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# PACE II

## PRICING AND COST ESTIMATING HANDBOOK

Prepared by
Systems Analysis and Integration Laboratory
and Computer Services Office

July 1977

## NASA

*George C. Marshall Space Flight Center*

*Marshall Space Flight Center, Alabama*

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16. ABSTRACT

In early 1973 the Marshall Space Flight Center (MSFC) initiated an effort to develop and establish an automatic data processing system to be used primarily for the preparation of industrial-engineering-type manhour-and-material cost estimates. This computer system, termed PACE (Pricing and Cost Estimating), was established and has evolved over the past several years through the PACE I and PACE II systems into a highly versatile and highly flexible tool which significantly reduces computation time, eliminates computational errors, and reduces typing and reproduction time for estimators and pricers. Because this system makes all mathematical and clerical functions automatic once basic inputs are derived, the time of estimators, estimate managers, secretarial personnel, and engineers involved in the estimating and cost analysis process can be devoted to publication of ground rules, and collection, analysis, and adjustment of inputs and rationale. This system also reduces the manhours required for manual computations and documentation.

This handbook has been prepared to facilitate use by those not familiar with the PACE II system or with detailed automatic data processing techniques; therefore, an attempt has been made to be explanatory and specific in all areas where actions are required to implement and activate the system. (The PACE I system is described in detail in TM X-73325.)

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## PRICING AND COST ESTIMATING HANDBOOK

## I. INTRODUCTION AND BACKGROUND

In early 1973 the Marshall Space Flight Center (MSFC) initiated an effort to develop and establish an automatic data processing system to be used primarily for the preparation of industrial engineering type manhour and material cost estimates. This computer system, termed PACE (Pricing and Cost Estimating), was established and has evolved over the past several years through the PACE I and PACE II systems into a highly versatile and highly flexible tool which significantly reduces computation time, eliminates computational errors, and reduces typing and reproduction time for estimators and pricers. Because this system makes all mathematical and clerical functions automatic once basic inputs are derived, the time of estimators, estimate managers, secretarial personnel, and engineers involved in the estimating and cost analysis process can be devoted to publication of ground rules, and collection, analysis, and adjustment of inputs and rationale. This system also reduces the manhours required for manual computations and documentation.

Basic features of the PACE II system are: (1) a uniform method of depicting and numbering a Work Breakdown Structure (WBS), (2) a uniform labor rate structure, (3) a uniform format for input and output data, and (4) uniform methods in applying overhead, General and Administrative (G&A) costs, fee, and escalation. Principal improvements of the PACE II system over the PACE I system are: (1) a simplified input and run deck, (2) a revised output format, and (3) a detailed "edit" procedure designed to identify, reduce, and eliminate input errors. The PACE II system is also more efficient from the standpoint of computer time utilization.

The PACE II programs are written in COBOL programming language for execution on a UNIVAC 1108 computer under the EXEC 8 operating system. The minimum hardware configuration required for running the PACE II system is one central processor, one card reader, one uniservo tape drive, one FASTRAND or disk mass storage unit, and an on-line printer.

This handbook has been prepared to facilitate use by those not familiar with the PACE II system or with detailed automatic data processing techniques; therefore, an attempt has been made to be explanatory and specific in all areas where actions are required to implement and activate the system. (The PACE I system is described in detail in TM X-73325.)

# II. USES OF THE PACE II COMPUTER SYSTEM

The PACE II computer system is designed primarily for the preparation of "industrial-engineering-type" "manhour-and-material" cost estimates; however, a number of other applications are feasible. Some of the existing and possible uses of the PACE II system are described in the following paragraphs.

## A. Major Projects

For major projects, entering Phases C and D, the PACE II system can be used to generate budgetary estimates down to the lowest WBS level. The PACE II system can also be used for a comparative analysis of preliminary concepts where several options are being considered. Speed of computation and ease of comparison due to uniform format make the PACE II system attractive for this purpose. The current principal use of the PACE II system is the initial pricing and updating of government estimates in support of Source Evaluation Board (SEB) proceedings; but it can also be used in tradeoff studies, change estimates, and budgetary studies. (A "grounds-up" industrial-engineering-type, manhour-and-material cost estimate using the PACE II system can be used as a baseline for estimating changes, for evaluating contractor proposals, and for establishing preliminary budgets.) These applications are described in more detail in the following paragraphs.

## B. Experiments, Modules, and Subsystems

Because of flexibility in the WBS numbering system, the PACE II system can be used for developing a "stand-alone" estimate for part of a major program. Hence, estimates of experiments, modules, and subsystems can be made independent of the major program.

## C. Source Evaluation

The PACE II computer system will find its greatest use in the preparation of independent government estimates to be used in SEB evaluation proceedings. Some additional foreseeable applications to support SEB's are: (1) preparation of initial adjustments to the government estimate, (2) adjustments resulting from written and oral discussions, and (3) adjustments based on best and final offers. The "adjusted government estimate" is often used for substantiation of the government's position in the event of a protest; therefore, the accuracy and speed provided by the PACE II system are of the utmost importance. Adaptability of the PACE II system to the pricing or verification of contractor quotes, or preparation of "most probable costs," would depend upon the specific contractor pricing formula and estimating methodology.

## D. Other Possible Uses

The basic structure and methodology of the PACE II system make it adaptable to the performance of sensitivity analyses (i.e., sensitivity of labor rate and skill mix variations), "design-to-cost" exercises, and economic analyses involving the time value of money.

## III. METHODOLOGY OF ESTIMATING[1]

Use of the PACE II computer system is based on the development of manhours and materials, travel, and other direct costs for the lowest level (down to level eight) of each WBS being estimated. Therefore, application of the PACE II system is appropriate primarily where sufficient definition exists to define design and configuration parameters of hardware, man-loading, and time-phasing of engineering and support type functions; specific plans relative to location of the work documentation required; and type of skill required.

In a design-to-cost situation, a grounds-up estimate must be made first to develop a baseline. The design-to-cost factor is then applied to spread the reduction or increase to the lowest WBS level. Use of this technique requires a detailed negotiation and rationalization of the adjusted manhours of the work to be performed (i.e., the schedule, hardware requirements, specifications, or

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1. Estimating methodology is described in more detail in TMX-64966.

design must be adaptable to the manhour and material constraints developed in the design-to-cost estimate). The methodology of estimating described in TMX-64966 shows how the basic estimate worksheets are derived through a process of ground rule development, information interchange, and estimate synthesis.

# IV. PACE II COMPUTER SYSTEM

## A. Automation of Basic Estimates

1. General. Figure 1 illustrates the general flow of the PACE II system. This includes the necessary inputs to the system, the computer program phases of data manipulation, and the various reports generated by the system in the course of a basic cost estimate computer run. Figure 2 illustrates a sample WBS hierarchy structure.

a. Input Types and Definitions. The five types of user-supplied inputs to the PACE II system are as follows:

1. Labor Rate Header — This input type includes the project name, the fiscal year span for the cost estimate, the design-to-cost percentage factor (if applicable), and contractor fee percentage (if applicable). Only one labor rate header card is allowed.

2. Labor and Overhead Rate Card — This input type contains one labor category per card, the labor rate in dollars, and an overhead percentage factor per fiscal year.

3. Dollar Escalation — Data defined by this input type are projected dollar escalation rates per fiscal year for the span of the cost estimate. These rates apply only to material, travel, and other direct dollar expenses.

4. WBS Title — The cards for this input type supply descriptive titles to the corresponding WBS element number. The WBS element number and corresponding title are displayed in the total cost report.

5. Base Data — Each card of this input type represents one element or block at the lowest extremities of the WBS for a particular fiscal year and contains the estimated amount of labor in manhours per labor category, and dollar expenses (material, travel, and other direct) for that fiscal year WBS element combination.
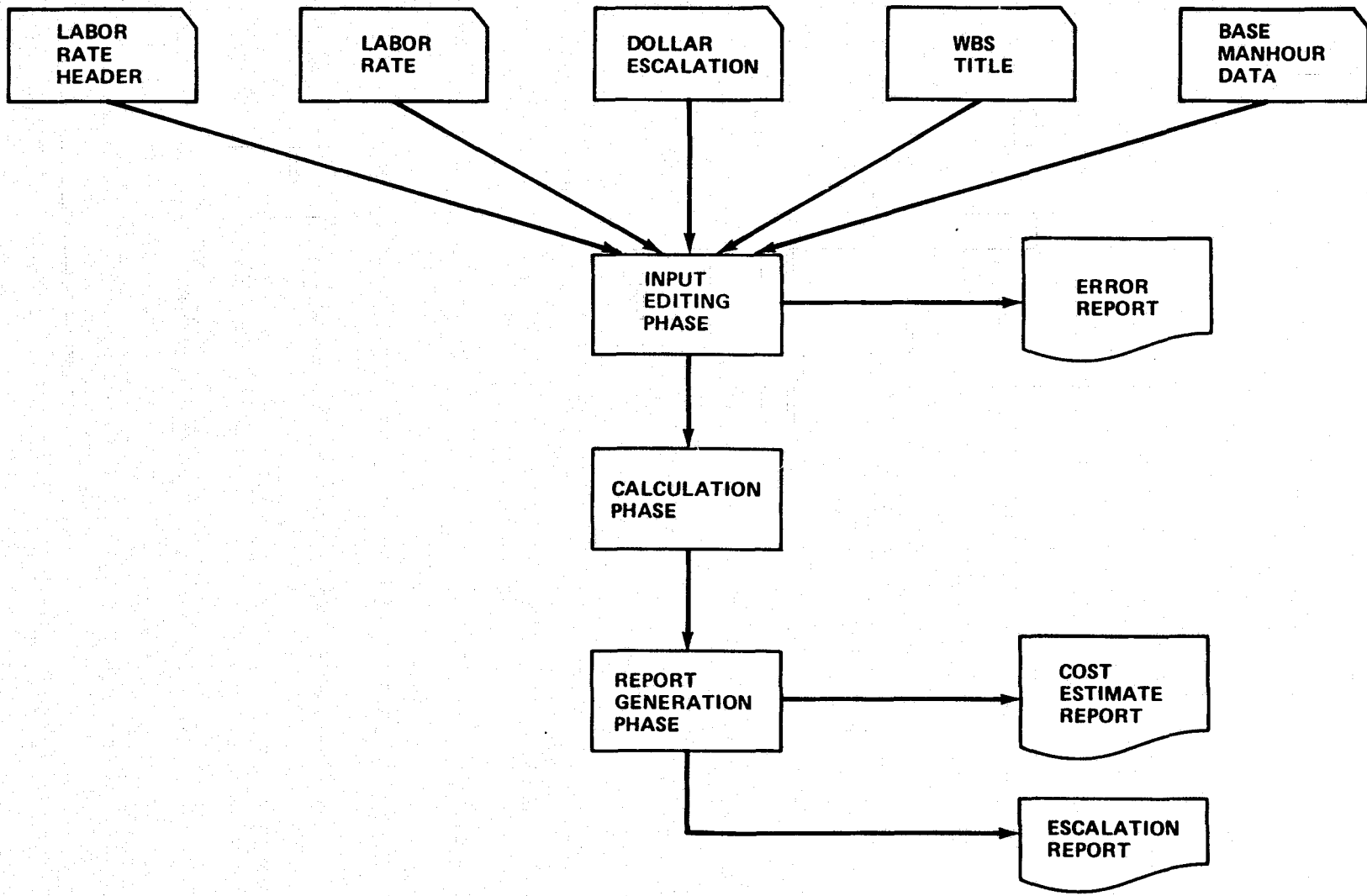
Figure 1. General schematic of PACE II flow.

