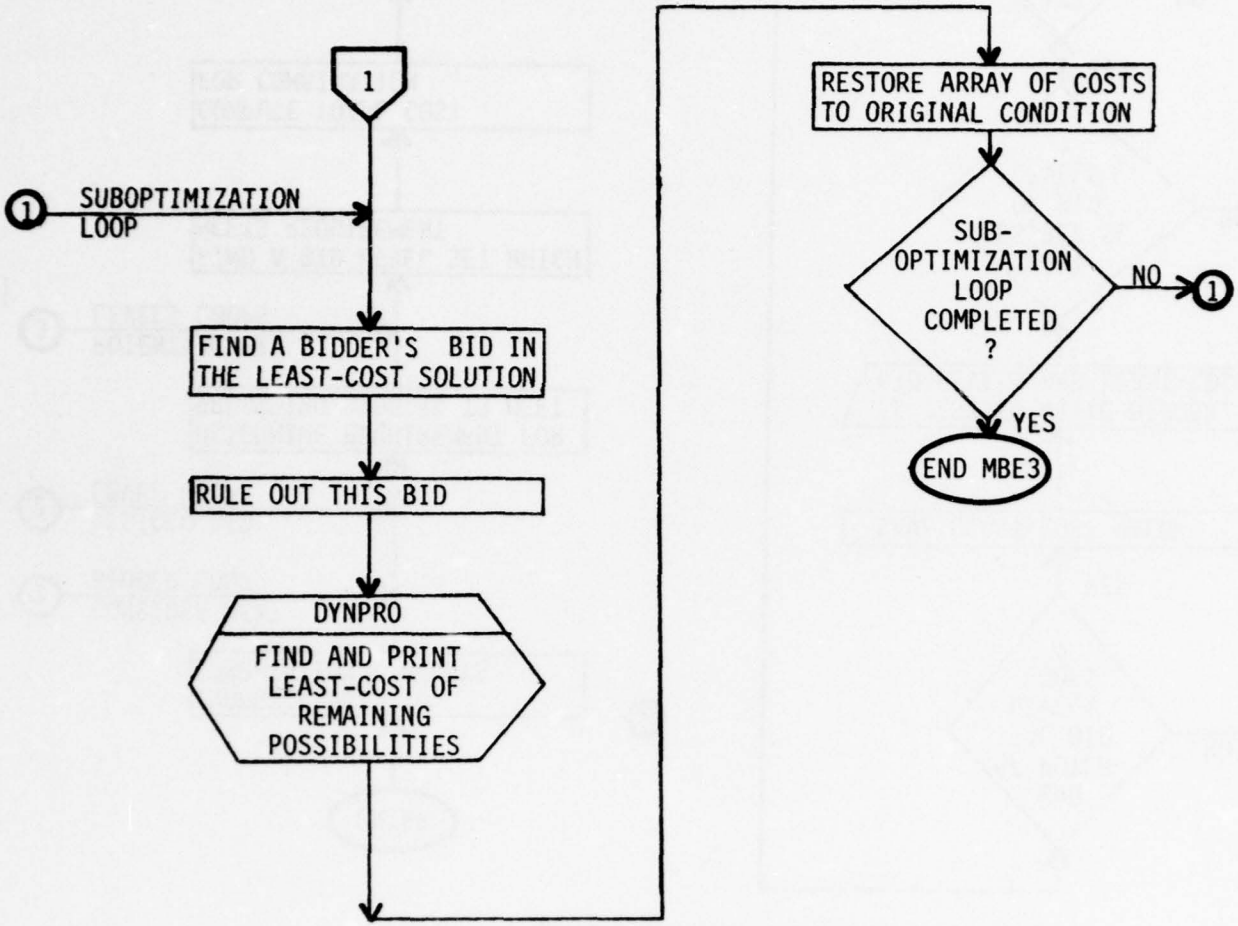
MBE2 - FLOWCHART - MAIN PROGRAM (Cont)



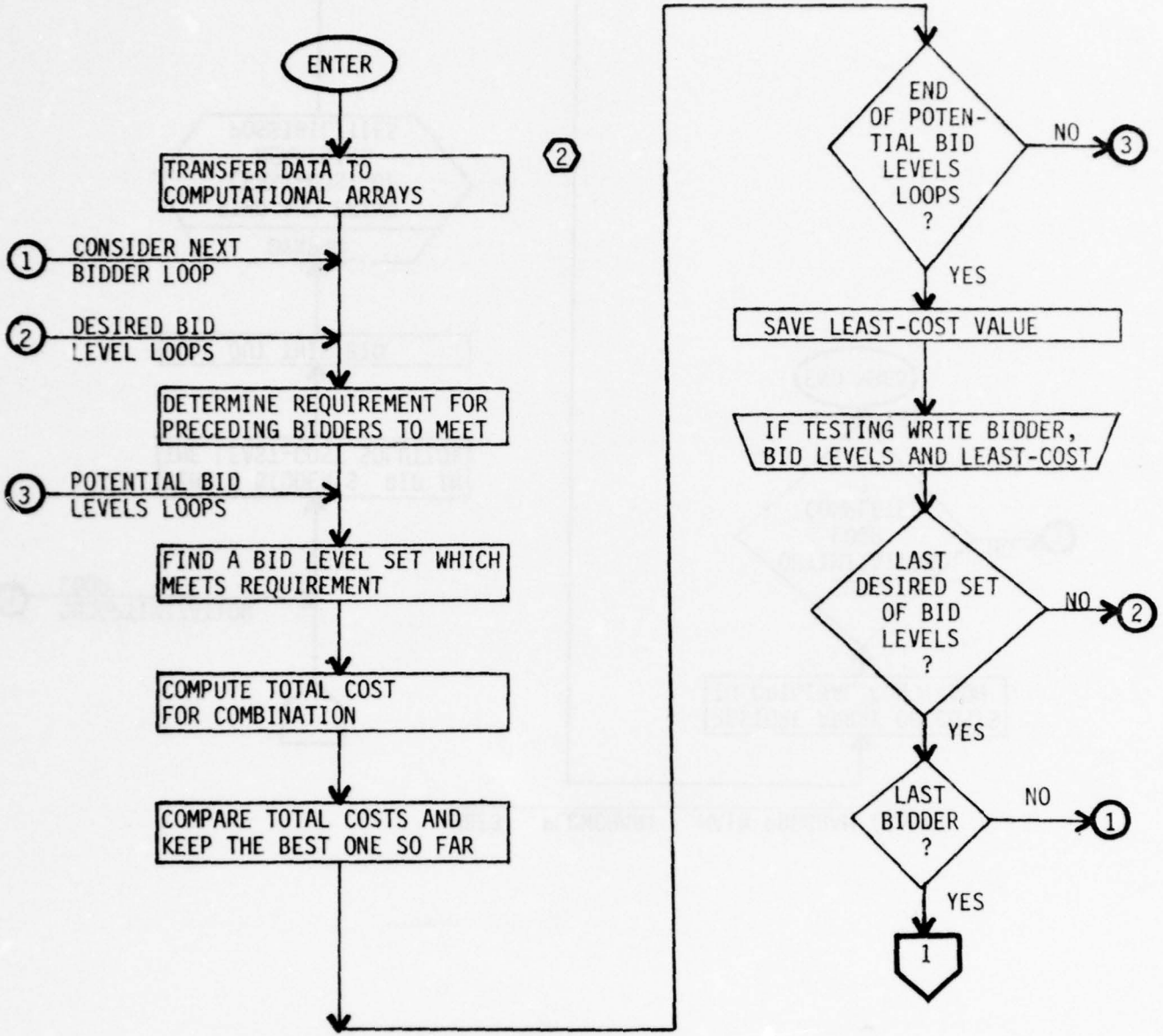
MBE3 - FLOW CHART - MAIN PROGRAM



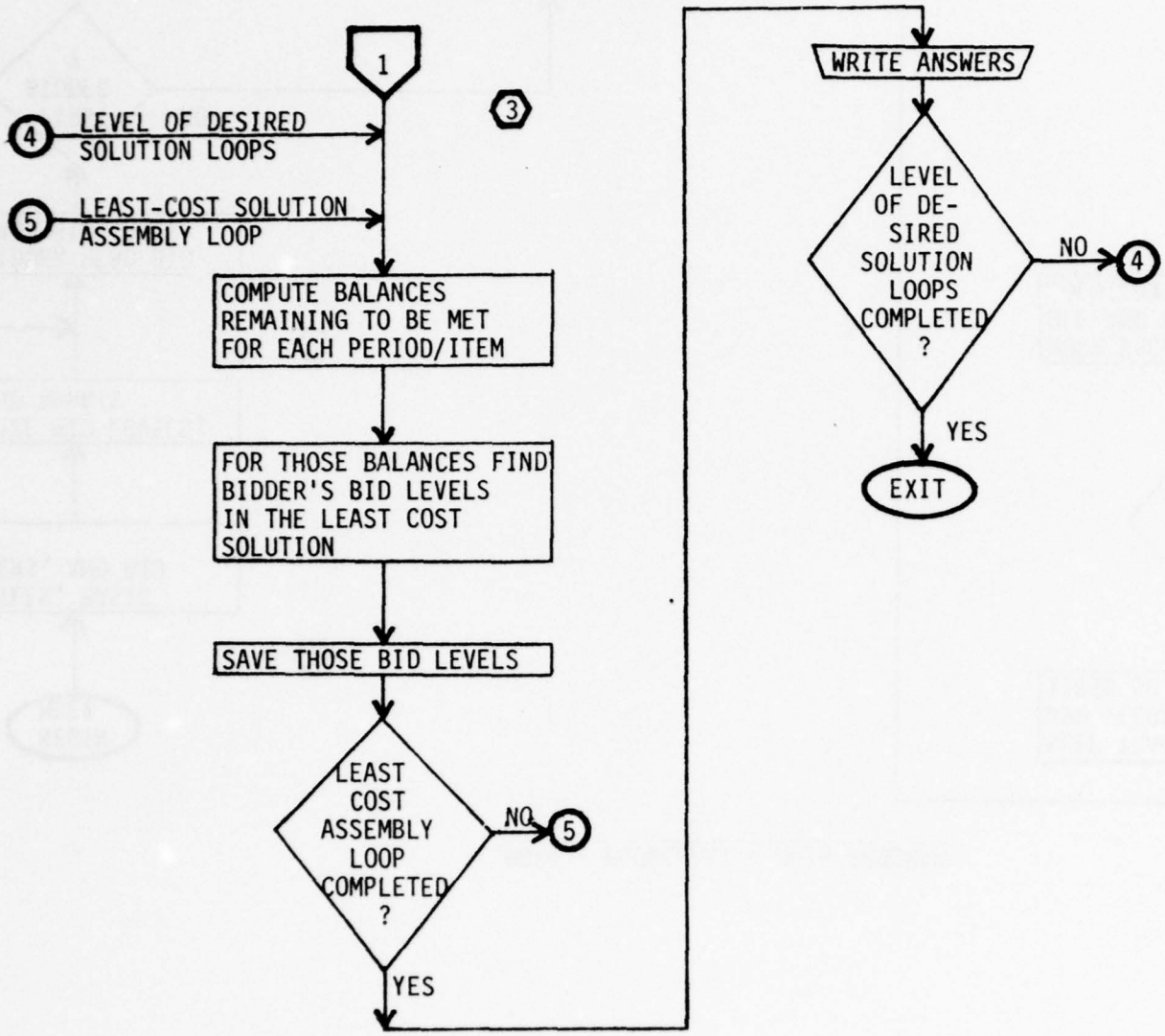
MBE3 - FLOWCHART - MAIN PROGRAM (Cont)



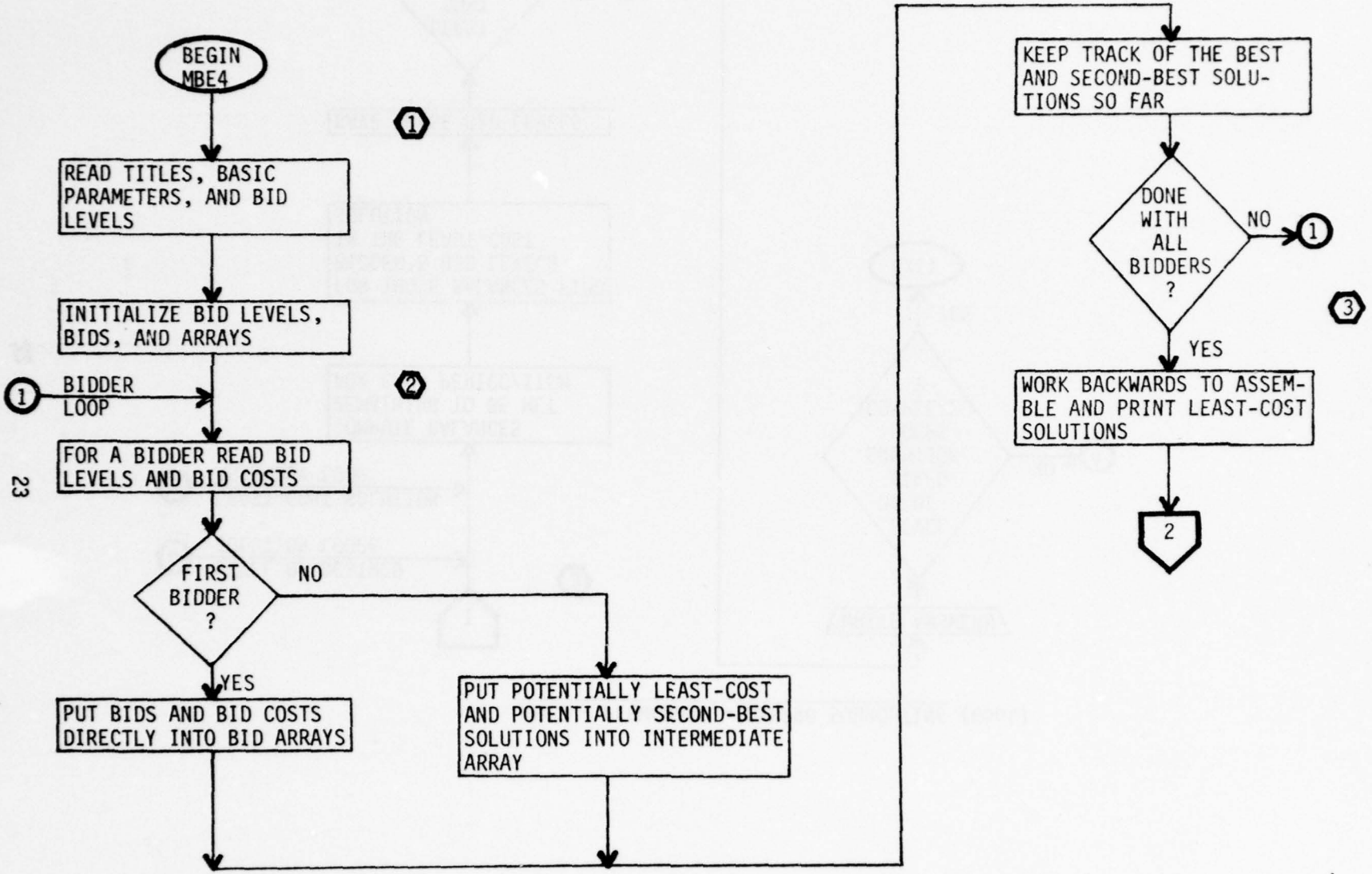
MBE3 - FLOWCHART - DYNPRO SUBROUTINE



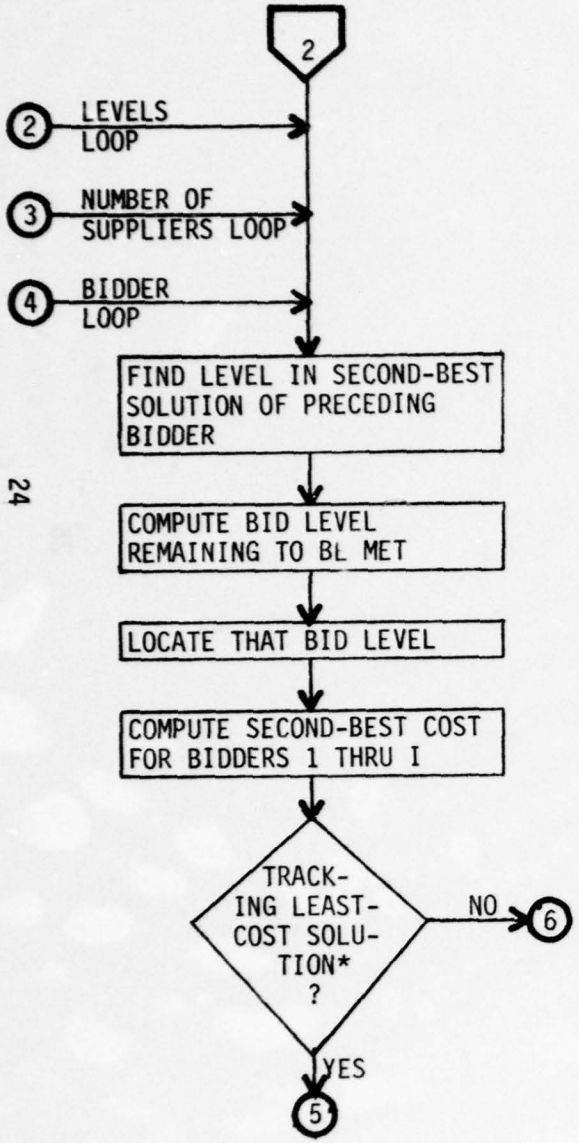
MBE3 - FLOWCHART - DYNPRO SUBROUTINE (Cont)