1

1.1  1.2

1.1.1  1.1.2  1.2.1  1.2.2

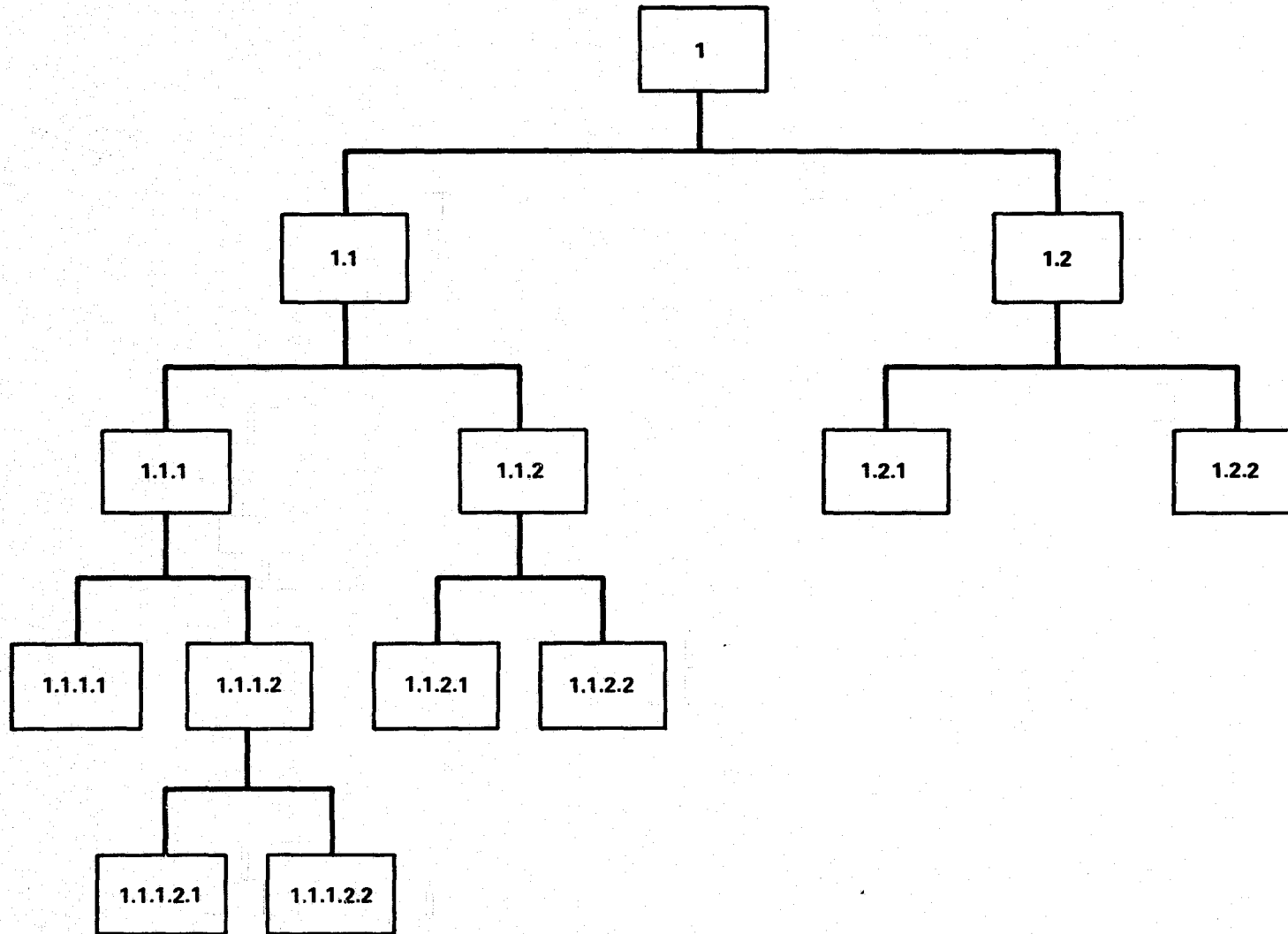1.1.1.1  1.1.1.2  1.1.2.1  1.1.2.2

1.1.1.2.1  1.1.1.2.2

Figure 2.  Sample WBS.

b. Input Data Worksheets. Input worksheets are used by the cost estimator to code input data for the PACE II run. An example of these worksheets is shown in Appendix A.

c. System Data Manipulations. As the inputs flow through the logic of the system, they are channelled through numerous arithmetic calculations and data manipulation routines. These routines are categorized into the following three basic phases:

1. Input Editing Phase — The editing phase ensures that the inputs conform to the specified requirements of the different types. All cards with input errors are printed on the error report along with an error code and an error message.

2. Calculation Phase — PACE II system's logic contains numerous calculations which are made in the course of preparing a cost estimate of a given WBS element for each fiscal year. The following is a list of the calculations made in computing a given estimate:

- Multiply the labor hours of each labor category by their respective labor rates to obtain labor dollars.

- Multiply the labor dollars of each labor category by their respective overhead rates giving overhead dollars.

- Multiply the unescalated material (shown as material and subcon), travel, and other direct dollars by 1 plus their respective escalation rates, if any.

- Multiply the material dollars by the material burden percentage giving material overhead.

- Add, the total labor dollars, labor overhead, material, material overhead, and the travel and other direct dollars giving the subtotal estimated cost.

- Multiply the subtotal estimated cost by the G& A expense percentage for the appropriate fiscal year, giving the G& A expense.

- Add the subtotal estimated cost and the G& A expense giving the total estimated cost.

- Multiply the total estimated cost by the contractor fee percentage, if any, which is constant for all fiscal years, giving the fee amount.

- Add the total estimated cost and the fee amount giving the grand total for the fiscal year.

    3. Report Generation Phase — The data structure produced by the calculation and editing phases comprise the inputs to the cost estimate report generation phase. The cost estimate report is formatted and printed on continuous forms showing the cost breakdown per fiscal year of the estimated project from the highest to the lowest levels of the WBS.

    The escalation report is produced and formatted on a separate page from the cost estimate report.

    d. Outputs Developed. Three reports are generated in a cost estimate run. These reports are: (1) error report (Fig. 3), (2) cost estimate report (Appendix B), and (3) dollar escalation report (Fig. 4). All reports are printed on standard 11 × 14-1/2 in. continuous computer forms.

    2. Input Preparation. Data cards will be placed in the run deck as shown in Figure 5. All types of input data are identified by the first two columns of the card. The first two columns of every card must contain a numerical two digit identifier. This identifier will be called type-code. The type-codes for PACE II input data are:

- Labor Rate Heater — Type 10 card

- Labor Rate — Type 20 card

- Dollar Escalation — Type 30 card

- WBS Title — Type 40 card

- Base Data — Type 50 card

Descriptions of the cards are as follows:

8

```
                              TRANSACTIONS                                    EC      ERROR MESSAGE

3000R     020    1LD         JJJ                                             11  INVALID PERCENTAGE FACTOR
                            ***
10CDE                              1960                         050 B9       12  INVALID FEE PERCENTAGE
                                                                  **
401.8.9.8.4      TEST-PROJ23T                                                06  INVALID WBS NUMBER
  *****************
60XYZ            KKK AAA      DDD              111                            01  INVALID TRANSACTION TYPE
**
3000R     100    C35                030                                      17  DUPLICATE ACT CODE ON 30CD
   ***
20XNG7457                                                                    02  INVALID ACTIVITY CODE
   ***                                                                       03  INVALID RATE
     ****
60010203         TOM                                                         01  INVALID TRANSACTION TYPE
  **                                                                         07  INVALID-MUST BE NUMERIC
           *******
3CENG     100                                                               10  INVALID CATEGORY
   ***
30MAT     100    200    300    350    405    41C                             17  DUPLICATE ACT CODE ON 30CD
   ***
30009     200    300    350    215    220    230                             17  DUPLICATE ACT CODE ON 30CD
   ***
3CTRV     300    450    475    480    490    500                             17  DUPLICATE ACT CODE ON 30CD
   ***
10PCX PROJECT              1977 1978 1979 1990 1981 1982 1983 1984    08     14  MORE THAN 1 TYPE 10 CARD
**
20ENG14901000 14901000 14901000 14901000 14901000 14901000 14901000 14901110  16  DUPLICATE ACT CODE ON 20CD
   ***
20GA      120    120    120    120    120    120    120    120               15  EXCESSIVE TYPE 20 CARDS
   ***

8ADD,P  .PACEII-2
```

Figure 3.  Error report.

ESCALATION RATES

| ELEMENTS OF COST | FY - 77 | FY - 78 | FY - 79 | FY - 80 | FY - 81 | FY - 82 | FY - 83 | FY - 84 |
|---|---|---|---|---|---|---|---|---|
| MATERIAL & SUBCON. | .100 | .200 | .300 | .350 | .405 | .410 | .000 | .000 |
| TRAVEL | .200 | .300 | .350 | .215 | .220 | .230 | .000 | .000 |
| OTHER | .300 | .450 | .475 | .480 | .490 | .500 | .000 | .000 |

Figure 4.  Dollar escalation report.

```
@RUN PACEII, 1HEL02A2061A,JONESGBIN229,15,500

@ASG,T PUR,T,XXXXX
@FREE TPF$
@ASG,T TPF$.,F/1/POS/10
@COPIN PUR.,TPF$.
@FREE PUR.
@ADD,P .PACEII-1
   DATA CARDS
@ADD,P .PACEII-2
@FIN
```

Figure 5.   Placement of data cards in run deck.

### Labor Rate Header Card — Type 10

| Card Columns | Item | Content |
|---|---|---|
| 1-2 | Type Code | Must Be 10 |
| 3-32 | Project Name | Free Form |
| 33-36 | Fiscal Year No. 1 | Four Digits, Numeric (1977, etc.) |
| 37 | N/A | Blank |
| 38-41 | Fiscal Year No. 2 | Four Digits, Numeric |
| 42 | N/A | Blank |
| 43-46 | Fiscal Year No. 3 | Four Digits, Numeric |
| 47 | N/A | Blank |
| 48-51 | Fiscal Year No. 4 | Four Digits, Numeric |
| 52 | N/A | Blank |
| 53-56 | Fiscal Year No. 5 | Four Digits, Numeric |
| 57 | N/A | Blank |
| 58-61 | Fiscal Year No. 6 | Four Digits, Numeric |
| 62 | N/A | Blank |
| 63-66 | Fiscal Year No. 7 | Four Digits, Numeric |
| 67 | N/A | Blank |
| 68-71 | Fiscal Year No. 8 | Four Digits, Numeric |
| 72 | N/A | Blank |
| 73-75 | Design-to-Cost Percentage Factor | Three Digits, Numeric |
| 76 | N/A | Blank |
| 77-78 | Contractor Fee Percentage | Two Digits, Numeric |
| 78-80 | N/A | Blanks |

Note:  Only one labor rate header card is allowed for a production run.

## Labor Rate Card — Type 20

| Card Columns | Item | Content |
|---|---|---|
| 1-2 | Type Code | Must Be 20 |
| 3-5 | Activity Code | 'ENG' (Engineering)<br>'GA' (General and Administrative Expense Percentage)<br>'MAT' (Material Burden Percentage)<br>'OTH' (Other)<br>'QRA' (Quality and Reliability Assurance)<br>'TLG' (Tooling)<br>'TST' (Testing) |
| 6-9 | Labor Rate No. 1 | Numeric Rate with Two Decimal Positions (99.99) |
| 10-13 | Overhead Percent No. 1 | Numeric Percentage One Decimal Position (999.9) |
| 14 | N/A | Blank |
| 15-18 | Labor Rate No. 2 | Numeric Rate with Two Decimal Positions (99.99) |
| 19-22 | Overhead Percent No. 2 | Numeric Percentage One Decimal Position (999.9) |
| 23 | N/A | Blank |
| 24-27 | Labor Rate No. 3 | Numeric Rate with Two Decimal Positions (99.99) |
| 28-31 | Overhead Percent No. 3 | Numeric Percentage with One Decimal Position (999.9) |
| 32 | N/A | Blank |
| 33-36 | Labor Rate No. 4 | Numeric Rate with Two Decimal Positions (99.99) |
| 37-40 | Overhead Percent No. 4 | Numeric Percentage with One Decimal Position (999.9) |
| 41 | N/A | Blank |
| 42-45 | Labor Rate No. 5 | Numeric Rate with Two Decimal Positions (99.99) |
| 46-49 | Overhead Percent No. 5 | Numeric Percentage with One Decimal Position (999.9) |
| 50 | N/A | Blank |
| 51-54 | Labor Rate No. 6 | Numeric Rate with Two Decimal Positions (99.99) |

| Card Columns | Item | Content |
|---|---|---|
| 55-58 | Overhead Percent No. 6 | Numeric Percentage with One Decimal Position (999.9) |
| 59 | N/A | Blank |
| 60-63 | Labor Rate No. 7 | Numeric Rate with Two Decimal Positions (99.99) |
| 64-67 | Overhead Percent No. 7 | Numeric Percentage with One Decimal Position (999.9) |
| 68 | N/A | Blank |
| 69-72 | Labor Rate No. 8 | Numeric Rate with Two Decimal Positions (99.99) |
| 73-76 | Overhead Percent No. 8 | Numeric Percentage with One Decimal Position (999.9) |
| 77-80 | N/A | Blanks |

## Dollar Escalation Card — Type 30

| Card Columns | Item | Content |
|---|---|---|
| 1-2 | Type Code | Must Be 30 |
| 3-5 | Category of Escalation | 'MAT' (Material and Subcontractor) 'TRAV' (Travel) 'ODR' (Other Direct) |
| 6-10 | N/A | Blanks |
| 11-13 | Escalation Percent No. 1 | Three Numeric Digits, No Decimals (999) |
| 14-19 | N/A | Blanks |
| 20-22 | Escalation Percent No. 2 | Three Numeric Digits, No Decimals (999) |
| 23-28 | N/A | Blanks |
| 20-31 | Escalation Percent No. 3 | Three Numeric Digits, No Decimals (999) |
| 32-37 | N/A | Blanks |
| 38-40 | Escalation Percent No. 4 | Three Numeric Digits, No Decimals (999) |
| 41-46 | N/A | Blanks |
| 47-49 | Escalation Percent No. 5 | Three Numeric Digits, No Decimals (999) |

| Card Columns | Item | Content |
|---|---|---|
| 50-55 | N/A | Blanks |
| 56-58 | Escalation Percent No. 6 | Three Numeric Digits, No Decimals (999) |
| 59-64 | N/A | Blanks |
| 65-67 | Escalation Percent No. 7 | Three Numeric Digits, No Decimals (999) |
| 68-73 | N/A | Blanks |
| 74-76 | Escalation Percent No. 8 | Three Numeric Digits, No Decimals (999) |
| 77-80 | N/A | Blanks |

## WBS Title Card — Type 40

| Card Columns | Item | Content |
|---|---|---|
| 1-2 | Type Code | Must Be 40 |
| 3-18 | WBS Element No. | Left Justified, Numeric, with Decimals |
| 19-48 | WBS Title | Free Form |
| 49-80 | N/A | Blanks |

## Base Data Card — Type 50

| Card Columns | Item | Content |
|---|---|---|
| 1-2 | Type Code | Must Be 50 |
| 3-18 | WBS Element No. | Left Justified, Numeric, with Decimals |
| 19-20 | Fiscal Year | Two Digits, Numeric (77, 78 etc.) |
| 21-47 | Engineering | Numeric Whole Numbers |
| 28-34 | Manufacturing | Same as Above |
| 35-40 | Tooling | Same as Above |
| 41-46 | Q& RA | Same as Above |
| 47-52 | Testing | Same as Above |
| 53-58 | Other | Same as Above |
| 59-66 | Material Dollars | Same as Above |
| 67-72 | Travel Dollars | Same as Above |
| 73-79 | Other Direct Dollars | Same as Above |
| 80 | N/A | Blank |

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3. <u>Editing of User Input Data.</u> To improve the reliability and validity of the user's input data before it becomes an integral part of permanent files, reports, etc., it is a policy of good automatic data processing practices to provide as many tests for accuracy as is possible early in the processing flow. This process is commonly referred to as editing.

The editing procedures executed within the PACE II system are accomplished by the first phase of the execution flow. This phase includes the input editing functions as well as the sorting and sequencing of all valid input transactions for subsequent processing.

Whenever a data error is detected in an input card, an image of the transaction card is printed on an error listing accompanied by an error code and an error message. Asterisks will be printed under each card column which is in error to assist the user in correcting errors. The explanation of error codes and required corrections are shown in Appendix C.

4. <u>Processing of Sensitive Data.</u> Because the PACE II system was designed for use in support of NASA SEB's and other groups of government personnel who handle proprietary data developed by private contractors, a procedure is in effect at MSFC for eliminating the exposure of cost estimate data to nongovernment personnel so as to protect the confidentiality of the contracting relationship.

This sensitive run procedure places the control of data preparation (keypunching) and run deck setup directly in the hands of the system user. The entire execution process from job submittal through collection of printed output is performed under the direct observation of a government monitor. At the completion of each production run, the computer memory and all mass-storage hardware are cleared of data utilized or generated by PACE II. A copy of the sensitive run procedure is illustrated in Appendix C.

# B.  Cost Estimate Variations

In addition to calculating the basic cost estimates previously described, the PACE II system contains options for modifying the results that are produced by a basic estimate. The options are design-to-cost; labor, burden, and G&A factors; direct dollar escalation; and contractor fee.

1. <u>Design-to-Cost.</u> The design-to-cost option is available for use in situations where a previously calculated cost estimate varies significantly from a design target cost and where it is desired to determine the impact of a change at all levels of the estimate so that the project technical and programmatic aspects can be altered to meet the cost target. If the need for a uniform

redistribution of resources occurs, this can be achieved by including a design-to-cost factor as input in the PACE II run deck. This factor, expressed as either a percent increase or decrease, will then be applied to the manpower and fixed dollar values in the base data for all WBS elements present. The resulting printouts will indicate the modified costs from the highest to the lowest level of the WBS, and the design-to-cost factor utilized will be shown on the total cost estimate report.

In using this feature, care must be taken to assure that man-hour and material quantities resulting from the overall increase or decrease are reconciled with the schedule, hardware quantities, skill mix, specifications, and/or work elements of a revised (reduced or expanded) program or project. A cut or increase unaccompanied by a corresponding change in the work to be performed can be dangerously misleading to estimators, work package managers, or management. Use of the design-to-cost feature must, therefore, be accompanied by a renegotiation of resources versus specification, design, and/or hardware requirements down to the lowest level. If this renegotiation of resources estimates fails to yield a commitment to perform or a commitment to manage within these resources, the design-to-cost estimate must be voided in preference for either the original grounds-up estimate or an alternate estimate that can be restructured down to the lowest level by deleting or adding certain elements to assure total project accomplishment within the target resource level. This stipulation, although it is a part of a project definition/engineering/cost estimating activity rather than the ADP data manipulation activity, must be remembered and followed to prevent the generation of unrealistic estimates.

a. Input Preparation. The design-to-cost factor should be entered in columns 73-75 on the Labor Rate Header card. Figure 6 illustrates the design-to-cost factor on the Labor Rate Header card. An increase percentage may be specified by entering any number greater than 100 up to a maximum value of 999. With the assumed decimal, an entry of 105 would result in a 5 percent increase, 110 a 10 percent increase, etc. Likewise, an entry of 099 would represent a 1 percent decrease, 095 a 5 percent decrease, etc., with a lower input limit of 001.

b. Calculations. Upon execution, the PACE II system will modify the values of the manpower figures and fixed dollar costs specified in the WBS base data by multiplying them by the design-to-cost factor. The remaining processing then continues identically to that of a basic estimate with the exception that the modified labor and dollar values will appear on the manpower summary and total cost estimate reports in place of the basic values. The data on the transaction list report, however, will be unaffected by this change. Revised manhour and material figures are then ready for return to and examination by individual estimators for development of impact statements, work scope, changes,

DESIGN-TO-COST FACTOR ————————————
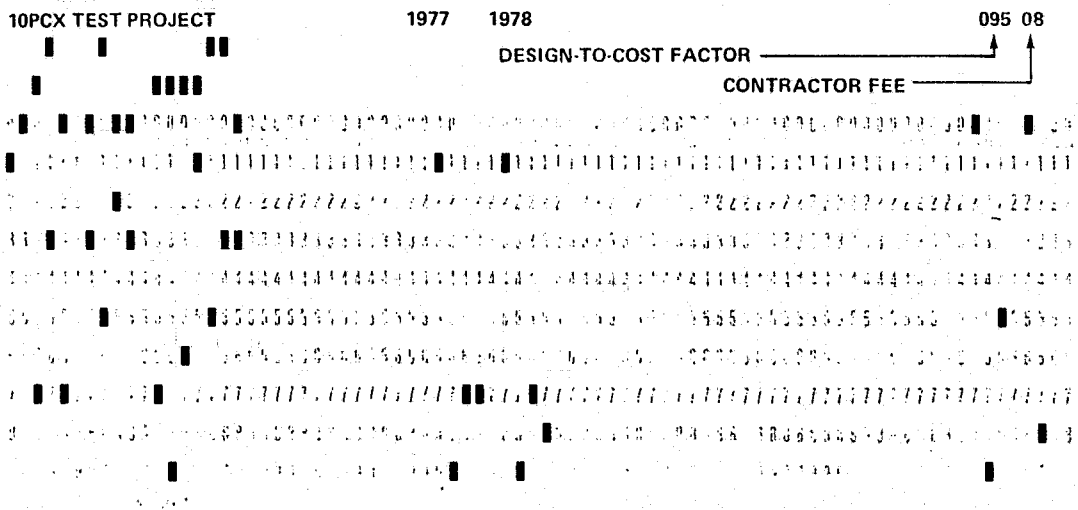
CONTRACTOR FEE ————————

Figure 6.   Design-to-cost and contractor fee card.

schedule changes, or recombination or redivision of work elements resulting
from the change in resources.  It is reemphasized that this reconciliation
process is mandatory to retain the credibility of the estimate.