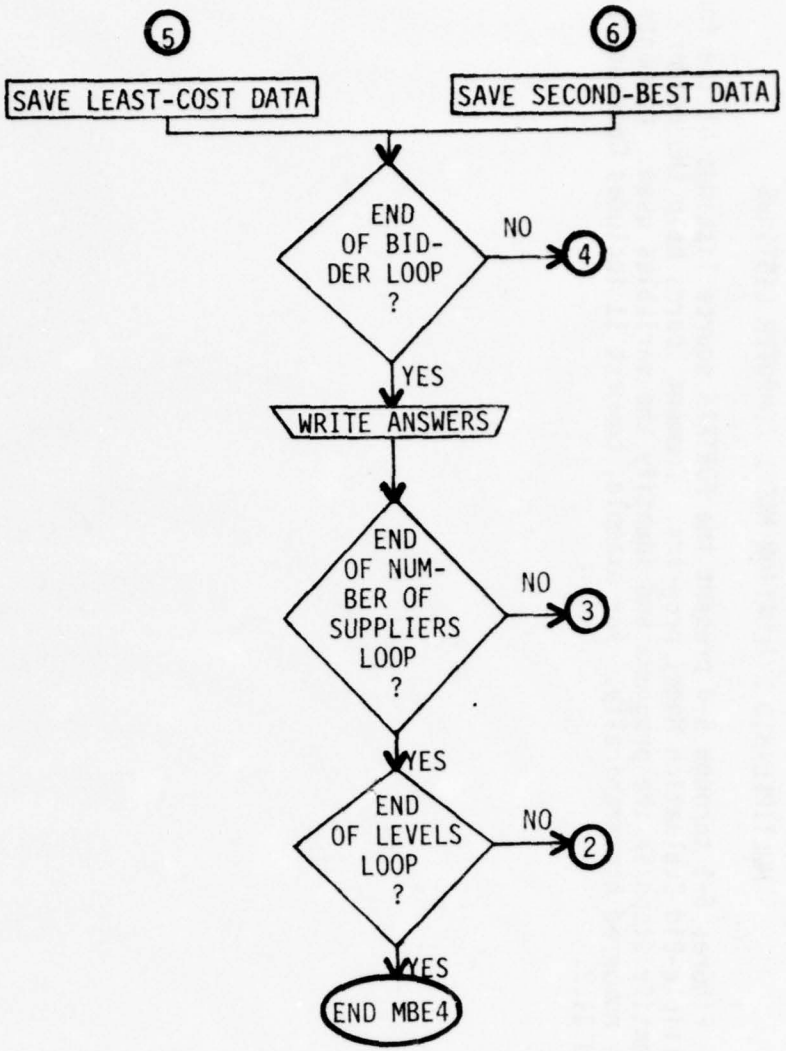


MBE4 - FLOWCHART - MAIN PROGRAM



MBE4 - FLOWCHART - MAIN PROGRAM (Cont)





* Beyond a certain point the second-best solution for all bidders may be the same as the least-cost solution for the first several bidders.

SECTION V

MULTIPLE-BID EVALUATION MODEL COMPUTER LISTINGS

Figures 5-1 through 5-6 present the FORTRAN source listings of the four Multiple-Bid Evaluation Model programs. Comment cards help the reader identify steps in the programs and identify the variables used. Comments are numbered hierarchically. For example, Comment 11 includes Comments 11.1 and 11.2.

```
C      PROGRAM 1                                                                00000010
C      BASIC MULTIPLE BID EVALUATION - PROVIDES LEAST-COST SOLUTIONS AT          00000020
C      EACH POSSIBLE BID LEVEL.  PROVIDES NEXT-BEST SOLUTIONS AT THE            00000030
C      TOTAL REQUIREMENT BID LEVEL.                                             00000040
C                                                                               00000050
C      1    IDENTIFICATION OF VARIABLES.                                        00000060
C                                                                               00000070
C      BID - BID COST.                                                          00000080
C      BLEVEL - BID LEVEL.                                                      00000090
C      COST(I,L) - THE ARRAY OF BID COSTS FOR EACH BIDDER I AND BID             00000100
C            LEVEL L.                                                           00000110
C      DELT(I) - AMOUNT OF REQUIREMENT MET BY BIDDERS 1 THRU I.                 00000120
C      DIFF - BID LEVEL DESIRED FOR PRECEDING BIDDERS.  WHEN ADDED TO           00000130
C            CURRENT BIDDER'S LEVEL K GIVES TOTAL BID LEVEL L.                  00000140
C      DUMMY - A HIGH VALUE USED TO INITIALIZE THE COST ARRAY FOR EASE          00000150
C            OF HANDLING BIDS NOT MADE.                                         00000160
C      DYNPRO - THE SUBROUTINE WHICH FINDS THE LEAST-COST SOLUTIONS.            00000170
C      F(I,L) - MINIMUM COST FOR BIDDERS 1 THRU I AT LEVEL L.                   00000180
C      FF(K) - THE POSSIBLE INTERMEDIATE SOLUTIONS FROM WHICH THE LEAST-        00000190
C            COST INTERMEDIATE SOLUTION IS FOUND.                               00000200
C      FINX(I) - ARRAY IN WHICH OPTIMAL SOLUTION BID LEVELS ARE SAVED IN        00000210
C            ORDER TO HELP DETERMINE SUBOPTIMAL SOLUTIONS.                      00000220
C      I - BIDDER.                                                              00000230
C      IT - TITLE ELEMENT INDEX.                                                00000240
C      ITEST -  =1 MEANS THAT OPTIMIZATION IS DESIRED FOR AMOUNTS LESS          00000250
C            THAN THE TOTAL REQUIREMENT LEVEL.                                  00000260
C               =0 MEANS OPTIMIZATION IS NOT DESIRED FOR SUBMAXIMAL             00000270
C            REQUIREMENT LEVELS.                                                00000280
C      J - BID LEVEL INDEX.                                                     00000290
C      K - BID LEVEL INDEX.                                                     00000300
C      KA - BID LEVEL INDEX.                                                    00000310
C      KK - THE NUMBER OF BIDS MADE BY A BIDDER.                                00000320
C      L - IN OPTIMIZATION SECTION, BID LEVEL INDEX.  IN SUBOPTIMIZATION        00000330
C            SECTION, BIDDER INDEX.                                             00000340
C      LC - INITIAL BID LEVEL INDEX, 1 TO SOLVE FOR ALL BID LEVELS AND          00000350
C            NLEV OTHERWISE.                                                    00000360
C      LEV(I) - IN INPUT SECTION, NUMBER OF BIDS MADE BY EACH BIDDER, I.        00000370
C            IN COMPUTATION SECTION, INCLUDES BIDS NOT MADE BUT DUMMIED         00000380
C            IN, I.E. EQUALS NUMBER OF BID LEVELS.                              00000390
C      LEVL - NUMBER OF BIDS FOR EACH BIDDER.                                   00000400
C      LL - BID LEVEL INDEX.                                                    00000410
C      N - INITIAL BID LEVEL INDEX, 1 TO SOLVE FOR ALL BID LEVELS AND           00000420
C            NLEV OTHERWISE.                                                    00000430
C      NLEV - NUMBER OF BID LEVELS.                                             00000440
C      NSUP - NUMBER OF BIDDERS.                                                00000450
C      PLEV(I,L) - THE ARRAY OF BID QUANTITIES FOR EACH BIDDER I AND            00000460
C            BID LEVEL INDEX L.                                                 00000470
C      R - MINIMUM COST YET FOUND FOR THE INTERMEDIATE SOLUTION                 00000480
C            CURRENTLY BEING SOUGHT.                                            00000490
C      SAVE - VARIABLE USED TO SAVE LEAST COST FOR RESTORING COST ARRAY         00000500
C            AFTER EACH SUBOPTIMIZATION.                                        00000510
C      SURP - THE BID LEVELS.                                                   00000520
C      TITLE - TITLE OF STUDY.                                                  00000530
```

Figure 5-1. Program 1 Listing, MAIN Routine (1 of 4)

```
C       X(I,L) - BID LEVEL OF BIDDER I'S CONTRIBUTION TO THE LEAST-COST    00000540
C              SOLUTION AT LEVEL L USING ONLY BIDDERS 1 THRU I.            00000550
C       XFIN(I) - BID LEVEL OF BIDDER I'S CONTRIBUTION TO THE LEAST-COST   00000560
C              SOLUTION.                                                   00000570
C                                                                          00000580
C       2    COMMON AND DIMENSION STATEMENTS.                              00000590
C                                                                          00000600
        COMMON XFIN(21),SURP(21),PLEV(21,21),COST(21,21),LEV(21),NSUP,NLEV00000610
        COMMON ITEST                                                       00000620
        DIMENSION FINX(21), TITLE(5)                                       00000630
C                                                                          00000640
C       3    READ TITLE, BASIC PARAMETERS, AND BID LEVELS.                 00000650
C                                                                          00000660
        READ (5,130) (TITLE(I),I=1,5)                                      00000670
        WRITE (6,140) (TITLE(I),I=1,5)                                     00000680
        READ (5,150) NSUP,NLEV,ITEST                                       00000690
        WRITE (6,160) NSUP,NLEV                                            00000700
        IF (NSUP.GT.21) WRITE (6,170) NSUP                                 00000710
        IF (NLEV.GT.21) WRITE (6,180) NLEV                                 00000720
        IF (NSUP.GT.21.OR.NLEV.GT.21) STOP                                 00000730
        WRITE (6,190)                                                      00000740
        DO 10 L=1,NLEV                                                     00000750
        READ 200, SURP(L)                                                  00000760
10      PRINT 200, SURP(L)                                                 00000770
C                                                                          00000780
C       4    INITIALIZE BID LEVELS AND BIDS.                               00000790
C                                                                          00000800
        DUMMY=1.E+15                                                       00000810
        DO 30 I=1,NSUP                                                     00000820
        DO 20 L=1,NLEV                                                     00000830
        PLEV(I,L)=SURP(L)                                                  00000840
        COST(I,L)=DUMMY                                                    00000850
20      CONTINUE                                                           00000860
30      CONTINUE                                                           00000870
C                                                                          00000880
C       5    READ BIDS FOR EACH BIDDER.                                    00000890
C                                                                          00000900
        WRITE (6,210)                                                      00000910
        DO 70 I=1,NSUP                                                     00000920
        WRITE (6,220) I                                                    00000930
        WRITE (6,230)                                                      00000940
        READ 240, LEV(I)                                                   00000950
        KK=LEV(I)                                                          00000960
        DO 60 K=1,KK                                                       00000970
        READ (5,250) BLEVEL,BID                                            00000980
        WRITE (6,250) BLEVEL,BID                                           00000990
        DO 40 L=1,NLEV                                                     00001000
        IF (BLEVEL.EQ.SURP(L)) GO TO 50                                    00001010
40      CONTINUE                                                           00001020
        WRITE (6,260) I,BLEVEL                                             00001030
        STOP                                                               00001040
50      COST(I,L)=BID                                                      00001050
60      CONTINUE                                                           00001060
```

Figure 5-1. Program 1 Listing, MAIN Routine (2 of 4)

```
70    CONTINUE                                                          00001070
C                                                                       00001080
C     6     SETUP TO PROCESS ALL BID LEVELS.                            00001090
C                                                                       00001100
      DO 80 I=1,NSUP                                                    00001110
      LEV(I)=NLEV                                                       00001120
80    CONTINUE                                                          00001130
C                                                                       00001140
C     7     FIND LEAST-COST SOLUTIONS.                                  00001150
C                                                                       00001160
      I=1                                                               00001170
      CALL DYNPRO                                                       00001180
      ITEST=0                                                           00001190
C                                                                       00001200
C     8     SAVE LEAST-COST SOLUTIONS FOR DETERMINING NEXT-BEST ONES.   00001210
C                                                                       00001220
      DO 90 L=1,NSUP                                                    00001230
90    FINX(L)=XFIN(L)                                                   00001240
C                                                                       00001250
C     9     FIND NEXT-BEST SOLUTIONS.  FOR EACH SUPPLIER, ONE AT A TIME, 00001260
C     RULE OUT THE LEAST-COST PRODUCTION LEVEL AND FIND THE LEAST-COST  00001270
C     OF THE REMAINING POSSIBILITIES.                                   00001280
C                                                                       00001290
      DO 120 L=1,NSUP                                                   00001300
      PRINT 270, L                                                      00001310
      LEVL=LEV(L)                                                       00001320
      DO 100 LL=1,LEVL                                                  00001330
      IF (PLEV(L,LL)-FINX(L)) 100,110,100                               00001340
100   CONTINUE                                                          00001350
      PRINT 280, FINX(L),L                                              00001360
      STOP                                                              00001370
110   SAVE=COST(L,LL)                                                   00001380
      COST(L,LL)=DUMMY                                                  00001390
      CALL DYNPRO                                                       00001400
      ITEST=0                                                           00001410
120   COST(L,LL)=SAVE                                                   00001420
      STOP                                                              00001430
C                                                                       00001440
130   FORMAT (5A4)                                                      00001450
140   FORMAT (1H1,5A4)                                                  00001460
150   FORMAT (4I3)                                                      00001470
160   FORMAT (1H0,I2,9H BIDDERS,,I3,11H BID LEVELS)                     00001480
170   FORMAT (1H0,I3,31H SUPPLIERS IS TOO MANY (21 MAX))                00001490
180   FORMAT (1H0,I3,32H BID LEVELS IS TOO MANY (21 MAX))               00001500
190   FORMAT (1H0,10HBID LEVELS)                                        00001510
200   FORMAT (F10.0)                                                    00001520
210   FORMAT (1H0,4HBIDS)                                               00001530
220   FORMAT (1H0,6HBIDDER,I3)                                          00001540
230   FORMAT (1H0,20HBID LEVEL TOTAL COST)                              00001550
240   FORMAT (I3)                                                       00001560
250   FORMAT (2F10.0)                                                   00001570
260   FORMAT (1H0,6HBIDDER,I3,25H BID AT ILLEGAL BID LEVEL,F4.0)        00001580
270   FORMAT (1H1,20X,11HSUBOPT SOLN,I5//)                              00001590
```

Figure 5-1. Program 1 Listing, MAIN Routine (3 of 4)

```
280   FORMAT (1X,6HBID OF,E10.3,24HWAS NOT FOUND FOR BIDDER,I5)          00001600
      END                                                                00001610
```