2.  **Labor, Burden, and G& A Factors.**  Labor rates, overhead, and G& A
rates are subject to fluctuation.  The PACE II system affords fast turn-around
when revised rates and the resulting impact are required.  The revised rates
are input in the same manner as previously described in this handbook.

3.  **Direct Dollar Escalation.**  Material and subcontractor costs, travel
costs, and other direct dollar values which have previously been utilized in a
basic cost estimate on the PACE II system can be modified for subsequent runs
without disturbing the WBS base data cards used in the basic run.  This feature
has been provided to satisfy situations where it is desired to know the impact
of increases to these costs over the time span of the estimate due to economic
influences such as inflation.  By means of escalation factors which are specified
in the run deck, one or more PACE II production runs can be made to show the
effects of these variations while leaving the basic data intact.

a.  Input Preparation.  The categories of escalation are as follows:

● MAT = MATERIAL ESCALATION

● TRV = TRAVEL COSTS ESCALATION

● ODR = OTHER DIRECT ESCALATION

Three numeric characters must be furnished for each fiscal year value to be escalated with a decimal point assumed between the second and third character. Thus an entry of 025 would represent an increase of 2.5 percent. Any non-numeric input other than blanks will be interpreted as an error. Escalation percentages are entered on the Dollar Escalation Card (Type 30). An escalation percentage may be entered for each or any of the fiscal years in the cost estimate.

Any or all of the three categories of cost can be escalated in the same PACE II run. The direct dollar escalation cards are illustrated in Figure 7.

b. Calculations. In preparing the total cost estimate report for escalation, the WBS base data for direct dollars are increased in the first fiscal year by the amounts specified by the first percentage factor entered in their respective escalation cards. The remaining fiscal years are increased by adding their escalation factors to the sum of all previous factors and multiplying the direct dollar value for that year by the accumulated factor. These increased values will be shown for each WBS element and on all versions of the total cost estimate report.

4. Contractor Fee. Fees paid to government contractors can be included in a cost estimate by means of an optional input to the PACE II system which specifies a percentage factor which is to be used in figuring the fee. The fee amount is calculated at the highest level of the WBS and is printed out on the total cost estimate report together with a grand total for the entire estimate which includes the total estimated cost plus the fee.

a. Input Preparation. The contractor fee percentage is entered in columns 77-78 on the Labor Rate Header card. Fees may range from 01 to 99 representing whole number percentage.

b. Calculations. After the final summation of total estimated cost is made, the contractor fee percentage is applied to the summary figures for each fiscal year and added to the total cost giving a grand total. The fee amounts and grand totals are then printed out as additional data on the total cost estimate page for the highest level WBS element. This is the only place where this information is shown. No other reports or report variations are affected by the contractor fee option.

c. Sample Report. A sample page of the total cost estimate report for the highest level WBS element in the basic estimate example using a contractor fee input of eight percent is shown in Appendix B. Figure 6 illustrates the contractor fee card used to produce this option.

**"MATERIAL" ESCALATION**

30MAT     025     025     030

**"TRAVEL" ESCALATION**

30TRV     030     030     035

**"OTHER DIRECT" ESCALATION**

300DR     035     035     040

Figure 7.  Dollar escalation cards.

# V. FUTURE IMPROVEMENTS AND POTENTIAL MODIFICATIONS

As presently configured, the PACE II system is a highly versatile and flexible tool that can be used for a wide variety of functions. However, one can envision a number of other applications for the system ranging from minor to significant, if modifications were made to the system. A general description of these potential uses are described in this section. It is emphasized that detailed planning or estimating of programming effort to accomplish these modifications or changes have not been completed. At the present time, the following are only ideas for potential improvements.

## A. De-escalation, Computation of Present Worth, Future Worth, or Annual Equivalent Costs of Alternate Proposals

Certain limited economic studies can be accomplished with the PACE II system as now configured by applying various escalation rates to fixed dollar costs. Adaptation of this feature to accommodate de-escalation of labor, materials cost, and other costs could facilitate the computation of present worth, future worth, or annual equivalent costs for use in economic analyses and comparison of alternate proposals. Thus, the "time value of money" could be taken into account in comparing two program funding alternatives. This feature would be particularly useful when the two alternatives vary considerably in distribution of funding requirements over the program time span. Comparisons on a present worth or annual equivalent basis are prevalent in industrial decisions where interest rates, discount factors, or rate-of-return comparisons are essential to choose the most economically attractive alternative.

## B. Computation of Make/Buy and Skill Mix Ratios and Percentages

All of the basic data needed to compute labor/materials and/or make/buy ratios at each level of the WBS are available in a PACE II estimate. These ratios are particularly meaningful when it is necessary to determine what proportion of the work in each area and in the total proposal or estimate is to be accomplished in-house and what portion is to be subcontracted. Sufficient data are also available in a PACE II estimate to compute skill-mix ratios at each level of the WBS. These ratios would indicate what proportion of the total labor hours is in the engineering category, what portion is manufacturing, etc.

## C. Respreading of Costs

Real government estimating situations often encounter problems where (1) funding is limited for the first year or two years to a specified amount,

(2) the maximum annual funding is specified, or (3) the shape of the funding curve is specified in some other manner. Many industrial concerns have a standard set of funding spread curves which can be applied to any estimate and which will adjust the total and detailed costs to match the time-oriented expenditure of manhours or funds. The basic information required to accomplish this type of fund curve adjustment is available in a PACE II generated cost estimate.

## D. Reduction of Time Increments Estimated

Perhaps the most extensive modification to the system envisioned would be the reduction of the time span estimated for each element from the 1 year increment to a quarterly, monthly, or even weekly increment. Alteration of this time increment would involve sizable changes in the current estimating process as well as the computer system, but may be worthwhile at a later date due to various factors. First, requests for proposal are now requiring that the proposers subdivide costs into quarter-year increments. Verification of cost computations at this level of breakout by the PACE II system would require reduction of the time increment estimated from yearly to quarterly. Secondly, a quarterly or monthly breakout would facilitate collection of fiscal year costs when different fiscal year bases are used (i.e., July 1 to June 30 versus October 1 to September 30 versus January 1 to December 31). Third, greater visibility of manpower and fund buildup over shorter increments in early years may be desirable because funding constraints during buildup are normally given close scrutiny to avoid too rapid an acquisition of a recurring funding requirements.

## E. Cost Impact of Schedule Adjustments

Various PACE II system modifications can be envisioned which would modify the fiscal year spread of manhours and resulting labor or material costs to account for differences in the scheduling of development, production, or operations support activities of a program. With the present cost breakout by fiscal year, costs for each WBS increment could be accelerated or decelerated in yearly increments. Further PACE II system modifications to permit smaller time increments (semiannual, quarterly, or monthly) would permit finer adjustments in schedule-related costs. Differences in escalation costs brought about by these cost/schedule adjustments would be taken into account in the use of the appropriate escalated labor rate for each increment of time.

These and other modifications of the PACE II system will be studied in the coming months to determine the economic and practical benefits of implementing them. Provided sufficient demand develops for the PACE II system and its potential modifications, a time-phase program for system improvement will be instituted.

# F. Graphics

An early addition to the PACE II system which is envisioned is a graphics output capability which would allow the plotting of manhours and/or dollars versus fiscal year for the total estimate or for selected WBS elements. This capability will provide a quick-look visual picture of cost and/or manpower trends.

# APPENDIX A

# WORKSHEETS

| WBS NUMBER: | COMPUTER INPUT AND WORKSHEET (Control Data) PACE II SYSTEM (Pricing and Cost Estimating) | DATE: May 10, 1977 | PAGE 1 OF 1 |
|---|---|---|---|
| WBS TITLE: | PROJECT NAME: ACPL | PREPARED BY: L. Yadin | |

## LABOR RATE HEADER

| TYPE CODE | PROJECT NAME | FISCAL YEAR NO. 1 | FISCAL YEAR NO. 2 | FISCAL YEAR NO. 3 | FISCAL YEAR NO. 4 | FISCAL YEAR NO. 5 | FISCAL YEAR NO. 6 | FISCAL YEAR NO. 7 | FISCAL YEAR NO. 8 | DESIGN TO COST FACTOR % | CONTCR FEE % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | ATMOSPHERIC CLOUD PHYSICS LAB | 1977 | 1978 | 1979 | 1980 | 1981 | | | | 092 | 08 |

## LABOR RATE CARDS

| TYPE CODE | ACTIVITY CODE | LABOR RATE NO. 1 | OVERHEAD PERCENT NO. 1 | LABOR RATE NO. 2 | OVERHEAD PERCENT NO. 2 | LABOR RATE NO. 3 | OVERHEAD PERCENT NO. 3 | LABOR RATE NO. 4 | OVERHEAD PERCENT NO. 4 | LABOR RATE NO. 5 | OVERHEAD PERCENT NO. 5 | LABOR RATE NO. 6 | OVERHEAD PERCENT NO. 6 | LABOR RATE NO. 7 | OVERHEAD PERCENT NO. 7 | LABOR RATE NO. 8 | OVERHEAD PERCENT NO. 8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | ENG | 10.59 | 200 | 11.67 | 200 | 12.18 | 200 | 12.89 | 200 | 13.10 | 200 | | | | | | |
| 20 | MFG | 7.86 | 300 | 8.45 | 300 | 8.97 | 300 | 9.46 | 300 | 10.27 | 300 | | | | | | |
| 20 | TLG | | | | | | | | | | | | | | | | |
| 20 | QRA | 8.57 | 100 | 9.09 | 100 | 9.83 | 100 | 10.24 | 110 | 10.76 | 100 | | | | | | |
| 20 | TST | 7.56 | 100 | 9.83 | 100 | 10.41 | 100 | 11.01 | 110 | 11.58 | 100 | | | | | | |
| 20 | OTH | 10.58 | 120 | 11.67 | 200 | 12.18 | 200 | 12.89 | 200 | 13.10 | 200 | | | | | | |

| TYPE CODE | ACTIVITY CODE | PERCENT NO. 1 | PERCENT NO. 2 | PERCENT NO. 3 | PERCENT NO. 4 | PERCENT NO. 5 | PERCENT NO. 6 | PERCENT NO. 7 | PERCENT NO. 8 |
|---|---|---|---|---|---|---|---|---|---|
| 20 | GA | 180 | 180 | 180 | 180 | 180 | | | |
| 20 | MAT | 50 | 50 | 50 | 50 | 50 | | | |

## DOLLAR ESCALATION CARDS

| | CATEGORY OF ESCALATION | ESCALATION PERCENT NO. 1 | ESCALATION PERCENT NO. 2 | ESCALATION PERCENT NO. 3 | ESCALATION PERCENT NO. 4 | ESCALATION PERCENT NO. 5 | ESCALATION PERCENT NO. 6 | ESCALATION PERCENT NO. 7 | ESCALATION PERCENT NO. 8 |
|---|---|---|---|---|---|---|---|---|---|
| 30 | MAT | 70 | 70 | 70 | 70 | 70 | | | |
| 30 | TRV | 60 | 60 | 60 | 60 | 60 | | | |
| 30 | ODR | 65 | 65 | 65 | 65 | 65 | | | |

MSFC - Form 514-1 (March 1977)

| WBS NUMBER: | | | COMPUTER INPUT AND WORKSHEET (Base Data) PACE II SYSTEM (Pricing and Cost Estimating) | | | | | DATE May 10, 19 1 | | | PAGE 1 OF 6 |

WBS TITLE:

PROJECT NAME: AC PL

PREPARED BY L. Hardin

| TYPE CODE | WORK BREAKDOWN STRUCTURE CODE | FY | MANPOWER | | | | | | DOLLARS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ENGINEERING | MANUFACTURING | TOOLING | QUAL. & REL ASSURANCE | TESTING | OTHER | MATERIAL $ | TRAVEL $ | OTHER DIRECT $ |
| 50 | 1.1.1.1 | 77 | | | | | | 744 | | 1200 | |
| 50 | | 78 | | | | | | 9731 | | 850 | |
| | | 79 | | | | | | 117 | | 1700 | |
| | 1.1.1.2 | 77 | | 6391 | | | | | | | |
| | | 78 | | 183 | | 861 | | | | | |
| | | 79 | | 756 | | | | | 6000 | | |
| | | 80 | | 432 | | | 382 | | | | 8000 |
| | | 81 | | 1245 | | | | | | | |
| | 1.1.2.2 | 77 | 683 | | | | | | | | 6963 |
| | | 78 | 52 | | | | | | | | |
| | | 79 | 7321 | | | | 683 | | 6234 | | |
| | | 80 | 850 | | | | | 121 | | | |
| | | 81 | 1123 | | | | | | | | |
| | 1.1.3.4 | 78 | | | | | | 673 | 75461 | | 5431 |
| | | 79 | | 631 | | | | 784 | | | |
| | | 80 | | | | | | 860 | | | |

| WBS NUMBER: | COMPUTER INPUT AND WORKSHEET (Title Data) PACE II SYSTEM (Pricing and Cost Estimating) | DATE: May 10, 1977 PAGE 1 OF 2 |
|---|---|---|
| WBS TITLE: | PROJECT NAME: ACPL | PREPARED BY: L. Hardin |

| TYPE CODE | WBS ELEMENT NO. | WBS TITLE |
|---|---|---|
| 4 0 | 1 . 1 | ATMOSPHERIC CLOUD PHYSICS LAB |
| 4 0 | 1 . 1 . 1 | PROJECT MANAGEMENT |
| 4 0 | 1 . 1 . 1 . 2 | PROJECT PLANNING AND CONTROL |
| 4 0 | | |
| 4 0 | 1 . 1 . 2 | SYSTEM ENGINEERING AND INTEG |
| 4 0 | 1 . 1 . 2 . 3 | LOGISTICS REQUIREMENTS |
| 4 0 | | |
| 4 0 | 1 . 1 . 3 | ACPL SYSTEM (DDT+E) |
| 4 0 | 1 . 1 . 3 . 5 | CFD CHAMBER S/S |
| 4 0 | | |
| 4 0 | 1 . 1 . 4 | GROUND SUPPORT EQUIPMENT (GSE) |
| 4 0 | 1 . 1 . 4 . 1 | ELECTRICAL |
| 4 0 | | |
| 4 0 | 1 . 1 . 5 | DELIVERABLE ACPL PROTOFLIGHT |
| 4 0 | 1 . 1 . 5 . 1 | FLUID SUBSYSTEM |
| 4 0 | | |
| 4 0 | | |
| 4 0 | | |
| 4 0 | | |
| 4 0 | | |

MSFC - Form 514-2 (February 1977)

# APPENDIX B

# COST ESTIMATE REPORT

| DATE 19 NOV 77 | | PROJECT- PCX PROJECT | | | DESIGN-TO-COST-FACTOR = 0.00 | | | | PAGE 1 |
| WBS 1 | | TITLE- | | | | | | | |
| ELEMENTS OF COST | FY - 81 | FY - 82 | FY - 83 | FY - 84 | FY - 85 | FY - 86 | FY - 87 | FY - 88 | TOTAL |
| ENGR. HOURS | 198,953 | 272,733 | 271,534 | 191,498 | 94,521 | | | | 1,029,239 |
| LABOR $ | 2,964,401 | 4,063,722 | 4,045,855 | 2,853,319 | 1,408,363 | | | | 15,335,660 |
| OVERHEAD $ | 2,964,401 | 4,063,722 | 4,045,855 | 2,853,319 | 1,408,363 | | | | 15,335,660 |
| MFG. HOURS | 123 | 3,241 | 22,603 | 20,712 | | | | | 46,759 |
| LABOR $ | 1,108 | 29,202 | 204,374 | 186,616 | | | | | 421,300 |
| OVERHEAD $ | 1,662 | 43,809 | 306,563 | 279,929 | | | | | 631,953 |
| TOOLING HOURS | 73 | 43,643 | 26,629 | | | | | | 70,345 |
| LABOR $ | 623 | 372,276 | 227,145 | | | | | | 600,044 |
| OVERHEAD $ | 935 | 558,416 | 340,719 | | | | | | 900,070 |
| Q&RA HOURS | 71,914 | 98,925 | 137,470 | 121,858 | 12,425 | | | | 442,592 |
| LABOR $ | 771,636 | 1,061,465 | 1,475,054 | 1,307,536 | 133,320 | | | | 4,749,011 |
| OVERHEAD $ | 1,157,456 | 1,592,199 | 2,212,583 | 1,961,306 | 199,980 | | | | 7,123,524 |
| TEST HOURS | 16,794 | 24,250 | 19,427 | 24,486 | | | | | 84,957 |
| LABOR $ | 176,169 | 254,383 | 203,789 | 256,859 | | | | | 891,200 |
| OVERHEAD $ | 264,254 | 381,577 | 305,684 | 385,290 | | | | | 1,336,805 |
| OTHER HOURS | 36,926 | 56,134 | 53,622 | 30,478 | 22,814 | | | | 199,974 |
| LABOR $ | 664,668 | 1,010,412 | 965,196 | 548,604 | 410,652 | | | | 3,599,532 |
| OVERHEAD $ | 664,668 | 1,010,412 | 965,196 | 548,604 | 410,652 | | | | 3,599,532 |
| TOTAL HOURS | 324,783 | 498,926 | 531,365 | 389,032 | 129,760 | | | | 1,873,866 |
| LABOR $ | 4,578,605 | 6,791,460 | 7,121,413 | 5,152,934 | 1,952,335 | | | | 25,596,747 |
| OVERHEAD $ | 5,053,376 | 7,650,130 | 8,176,600 | 6,028,443 | 2,018,995 | | | | 28,927,544 |
| MATERIAL & SUBCON. | 470,816 | 652,150 | 329,962 | 74,148 | 11,224 | | | | 1,538,300 |
| MATERIAL OVERHEAD | 23,541 | 32,608 | 16,497 | 3,708 | 561 | | | | 76,915 |
| TRAVEL | 12,782 | 21,951 | 23,631 | 16,557 | 9,262 | | | | 84,183 |
| OTHER | 606,516 | 858,693 | 878,307 | 609,459 | 377,386 | | | | 3,330,361 |
| SUBTOTAL EST. COST | 10,745,636 | 16,006,992 | 16,546,410 | 11,885,249 | 4,369,763 | | | | 59,554,050 |
| G & A EXPENSE | 1,289,476 | 1,920,839 | 1,985,569 | 1,426,231 | 524,372 | | | | 7,146,487 |
| TOTAL EST. COST | 12,035,112 | 17,927,831 | 18,531,979 | 13,311,480 | 4,894,135 | | | | 66,700,537 |
| FEE 8% | 962,808 | 1,439,226 | 1,482,558 | 1,064,918 | 391,530 | | | | 5,336,040 |
| GRAND TOTAL | 12,997,920 | 19,362,857 | 20,014,537 | 14,376,398 | 5,285,665 | | | | 72,036,577 |

| ELEMENTS OF COST | | FY - 81 | FY - 82 | FY - 83 | FY - 84 | FY - 85 | FY - 86 | FY - 87 | FY - 88 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| ENGR. | HOURS | 198,953 | 272,733 | 271,534 | 191,498 | 94,521 | | | | 1,029,239 |
| | LABOR $ | 2,964,401 | 4,263,722 | 4,345,855 | 2,853,319 | 1,408,363 | | | | 15,335,660 |
| | OVERHEAD $ | 2,964,401 | 4,263,722 | 4,045,855 | 2,853,319 | 1,408,363 | | | | 15,335,660 |
| MFG. | HOURS | 123 | 3,241 | 22,683 | 20,712 | | | | | 46,759 |
| | LABOR $ | 1,108 | 29,202 | 204,374 | 186,616 | | | | | 421,300 |
| | OVERHEAD $ | 1,662 | 43,804 | 306,563 | 279,924 | | | | | 631,953 |
| TOOLING | HOURS | 73 | 43,643 | 26,629 | | | | | | 70,345 |
| | LABOR $ | 623 | 372,276 | 227,145 | | | | | | 600,044 |
| | OVERHEAD $ | 935 | 558,416 | 340,719 | | | | | | 900,070 |
| Q&RA | HOURS | 71,914 | 98,925 | 137,470 | 121,858 | 12,425 | | | | 442,592 |
| | LABOR $ | 771,636 | 1,061,465 | 1,475,054 | 1,307,536 | 133,320 | | | | 4,749,011 |
| | OVERHEAD $ | 1,157,456 | 1,592,199 | 2,212,583 | 1,961,306 | 199,980 | | | | 7,123,524 |
| TEST | HOURS | 16,794 | 24,250 | 19,427 | 24,486 | | | | | 84,957 |
| | LABOR $ | 176,169 | 254,383 | 203,789 | 256,859 | | | | | 891,200 |
| | OVERHEAD $ | 264,254 | 381,577 | 305,684 | 385,290 | | | | | 1,336,805 |
| OTHER | HOURS | 36,926 | 56,134 | 53,622 | 30,478 | 22,814 | | | | 199,974 |
| | LABOR $ | 664,668 | 1,010,412 | 965,196 | 548,604 | 410,652 | | | | 3,599,532 |
| | OVERHEAD $ | 664,668 | 1,010,412 | 965,196 | 548,604 | 410,652 | | | | 3,599,532 |
| TOTAL | HOURS | 324,783 | 498,926 | 531,365 | 389,032 | 129,760 | | | | 1,873,866 |
| | LABOR $ | 4,578,605 | 6,791,460 | 7,121,413 | 5,152,934 | 1,952,335 | | | | 25,596,747 |
| | OVERHEAD $ | 5,053,376 | 7,650,130 | 8,176,600 | 6,028,443 | 2,018,995 | | | | 28,927,544 |
| MATERIAL & SUBCON. | | 470,816 | 652,150 | 329,962 | 74,148 | 11,224 | | | | 1,538,300 |
| MATERIAL OVERHEAD | | 23,541 | 32,608 | 16,497 | 3,708 | 561 | | | | 76,915 |
| TRAVEL | | 12,782 | 21,951 | 23,631 | 16,557 | 9,262 | | | | 84,183 |
| OTHER | | 606,516 | 858,693 | 878,307 | 609,459 | 377,386 | | | | 3,330,361 |
| SUBTOTAL EST. COST | | 10,745,636 | 16,006,992 | 16,546,410 | 11,885,249 | 4,369,763 | | | | 59,554,050 |
| G & A EXPENSE | | 1,289,476 | 1,920,839 | 1,985,569 | 1,426,231 | 524,372 | | | | 7,146,487 |
| TOTAL EST. COST | | 12,035,112 | 17,927,831 | 18,531,979 | 13,311,480 | 4,894,135 | | | | 66,700,537 |
| GRAND TOTAL | | 12,035,112 | 17,927,831 | 18,531,979 | 13,311,480 | 4,894,135 | | | | 66,700,537 |