Figure 5-1. Program 1 Listing, MAIN Routine (4 of 4)

```
      SUBROUTINE DYNPRO                                                 00001620
      COMMON XFIN(21),SURP(21),PLEV(21,21),COST(21,21),LEV(21),NSUP,NLEV00001630
      COMMON ITEST                                                      00001640
      DIMENSION DELT(21), FF(21), F(21,21), X(21,21)                    00001650
      WRITE (6,260)                                                     00001660
C                                                                       00001670
C     10   SETUP INITIAL BIDDER'S COSTS AND BID LEVELS.                 00001680
C                                                                       00001690
      I=1                                                               00001700
      KK=LEV(I)                                                         00001710
      DO 30 L=1,NLEV                                                    00001720
      DO 10 K=1,KK                                                      00001730
      IF (SURP(L)-PLEV(I,K)) 30,20,10                                   00001740
10    CONTINUE                                                          00001750
20    F(I,L)=COST(I,K)                                                  00001760
      X(I,L)=PLEV(I,K)                                                  00001770
30    CONTINUE                                                          00001780
C                                                                       00001790
C     11   COMBINE LEAST-COSTS FOR PREVIOUS BIDDERS WITH COSTS FOR NEXT 00001800
C     BIDDER, GIVING NEW LEAST-COSTS.                                   00001810
C-                                                                      00001820
      DO 160 I=2,NSUP                                                   00001830
      IF (I-NSUP) 40,50,50                                              00001840
40    LC=1                                                              00001850
      GO TO 70                                                          00001860
50    IF (ITEST) 40,60,40                                               00001870
60    LC=NLEV                                                           00001880
70    DO 150 L=LC,NLEV                                                  00001890
      KK=LEV(I)                                                         00001900
C                                                                       00001910
C     11.1 FOR A PRODUCTION LEVEL FIND VARIOUS COMBINATIONS WHICH MEET  00001920
C     THE REQUIREMENTS.                                                 00001930
C                                                                       00001940
      DO 110 K=1,KK                                                     00001950
      DIFF=SURP(L)-PLEV(I,K)                                            00001960
      IF (DIFF) 120,80,80                                               00001970
80    DO 90 J=1,NLEV                                                    00001980
      IF (DIFF-SURP(J)) 110,100,90                                      00001990
90    CONTINUE                                                          00002000
100   FF(K)=COST(I,K)+F(I-1,J)                                          00002010
110   CONTINUE                                                          00002020
      K=KK+1                                                            00002030
120   K=K-1                                                             00002040
      J=K                                                               00002050
      R=10.E+20                                                         00002060
C                                                                       00002070
C     11.2 SELECT THE LOWEST COST ALTERNATIVE AND SAVE IT FOR           00002080
C     COMBINATION WITH THE NEXT BIDDER'S COSTS.                         00002090
C                                                                       00002100
      DO 140 K=1,J                                                      00002110
      IF (FF(K)-R) 130,140,140                                          00002120
130   R=FF(K)                                                           00002130
      KA=K                                                              00002140
```

Figure 5-2. Program 1 Listing, DYNPRO Subroutine (1 of 2)

```
      X(I,L)=PLEV(I,KA)                                                 00002150
140   CONTINUE                                                          00002160
      F(I,L)=R                                                          00002170
150   CONTINUE                                                          00002180
160   CONTINUE                                                          00002190
C                                                                       00002200
C     12   FOR EACH BID LEVEL FOR WHICH A SOLUTION IS DESIRED, WORK    00002210
C     BACKWARDS BIDDER BY BIDDER TO ASSEMBLE AND THEN PRINT THE         00002220
C     LEAST-COST SOLUTION.                                              00002230
C                                                                       00002240
      N=1                                                               00002250
      IF (ITEST.EQ.0) N=NLEV                                            00002260
      DO 230 LL=N,NLEV                                                  00002270
C                                                                       00002280
C     12.1 ASSEMBLE THE SOLUTION.                                       00002290
C                                                                       00002300
      I=NSUP                                                            00002310
      DELT(I)=SURP(LL)                                                  00002320
      XFIN(I)=X(I,LL)                                                   00002330
170   I=I-1                                                             00002340
C                                                                       00002350
C     12.11 FIRST COMPUTE THE BALANCE REMAINING TO BE MET.              00002360
C                                                                       00002370
      DELT(I)=DELT(I+1)-XFIN(I+1)                                       00002380
C                                                                       00002390
C     12.12 FOR THIS BALANCE FIND BIDDER I'S BID LEVEL IN THE LEAST-COST00002400
C     SOLUTION.                                                         00002410
C                                                                       00002420
      DO 180 L=1,NLEV                                                   00002430
      IF (DELT(I)-SURP(L)) 200,190,180                                  00002440
180   CONTINUE                                                          00002450
C                                                                       00002460
C     12.13 SAVE BIDDER I'S BID LEVEL.                                  00002470
C                                                                       00002480
190   XFIN(I)=X(I,L)                                                    00002490
200   CONTINUE                                                          00002500
      IF (I-1) 210,210,170                                              00002510
C                                                                       00002520
C     12.2 WHEN DONE FOR ALL BIDDERS, WRITE ANSWERS.                    00002530
C                                                                       00002540
210   PRINT 250, SURP(LL),F(NSUP,LL)                                    00002550
      DO 220 I=1,NSUP                                                   00002560
220   PRINT 240, I,XFIN(I)                                              00002570
230   CONTINUE                                                          00002580
      RETURN                                                            00002590
C                                                                       00002600
240   FORMAT (7H BIDDER,I3,F12.0)                                       00002610
250   FORMAT (/,19H REQUIREMENT LEVEL ,F10.0,14H MINIMUM COST ,F10.0)   00002620
260   FORMAT (10HOSOLUTIONS)                                            00002630
      END                                                               00002640
```

Figure 5-2. Program 1 Listing, DYNPRO Subroutine (2 of 2)

```
C     PROGRAM 2                                                          00000010
C     TWO PERIOD/ITEM MULTIPLE BID EVALUATION - FOR TWO BID PERIODS      00000020
C     OR TWO BID ITEMS.  PROVIDES LEAST-COST SOLUTIONS AT EACH POSSIBLE  00000030
C     SET OF BID LEVELS.                                                 00000040
C                                                                        00000050
C     1    IDENTIFICATION OF VARIABLES.                                  00000060
C                                                                        00000070
C     BID - BID COST.                                                    00000080
C     BLEVEL - BID LEVEL.                                                00000090
C     COST(I,L,LL) - THE ARRAY OF BID COSTS FOR EACH BIDDER I, FOR       00000100
C           FIRST PERIOD/ITEM BID LEVEL L AND SECOND PERIOD/ITEM BID     00000110
C           LEVEL LL.                                                    00000120
C     DELT1(I) - AMOUNT OF FIRST PERIOD/ITEM REQUIREMENT MET BY BIDDERS  00000130
C           1 THRU I.                                                    00000140
C     DELT2(I) - AMOUNT OF SECOND PERIOD/ITEM REQUIREMENT MET BY         00000150
C           BIDDERS 1 THRU I.                                            00000160
C     DIF1 - FIRST PERIOD/ITEM BID LEVEL DESIRED FOR PREVIOUS BIDDERS.   00000170
C           WHEN ADDED TO CURRENT BIDDER'S FIRST LEVEL OF K, GIVES A     00000180
C           TOTAL FIRST BID LEVEL OF L.                                  00000190
C     DIF2 - SECOND BID LEVEL DESIRED FOR PREVIOUS BIDDERS.  WHEN ADDED  00000200
C           TO CURRENT BIDDER'S SECOND BID LEVEL OF KK, GIVES A TOTAL     00000210
C           SECOND BID LEVEL OF LL.                                      00000220
C     DUMMY - A HIGH VALUE USED TO INITIALIZE THE COST ARRAY FOR EASE    00000230
C           OF HANDLING BIDS NOT MADE.                                   00000240
C     F(I,L,LL) - MINIMUM COST FOR BIDDERS 1 THRU I AT FIRST             00000250
C           PERIOD/ITEM LEVEL L AND SECOND PERIOD/ITEM LEVEL LL.         00000260
C     FF - COST OF MEETING DESIRED REQUIREMENTS USING CURRENT BIDDER     00000270
C           AT CURRENT LEVEL AND PREVIOUS BIDDERS AT BEST COMBINED       00000280
C           LEVEL.                                                       00000290
C     I - BIDDER.                                                        00000300
C     ICON - CONTRACTOR OR BIDDER INDEX.                                 00000310
C     IT - TITLE ELEMENT INDEX.                                          00000320
C     ITEST -  =1 - COMPUTING ANSWERS FOR SUBMAXIMAL AS WELL AS MAXIMAL  00000330
C           BID LEVELS.                                                  00000340
C              =0 - COMPUTING FOR MAXIMAL BID LEVELS ONLY.               00000350
C     ITYPE -  =1 - STUDY IS FOR TWO ITEMS.                              00000360
C              =0 - STUDY IS FOR TWO PERIODS.                            00000370
C     J - SECOND LEVEL BID INDEX.                                        00000380
C     JJ - SECOND PERIOD/ITEM BID LEVEL FOR PRECEDING BIDDERS.  JJ AND   00000390
C           CURRENT BIDDER'S SECOND LEVEL KK ADD TO SECOND LEVEL LL.     00000400
C     K1 - NUMBER OF BID LEVELS FOR BIDDER FOR FIRST PERIOD/ITEM.        00000410
C     K2 - NUMBER OF BID LEVELS FOR BIDDER FOR SECOND PERIOD/ITEM.       00000420
C     L - FIRST BID LEVEL INDEX.                                         00000430
C     LC - INDEX OF LOWEST FIRST PERIOD/ITEM BID LEVEL FOR WHICH         00000440
C           SOLUTION IS DESIRED.                                         00000450
C     LEV1(I) - NUMBER OF FIRST PERIOD/ITEM BID LEVELS BID BY BIDDER I.  00000460
C           IN COMPUTATION SECTION, EQUALS NLEV1.                        00000470
C     LEV2(I) - NUMBER OF SECOND PERIOD/ITEM BID LEVELS BID BY BIDDER I. 00000480
C           IN COMPUTATION SECTION, EQUALS NLEV2.                        00000490
C     LL - SECOND BID LEVEL INDEX.                                       00000500
C     LLC - INDEX OF LOWEST SECOND PERIOD/ITEM BID LEVEL FOR WHICH       00000510
C           SOLUTION IS DESIRED.                                         00000520
C     LLL - FIRST BID LEVEL INDEX.                                       00000530
```

Figure 5-3. Program 2 Listing (1 of 7)

```
C     LLLL - SECOND BID LEVEL INDEX.                                          00000540
C     M - FIRST PERIOD/ITEM BID LEVEL PLUS 1.                                 00000550
C     MCON - CONTRACTOR COUNTER.                                              00000560
C     MM - SECOND PERIOD/ITEM BID LEVEL PLUS 1.                               00000570
C     NLEV1 - NUMBER OF FIRST PERIOD/ITEM BID LEVELS.                         00000580
C     NLEV2 - NUMBER OF SECOND PERIOD/ITEM BID LEVELS.                        00000590
C     NSUP - NUMBER OF BIDDERS.                                               00000600
C     NTEST -    =1 TO PRINT BID LEVELS AND LEAST COSTS FOR TESTING.          00000610
C                =0 IF NOT TESTING.                                           00000620
C     PLEV1 - BID LEVELS FOR PERIOD/ITEM 1.                                   00000630
C     PLEV2 - BID LEVELS FOR PERIOD/ITEM 2.                                   00000640
C     R - MINIMUM COST FOUND SO FAR, AN INTERMEDIATE RESULT.                  00000650
C     SURP1 - BID LEVELS FOR PERIOD/ITEM 1.                                   00000660
C     SURP2 - BID LEVELS FOR PERIOD/ITEM 2.                                   00000670
C     X1(I,L,LL) - FIRST PERIOD/ITEM BID LEVEL OF BIDDER I'S CONTRIBU-        00000680
C           TION TO LEAST-COST SOLUTION AT FIRST PERIOD/ITEM LEVEL L          00000690
C           AND SECOND PERIOD/ITEM LEVEL LL USING ONLY BIDDERS 1 THRU I.      00000700
C     X2(I,L,LL) - SECOND PERIOD/ITEM BID LEVEL OF BIDDER I'S CONTRIBU-       00000710
C           TION TO LEAST-COST SOLUTION AT FIRST PERIOD/ITEM LEVEL L          00000720
C           AND SECOND PERIOD/ITEM LEVEL LL USING ONLY BIDDERS 1 THRU I.      00000730
C     XFIN1(I) - BID LEVEL OF BIDDER I'S FIRST PERIOD/ITEM BID WHICH IS       00000740
C           PART OF THE LEAST-COST SOLUTION.                                  00000750
C     XFIN2(I) - BID LEVEL OF BIDDER I'S SECOND PERIOD/ITEM BID WHICH         00000760
C           IS PART OF THE LEAST-COST SOLUTION.                               00000770
C     XX1 - SET OF FIRST PERIOD/ITEM BID LEVELS FOR A CONTRACTOR FOR          00000780
C           SUCCESSIVELY IMPROVING BIDS.  FOR TESTING ONLY.                   00000790
C     XX2 - SET OF SECOND PERIOD/ITEM BID LEVELS FOR A CONTRACTOR FOR         00000800
C           SUCCESSIVELY IMPROVING BIDS.  FOR TESTING ONLY.                   00000810
C                                                                             00000820
C     2    DIMENSION STATEMENTS.                                              00000830
      DIMENSION XX1(50), XX2(50)                                              00000840
      DIMENSION SURP1(21), SURP2(21), X1(10,21,21), X2(10,21,21)              00000850
      DIMENSION F(10,21,21)                                                   00000860
      DIMENSION LEV1(10), LEV2(10), PLEV1(10,21), PLEV2(10,21)                00000870
      DIMENSION COST(10,21,21)                                                00000880
      DIMENSION XFIN1(10), XFIN2(10), DELT1(10), DELT2(10)                    00000890
      DIMENSION BLEVEL(2), TITLE(5)                                           00000900
C                                                                             00000910
C     3    READ TITLE, BASIC PARAMETERS, AND BID LEVELS.                      00000920
C                                                                             00000930
      READ (5,580) (TITLE(IT),IT=1,5)                                         00000940
      WRITE (6,590) (TITLE(IT),IT=1,5)                                        00000950
      READ (5,540) NSUP,NLEV1,NLEV2,ITYPE,NTEST,ITEST                         00000960
      WRITE (6,600) NSUP                                                      00000970
      IF (ITYPE.EQ.0) WRITE (6,610) NLEV1                                     00000980
      IF (ITYPE.EQ.0) WRITE (6,620) NLEV2                                     00000990
      IF (ITYPE.EQ.1) WRITE (6,630) NLEV1                                     00001000
      IF (ITYPE.EQ.1) WRITE (6,640) NLEV2                                     00001010
      IF (NSUP.GT.10) WRITE (6,650) NSUP                                      00001020
      IF (NLEV1.GT.21) WRITE (6,660) NLEV1                                    00001030
      IF (NLEV2.GT.21) WRITE (6,660) NLEV2                                    00001040
      IF (NSUP.GT.10.OR.NLEV1.GT.21.OR.NLEV2.GT.21) STOP                      00001050
      DUMMY=1.E+15                                                            00001060
```