DATE 19 NOV 77　　　　　　　　PROJECT- PCX PROJECT　　　　　　　　DESIGN-TO-COST-FACTOR = C.00　　　　PAGE　　3
WBS 1.9.1　　　　　　　　　　TITLE- PROJECT MANAGEMENT

| ELEMENTS OF COST | | FY - 81 | FY - 82 | FY - 83 | FY - 84 | FY - 85 | FY - 86 | FY - 87 | FY - 88 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| ENGR. | HOURS | 980 | 1,960 | 8,825 | 7,360 | 2,940 | | | | 22,040 |
| | LABOR $ | 14,602 | 29,204 | 131,418 | 109,664 | 43,806 | | | | 328,694 |
| | OVERHEAD $ | 14,602 | 29,204 | 131,418 | 109,664 | 43,806 | | | | 328,694 |
| MFG. | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| TOOLING | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| Q&RA | HOURS | 45,492 | 47,608 | 78,792 | 90,689 | 12,425 | | | | 275,006 |
| | LABOR $ | 488,129 | 510,833 | 845,439 | 973,093 | 133,320 | | | | 2,950,814 |
| | OVERHEAD $ | 732,194 | 766,250 | 1,268,159 | 1,459,642 | 199,980 | | | | 4,426,223 |
| TEST | HOURS | 490 | 490 | 490 | 17,890 | | | | | 19,360 |
| | LABOR $ | 5,140 | 5,140 | 5,140 | 187,666 | | | | | 203,086 |
| | OVERHEAD $ | 7,710 | 7,710 | 7,710 | 281,499 | | | | | 304,629 |
| OTHER | HOURS | 30,458 | 47,138 | 44,590 | 24,598 | 21,050 | | | | 167,834 |
| | LABOR $ | 548,244 | 848,484 | 802,620 | 442,764 | 378,900 | | | | 3,021,012 |
| | OVERHEAD $ | 548,244 | 848,484 | 802,620 | 442,764 | 378,900 | | | | 3,021,012 |
| TOTAL | HOURS | 77,420 | 97,196 | 132,692 | 140,537 | 36,415 | | | | 484,260 |
| | LABOR $ | 1,056,115 | 1,393,661 | 1,764,617 | 1,713,187 | 556,026 | | | | 6,503,606 |
| | OVERHEAD $ | 1,302,750 | 1,651,648 | 2,209,907 | 2,293,567 | 622,686 | | | | 8,080,558 |
| MATERIAL & SUBCON. | | 9,015 | 9,160 | 19,600 | 20,976 | 11,224 | | | | 69,975 |
| MATERIAL OVERHEAD | | 451 | 458 | 980 | 1,049 | 561 | | | | 3,499 |
| TRAVEL | | 5,849 | 8,932 | 10,658 | 9,439 | 6,315 | | | | 41,193 |
| OTHER | | 28,759 | 41,042 | 54,934 | 60,757 | 33,239 | | | | 218,731 |
| SUBTOTAL EST. COST | | 2,402,939 | 3,104,901 | 4,080,696 | 4,098,975 | 1,230,051 | | | | 14,917,562 |
| G & A EXPENSE | | 288,352 | 372,588 | 489,683 | 491,878 | 147,605 | | | | 1,790,106 |
| TOTAL EST. COST | | 2,691,291 | 3,477,489 | 4,570,379 | 4,590,853 | 1,377,656 | | | | 16,707,668 |
| GRAND TOTAL | | 2,691,291 | 3,477,489 | 4,570,379 | 4,590,853 | 1,377,656 | | | | 16,707,668 |

| ELEMENTS OF COST | FY - 81 | FY - 82 | FY - 83 | FY - 84 | FY - 85 | FY - 86 | FY - 87 | FY - 88 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| ENGR. HOURS | | | | | | | | | |
| LABOR $ | | | | | | | | | |
| OVERHEAD $ | | | | | | | | | |
| MFG. HOURS | | | | | | | | | |
| LABOR $ | | | | | | | | | |
| OVERHEAD $ | | | | | | | | | |
| TOOLING HOURS | | | | | | | | | |
| LABOR $ | | | | | | | | | |
| OVERHEAD $ | | | | | | | | | |
| G&RA HOURS | | | | | | | | | |
| LABOR $ | | | | | | | | | |
| OVERHEAD $ | | | | | | | | | |
| TEST HOURS | | | | | | | | | |
| LABOR $ | | | | | | | | | |
| OVERHEAD $ | | | | | | | | | |
| OTHER HOURS | 3,312 | 4,413 | 4,413 | 4,413 | 3,312 | | | | 19,854 |
| LABOR $ | 59,616 | 79,389 | 79,383 | 79,383 | 59,616 | | | | 357,372 |
| OVERHEAD $ | 59,616 | 79,380 | 79,383 | 79,380 | 59,616 | | | | 357,372 |
| TOTAL HOURS | 3,312 | 4,413 | 4,413 | 4,413 | 3,312 | | | | 19,854 |
| LABOR $ | 59,616 | 79,380 | 79,383 | 79,380 | 59,616 | | | | 357,372 |
| OVERHEAD $ | 59,616 | 79,380 | 79,380 | 79,380 | 59,616 | | | | 357,372 |
| MATERIAL & SUBCON. | | | | | | | | | |
| MATERIAL OVERHEAD | | | | | | | | | |
| TRAVEL | 642 | 1,374 | 1,470 | 1,573 | 842 | | | | 5,901 |
| OTHER | 19,103 | 26,459 | 28,298 | 36,289 | 25,044 | | | | 129,176 |
| SUBTOTAL EST. COST | 138,974 | 186,584 | 188,528 | 190,617 | 145,118 | | | | 849,821 |
| G & A EXPENSE | 16,677 | 22,390 | 22,623 | 22,874 | 17,414 | | | | 101,978 |
| TOTAL EST. COST | 155,651 | 208,974 | 211,151 | 213,491 | 162,532 | | | | 951,799 |
| GRAND TOTAL | 155,651 | 208,974 | 211,151 | 213,491 | 162,532 | | | | 951,799 |

31

DATE 19 NOV 77        PROJECT- PCX PROJECT        DESIGN-TO-COST-FACTOR = 0.00       
WBS 1.4.1.2        TITLE- LOGISTICS MANAGEMENT

| ELEMENTS OF COST | | FY - 81 | FY - 82 | FY - 83 | FY - 84 | FY - 85 | FY - 86 | FY - 87 | FY - 88 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| ENGR. | HOURS | 980 | 1,960 | 1,960 | | | | | | 4,900 |
| | LABOR $ | 14,602 | 29,204 | 29,204 | | | | | | 73,010 |
| | OVERHEAD $ | 14,602 | 29,204 | 29,204 | | | | | | 73,010 |
| MFG. | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| TOOLING | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| Q&RA | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| TEST | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| OTHER | HOURS | 588 | 2,158 | 2,548 | 4,018 | 4,508 | | | | 13,720 |
| | LABOR $ | 10,584 | 37,144 | 45,864 | 72,324 | 81,144 | | | | 246,960 |
| | OVERHEAD $ | 10,584 | 37,144 | 45,864 | 72,324 | 81,144 | | | | 246,960 |
| TOTAL | HOURS | 1,568 | 4,018 | 4,508 | 4,018 | 4,508 | | | | 18,620 |
| | LABOR $ | 25,186 | 66,248 | 75,068 | 72,324 | 81,144 | | | | 319,970 |
| | OVERHEAD $ | 25,186 | 66,248 | 75,068 | 72,324 | 81,144 | | | | 319,970 |
| MATERIAL & SUBCON. | | | | | | | | | | |
| MATERIAL OVERHEAD | | | | | | | | | | |
| TRAVEL | | 321 | 687 | 735 | 787 | 421 | | | | 2,951 |
| OTHER | | | | | | | | | | |
| SUBTOTAL EST. COST | | 50,693 | 133,183 | 150,871 | 145,435 | 162,709 | | | | 642,891 |
| G & A EXPENSE | | 6,083 | 15,982 | 18,105 | 17,452 | 19,525 | | | | 77,147 |
| TOTAL EST. COST | | 56,776 | 149,165 | 168,976 | 162,887 | 182,234 | | | | 720,038 |
| GRAND TOTAL | | 56,776 | 149,165 | 168,976 | 162,887 | 182,234 | | | | 720,038 |

| ELEMENTS OF COST | FY - 81 | FY - 82 | FY - 83 | FY - 84 | FY - 85 | FY - 86 | FY - 87 | FY - 88 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| ENGR.   HOURS | | | | | | | | | |
|   LABOR  s | | | | | | | | | |
|   OVERHEAD s | | | | | | | | | |
| MFG.    HOURS | | | | | | | | | |
|   LABOR  s | | | | | | | | | |
|   OVERHEAD s | | | | | | | | | |
| TOOLING HOURS | | | | | | | | | |
|   LABOR  s | | | | | | | | | |
|   OVERHEAD s | | | | | | | | | |
| Q&RA   HOURS | | | | | | | | | |
|   LABOR  s | | | | | | | | | |
|   OVERHEAD s | | | | | | | | | |
| TEST   HOURS | | | | | | | | | |
|   LABOR  s | | | | | | | | | |
|   OVERHEAD s | | | | | | | | | |
| OTHER  HOURS | 492 | 4,900 | 4,900 | 4,410 | 4,410 | | | | 19,110 |
|   LABOR  s | 8,820 | 88,200 | 88,200 | 79,380 | 79,380 | | | | 343,980 |
|   OVERHEAD s | 8,820 | 88,200 | 88,200 | 79,380 | 79,380 | | | | 343,980 |
| TOTAL  HOURS | 490 | 4,900 | 4,900 | 4,410 | 4,410 | | | | 19,110 |
|   LABOR  s | 8,820 | 88,200 | 88,200 | 79,380 | 79,380 | | | | 343,980 |
|   OVERHEAD s | 8,820 | 88,200 | 88,200 | 79,380 | 79,380 | | | | 343,980 |
| MATERIAL & SUBCON. | | | | | | | | | |
| MATERIAL OVERHEAD | | | | | | | | | |
| TRAVEL | 369 | 1,374 | 1,470 | 1,180 | 842 | | | | 5,235 |
| OTHER | | | | | | | | | |
| SUBTOTAL EST. COST | 18,009 | 177,774 | 177,870 | 159,940 | 159,602 | | | | 693,195 |
| G & A EXPENSE | 2,161 | 21,333 | 21,344 | 19,193 | 19,152 | | | | 83,183 |
| TOTAL EST. COST | 20,170 | 199,107 | 199,214 | 179,133 | 178,754 | | | | 776,378 |
| GRAND TOTAL | 20,170 | 199,107 | 199,214 | 179,133 | 178,754 | | | | 776,378 |

DATE 19 NOV 77          PROJECT- PCX PROJECT                    DESIGN-TO-COST-FACTOR = 0.08                PAGE   7
WBS  1.9.1.9            TITLE- CONFIGURATION MANAGEMENT

| ELEMENTS OF COST | | FY - 81 | FY - 82 | FY - 83 | FY - 84 | FY - 85 | FY - 86 | FY - 87 | FY - 88 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| ENGR. | HOURS | | | 3,920 | 3,920 | 2,990 | | | | 10,780 |
| | LABOR $ | | | 58,408 | 58,408 | 43,806 | | | | 160,622 |
| | OVERHEAD $ | | | 58,408 | 58,408 | 43,806 | | | | 160,622 |
| MFG. | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| TOOLING | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| Q&RA | HOURS | | | 990 | 990 | | | | | 980 |
| | LABOR $ | | | 5,258 | 5,258 | | | | | 10,516 |
| | OVERHEAD $ | | | 7,887 | 7,887 | | | | | 15,779 |
| TEST | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| OTHER | HOURS | 1,470 | 1,960 | 1,960 | 1,960 | 1,470 | | | | 8,820 |
| | LABOR $ | 26,460 | 35,280 | 35,280 | 35,280 | 26,460 | | | | 158,760 |
| | OVERHEAD $ | 26,460 | 35,280 | 35,280 | 35,280 | 26,460 | | | | 158,760 |
| TOTAL | HOURS | 1,470 | 1,960 | 6,370 | 6,370 | 4,410 | | | | 20,580 |
| | LABOR $ | 26,460 | 35,280 | 98,946 | 98,946 | 70,266 | | | | 329,898 |
| | OVERHEAD $ | 26,460 | 35,280 | 101,575 | 101,575 | 70,266 | | | | 335,156 |
| MATERIAL & SUBCON. | | | | | | | | | | |
| MATERIAL OVERHEAD | | | | | | | | | | |
| TRAVEL | | 963 | 1,374 | 1,470 | 1,573 | 1,263 | | | | 6,643 |
| OTHER | | 9,659 | 14,592 | 26,636 | 28,506 | 8,195 | | | | 87,588 |
| SUBTOTAL EST. COST | | 63,542 | 86,526 | 228,627 | 230,600 | 149,990 | | | | 759,285 |
| G & A EXPENSE | | 7,625 | 10,383 | 27,435 | 27,672 | 17,999 | | | | 91,114 |
| TOTAL EST. COST | | 71,167 | 96,909 | 256,062 | 258,272 | 167,989 | | | | 850,399 |
| GRAND TOTAL | | 71,167 | 96,909 | 256,062 | 258,272 | 167,989 | | | | 850,399 |

PROJECT- PCX PROJECT  
TITLE- INFORMATION MANAGEMENT

DESIGN-TO-COST-FACTOR = 0.00

| ELEMENTS OF COST | | FY - 81 | FY - 82 | FY - 83 | FY - 84 | FY - 85 | FY - 86 | FY - 87 | FY - 88 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| ENGR. | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| MFG. | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| TOOLING | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| U&RA | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| TEST | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| OTHER | HOURS | 1,960 | | 3,920 | 3,920 | 2,940 | | | | |
| | LABOR $ | 35,280 | | 70,560 | 70,560 | 52,920 | | | | 12,740 |
| | OVERHEAD $ | 35,280 | | 70,560 | 70,560 | 52,920 | | | | 229,320 |
| | | | | | | | | | | 229,320 |
| TOTAL | HOURS | 1,960 | | 3,920 | 3,920 | 2,940 | | | | |
| | LABOR $ | 35,280 | | 70,560 | 70,560 | 52,920 | | | | 12,740 |
| | OVERHEAD $ | 35,280 | | 70,560 | 70,560 | 52,920 | | | | 229,320 |
| | | | | | | | | | | 229,320 |
| MATERIAL & SUBCON. | | | | | | | | | | |
| MATERIAL OVERHEAD | | | | | | | | | | |
| TRAVEL | | 344 | | 368 | 393 | 421 | | | | |
| OTHER | | | | | | | | | | 1,526 |
| SUBTOTAL EST. COST | | 70,904 | | 141,488 | 141,513 | 106,261 | | | | |
| G & A EXPENSE | | 8,508 | | 16,979 | 16,982 | 12,751 | | | | 460,166 |
| TOTAL EST. COST | | 79,412 | | 158,467 | 158,495 | 119,012 | | | | 55,220 |
| GRAND TOTAL | | 79,412 | | 158,467 | 158,495 | 119,012 | | | | 515,386 |
| | | | | | | | | | | 515,386 |

DATE 19 NOV 77                    PROJECT- PCX PROJECT                         DESIGN-TO-COST-FACTOR = 8.88                    PAGE    9
WBS  T.9.1.6                      TITLE- QUALITY AND REL MANAGEMENT

| ELEMENTS OF COST | | FY - 81 | FY - 82 | FY - 83 | FY - 84 | FY - 85 | FY - 86 | FY - 87 | FY - 88 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| ENGR. | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| MFG. | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| TOOLING | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| Q&RA | HOURS | 42,140 | 37,828 | 65,268 | 48,510 | 9,880 | | | | 203,546 |
| | LABOR $ | 452,162 | 415,894 | 700,326 | 520,512 | 105,154 | | | | 2,184,048 |
| | OVERHEAD $ | 678,243 | 608,841 | 1,050,489 | 788,768 | 157,731 | | | | 3,276,072 |
| TEST | HOURS | 490 | 490 | 490 | 490 | | | | | 1,960 |
| | LABOR $ | 5,140 | 5,140 | 5,140 | 5,140 | | | | | 20,560 |
| | OVERHEAD $ | 7,710 | 7,710 | 7,710 | 7,710 | | | | | 30,840 |
| OTHER | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| TOTAL | HOURS | 42,630 | 38,318 | 65,758 | 49,000 | 9,880 | | | | 206,506 |
| | LABOR $ | 457,302 | 411,034 | 705,466 | 525,652 | 105,154 | | | | 2,204,608 |
| | OVERHEAD $ | 685,953 | 616,551 | 1,058,199 | 788,478 | 157,731 | | | | 3,306,912 |
| MATERIAL & SUBCON. | | 2,140 | 9,160 | 19,600 | 20,976 | 11,224 | | | | 63,100 |
| MATERIAL OVERHEAD | | 107 | 458 | 980 | 1,049 | 561 | | | | 3,155 |
| TRAVEL | | 1,926 | 2,061 | 2,940 | 2,360 | 1,684 | | | | 10,971 |
| OTHER | | | | | | | | | | |
| SUBTOTAL EST. COST | | 1,147,428 | 1,039,264 | 1,787,185 | 1,338,515 | 276,354 | | | | 5,588,746 |
| G & A EXPENSE | | 137,691 | 124,712 | 214,462 | 160,622 | 33,162 | | | | 670,649 |
| TOTAL EST. COST | | 1,285,119 | 1,163,976 | 2,001,647 | 1,499,137 | 309,516 | | | | 6,259,395 |
| GRAND TOTAL | | 1,285,119 | 1,163,976 | 2,001,647 | 1,499,137 | 309,516 | | | | 6,259,395 |

| ELEMENTS OF COST | FY - 81 | FY - 82 | FY - 83 | FY - 84 | FY - 85 | FY - 86 | FY - 87 | FY - 88 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| ENGR.    HOURS |  |  |  |  |  |  |  |  |  |
|     LABOR s |  |  |  |  |  |  |  |  |  |
|     OVERHEAD s |  |  |  |  |  |  |  |  |  |
| MFG.     HOURS |  |  |  |  |  |  |  |  |  |
|     LABOR s |  |  |  |  |  |  |  |  |  |
|     OVERHEAD s |  |  |  |  |  |  |  |  |  |
| TOOLING HOURS |  |  |  |  |  |  |  |  |  |
|     LABOR s |  |  |  |  |  |  |  |  |  |
|     OVERHEAD s |  |  |  |  |  |  |  |  |  |
| Q&RA     HOURS |  |  |  |  |  |  |  |  |  |
|     LABOR s |  |  |  |  |  |  |  |  |  |
|     OVERHEAD s |  |  |  |  |  |  |  |  |  |
| TEST     HOURS |  |  |  |  |  |  |  |  |  |
|     LABOR s |  |  |  |  |  |  |  |  |  |
|     OVERHEAD s |  |  |  |  |  |  |  |  |  |
| OTHER    HOURS | 18,228 | 27,930 | 20,972 |  |  |  |  |  | 67,130 |
|     LABOR s | 328,104 | 5u2,740 | 377,496 |  |  |  |  |  | 1,208,340 |
|     OVERHEAD s | 328,104 | 5u2,740 | 377,496 |  |  |  |  |  | 1,208,340 |
| TOTAL    HOURS | 18,228 | 27,930 | 20,972 |  |  |  |  |  | 67,130 |
|     LABOR s | 328,104 | 5u2,740 | 377,496 |  |  |  |  |  | 1,208,340 |
|     OVERHEAD s | 328,104 | 5u2,740 | 377,496 |  |  |  |  |  | 1,208,340 |
| MATERIAL & SUBCON. |  |  |  |  |  |  |  |  |  |
| MATERIAL OVERHEAD |  |  |  |  |  |  |  |  |  |
| TRAVEL | 642 | 1,031 | 735 |  |  |  |  |  | 2,408 |
| OTHER |  |  |  |  |  |  |  |  |  |
| SUBTOTAL EST. COST | 656,850 | 1,006,511 | 755,727 |  |  |  |  |  | 2,419,088 |
| G & A EXPENSE | 78,822 | 120,781 | 90,687 |  |  |  |  |  | 290,290 |
| TOTAL EST. COST | 735,672 | 1,127,292 | 846,414 |  |  |  |  |  | 2,709,378 |
| GRAND TOTAL | 735,672 | 1,127,292 | 646,414 |  |  |  |  |  | 2,709,378 |