Figure 5-3. Program 2 Listing (2 of 7)

```
      IF (ITYPE.EQ.0) WRITE (6,730)                                    00001070
      IF (ITYPE.EQ.1) WRITE (6,740)                                    00001080
      DO 10 L=1,NLEV1                                                  00001090
      READ 570, SURP1(L)                                               00001100
      PRINT 570, SURP1(L)                                              00001110
10    CONTINUE                                                         00001120
      IF (ITYPE.EQ.0) WRITE (6,750)                                    00001130
      IF (ITYPE.EQ.1) WRITE (6,760)                                    00001140
      DO 20 L=1,NLEV2                                                  00001150
      READ 570, SURP2(L)                                               00001160
      PRINT 570, SURP2(L)                                              00001170
20    CONTINUE                                                         00001180
      WRITE (6,770)                                                    00001190
C                                                                      00001200
C     4     INITIALIZE BID LEVELS, BIDS, AND ARRAY OF LEAST-COSTS.     00001210
C                                                                      00001220
      DO 70 I=1,NSUP                                                   00001230
      DO 30 L=1,NLEV1                                                  00001240
      PLEV1(I,L)=SURP1(L)                                              00001250
30-   CONTINUE                                                         00001260
      DO 40 LL=1,NLEV2                                                 00001270
      PLEV2(I,LL)=SURP2(LL)                                            00001280
40    CONTINUE                                                         00001290
      DO 60 L=1,NLEV1                                                  00001300
      DO 50 LL=1,NLEV2                                                 00001310
      COST(I,L,LL)=DUMMY                                               00001320
50    CONTINUE                                                         00001330
60    CONTINUE                                                         00001340
70    CONTINUE                                                         00001350
      DO 90 K=1,NLEV1                                                  00001360
      DO 80 J=1,NLEV2                                                  00001370
      F(1,K,J)=DUMMY                                                   00001380
80    CONTINUE                                                         00001390
90    CONTINUE                                                         00001400
C                                                                      00001410
C     5     READ BIDS FOR EACH BIDDER.                                 00001420
C                                                                      00001430
      DO 160 I=1,NSUP                                                  00001440
      READ 550, LEV1(I),LEV2(I)                                        00001450
      K1=LEV1(I)                                                       00001460
      K2=LEV2(I)                                                       00001470
      IF (ITYPE.EQ.0) WRITE (6,780)                                    00001480
      IF (ITYPE.EQ.1) WRITE (6,790)                                    00001490
      DO 150 K=1,K1                                                    00001500
      DO 140 J=1,K2                                                    00001510
      READ 560, BLEVEL(1),BLEVEL(2),BID                                00001520
      WRITE (6,800) I,BLEVEL(1),BLEVEL(2),BID                          00001530
      DO 100 L=1,NLEV1                                                 00001540
      IF (BLEVEL(1).EQ.SURP1(L)) GO TO 110                             00001550
100   CONTINUE                                                         00001560
      WRITE (6,810)                                                    00001570
      STOP                                                             00001580
110   DO 120 LL=1,NLEV2                                                00001590
```

Figure 5-3. Program 2 Listing (3 of 7)

```
      IF (BLEVEL(2).EQ.SURP2(LL)) GO TO 130                              00001600
120   CONTINUE                                                           00001610
      WRITE (6,820)                                                      00001620
      STOP                                                               00001630
130   COST(I,L,LL)=BID                                                   00001640
140   CONTINUE                                                           00001650
150   CONTINUE                                                           00001660
160   CONTINUE                                                           00001670
C                                                                        00001680
C     6     SETUP TO PROCESS ALL BID LEVELS.                             00001690
C                                                                        00001700
      DO 170 I=1,NSUP                                                    00001710
      LEV1(I)=NLEV1                                                      00001720
      LEV2(I)=NLEV2                                                      00001730
170   CONTINUE                                                           00001740
C                                                                        00001750
C     7     TRANSFER DATA TO COMPUTATIONAL ARRAYS.                       00001760
C                                                                        00001770
      I=1                                                                00001780
      K1=LEV1(I)                                                         00001790
      K2=LEV2(1)                                                         00001800
      DO 200 K=1,K1                                                      00001810
      DO 190 J=1,K2                                                      00001820
      F(I,K,J)=COST(I,K,J)                                               00001830
      X1(I,K,J)=PLEV1(I,K)                                               00001840
      X2(I,K,J)=PLEV2(I,J)                                               00001850
      MCON=1                                                             00001860
      XX1(1)=PLEV1(I,K)                                                  00001870
      XX2(1)=PLEV2(I,J)                                                  00001880
      IF (NTEST) 180,190,180                                             00001890
180   WRITE (6,830) I,K,J,F(I,K,J)                                       00001900
      IF (ITYPE.EQ.0) WRITE (6,840) XX1(MCON)                            00001910
      IF (ITYPE.EQ.0) WRITE (6,850) XX2(MCON)                            00001920
      IF (ITYPE.EQ.1) WRITE (6,860) XX1(MCON)                            00001930
      IF (ITYPE.EQ.1) WRITE (6,870) XX2(MCON)                            00001940
190   CONTINUE                                                           00001950
200   CONTINUE                                                           00001960
C                                                                        00001970
C     8     FIND LEAST-COST SOLUTIONS BY CONSIDERING ADDITIONAL BIDDERS  00001980
C     ONE AT A TIME.                                                     00001990
C                                                                        00002000
      WRITE (6,880)                                                      00002010
      DO 400 I=2,NSUP                                                    00002020
      IF (I-NSUP) 230,210,210                                            00002030
210   IF (ITEST) 230,220,230                                             00002040
220   LC=NLEV1                                                           00002050
      LLC=NLEV2                                                          00002060
      GO TO 240                                                          00002070
230   LC=1                                                               00002080
      LLC=1                                                              00002090
C                                                                        00002100
C     8.1  SEARCH FOR LEAST COSTS FOR EACH DESIRED SET OF BID LEVELS.    00002110
C                                                                        00002120
```

Figure 5-3. Program 2 Listing (4 of 7)

```
240   DO 390 L=LC,NLEV1                                                  00002130
      DO 380 LL=LLC,NLEV2                                                00002140
      K1=LEV1(I)                                                         00002150
      MCON=1                                                             00002160
      M=1                                                                00002170
      MM=1                                                               00002180
      R=100000*DUMMY                                                     00002190
C                                                                        00002200
C     8.11 DETERMINE REQUIREMENT FOR PRECEDING BIDDERS TO MEET.          00002210
C                                                                        00002220
      DO 340 K=1,K1                                                      00002230
      DIF1=SURP1(L)-PLEV1(I,K)                                           00002240
      IF (DIF1) 350,250,250                                              00002250
250   K2=LEV2(I)                                                         00002260
      DO 330 KK=1,K2                                                     00002270
      DIF2=SURP2(LL)-PLEV2(I,KK)                                         00002280
      IF (DIF2) 340,260,260                                              00002290
C                                                                        00002300
C     8.12 FIND BID LEVELS WHICH MEET THAT REQUIREMENT.                  00002310
C                                                                        00002320
260   DO 270 J=1,NLEV1                                                   00002330
      IF (DIF1-SURP1(J)) 280,280,270                                     00002340
270   CONTINUE                                                           00002350
280   DO 290 JJ=1,NLEV2                                                  00002360
      IF (DIF2-SURP2(JJ)) 300,300,290                                    00002370
290   CONTINUE                                                           00002380
C                                                                        00002390
C     8.13 COMPUTE TOTAL COST FOR COMBINATION.                           00002400
C                                                                        00002410
300   FF=COST(I,K,KK)+F(I-1,J,JJ)                                        00002420
C                                                                        00002430
C     8.14 COMPARE TOTAL COST FOR THIS COMBINATION WITH THE TOTAL COST   00002440
C     OF THE PREVIOUSLY BEST COMBINATION.  KEEP THE BETTER ONE.          00002450
C                                                                        00002460
      IF (R-FF) 330,310,320                                              00002470
310   XX1(MCON)=PLEV1(I,K)                                               00002480
      XX2(MCON)=PLEV2(I,KK)                                              00002490
      MCON=MCON+1                                                        00002500
      GO TO 330                                                          00002510
320   M=K+1                                                              00002520
      MM=KK+1                                                            00002530
      MCON=1                                                             00002540
      R=FF                                                               00002550
      GO TO 310                                                          00002560
330   CONTINUE                                                           00002570
340   CONTINUE                                                           00002580
C                                                                        00002590
C     8.2  SAVE BEST VALUES.                                             00002600
C                                                                        00002610
350   F(I,L,LL)=R                                                        00002620
      X1(I,L,LL)=PLEV1(I,M-1)                                            00002630
      X2(I,L,LL)=PLEV2(I,MM-1)                                           00002640
C                                                                        00002650
```

Figure 5-3. Program 2 Listing (5 of 7)

```
C     8.3  IF TESTING, WRITE THE BIDDER, THE BID LEVELS, AND THE LEAST  00002660
C     COST FOR BIDDERS 1 THRU I AT THESE LEVELS.                        00002670
C                                                                       00002680
      IF (NTEST) 360,380,360                                            00002690
360   WRITE (6,830) I,L,LL,F(I,L,LL)                                    00002700
      MCON=MCON-1                                                       00002710
      DO 370 ICON=1,MCON                                                00002720
      WRITE (6,840) XX1(MCON)                                           00002730
      WRITE (6,850) XX2(MCON)                                           00002740
370   CONTINUE                                                          00002750
380   CONTINUE                                                          00002760
390   CONTINUE                                                          00002770
400   CONTINUE                                                          00002780
C                                                                       00002790
C     9    FOR EACH DESIRED PAIR OF BID LEVELS, WORK BACKWARDS BIDDER   00002800
C     BY BIDDER TO ASSEMBLE AND PRINT FINAL SOLUTIONS.                  00002810
C                                                                       00002820
      DO 530 LLL=LC,NLEV1                                               00002830
      DO 520 LLLL=LLC,NLEV2                                             00002840
C                                                                       00002850
C     9.1  ASSEMBLE SOLUTIONS.                                          00002860
C                                                                       00002870
      I=NSUP                                                            00002880
      DELT1(I)=SURP1(LLL)                                               00002890
      DELT2(I)=SURP2(LLLL)                                              00002900
      XFIN1(I)=X1(I,LLL,LLLL)                                           00002910
      XFIN2(I)=X2(I,LLL,LLLL)                                           00002920
410   I=I-1                                                             00002930
C                                                                       00002940
C     9.11 COMPUTES BALANCE REMAINING TO BE MET FOR EACH PERIOD/ITEM.   00002950
C                                                                       00002960
      DELT1(I)=DELT1(I+1)-XFIN1(I+1)                                    00002970
      DELT2(I)=DELT2(I+1)-XFIN2(I+1)                                    00002980
C                                                                       00002990
C     9.12 FOR THOSE BALANCES FIND BIDDER I'S BID LEVELS IN THE         00003000
C     LEAST-COST SOLUTION.                                              00003010
C                                                                       00003020
      DO 420 L=1,NLEV1                                                  00003030
      IF (DELT1(I)-SURP1(L)) 430,430,420                                00003040
420   CONTINUE                                                          00003050
430   DO 440 LL=1,NLEV2                                                 00003060
      IF (DELT2(I)-SURP2(LL)) 460,450,440                               00003070
440   CONTINUE                                                          00003080
C                                                                       00003090
C     9.13 SAVE THOSE BID LEVELS.                                       00003100
C                                                                       00003110
450   XFIN1(I)=X1(I,L,LL)                                               00003120
      XFIN2(I)=X2(I,L,LL)                                               00003130
460   CONTINUE                                                          00003140
C                                                                       00003150
C     9.2  WHEN DONE, WRITE ANSWERS.                                    00003160
C                                                                       00003170
      IF (I-1) 470,470,410                                              00003180
```

Figure 5-3. Program 2 Listing (6 of 7)

```
470   IF (F(NSUP,LLL,LLLL)-DUMMY) 490,480,480                          00003190
480   WRITE (6,680) SURP1(LLL),SURP2(LLLL)                             00003200
      WRITE (6,720)                                                    00003210
      GO TO 510                                                        00003220
490   WRITE (6,670) SURP1(LLL),SURP2(LLLL),F(NSUP,LLL,LLLL)            00003230
      IF (ITYPE.EQ.0) WRITE (6,690)                                    00003240
      IF (ITYPE.EQ.1) WRITE (6,700)                                    00003250
      DO 500 I=1,NSUP                                                  00003260
      WRITE (6,710) I,XFIN1(I),XFIN2(I)                                00003270
500   CONTINUE                                                         00003280
510   CONTINUE                                                         00003290
520   CONTINUE                                                         00003300
530   CONTINUE                                                         00003310
      STOP                                                             00003320
C                                                                      00003330
540   FORMAT (10I3)                                                    00003340
550   FORMAT (2I3)                                                     00003350
560   FORMAT (3F10.0)                                                  00003360
570   FORMAT (F10.0)                                                   00003370
580   FORMAT (5A4)                                                     00003380
590   FORMAT (1H1,5A4)                                                 00003390
600   FORMAT (1HO,I2,8H BIDDERS)                                       00003400
610   FORMAT (1H ,I2,28H BID LEVELS FOR FIRST PERIOD)                  00003410
620   FORMAT (1H ,I2,29H BID LEVELS FOR SECOND PERIOD)                 00003420
630   FORMAT (1H ,I2,26H BID LEVELS FOR FIRST ITEM)                    00003430
640   FORMAT (1H ,I2,27H BID LEVELS FOR SECOND ITEM)                   00003440
650   FORMAT (1HO,I3,31H SUPPLIERS IS TOO MANY (10 MAX))              00003450
660   FORMAT (1HO,I3,32H BID LEVELS IS TOO MANY (21 MAX))             00003460
670   FORMAT (1HO,19H REQUIREMENT LEVEL1,F10.0,19H REQUIREMENT LEVEL2,F100003470
     10.0,14H MINIMUM COST ,F10.0)                                     00003480
680   FORMAT (1HO,19H REQUIREMENT LEVEL1,F10.0,19H REQUIREMENT LEVEL2,F100003490
     10.0)                                                             00003500
690   FORMAT (1H ,14X,9H PERIOD 1,10X,9H PERIOD 2)                     00003510
700   FORMAT (1H ,14X,9H   ITEM 1,10X,9H   ITEM 2)                     00003520
710   FORMAT (1H ,6HBIDDER,I3,2X,F10.0,10X,F10.0)                      00003530
720   FORMAT (1H ,22H NO FEASIBLE SOLUTIONS)                           00003540
730   FORMAT (28HOBID LEVELS FOR FIRST PERIOD)                         00003550
740   FORMAT (26HOBID LEVELS FOR FIRST ITEM)                           00003560
750   FORMAT (29HOBID LEVELS FOR SECOND PERIOD)                        00003570
760   FORMAT (27HOBID LEVELS FOR SECOND ITEM)                          00003580
770   FORMAT (5H1BIDS)                                                 00003590
780   FORMAT (1HO,11X,30H PERIOD 1 PERIOD 2 TOTAL COST )               00003600
790   FORMAT (1HO,11X,30H   ITEM 1   ITEM 2 TOTAL COST )               00003610
800   FORMAT (1HO,6HBIDDER,I3,3F10.0)                                  00003620
810   FORMAT (1HO,26HFIRST BID LEVEL IS ILLEGAL)                       00003630
820   FORMAT (1HO,27HSECOND BID LEVEL IS ILLEGAL)                      00003640
830   FORMAT (1HO,3I3,F10.0)                                           00003650
840   FORMAT (1HO,9HPERIOD 1,F10.0)                                    00003660
850   FORMAT (1H ,9HPERIOD 2,F10.0)                                    00003670
860   FORMAT (1HO,9H  ITEM 1,F10.0)                                    00003680
870   FORMAT (1H ,9H  ITEM 2,F10.0)                                    00003690
880   FORMAT (1H1,20X,17HOPTIMAL SOLUTIONS)                            00003700
      END                                                              00003710
```

Figure 5-3. Program 2 Listing (7 of 7)

```
C      PROGRAM 3                                                              00000010
C      THREE PERIOD/ITEM MULTIPLE BID EVALUATION - FOR THREE BID PERIODS      00000020
C      OR THREE BID ITEMS.  PROVIDES LEAST-COST SOLUTIONS AT EACH             00000030
C      POSSIBLE SET OF BID LEVELS.  PROVIDES SECOND-BEST SOLUTIONS AT         00000040
C      THE TOTAL REQUIREMENT BID LEVELS.                                      00000050
C                                                                             00000060
C      1     IDENTIFICATION OF VARIABLES.                                     00000070
C                                                                             00000080
C      BID - BID COST.                                                        00000090
C      BLEVEL - BID LEVEL                                                     00000100
C      COST(I,J,K,L) - THE ARRAY OF BID COSTS FOR EACH BIDDER I, FOR          00000110
C            FIRST PERIOD/ITEM BID LEVEL J, SECOND PERIOD/ITEM BID            00000120
C            LEVEL K, AND THIRD PERIOD/ITEM BID LEVEL L.                      00000130
C      DELT1(I) - AMOUNT OF FIRST PERIOD/ITEM REQUIREMENT MET BY              00000140
C            BIDDERS 1 THRU I.                                                00000150
C      DELT2(I) - AMOUNT OF SECOND PERIOD/ITEM REQUIREMENT MET BY             00000160
C            BIDDERS 1 THRU I.                                                00000170
C      DELT3(I) - AMOUNT OF THIRD PERIOD/ITEM REQUIREMENT MET BY              00000180
C            BIDDERS 1 THRU I.                                                00000190
C      DIF1 - FIRST PERIOD/ITEM BID LEVEL DESIRED FOR PRECEDING BIDDERS.      00000200
C            WHEN ADDED TO CURRENT BIDDER'S FIRST BID LEVEL OF J, GIVES       00000210
C            A TOTAL FIRST BID LEVEL OF LS.                                   00000220
C      DIF2 - SECOND PERIOD/ITEM BID LEVEL DESIRED FOR PRECEDING              00000230
C            BIDDERS.                                                         00000240
C      DIF3 - THIRD PERIOD/ITEM BID LEVEL DESIRED FOR PRECEDING BIDDERS.      00000250
C      DUMMY - A HIGH VALUE USED TO INITIALIZE THE COST ARRAY FOR EASE        00000260
C            OF HANDLING BIDS NOT MADE.                                       00000270
C      DYNPRO - THE SUBROUTINE WHICH FINDS THE LEAST-COST AND NEXT-BEST       00000280
C            SOLUTIONS.                                                       00000290
C      F(I,LS,LLS,LLLS) - MINIMUM COST FOR BIDDERS 1 THRU I AT LEVEL LS       00000300
C            FOR FIRST PERIOD/ITEM, LEVEL LLS FOR SECOND PERIOD/ITEM,         00000310
C            AND LEVEL LLS FOR THIRD PERIOD/ITEM.                             00000320
C      FF - TRIAL COST OF AN INTERMEDIATE SOLUTION.                           00000330
C      FINX1(I) - ARRAY IN WHICH FIRST PERIOD/ITEM LEAST-COST BID             00000340
C            LEVELS ARE STORED TO AID IN FINDING NEXT-BEST SOLUTIONS.         00000350
C      FINX2(I) - ARRAY IN WHICH SECOND PERIOD/ITEM LEAST-COST BID            00000360
C            LEVELS ARE STORED TO AID IN  FINDING NEXT-BEST SOLUTIONS.        00000370
C      FINX3(I) - ARRAY IN WHICH THIRD PERIOD/ITEM LEAST-COST BID LEVELS      00000380
C            ARE STORED TO AID IN FINDING NEXT-BEST SOLUTIONS.                00000390
C      I - BIDDER                                                             00000400
C      ICON - CONTRACTOR/BIDDER INDEX.                                        00000410
C      IJ - FIRST PERIOD/ITEM BID LEVEL INDEX.                                00000420
C      IJJ - SECOND PERIOD/ITEM BID LEVEL INDEX.                              00000430
C      IJJJ - THIRD PERIOD/ITEM BID LEVEL INDEX.                              00000440
C      IT - TITLE ELEMENT INDEX.                                              00000450
C      ITEST - EQUATED TO ITES1 AND LATER TO ITES2.                           00000460
C               =1 FOR PRINTING SOLUTIONS FOR SUBMAXIMAL PRODUCTION           00000470
C                  LEVELS.                                                    00000480
C               =0 FOR PRINTING TOTAL REQUIREMENT LEVEL SOLUTIONS ONLY.       00000490
C      ITES1 - INPUT PARAMETER.                                               00000500
C               =1 FOR PRINTING LEAST-COST SOLUTIONS FOR SUBMAXIMAL           00000510
C                  PRODUCTION LEVELS.                                         00000520
C               =0 FOR PRINTING LEAST-COST SOLUTIONS FOR TOTAL                00000530
```

Figure 5-4. Program 3 Listing, MAIN Routine (1 of 7)

```
C                  REQUIREMENT LEVEL ONLY.                                    00000540
C      ITES2 - INPUT PARAMETER.                                               00000550
C              =1 FOR PRINTING NEXT-LEAST-COST SOLUTIONS FOR SUBMAXIMAL       00000560
C                 PRODUCTION LEVELS.                                          00000570
C              =0 FOR PRINTING NEXT-LEAST-COST SOLUTIONS FOR TOTAL            00000580
C                 REQUIREMENT LEVEL ONLY.                                     00000590
C      ITYPE -  =1 IF STUDY IS FOR THREE ITEMS.                               00000600
C              =0 IF STUDY IS FOR THREE PERIODS.                              00000610
C      J - BID LEVEL INDEX.                                                   00000620
C      K - BID LEVEL INDEX.                                                   00000630
C      K1 - NUMBER OF FIRST PERIOD/ITEM LEVELS BID.                           00000640
C      K2 - NUMBER OF SECOND PERIOD/ITEM LEVELS BID.                          00000650
C      K3 - NUMBER OF THIRD PERIOD/ITEM LEVELS BID.                           00000660
C      L - FIRST PERIOD/ITEM BID LEVEL INDEX.  ALSO USED AS THIRD             00000670
C          PERIOD/ITEM BID LEVEL INDEX.                                       00000680
C      L1 - THIRD PERIOD/ITEM BID LEVEL INDEX.                                00000690
C      LC - INDEX OF LOWEST FIRST PERIOD/ITEM BID LEVEL FOR WHICH             00000700
C          SOLUTION IS DESIRED                                                00000710
C      LEV1(I) - NUMBER OF FIRST PERIOD/ITEM BID LEVELS BID BY BIDDER I.      00000720
C          IN COMPUTATION SECTION, EQUALS NLEV1.                              00000730
C      LEV2(I) - NUMBER OF SECOND PERIOD/ITEM BID LEVELS BID BY BIDDER I.     00000740
C          IN COMPUTATION SECTION, EQUALS NLEV2.                              00000750
C      LEV3(I) - NUMBER OF THIRD PERIOD/ITEM BID LEVELS BID BY BIDDER I.      00000760
C          IN COMPUTATION SECTION, EQUALS NLEV3.                              00000770
C      LL - SECOND PERIOD/ITEM BID LEVEL INDEX.                               00000780
C      LLC - INDEX OF LOWEST SECOND PERIOD/ITEM BID LEVEL FOR WHICH           00000790
C          SOLUTION IS DESIRED.                                               00000800
C      LLL - THIRD PERIOD/ITEM BID LEVEL INDEX.  ALSO USED AS FIRST           00000810
C          PERIOD/ITEM BID LEVEL INDEX.                                       00000820
C      LLLC - INDEX OF LOWEST THIRD PERIOD/ITEM BID LEVEL FOR WHICH           00000830
C          SOLUTION IS DESIRED.                                               00000840
C      LLLL - SECOND PERIOD/ITEM BID LEVEL INDEX.                             00000850
C      LLLLL - THIRD PERIOD/ITEM BID LEVEL INDEX.                             00000860
C      LLLS - THIRD PERIOD/ITEM BID LEVEL INDEX.                              00000870
C      LLS - SECOND PERIOD/ITEM BID LEVEL INDEX.                              00000880
C      LS - FIRST PERIOD/ITEM BID LEVEL INDEX.                                00000890
C      M - FIRST PERIOD/ITEM BID LEVEL INDEX PLUS 1.                          00000900
C      MCON - CONTRACTOR COUNTER.                                             00000910
C      MM - SECOND PERIOD/ITEM BID LEVEL INDEX PLUS 1.                        00000920
C      MMM - THIRD PERIOD/ITEM BID LEVEL INDEX PLUS 1.                        00000930
C      NLEV1 - NUMBER OF FIRST PERIOD/ITEM BID LEVELS.                        00000940
C      NLEV2 - NUMBER OF SECOND PERIOD/ITEM BID LEVELS.                       00000950
C      NLEV3 - NUMBER OF THIRD PERIOD/ITEM BID LEVELS.                        00000960
C      NSUP - NUMBER OF BIDDERS.                                              00000970
C      NTEST - FOR PROGRAM INPUT TESTING.                                     00000980
C              =1 FOR A SECOND PRINTOUT OF ALL BIDS INCLUDING BIDS NOT        00000990
C          MADE BUT DUMMIED IN.                                               00001000
C              =0 TO SKIP THIS PRINTOUT.                                      00001010
C      PLEV1 - BID LEVELS FOR PERIOD/ITEM 1.                                  00001020
C      PLEV2 - BID LEVELS FOR PERIOD/ITEM 2.                                  00001030
C      PLEV3 - BID LEVELS FOR PERIOD/ITEM 3.                                  00001040
C      R - MINIMUM COST YET FOUND FOR THE INTERMEDIATE SOLUTION               00001050
C          CURRENTLY BEING SOUGHT.                                            00001060
```

Figure 5-4. Program 3 Listing, MAIN Routine (2 of 7)

```
C      SAVE - VARIABLE USED TO SAVE OPTIMAL COST FOR RESTORING COST      00001070
C           ARRAY AFTER EACH SUBOPTIMIZATION.                            00001080
C      SURP1 - THE FIRST PERIOD/ITEM BID LEVELS.                         00001090
C      SURP2 - THE SECOND PERIOD/ITEM BID LEVELS.                        00001100
C      SURP3 - THE THIRD PERIOD/ITEM BID LEVELS.                         00001110
C      TITLE - TITLE OF STUDY.                                           00001120
C      XFIN1(I) - BID LEVEL OF BIDDER I'S CONTRIBUTION TO THE LEAST-COST 00001130
C           SOLUTION FOR PERIOD/ITEM 1.                                  00001140
C      XFIN2(I) - BID LEVEL OF BIDDER I'S CONTRIBUTION TO THE LEAST-COST 00001150
C           SOLUTION FOR PERIOD/ITEM 2.                                  00001160
C      XFIN3(I) - BID LEVEL OF BIDDER I'S CONTRIBUTION TO THE LEAST-COST 00001170
C           SOLUTION FOR PERIOD/ITEM 3.                                  00001180
C      X1(I,L,LL,LLL) - FIRST PERIOD/ITEM BID LEVEL OF BIDDER I'S        00001190
C           CONTRIBUTION TO THE LEAST-COST SOLUTION AT LEVELS L, LL,     00001200
C           AND LLL USING ONLY BIDDERS 1 THRU I.                         00001210
C      X2(I,L,LL,LLL) - SECOND PERIOD/ITEM BID LEVEL OF BIDDER I'S       00001220
C           CONTRIBUTION TO THE LEAST-COST SOLUTION AT LEVELS L, LL,     00001230
C           AND LLL USING ONLY BIDDERS 1 THRU I.                         00001240
C      X3(I,L,LL,LLL) - THIRD PERIOD/ITEM BID LEVEL OF BIDDER I'S        00001250
C           CONTRIBUTION TO THE LEAST-COST SOLUTION AT LEVELS L, LL,     00001260
C           AND LLL USING ONLY BIDDERS 1 THRU I.                         00001270
C      XX1 - SET OF FIRST PERIOD/ITEM BID LEVELS FOR A CONTRACTOR FOR    00001280
C           SUCCESSIVELY IMPROVING BIDS.  FOR TESTING ONLY.              00001290
C      XX2 - SET OF SECOND PERIOD/ITEM BID LEVELS FOR A CONTRACTOR FOR   00001300
C           SUCCESSIVELY IMPROVING BIDS.  FOR TESTING ONLY.              00001310
C      XX3 - SET OF THIRD PERIOD/ITEM BID LEVELS FOR A CONTRACTOR FOR    00001320
C           SUCCESSIVELY IMPROVING BIDS.  FOR TESTING ONLY.              00001330
C                                                                        00001340
C      2    COMMON AND DIMENSION STATEMENTS.                            00001350
C                                                                        00001360
       COMMON PLEV1(10,6),PLEV2(10,6),PLEV3(10,6)                        00001370
       COMMON XFIN1(10),XFIN2(10),XFIN3(10),SURP1(6),SURP2(6),SURP3(6)   00001380
       COMMON LEV1(10),LEV2(10),LEV3(10),COST(10,6,6,6),DUMMY            00001390
       COMMON NSUP,NLEV1,NLEV2,NLEV3,ITYPE,NTEST,ITEST                   00001400
       DIMENSION FINX1(10), FINX2(10), FINX3(10), BLEVEL(3), TITLE(5)    00001410
C                                                                        00001420
C      3    INITIALIZE COSTS.                                           00001430
C                                                                        00001440
       DUMMY=1.E+15                                                      00001450
       DO 10 I=1,10                                                      00001460
       DO 10 J=1,6                                                       00001470
       DO 10 K=1,6                                                       00001480
       DO 10 L=1,6                                                       00001490
       COST(I,J,K,L)=DUMMY                                               00001500
10     CONTINUE                                                          00001510
C                                                                        00001520
C      4    READ TITLE, BASIC PARAMETERS, AND BID LEVELS.               00001530
C                                                                        00001540
       READ (5,320) (TITLE(IT),IT=1,5)                                   00001550
       WRITE (6,330) (TITLE(IT),IT=1,5)                                  00001560
       READ (5,500) NSUP,NLEV1,NLEV2,NLEV3,ITYPE,NTEST,ITES1,ITES2       00001570
       WRITE (6,340) NSUP                                                00001580
       IF (ITYPE.EQ.1) GO TO 20                                          00001590
```

Figure 5-4. Program 3 Listing, MAIN Routine (3 of 7)

```
      WRITE (6,350) NLEV1                                              00001600
      WRITE (6,360) NLEV2                                              00001610
      WRITE (6,370) NLEV3                                              00001620
      GO TO 30                                                         00001630
20    WRITE (6,380) NLEV1                                              00001640
      WRITE (6,390) NLEV2                                              00001650
      WRITE (6,400) NLEV3                                              00001660
30    CONTINUE                                                         00001670
      ITEST=ITES1                                                      00001680
      DO 40 LS=1,NLEV1                                                 00001690
      READ 410, SURP1(LS)                                              00001700
40    CONTINUE                                                         00001710
      DO 50 LS=1,NLEV2                                                 00001720
      READ 410, SURP2(LS)                                              00001730
50    CONTINUE                                                         00001740
      DO 60 LS=1,NLEV3                                                 00001750
      READ 410, SURP3(LS)                                              00001760
60    CONTINUE                                                         00001770
C                                                                      00001780
C     5    INITIALIZE BID LEVELS.                                      00001790
C                                                                      00001800
      DO 100 I=1,NSUP                                                  00001810
      DO 70 L=1,NLEV1                                                  00001820
      PLEV1(I,L)=SURP1(L)                                              00001830
70    CONTINUE                                                         00001840
      DO 80 LL=1,NLEV2                                                 00001850
      PLEV2(I,LL)=SURP2(LL)                                            00001860
80    CONTINUE                                                         00001870
      DO 90 LLL=1,NLEV3                                                00001880
      PLEV3(I,LLL)=SURP3(LLL)                                          00001890
90    CONTINUE                                                         00001900
100   CONTINUE                                                         00001910
C                                                                      00001920
C     6    READ AND ENTER BIDS FOR EACH BIDDER.                        00001930
C                                                                      00001940
      WRITE (6,420)                                                    00001950
      DO 200 I=1,NSUP                                                  00001960
      READ 510, LEV1(I),LEV2(I),LEV3(I)                                00001970
      K1=LEV1(I)                                                       00001980
      K2=LEV2(I)                                                       00001990
      K3=LEV3(I)                                                       00002000
      IF (ITYPE.EQ.0) WRITE (6,430)                                    00002010
      IF (ITYPE.EQ.1) WRITE (6,440)                                    00002020
      DO 190 J=1,K1                                                    00002030
      DO 180 K=1,K2                                                    00002040
      DO 170 L1=1,K3                                                   00002050
      READ 490, (BLEVEL(M),M=1,3),BID                                  00002060
      WRITE (6,480) I,(BLEVEL(M),M=1,3),BID                            00002070
      DO 110 L=1,NLEV1                                                 00002080
      IF (BLEVEL(1).EQ.SURP1(L)) GO TO 120                             00002090
110   CONTINUE                                                         00002100
      WRITE (6,450)                                                    00002110
      STOP                                                             00002120
```

Figure 5-4. Program 3 Listing, MAIN Routine (4 of 7)

```
120   DO 130 LL=1,NLEV2                                                    00002130
      IF (BLEVEL(2).EQ.SURP2(LL)) GO TO 140                                00002140
130   CONTINUE                                                             00002150
      WRITE (6,460)                                                        00002160
      STOP                                                                 00002170
140   DO 150 LLL=1,NLEV3                                                   00002180
      IF (BLEVEL(3).EQ.SURP3(LLL)) GO TO 160                               00002190
150   CONTINUE                                                             00002200
      WRITE (6,470)                                                        00002210
      STOP                                                                 00002220
160   COST(I,L,LL,LLL)=BID                                                 00002230
170   CONTINUE                                                             00002240
180   CONTINUE                                                             00002250
190   CONTINUE                                                             00002260
200   CONTINUE                                                             00002270
C                                                                          00002280
C     7     SET UP TO PROCESS ALL BID LEVELS.                              00002290
C                                                                          00002300
      DO 210 I=1,NSUP                                                      00002310
      LEV1(I)=NLEV1                                                        00002320
      LEV2(I)=NLEV2                                                        00002330
      LEV3(I)=NLEV3                                                        00002340
210   CONTINUE                                                             00002350
C                                                                          00002360
C     8     PRINT ALL BID LEVELS IF DESIRED.                               00002370
C                                                                          00002380
      IF (NTEST.NE.1) GO TO 230                                            00002390
      DO 220 I=1,NSUP                                                      00002400
      WRITE (6,570) I                                                      00002410
      DO 220 J=1,NLEV1                                                     00002420
      DO 220 K=1,NLEV2                                                     00002430
      DO 220 L=1,NLEV3                                                     00002440
      WRITE (6,580) PLEV1(I,J),PLEV2(I,K),PLEV3(I,L),COST(I,J,K,L)         00002450
220   CONTINUE                                                             00002460
230   CONTINUE                                                             00002470
C                                                                          00002480
C     9     FIND AND PRINT LEAST-COST SOLUTIONS.                           00002490
C                                                                          00002500
      WRITE (6,520)                                                        00002510
      CALL DYNPRO                                                          00002520
      ITEST=ITES2                                                          00002530
C                                                                          00002540
C     10    SAVE LEAST-COST SOLUTIONS FOR USE IN FINDING NEXT-BEST ONES.   00002550
C                                                                          00002560
      DO 240 I=1,NSUP                                                      00002570
      FINX1(I)=XFIN1(I)                                                    00002580
      FINX2(I)=XFIN2(I)                                                    00002590
240   FINX3(I)=XFIN3(I)                                                    00002600
C                                                                          00002610
C     11    FIND AND PRINT NEXT-BEST SOLUTIONS.                            00002620
C                                                                          00002630
      DO 310 I=1,NSUP                                                      00002640
      PRINT 530, I                                                         00002650
```

Figure 5-4. Program 3 Listing, MAIN Routine (5 of 7)

```
C                                                                       00002660
C     11.1 FOR BIDDER I FIND BID LEVELS J,K,AND L OF LEAST-COST         00002670
C     SOLUTION.                                                         00002680
C                                                                       00002690
      K1=LEV1(I)                                                        00002700
      K2=LEV2(I)                                                        00002710
      K3=LEV3(I)                                                        00002720
      DO 250 J=1,K1                                                     00002730
      IF (PLEV1(I,J)-FINX1(I)) 250,260,250                              00002740
250   CONTINUE                                                          00002750
      PRINT 540, FINX1(I),I                                             00002760
      STOP 110                                                          00002770
260   DO 270 K=1,K2                                                     00002780
      IF (PLEV2(I,K)-FINX2(I)) 270,280,270                              00002790
270   CONTINUE                                                          00002800
      PRINT 550, FINX2(I),I                                             00002810
      STOP 120                                                          00002820
280   DO 290 L=1,K3                                                     00002830
      IF (PLEV3(I,L)-FINX3(I)) 290,300,290                              00002840
290   CONTINUE                                                          00002850
      PRINT 560, FINX3(I),I                                             00002860
      STOP 130                                                          00002870
C                                                                       00002880
C     11.2 RULE OUT THE LEAST-COST PRODUCTION LEVEL J,K,L AND FIND THE  00002890
C     LEAST-COST OF THE REMAINING POSSIBILITIES.                        00002900
C                                                                       00002910
300   SAVE=COST(I,J,K,L)                                                00002920
      COST(I,J,K,L)=DUMMY                                               00002930
      CALL DYNPRO                                                       00002940
      IF (ITES2.NE.0) WRITE (6,590)                                     00002950
310   COST(I,J,K,L)=SAVE                                                00002960
      STOP                                                              00002970
C                                                                       00002980
320   FORMAT (5A4)                                                      00002990
330   FORMAT (1H1,5A4)                                                  00003000
340   FORMAT (1HO,I2,8H BIDDERS)                                        00003010
350   FORMAT (1H ,I2,28H BID LEVELS FOR FIRST PERIOD)                   00003020
360   FORMAT (1H ,I2,29H BID LEVELS FOR SECOND PERIOD)                  00003030
370   FORMAT (1H ,I2,28H BID LEVELS FOR THIRD PERIOD)                   00003040
380   FORMAT (1HO,I2,26H BID LEVELS FOR FIRST ITEM)                     00003050
390   FORMAT (1H ,I2,27H BID LEVELS FOR SECOND ITEM)                    00003060
400   FORMAT (1H ,I2,26H BID LEVELS FOR THIRD ITEM)                     00003070
410   FORMAT (F10.0)                                                    00003080
420   FORMAT (5H1BIDS)                                                  00003090
430   FORMAT (1HO,11X,40H PERIOD 1  PERIOD 2  PERIOD 3 TOTAL COST)      00003100
440   FORMAT (1HO,11X,40H   ITEM 1    ITEM 2    ITEM 3 TOTAL COST)     00003110
450   FORMAT (1HO,26HFIRST BID LEVEL IS ILLEGAL)                        00003120
460   FORMAT (1HO,27HSECOND BID LEVEL IS ILLEGAL)                       00003130
470   FORMAT (1HO,26HTHIRD BID LEVEL IS ILLEGAL)                        00003140
480   FORMAT (1HO,6HBIDDER,I3,4F10.0)                                   00003150
490   FORMAT (4F10.0)                                                   00003160
500   FORMAT (10I3)                                                     00003170
510   FORMAT (3I3)                                                      00003180
```

Figure 5-4. Program 3 Listing, MAIN Routine (6 of 7)

```
520    FORMAT (1H1,20X,17HOPTIMAL SOLUTIONS)                                  00003190
530    FORMAT (1H1,20X,11HSUBOPT SOLN,I5//)                                   00003200
540    FORMAT (1X,6HBID OF,E10.3,24HWAS NOT FOUND FOR BIDDER,I5,6H PER 1)00003210
550    FORMAT (1X,6HBID OF,E10.3,24HWAS NOT FOUND FOR BIDDER,I5,6H PER 2)00003220
560    FORMAT (1X,6HBID OF,E10.3,24HWAS NOT FOUND FOR BIDDER,I5,6H PER 3)00003230
570    FORMAT (1H1,I2)                                                        00003240
580    FORMAT (1H0,3F6.0,F10.0)                                               00003250
590    FORMAT (1H0,///,41H      THE ONLY TRULY SUBOPTIMAL SOLUTION ,29H1S00003260
     1 THE 100%  100%  100% ONE -,/,39H THE REST MAY OR MAY NOT BE SUBOP00003270
     2TIMAL ,34HAND ARE PRINTED AS DEBUGGING AIDS.)                         00003280
      END                                                                   00003290
```

Figure 5-4. Program 3 Listing, MAIN Routine (7 of 7)

```
      SUBROUTINE DYNPRO                                                    00003300
      COMMON PLEV1(10,6),PLEV2(10,6),PLEV3(10,6)                           00003310
      COMMON XFIN1(10),XFIN2(10),XFIN3(10),SURP1(6),SURP2(6),SURP3(6)      00003320
      COMMON LEV1(10),LEV2(10),LEV3(10),COST(10,6,6,6),DUMMY               00003330
      COMMON NSUP,NLEV1,NLEV2,NLEV3,ITYPE,NTEST,ITEST                      00003340
      DIMENSION DELT1(10), DELT2(10), DELT3(10)                            00003350
      DIMENSION F(10,6,6,6), X1(10,6,6,6), X2(10,6,6,6), X3(10,6,6,6)     00003360
      DIMENSION XX1(50), XX2(50), XX3(50)                                  00003370
C                                                                          00003380
C     12   TRANSFER DATA TO COMPUTATIONAL ARRAYS.                          00003390
C                                                                          00003400
      DO 10 I=1,10                                                         00003410
      DO 10 J=1,6                                                          00003420
      DO 10 K=1,6                                                          00003430
      DO 10 L=1,6                                                          00003440
      F(I,J,K,L)=DUMMY                                                     00003450
10    CONTINUE                                                             00003460
      I=1                                                                  00003470
      K1=LEV1(I)                                                           00003480
      K2=LEV2(I)                                                           00003490
      K3=LEV3(I)                                                           00003500
      DO 70 J=1,K1                                                         00003510
      DO 60 K=1,K2                                                         00003520
      DO 50 L=1,K3                                                         00003530
      F(I,J,K,L)=COST(I,J,K,L)                                             00003540
      X1(I,J,K,L)=PLEV1(I,J)                                               00003550
      X2(I,J,K,L)=PLEV2(I,K)                                               00003560
      X3(I,J,K,L)=PLEV3(I,L)                                               00003570
      MCON=1                                                               00003580
      XX1(MCON)=PLEV1(I,J)                                                 00003590
      XX2(MCON)=PLEV2(I,K)                                                 00003600
      XX3(MCON)=PLEV3(I,L)                                                 00003610
      IF (NTEST) 20,50,20                                                  00003620
20    WRITE (6,530) I,J,K,L,F(I,J,K,L)                                     00003630
      IF (ITYPE.EQ.1) GO TO 30                                             00003640
      WRITE (6,540) XX1(MCON)                                              00003650
      WRITE (6,560) XX2(MCON)                                              00003660
      WRITE (6,550) XX3(MCON)                                              00003670
      GO TO 40                                                             00003680
30    WRITE (6,570) XX1(MCON)                                              00003690
      WRITE (6,580) XX2(MCON)                                              00003700
      WRITE (6,590) XX3(MCON)                                              00003710
40    CONTINUE                                                             00003720
50    CONTINUE                                                             00003730
60    CONTINUE                                                             00003740
70    CONTINUE                                                             00003750
C                                                                          00003760
C     13   FIND LEAST-COST SOLUTIONS BY CONSIDERING ADDITIONAL BIDDERS     00003770
C     ONE AT A TIME.                                                       00003780
C                                                                          00003790
      DO 350 I=2,NSUP                                                      00003800
      IF (I-NSUP) 100,80,80                                                00003810
80    IF (ITEST) 100,90,100                                                00003820
```

Figure 5-5. Program 3 Listing, DYNPRO Subroutine (1 of 5)

```
90      LC=NLEV1                                                        00003830
        LLC=NLEV2 .                                                     00003840
        LLLC=NLEV3                                                      00003850
        GO TO 110                                                       00003860
100     LC=1                                                            00003870
        LLC=1                                                           00003880
        LLLC=1                                                          00003890
C                                                                       00003900
C       13.1 SEARCH FOR LEAST COSTS FOR EACH DESIRED SET OF BID LEVELS. 00003910
C                                                                       00003920
110     DO 340 LS=LC,NLEV1                                              00003930
        DO 330 LLS=LLC,NLEV2                                            00003940
        DO 320 LLLS=LLLC,NLEV3                                          00003950
        K1=LEV1(I)                                                      00003960
        MCON=1                                                          00003970
        M=1                                                             00003980
        MM=1                                                            00003990
        MMM=1                                                           00004000
        R=100000*DUMMY                                                  00004010
C                                                                       00004020
C       13.11 DETERMINE REQUIREMENT FOR PRECEDING BIDDERS TO MEET.      00004030
C                                                                       00004040
        DO 250 J=1,K1                                                   00004050
        DIF1=SURP1(LS)-PLEV1(I,J)                                       00004060
        IF (DIF1) 260,120,120                                           00004070
120     K2=LEV2(I)                                                      00004080
        DO 240 K=1,K2                                                   00004090
        DIF2=SURP2(LLS)-PLEV2(I,K)                                      00004100
        IF (DIF2) 250,130,130                                           00004110
130     K3=LEV3(I)                                                      00004120
        DO 230 L=1,K3                                                   00004130
        DIF3=SURP3(LLLS)-PLEV3(I,L)                                     00004140
        IF (DIF3) 240,140,140                                           00004150
C                                                                       00004160
C       13.12 FIND BID LEVELS WHICH MEET THAT REQUIREMENT.              00004170
C                                                                       00004180
140     DO 150 IJ=1,NLEV1                                               00004190
        IF (DIF1-SURP1(IJ)) 160,160,150                                 00004200
150     CONTINUE                                                        00004210
160     DO 170 IJJ=1,NLEV2                                              00004220
        IF (DIF2-SURP2(IJJ)) 180,180,170                                00004230
170     CONTINUE                                                        00004240
180     DO 190 IJJJ=1,NLEV3                                             00004250
        IF (DIF3-SURP3(IJJJ)) 200,200,190                               00004260
190     CONTINUE                                                        00004270
C                                                                       00004280
C       13.13 COMPUTE TOTAL COST FOR COMBINATION.                       00004290
C                                                                       00004300
200     FF=COST(I,J,K,L)+F(I-1,IJ,IJJ,IJJJ)                            00004310
C                                                                       00004320
C       13.14 COMPARE TOTAL COST FOR THIS COMBINATION WITH THE TOTAL    00004330
C       COST OF THE PREVIOUSLY BEST COMBINATION.  KEEP THE BETTER ONE.  00004340
C                                                                       00004350
```

Figure 5-5. Program 3 Listing, DYNPRO Subroutine (2 of 5)

```
      IF (R-FF) 230,210,220                                              00004360
210   XX1(MCON)=PLEV1(I,J)                                               00004370
      XX2(MCON)=PLEV2(I,K)                                               00004380
      XX3(MCON)=PLEV3(I,L)                                               00004390
      MCON=MCON+1                                                        00004400
      GO TO 230                                                          00004410
220   M=J+1                                                              00004420
      MM=K+1                                                             00004430
      MMM=L+1                                                            00004440
      MCON=1                                                             00004450
      R=FF                                                               00004460
      GO TO 210                                                          00004470
230   CONTINUE                                                           00004480
240   CONTINUE                                                           00004490
250   CONTINUE                                                           00004500
C                                                                        00004510
C     13.2 SAVE BEST VALUE.                                              00004520
C                                                                        00004530
260   F(I,LS,LLS,LLLS)=R                                                 00004540
      X1(I,LS,LLS,LLLS)=PLEV1(I,M-1)                                     00004550
      X2(I,LS,LLS,LLLS)=PLEV2(I,MM-1)                                    00004560
      X3(I,LS,LLS,LLLS)=PLEV3(I,MMM-1)                                   00004570
C                                                                        00004580
C     13.3 IF TESTING, WRITE THE BIDDER, THE BID LEVELS, AND THE LEAST   00004590
C     COST FOR BIDDERS 1 THRU I AT THESE LEVELS.                         00004600
C                                                                        00004610
      IF (NTEST) 270,310,270                                             00004620
270   WRITE (6,530) I,LS,LLS,LLLS,F(I,LS,LLS,LLLS)                       00004630
      MCON=MCON-1                                                        00004640
      DO 300 ICON=1,MCON                                                 00004650
      IF (ITYPE.EQ.1) GO TO 280                                          00004660
      WRITE (6,540) XX1(MCON)                                            00004670
      WRITE (6,560) XX2(MCON)                                            00004680
      WRITE (6,550) XX3(MCON)                                            00004690
      GO TO 290                                                          00004700
280   WRITE (6,570) XX1(MCON)                                            00004710
      WRITE (6,580) XX2(MCON)                                            00004720
      WRITE (6,590) XX3(MCON)                                            00004730
290   CONTINUE                                                           00004740
300   CONTINUE                                                           00004750
310   CONTINUE                                                           00004760
320   CONTINUE                                                           00004770
330   CONTINUE                                                           00004780
340   CONTINUE                                                           00004790
350   CONTINUE                                                           00004800
C                                                                        00004810
C     14   WORK BACKWARDS TO ASSEMBLE AND PRINT FINAL SOLUTIONS.         00004820
C                                                                        00004830
      K1=1                                                               00004840
      K2=1                                                               00004850
      K3=1                                                               00004860
      IF (ITEST) 370,360,370                                             00004870
360   K1=NLEV1                                                           00004880
```

Figure 5-5. Program 3 Listing, DYNPRO Subroutine (3 of 5)

```
      K2=NLEV2                                                          00004890
      K3=NLEV3                                                          00004900
370   DO 520 LLL=K1,NLEV1                                               00004910
      DO 510 LLLL=K2,NLEV2                                              00004920
      DO 500 LLLLL=K3,NLEV3                                             00004930
C                                                                       00004940
C     14.1 ASSEMBLE THE SOLUTIONS.                                      00004950
C                                                                       00004960
      I=NSUP                                                            00004970
      DELT1(I)=SURP1(LLL)                                               00004980
      DELT2(I)=SURP2(LLLL)                                              00004990
      DELT3(I)=SURP3(LLLLL)                                             00005000
      XFIN1(I)=X1(I,LLL,LLLL,LLLLL)                                     00005010
      XFIN2(I)=X2(I,LLL,LLLL,LLLLL)                                     00005020
      XFIN3(I)=X3(I,LLL,LLLL,LLLLL)                                     00005030
380   I=I-1                                                             00005040
C                                                                       00005050
C     14.11 COMPUTE BALANCES REMAINING TO BE MET.                       00005060
C                                                                       00005070
      DELT1(I)=DELT1(I+1)-XFIN1(I+1)                                    00005080
      DELT2(I)=DELT2(I+1)-XFIN2(I+1)                                    00005090
      DELT3(I)=DELT3(I+1)-XFIN3(I+1)                                    00005100
C                                                                       00005110
C     14.12 FOR THOSE BALANCES FIND BIDDER I'S BID LEVELS IN THE        00005120
C     LEAST-COST SOLUTION.                                              00005130
C                                                                       00005140
      DO 390 LS=1,NLEV1                                                 00005150
      IF (DELT1(I)-SURP1(LS)) 400,400,390                               00005160
390   CONTINUE                                                          00005170
400   DO 410 LLS=1,NLEV2                                                00005180
      IF (DELT2(I)-SURP2(LLS)) 410,420,410                              00005190
410   CONTINUE                                                          00005200
420   DO 430 LLLS=1,NLEV3                                               00005210
      IF (DELT3(I)-SURP3(LLLS)) 430,440,430                             00005220
430   CONTINUE                                                          00005230
C                                                                       00005240
C     14.13 SAVE THOSE BID LEVELS.                                      00005250
C                                                                       00005260
440   XFIN1(I)=X1(I,LS,LLS,LLLS)                                        00005270
      XFIN2(I)=X2(I,LS,LLS,LLLS)                                        00005280
      XFIN3(I)=X3(I,LS,LLS,LLLS)                                        00005290
C                                                                       00005300
C     14.2 WHEN DONE, WRITE ANSWERS.                                    00005310
C                                                                       00005320
      IF (I-1) 450,450,380                                              00005330
450   IF (F(NSUP,LLL,LLLL,LLLLL)-DUMMY) 470,460,460                    00005340
460   WRITE (6,650) SURP1(LLL),SURP2(LLLL),SURP3(LLLLL)                 00005350
      WRITE (6,640)                                                     00005360
      GO TO 490                                                         00005370
470   WRITE (6,600) SURP1(LLL),SURP2(LLLL),SURP3(LLLLL),F(NSUP,LLL,LLLL,00005380
     1LLLLL)                                                            00005390
      IF (ITYPE.EQ.0) WRITE (6,610)                                     00005400
      IF (ITYPE.EQ.1) WRITE (6,620)                                     00005410
```

Figure 5-5. Program 3 Listing, DYNPRO Subroutine (4 of 5)

```
      DO 480 I=1,NSUP                                                    00005420
480   WRITE (6,630) I,XFIN1(I),XFIN2(I),XFIN3(I)                         00005430
490   CONTINUE                                                           00005440
500   CONTINUE                                                           00005450
510   CONTINUE                                                           00005460
520   CONTINUE                                                           00005470
      RETURN                                                             00005480
C                                                                        00005490
530   FORMAT (1H0,4I3,F10.0)                                             00005500
540   FORMAT (1H0,9HPERIOD 1 ,F10.0)                                     00005510
550   FORMAT (1H ,9HPERIOD 3 ,F10.0)                                     00005520
560   FORMAT (1H ,9HPERIOD 2 ,F10.0)                                     00005530
570   FORMAT (1H0,9HPERIOD 1 ,F10.0)                                     00005540
580   FORMAT (1H ,9HPERIOD 2 ,F10.0)                                     00005550
590   FORMAT (1H ,9HPERIOD 3 ,F10.0)                                     00005560
600   FORMAT (1H0,19H REQUIREMENT LEVEL1,F10.0,19H REQUIREMENT LEVEL2,F100005570
     10.0,19H REQUIREMENT LEVEL3,F10.0,14H MINIMUM COST ,F10.0)          00005580
610   FORMAT (1H ,14X,10H PERIOD 1 ,10X,10H PERIOD 2 ,10X,10H PERIOD 3 )00005590
620   FORMAT (1H ,14X,10H   ITEM 1 ,10X,10H   ITEM 2 ,10X,10H   ITEM 3 )00005600
630   FORMAT (1H ,6HBIDDER,I3,2X,F10.0,10X,F10.0,10X,F10.0)              00005610
640   FORMAT (1H ,21H NO FEASIBLE SOLUTION)                              00005620
650   FORMAT (1H0,19H REQUIREMENT LEVEL1,F10.0,19H REQUIREMENT LEVEL2,F100005630
     10.0,19H REQUIREMENT LEVEL3,F10.0)                                  00005640
      END                                                                00005650
```

Figure 5-5. Program 3 Listing, DYNPRO Subroutine (5 of 5)

```
C     PROGRAM 4                                                          00000010
C     EXTENDED MULTIPLE BID EVALUATION - PROVIDES LEAST-COST AND         00000020
C     SECOND-BEST SOLUTIONS AT EACH POSSIBLE BID LEVEL FOR EACH          00000030
C     POSSIBLE NUMBER OF SUPPLIERS.                                      00000040
C                                                                        00000050
C     1    IDENTIFICATION OF VARIABLES.                                  00000070
C                                                                        00000075
C     BID - BID COST.                                                    00000080
C     BLEVEL - BID LEVEL.                                                00000090
C     COST(I,L) - THE ARRAY OF BID COSTS FOR EACH BIDDER I AND BID       00000100
C           LEVEL L.                                                     00000110
C     COSTB - THE CURRENT SECOND-BEST COST.                              00000120
C     DELT(I) - AMOUNT OF REQUIREMENT MET BY BIDDERS 1 THRU I.           00000130
C     DELTB - TEMPORARY CURRENT SECOND-BEST COST.                        00000140
C     DIFF - BID LEVEL DESIRED FOR PRECEDING BIDDERS.  WHEN ADDED TO     00000150
C           CURRENT BIDDER'S LEVEL K GIVES TOTAL BID LEVEL L.            00000160
C     DUMMY - A HIGH VALUE USED TO INITIALIZE THE COST ARRAY FOR EASE    00000170
C           OF HANDLING BIDS NOT MADE.                                   00000180
C     F1(I,L,JJ) - LEAST COST FOR BIDDERS 1 THRU I AT LEVEL L WITH       00000190
C           JJ-1 SUPPLIERS.                                              00000200
C     F2(I,L,JJ) - SECOND-BEST COST FOR BIDDERS 1 THRU I AT LEVEL L      00000210
C           WITH JJ-1 SUPPLIERS.                                         00000220
C     FF - COST OF MEETING DESIRED REQUIREMENT LEVEL L USING CURRENT     00000230
C           BIDDER AT LEVEL K, PREVIOUS BIDDERS AT COMBINED LEVEL J,     00000240
C           AND KSUP-1 BIDDERS.                                          00000250
C     G(KSUP,K,J) - COMPUTATIONAL ARRAY HOLDING COSTS FOR BIDDER         00000260
C           1 THRU I TO MEET BID LEVEL L WITH BIDDER I AT LEVEL K AND    00000270
C           WITH KSUP BIDDERS IN TOTAL.  FOR J=1, COST IS POTENTIALLY    00000280
C           EITHER LEAST OR NEXT-LEAST COST.  FOR J=2, COST IS           00000290
C           POTENTIALLY ONLY SECOND-BEST COST.                           00000300
C     IT - TITLE ELEMENT INDEX.                                          00000310
C     ITEST -  =1 FOR PRINTING SOLUTIONS FOR SUBMAXIMAL PRODUCTION       00000320
C           LEVELS.                                                      00000330
C              =0 FOR PRINTING MAXIMAL PRODUCTION LEVEL SOLUTIONS ONLY.  00000340
C     J - INDEX OF LEVEL OF DESIRED CONTRIBUTION BY THIS BIDDER.         00000350
C     JABLE - INDEX FOR THIRD SUBSCRIPT OF G ARRAY.                      00000360
C     JCOD - INDEX FOR THE NUMBER OF SUPPLIERS.  THE TRUE NUMBER OF      00000370
C           SUPPLIERS IS 1 LESS THAN JCOD, AS JCOD=1 CORRESPONDS         00000380
C           TO 0 BIDDERS.                                                00000390
C     JCON - SUPPLIER LEVEL.                                             00000400
C     JJ - SUPPLIER LEVEL SUBSCRIPT.                                     00000410
C     JJCC - SUPPLIER LEVEL SUBSCRIPT.                                   00000420
C     JJJJ - NUMBER OF SUPPLIERS.                                        00000430
C     JK - NUMBER OF SUPPLIERS INCREMENTER.                              00000440
C     JTON - NUMBER OF SUPPLIERS.                                        00000450
C     K - BID LEVEL INDEX.                                               00000460
C     K1 - BID LEVEL OF LEAST-COST SOLUTION.                             00000470
C     K2 - BID LEVEL OF SECOND-BEST SOLUTION.                            00000480
C     KCON - MAXIMUM NUMBER OF BID LEVELS TO CONSIDER.                   00000490
C     KSUP - SUPPLIER LEVEL.                                             00000500
C     L - BID LEVEL INDEX.                                               00000510
```

Figure 5-6. Program 4 Listing (1 of 8)

```
C     LC - LOWEST BID LEVEL TO CONSIDER FOR SUBMAXIMAL LEVEL            00000520
C          SOLUTIONS.  EQUALS NLEV IF SUBMAXIMAL SOLUTIONS ARE NOT TO   00000530
C          BE CONSIDERED.                                               00000540
C     LEV - NUMBER OF BIDS WHICH BIDDER IS MAKING.                      00000550
C     LL - BID LEVEL INDEX.                                             00000560
C     LLC - LOWEST BID LEVEL TO CONSIDER FOR SUBMAXIMAL SOLUTIONS.      00000570
C          EQUALS NLEV IF SUBMAXIMAL SOLUTIONS ARE NOT TO BE            00000580
C          CONSIDERED.                                                  00000590
C     LLCC - REQUIREMENT LEVEL INDEX.                                   00000600
C     LMET - BID LEVEL LAST MET.                                        00000610
C     MMM - MAXIMUM NUMBER OF SUPPLIER LEVELS IN SOLUTION.              00000620
C          EQUALS MXBID+1 BECAUSE IT INCLUDES THE ZERO-SUPPLIER         00000630
C          SOLUTION.                                                    00000640
C     MXBD - MAXIMUM POSSIBLE NUMBER OF SUPPLIERS IN A SOLUTION.        00000650
C     NLEV - NUMBER OF BID LEVELS.                                      00000660
C     NSUP - NUMBER OF SUPPLIERS.                                       00000670
C     PLEV - THE BID LEVELS.                                            00000680
C     SURP - THE BID LEVELS.                                            00000690
C     TITLE - TITLE OF STUDY.                                           00000700
C     X1(I,L,JJ) - BID LEVEL OF BIDDER I'S CONTRIBUTION TO THE          00000710
C          LEAST-COST SOLUTION AT LEVEL L FOR BIDDERS 1 THRU I WITH     00000720
C          JJ-1 SUPPLIERS.                                              00000730
C     X2(I,L,JJ) - BID LEVEL OF BIDDER I'S CONTRIBUTION TO THE          00000740
C          LEAST-COST SOLUTION AT LEVEL L FOR BIDDERS 1 THRU I WITH     00000750
C          JJ-1 SUPPLIERS.                                              00000760
C     XFIN1(I) - BID LEVEL OF BIDDER I'S CONTRIBUTION TO THE LEAST-COST 00000770
C          SOLUTION.                                                    00000780
C     XFIN2(I) - BID LEVEL OF BIDDER I'S CONTRIBUTION TO THE            00000790
C          SECOND-BEST SOLUTION.                                        00000800
C                                                                       00000810
C                                                                       00000820
C     2    DIMENSION AND DOUBLE PRECISION STATEMENTS.                   00000830
C                                                                       00000835
      DIMENSION F1(10,21,21), F2(10,21,21), X1(10,21,21), X2(10,21,21)  00000840
      DIMENSION SURP(21), PLEV(21), COST(10,21)                         00000850
      DIMENSION XFIN1(10), XFIN2(10), G(21,21,2), DELT(10), TITLE(5)    00000860
      DOUBLE PRECISION G,FF,F1,F2,X1,X2,BID,COST,DELT,DIFF              00000870
      DOUBLE PRECISION PLEV,SURP,COSTB,DELTA,DELTB,DUMMY                00000880
      DOUBLE PRECISION XFIN1,XFIN2,BLEVEL                               00000890
C                                                                       00000900
C     3    READ TITLE, BASIC PARAMETERS, AND BID LEVELS.                00000910
C                                                                       00000920
      READ (5,920) (TITLE(IT),IT=1,5)                                   00000930
      WRITE (6,930) (TITLE(IT),IT=1,5)                                  00000940
      READ (5,1000) NSUP,NLEV,ITEST                                     00000950
      WRITE (6,940) NSUP,NLEV                                           00000960
      WRITE (6,950)                                                     00000970
      IF (NSUP-NLEV) 20,10,10                                           00000980
10    MXBD=NLEV-1                                                       00000990
      GO TO 30                                                          00001000
20    MXBD=NSUP                                                         00001010
30    DO 40 L=1,NLEV                                                    00001020
40    READ 980, SURP(L)                                                 00001030
```

Figure 5-6. Program 4 Listing (2 of 8)

```
C                                                                       00001040
C     4    INITIALIZE BID LEVELS, BIDS, AND ARRAYS OF LEAST-COST AND    00001050
C     SECOND-BEST BIDS.                                                 00001060
C                                                                       00001070
      MMM=MXBD+1                                                        00001080
      DUMMY=1.E+15                                                      00001090
      DO 70 L=1,NLEV                                                    00001100
      PLEV(L)=SURP(L)                                                   00001110
      DO 60 I=1,NSUP                                                    00001120
      COST(I,L)=DUMMY                                                   00001130
      DO 50 JCON=1,MMM                                                  00001140
      F1(I,L,JCON)=DUMMY                                                00001150
      F2(I,L,JCON)=DUMMY                                                00001160
50    CONTINUE                                                          00001170
60    CONTINUE                                                          00001180
70    CONTINUE                                                          00001190
C                                                                       00001200
C     5    READ AND PROCESS BIDS FOR EACH BIDDER.                       00001210
C                                                                       00001220
      I=0                                                               00001230
      LC=1                                                              00001240
80    I=I+1                                                             00001250
C                                                                       00001260
C     5.1  THERE ARE SEVERAL "GO TO 80" STATEMENTS IN THE PROGRAM       00001270
C                                                                       00001280
      WRITE (6,960) I                                                   00001290
      WRITE (6,970)                                                     00001300
      READ 1000, LEV                                                    00001310
C                                                                       00001320
C     5.2  READ BID LEVELS AND BID COSTS.                               00001330
C                                                                       00001340
      DO 110 K=1,LEV                                                    00001350
      READ 980, BLEVEL,BID                                              00001360
      PRINT 980, BLEVEL,BID                                             00001370
      DO 90 L=1,NLEV                                                    00001380
      IF (BLEVEL.EQ.SURP(L)) GO TO 100                                  00001390
90    CONTINUE                                                          00001400
      WRITE (6,990) I,BLEVEL                                            00001410
      STOP                                                              00001420
100   COST(I,L)=BID                                                     00001430
110   CONTINUE                                                          00001440
      IF (I-1) 120,120,190                                              00001450
C                                                                       00001460
C     5.3  FOR THE FIRST BIDDER, PUT BIDS AND BID COSTS DIRECTLY INTO   00001470
C     THE BID ARRAYS.                                                   00001480
C                                                                       00001490
120   DO 180 L=1,NLEV                                                  00001500
      DO 130 K=1,NLEV                                                   00001510
      IF (SURP(L)-PLEV(K)) 130,140,130                                  00001520
130   CONTINUE                                                          00001530
140   IF (L-1) 160,150,160                                              00001540
150   JJ=1                                                              00001550
      GO TO 170                                                         00001560
```

Figure 5-6. Program 4 Listing (3 of 8)

```
160   JJ=2                                                              00001570
170   F1(I,L,JJ)=COST(I,K)                                              00001580
      X1(I,L,JJ)=PLEV(K)                                                00001590
180   CONTINUE                                                          00001600
      GO TO 80                                                          00001610
C                                                                       00001620
C     5.4  FOR SUBSEQUENT BIDDERS, FIRST FILL UP THE G ARRAY WITH THE   00001630
C     COSTS FOR POTENTIALLY LEAST-COST OR SECOND-BEST INTERMEDIATE       00001640
C     SOLUTIONS.                                                        00001645
C                                                                       00001650
190   DO 470 L=LC,NLEV                                                  00001660
      DO 350 K=1,NLEV                                                   00001670
C                                                                       00001680
C     5.41 COMPUTE BID LEVEL DESIRED FOR PREVIOUS BIDDERS.              00001690
C                                                                       00001700
      DIFF=SURP(L)-PLEV(K)                                              00001710
      IF (DIFF) 360,200,200                                             00001720
C                                                                       00001730
C     5.42 FIND THE INDEX OF THAT BID LEVEL.                            00001740
C                                                                       00001750
200   DO 210 J=1,NLEV                                                   00001760
      IF (DIFF-SURP(J)) 220,220,210                                     00001770
210   CONTINUE                                                          00001780
C                                                                       00001785
C     5.43 COMPUTE COSTS OF SOLUTIONS WHICH COULD BE EITHER LEAST-COST  00001790
C     OR SECOND-BEST.                                                   00001800
C                                                                       00001820
220   DO 280 JCON=1,MMM                                                 00001830
      FF=COST(I,K)+F1(I-1,J,JCON)                                       00001840
      IF (K-1) 240,230,240                                              00001850
230   JK=0                                                              00001860
      GO TO 250                                                         00001870
240   JK=1                                                              00001880
250   KSUP=JK+JCON                                                      00001890
      IF (KSUP-MMM) 270,270,260                                         00001900
260   KSUP=1                                                            00001910
270   G(KSUP,K,1)=FF                                                    00001920
280   CONTINUE                                                          00001930
C                                                                       00001940
C     5.44 COMPUTE COSTS OF SOLUTIONS WHICH COULD BE SECOND-BEST.       00001950
C                                                                       00001960
      DO 340 JCON=1,MMM                                                 00001970
      FF=COST(I,K)+F2(I-1,J,JCON)                                       00001980
      IF (K-1) 300,290,300                                              00001990
290   JK=0                                                              00002000
      GO TO 310                                                         00002010
300   JK=1                                                              00002020
310   KSUP=JK+JCON                                                      00002030
      IF (KSUP-MMM) 330,330,320                                         00002040
320   KSUP=1                                                            00002050
330   G(KSUP,K,2)=FF                                                    00002060
340   CONTINUE                                                          00002070
350   CONTINUE                                                          00002080
```

Figure 5-6. Program 4 Listing (4 of 8)

```
      K=NLEV+1                                                          00002090
360   K=K-1                                                             00002100
      KCON=K                                                            00002110
C                                                                       00002120
C     5.5  KEEP TRACK OF THE BEST AND SECOND-BEST SOLUTIONS SO FAR.     00002130
C                                                                       00002140
      DO 460 JCON=1,MMM                                                 00002150
      DO 450 K=1,KCON                                                   00002160
      DO 440 JABLE=1,2                                                  00002170
      IF (K-2) 370,400,400                                              00002180
370   IF (JABLE-1) 380,380,390                                          00002190
380   F1(I,L,JCON)=G(JCON,K,JABLE)                                      00002200
      K1=K                                                              00002210
      GO TO 440                                                         00002220
390   F2(I,L,JCON)=G(JCON,K,JABLE)                                      00002230
      K2=K                                                              00002240
      GO TO 440                                                         00002250
400   IF (G(JCON,K,JABLE)-F2(I,L,JCON)) 410,440,440                     00002260
410   IF (G(JCON,K,JABLE)-F1(I,L,JCON)) 420,420,430                     00002270
420   F2(I,L,JCON)=F1(I,L,JCON)                                         00002280
      K2=K1                                                             00002290
      F1(I,L,JCON)=G(JCON,K,JABLE)                                      00002300
      K1=K                                                              00002310
      GO TO 440                                                         00002320
430   F2(I,L,JCON)=G(JCON,K,JABLE)                                      00002330
      K2=K                                                              00002340
440   CONTINUE                                                          00002350
450   CONTINUE                                                          00002360
      X1(I,L,JCON)=PLEV(K1)                                             00002370
      X2(I,L,JCON)=PLEV(K2)                                             00002380
460   CONTINUE                                                          00002390
470   CONTINUE                                                          00002400
      IF (I-NSUP+1) 80,480,510                                          00002410
480   IF (ITEST) 500,490,500                                            00002420
490   LC=NLEV                                                           00002430
      GO TO 80                                                          00002440
500   LC=1                                                              00002450
      GO TO 80                                                          00002460
C                                                                       00002470
C     6     THAT WAS THE LAST "GO TO 80" STATEMENT.                     00002480
C                                                                       00002490
510   CONTINUE                                                          00002500
      IF (ITEST) 520,530,520                                            00002510
520   LLC=1                                                             00002520
      GO TO 540                                                         00002530
530   LLC=NLEV                                                          00002540
540   WRITE (6,1060)                                                    00002550
C                                                                       00002560
C     7     WORK BACKWARDS TO ASSEMBLE AND PRINT LEAST-COST SOLUTIONS.  00002570
C                                                                       00002580
      DO 700 LL=LLC,NLEV                                                00002590
      DO 690 JCOD=1,MMM                                                 00002600
      JCON=JCOD                                                         00002610
```

Figure 5-6. Program 4 Listing (5 of 8)

```
            JJJJ=JCON-1                                                    00002620
            JTON=JCON                                                      00002630
            I=NSUP                                                         00002640
            DELT(I)=SURP(LL)                                               00002650
            XFIN1(I)=X1(I,LL,JCON)                                         00002660
            IF (XFIN1(I)) 580,580,550                                      00002670
      550   IF (JCON-1) 560,560,570                                        00002680
      560   JCON=1                                                         00002690
            GO TO 580                                                      00002700
      570   JCON=JCON-1                                                    00002710
      580   I=I-1                                                          00002720
      C                                                                    00002730
      C     7.1  COMPUTE BALANCE REMAINING TO BE MET.                      00002740
      C                                                                    00002750
            DELT(I)=DELT(I+1)-XFIN1(I+1)                                   00002760
      C                                                                    00002770
      C     7.2  FIND CORRESPONDING BID LEVEL AND CONTRIBUTION OF BIDDER I. 00002780
      C                                                                    00002790
            DO 590 L=1,NLEV                                                00002800
            IF (DELT(I)-SURP(L)) 590,600,590                               00002810
      590   CONTINUE                                                       00002820
      600   XFIN1(I)=X1(I,L,JCON)                                          00002830
            IF (XFIN1(I)) 640,640,610                                      00002840
      610   IF (JCON-1) 620,620,630                                        00002850
      620   JCON=1                                                         00002860
            GO TO 640                                                      00002870
      630   JCON=JCON-1                                                    00002880
      640   IF (I-1) 650,650,580                                           00002890
      C                                                                    00002900
      C     7.3  WRITE ANSWERS.                                            00002910
      C                                                                    00002920
      650   WRITE (6,1010) SURP(LL),JJJJ                                   00002930
            IF (F1(NSUP,LL,JTON)-DUMMY) 670,660,660                        00002940
      660   WRITE (6,1050)                                                 00002950
            GO TO 690                                                      00002960
      670   WRITE (6,1020) F1(NSUP,LL,JTON)                                00002970
            DO 680 I=1,NSUP                                                00002980
      680   WRITE (6,1040) I,XFIN1(I)                                      00002990
      690   CONTINUE                                                       00003000
      700   CONTINUE                                                       00003010
            WRITE (6,1070)                                                 00003020
      C                                                                    00003030
      C     8    ASSEMBLE SECOND-BEST SOLUTION FOR OUTPUT.                 00003040
      C                                                                    00003050
            DO 910 LL=LLC,NLEV                                             00003060
            DO 900 JCOD=1,MMM                                              00003070
            LLCC=LL                                                        00003080
            JCON=JCOD                                                      00003090
            JTON=JCON                                                      00003100
            JJJJ=JCON-1                                                    00003110
            I=NSUP                                                         00003120
            DELT(I)=SURP(LL)                                               00003130
            XFIN2(I)=X2(I,LL,JCON)                                         00003140
```

Figure 5-6. Program 4 Listing (6 of 8)

```
      JJCC=JCON                                                          00003150
      COSTB=F2(I,LLCC,JJCC)                                              00003160
      IF (XFIN2(I)) 740,740,710                                          00003170
710   IF (JCON-1) 720,720,730                                            00003180
720   JCON=1                                                             00003190
      GO TO 740                                                          00003200
730   JCON=JCON-1                                                        00003210
740   I=I-1                                                              00003220
C                                                                        00003230
C     8.1  FIND 2ND-BEST SOLUTION BID LEVEL OF PRECEDING BIDDER.         00003240
C                                                                        00003250
      DO 750 K=1,NLEV                                                    00003260
      IF (XFIN2(I+1)-SURP(K)) 750,760,750                                00003270
750   CONTINUE                                                           00003280
760   LMET=K                                                             00003290
C                                                                        00003300
C     8.2  COMPUTE BID LEVEL REMAINING TO BE MET.                        00003310
C                                                                        00003320
      DELT(I)=DELT(I+1)-XFIN2(I+1)                                       00003330
C                                                                        00003340
C     8.3  LOCATE THAT BID LEVEL.                                        00003350
C                                                                        00003360
      DO 770 L=1,NLEV                                                    00003370
      IF (DELT(I)-SURP(L)) 770,780,770                                   00003380
770   CONTINUE                                                           00003390
C                                                                        00003400
C     8.4  COMPUTE 2ND-BEST BID COST FOR BIDDERS 1 THRU I.               00003410
C                                                                        00003420
780   DELTB=COSTB-COST(I+1,LMET)                                         00003430
C                                                                        00003440
C     8.5  BEYOND A CERTAIN POINT, THE 2ND-BEST SOLUTION FOR ALL         00003450
C     BIDDERS MAY BE THE SAME AS THE LEAST-COST SOLUTION FOR ALL         00003460
C     BIDDERS.  IF THE 2ND-BEST BID COST IS LESS THAN THE ARRAY          00003470
C     2ND-BEST BID COST, WE ARE TRACKING THE LEAST-COST SOLUTION,        00003480
C     SO WE SAVE THE LEAST-COST FOR BIDDERS 1 THRU I AT LEVEL L          00003490
C     AND SAVE BIDDER I'S BID LEVEL IN THAT SOLUTION.                    00003500
C                                                                        00003510
      IF (DELTB-F2(I,L,JCON)) 790,800,800                                00003520
790   XFIN2(I)=X1(I,L,JCON)                                              00003530
      COSTB=F1(I,L,JCON)                                                 00003540
      GO TO 810                                                          00003550
C                                                                        00003560
C     8.6  IF 2ND-BEST BID COST EQUALS ARRAY 2ND-BEST BID COST, WE ARE   00003570
C     TRACKING THE 2ND-BEST SOLUTION.  SAVE DATA FOR SAME.               00003580
C                                                                        00003590
800   XFIN2(I)=X2(I,L,JCON)                                              00003600
      COSTB=F2(I,L,JCON)                                                 00003610
810   IF (XFIN2(I)) 850,850,820                                          00003620
820   IF (JCON-1) 830,830,840                                            00003630
830   JCON=1                                                             00003640
      GO TO 850                                                          00003650
840   JCON=JCON-1                                                        00003660
850   IF (I-1) 860,860,740                                               00003670
```

Figure 5-6. Program 4 Listing (7 of 8)

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C                                                                       00003680
C     8.7  WRITE ANSWERS.                                               00003690
C                                                                       00003700
860   WRITE (6,1010) SURP(LL),JJJJ                                      00003710
      IF (F2(NSUP,LL,JTON)-DUMMY) 880,870,870                           00003720
870   WRITE (6,1050)                                                    00003730
      GO TO 900                                                         00003740
880   WRITE (6,1030) F2(NSUP,LL,JTON)                                   00003750
      DO 890 I=1,NSUP                                                   00003760
890   WRITE (6,1040) I,XFIN2(I)                                         00003770
900   CONTINUE                                                          00003780
910   CONTINUE                                                          00003790
      STOP                                                              00003800
C                                                                       00003810
920   FORMAT (5A4)                                                      00003820
930   FORMAT (1H1,5A4)                                                  00003830
940   FORMAT (1HO,I2,11H BIDDERS & ,I2,11H BID LEVELS)                  00003840
950   FORMAT (5HOBIDS)                                                  00003850
960   FORMAT (1HO,6HBIDDER,I3)                                          00003860
970   FORMAT (1HO,20HBID LEVEL TOTAL COST)                              00003870
980   FORMAT (8F10.0)                                                   00003880
990   FORMAT (1HO,6HBIDDER,I3,25H BID AT ILLEGAL BID LEVEL,F4.0)        00003890
1000  FORMAT (3I3)                                                      00003900
1010  FORMAT (1HO,19H REQUIREMENT LEVEL ,F10.0,13H NO. BIDDERS ,I5)     00003910
1020  FORMAT (1H ,14H OPTIMAL COST ,F10.0)                              00003920
1030  FORMAT (1H ,17HSECOND BEST SOL. ,F10.0)                           00003930
1040  FORMAT (1H ,6HBIDDER,I3,4X,F11.0)                                 00003940
1050  FORMAT (1H ,22H NO FEASIBLE SOLUTIONS)                            00003950
1060  FORMAT (1H1,25X,17HOPTIMAL SOLUTIONS)                             00003960
1070  FORMAT (1H1,25X,21HSECOND BEST SOLUTIONS)                         00003970
      END                                                               00003980
```

Figure 5-6. Program 4 Listing (8 of 8)