DATE 19 NOV 77         PROJECT- PCX PROJECT         DESIGN-TO-COST-FACTOR = 0.00         PAGE    11
WBS 1.4.1.8         TITLE- PROJECT DIRECTION

| ELEMENTS OF COST | FY - 81 | FY - 82 | FY - 83 | FY - 84 | FY - 85 | FY - 86 | FY - 87 | FY - 88 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| ENGR. HOURS | | | | | | | | | |
| LABOR $ | | | | | | | | | |
| OVERHEAD $ | | | | | | | | | |
| MFG. HOURS | | | | | | | | | |
| LABOR $ | | | | | | | | | |
| OVERHEAD $ | | | | | | | | | |
| TOOLING HOURS | | | | | | | | | |
| LABOR $ | | | | | | | | | |
| OVERHEAD $ | | | | | | | | | |
| Q&RA HOURS | | | | | | | | | |
| LABOR $ | | | | | | | | | |
| OVERHEAD $ | | | | | | | | | |
| TEST HOURS | | | | | | | | | |
| LABOR $ | | | | | | | | | |
| OVERHEAD $ | | | | | | | | | |
| OTHER HOURS | 4,410 | 5,880 | 5,880 | 5,880 | 4,410 | | | | 26,460 |
| LABOR $ | 79,380 | 105,840 | 105,840 | 105,840 | 79,380 | | | | 476,280 |
| OVERHEAD $ | 79,380 | 105,840 | 105,840 | 105,840 | 79,380 | | | | 476,280 |
| TOTAL HOURS | 4,410 | 5,880 | 5,880 | 5,880 | 4,410 | | | | 26,460 |
| LABOR $ | 79,380 | 105,840 | 105,840 | 105,840 | 79,380 | | | | 476,280 |
| OVERHEAD $ | 79,380 | 105,840 | 105,840 | 105,840 | 79,380 | | | | 476,280 |
| MATERIAL & SUBCON. | | | | | | | | | |
| MATERIAL OVERHEAD | | | | | | | | | |
| TRAVEL | 321 | 687 | 735 | 393 | | | | | 2,136 |
| OTHER | | | | | | | | | |
| SUBTOTAL EST. COST | 159,081 | 212,367 | 212,415 | 212,073 | 158,760 | | | | 954,696 |
| G & A EXPENSE | 19,090 | 25,484 | 25,490 | 25,449 | 19,051 | | | | 114,564 |
| TOTAL EST. COST | 178,171 | 237,851 | 237,905 | 237,522 | 177,811 | | | | 1,069,260 |
| GRAND TOTAL | 178,171 | 237,851 | 237,905 | 237,522 | 177,811 | | | | 1,069,260 |

| ELEMENTS OF COST | | FY - 81 | FY - 82 | FY - 83 | FY - 84 | FY - 85 | FY - 86 | FY - 87 | FY - 88 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| ENGR. | HOURS | | | 2,940 | 3,440 | | | | | 6,380 |
| | LABOR $ | | | 43,806 | 51,256 | | | | | 95,062 |
| | OVERHEAD $ | | | 43,806 | 51,256 | | | | | 95,062 |
| MFG. | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| TOOLING | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| Q&RA | HOURS | 3,352 | 9,780 | 13,034 | 41,689 | 2,625 | | | | 70,480 |
| | LABOR $ | 35,967 | 154,939 | 139,855 | 447,323 | 28,166 | | | | 756,250 |
| | OVERHEAD $ | 53,951 | 157,409 | 209,783 | 670,985 | 42,249 | | | | 1,130,377 |
| TEST | HOURS | | | | 17,400 | | | | | 17,400 |
| | LABOR $ | | | | 182,526 | | | | | 182,526 |
| | OVERHEAD $ | | | | 273,789 | | | | | 273,789 |
| OTHER | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| TOTAL | HOURS | 3,352 | 9,780 | 15,974 | 62,529 | 2,625 | | | | 94,260 |
| | LABOR $ | 35,967 | 154,939 | 183,661 | 681,105 | 28,166 | | | | 1,033,838 |
| | OVERHEAD $ | 53,951 | 157,409 | 253,589 | 946,630 | 42,249 | | | | 1,503,228 |
| MATERIAL & SUBCON. | | 6,875 | | | | | | | | 6,875 |
| MATERIAL OVERHEAD | | 344 | | | | | | | | 344 |
| TRAVEL | | 321 | 344 | 735 | 1,180 | 842 | | | | 3,422 |
| OTHER | | | | | 1,967 | | | | | 1,967 |
| SUBTOTAL EST. COST | | 97,458 | 262,692 | 437,985 | 1,680,282 | 71,257 | | | | 2,549,674 |
| G & A EXPENSE | | 11,695 | 31,523 | 52,558 | 201,634 | 8,551 | | | | 305,961 |
| TOTAL EST. COST | | 109,153 | 294,215 | 490,543 | 1,881,916 | 79,808 | | | | 2,855,635 |
| GRAND TOTAL | | 109,153 | 294,215 | 490,543 | 1,881,916 | 79,808 | | | | 2,855,635 |

| DATE 19 NOV 77<br>WBS 1.4.2 | | PROJECT- PCX PROJECT<br>TITLE- SYSTEM ENGINEERING | | | | DESIGN-TO-COST-FACTOR = 0.00 | | | PAGE 13 |
|---|---|---|---|---|---|---|---|---|---|
| ELEMENTS OF COST | | FY - 81 | FY - 82 | FY - 83 | FY - 84 | FY - 85 | FY - 86 | FY - 87 | FY - 88 | TOTAL |

| ELEMENTS OF COST | | FY - 81 | FY - 82 | FY - 83 | FY - 84 | FY - 85 | FY - 86 | FY - 87 | FY - 88 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| ENGR. | HOURS | 148,396 | 257,288 | 199,265 | 153,490 | 79,116 | | | | 787,555 |
| | LABOR $ | 2,211,101 | 3,088,591 | 2,969,048 | 2,287,001 | 1,178,828 | | | | 11,734,569 |
| | OVERHEAD $ | 2,211,101 | 3,088,591 | 2,969,048 | 2,287,001 | 1,178,828 | | | | 11,734,569 |
| MFG. | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| TOOLING | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| Q&RA | HOURS | 25,480 | 45,080 | 50,960 | 22,540 | | | | | 144,060 |
| | LABOR $ | 273,400 | 483,708 | 546,801 | 241,854 | | | | | 1,545,763 |
| | OVERHEAD $ | 410,100 | 725,562 | 820,202 | 362,781 | | | | | 2,318,645 |
| TEST | HOURS | 15,324 | 18,416 | 15,347 | 3,068 | | | | | 52,155 |
| | LABOR $ | 160,749 | 193,184 | 160,990 | 32,184 | | | | | 547,107 |
| | OVERHEAD $ | 241,124 | 289,777 | 241,485 | 48,277 | | | | | 820,663 |
| OTHER | HOURS | 6,076 | 8,604 | 8,640 | 5,880 | 1,764 | | | | 30,964 |
| | LABOR $ | 109,368 | 154,872 | 155,520 | 105,840 | 31,752 | | | | 557,352 |
| | OVERHEAD $ | 109,368 | 154,872 | 155,520 | 105,840 | 31,752 | | | | 557,352 |
| TOTAL | HOURS | 195,276 | 279,388 | 274,212 | 184,978 | 80,880 | | | | 1,014,734 |
| | LABOR $ | 2,754,618 | 3,920,355 | 3,832,359 | 2,666,879 | 1,210,580 | | | | 14,384,791 |
| | OVERHEAD $ | 2,971,693 | 4,258,832 | 4,186,255 | 2,803,899 | 1,210,580 | | | | 15,431,229 |
| MATERIAL & SUBCON. | | 320,198 | 141,458 | 64,006 | | | | | | 525,612 |
| MATERIAL OVERHEAD | | 16,010 | 7,071 | 3,200 | | | | | | 26,281 |
| TRAVEL | | 5,184 | 9,447 | 9,151 | 4,975 | 2,105 | | | | 30,862 |
| OTHER | | 457,849 | 687,841 | 716,172 | 463,998 | 275,750 | | | | 2,601,610 |
| SUBTOTAL EST. COST | | 6,525,552 | 9,024,924 | 8,811,143 | 5,939,751 | 2,699,015 | | | | 33,000,385 |
| G & A EXPENSE | | 783,066 | 1,082,991 | 1,057,337 | 712,770 | 323,882 | | | | 3,960,046 |
| TOTAL EST. COST | | 7,308,618 | 10,107,915 | 9,868,480 | 6,652,521 | 3,022,897 | | | | 36,960,431 |
| GRAND TOTAL | | 7,308,618 | 10,107,915 | 9,868,480 | 6,652,521 | 3,022,897 | | | | 36,960,431 |

| ELEMENTS OF COST | | FY - 81 | FY - 82 | FY - 83 | FY - 84 | FY - 85 | FY - 86 | FY - 87 | FY - 88 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| ENGR. | HOURS | 25,284 | 33,717 | 28,138 | 21,640 | 10,528 | | | | 119,307 |
| | LABOR $ | 376,732 | 502,383 | 419,256 | 322,436 | 156,867 | | | | 1,777,674 |
| | OVERHEAD $ | 376,732 | 502,383 | 419,256 | 322,436 | 156,867 | | | | 1,777,674 |
| MFG. | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| TOOLING | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| Q&RA | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| TEST | HOURS | 9,637 | 11,104 | 9,254 | 1,850 | | | | | 31,845 |
| | LABOR $ | 101,092 | 116,481 | 97,074 | 19,407 | | | | | 334,054 |
| | OVERHEAD $ | 151,638 | 174,722 | 145,611 | 29,111 | | | | | 501,082 |
| OTHER | HOURS | 698 | 1,143 | 1,161 | 600 | 180 | | | | 3,782 |
| | LABOR $ | 12,564 | 20,574 | 20,898 | 10,800 | 3,240 | | | | 68,076 |
| | OVERHEAD $ | 12,564 | 20,574 | 20,898 | 10,800 | 3,240 | | | | 68,076 |
| TOTAL | HOURS | 35,619 | 45,964 | 38,553 | 24,090 | 10,708 | | | | 154,934 |
| | LABOR $ | 490,388 | 639,438 | 537,228 | 352,643 | 160,107 | | | | 2,179,804 |
| | OVERHEAD $ | 540,934 | 697,679 | 585,765 | 362,347 | 160,107 | | | | 2,346,832 |
| MATERIAL & SUBCON. | | 212,342 | 93,776 | 42,446 | | | | | | 348,564 |
| MATERIAL OVERHEAD | | 10,617 | 4,689 | 2,122 | | | | | | 17,428 |
| TRAVEL | | 3,338 | 4,466 | 3,822 | 2,714 | 1,263 | | | | 15,603 |
| OTHER | | 68,266 | 150,554 | 103,978 | 68,880 | 41,894 | | | | 383,572 |
| SUBTOTAL EST. COST | | 1,325,885 | 1,590,602 | 1,275,361 | 786,584 | 363,371 | | | | 5,291,803 |
| G & A EXPENSE | | 159,106 | 184,872 | 153,043 | 94,390 | 43,605 | | | | 635,016 |
| TOTAL EST. COST | | 1,484,991 | 1,725,474 | 1,428,404 | 880,974 | 406,976 | | | | 5,926,819 |
| GRAND TOTAL | | 1,484,991 | 1,725,474 | 1,428,404 | 880,974 | 406,976 | | | | 5,926,819 |

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| ELEMENTS OF COST | | FY - 81 | FY - 82 | FY - 83 | FY - 84 | FY - 85 | FY - 86 | FY - 87 | FY - 88 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| ENGR. | HOURS | 123,112 | 173,571 | 171,127 | 131,850 | 68,588 | | | | 668,248 |
| | LABOR $ | 1,834,369 | 2,586,208 | 2,549,792 | 1,964,565 | 1,021,961 | | | | 9,956,895 |
| | OVERHEAD $ | 1,834,369 | 2,586,208 | 2,549,792 | 1,964,565 | 1,021,961 | | | | 9,956,895 |
| MFG. | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| TOOLING | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| Q&RA | HOURS | 25,480 | 45,080 | 50,960 | 22,540 | | | | | 144,060 |
| | LABOR $ | 273,400 | 483,738 | 546,801 | 241,854 | | | | | 1,545,763 |
| | OVERHEAD $ | 410,100 | 725,562 | 820,202 | 362,781 | | | | | 2,318,645 |
| TEST | HOURS | 5,687 | 7,312 | 6,093 | 1,218 | | | | | 20,310 |
| | LABOR $ | 59,657 | 76,703 | 63,916 | 12,777 | | | | | 213,053 |
| | OVERHEAD $ | 89,486 | 115,055 | 95,874 | 19,166 | | | | | 319,581 |
| OTHER | HOURS | 5,378 | 7,461 | 7,479 | 5,280 | 1,584 | | | | 27,182 |
| | LABOR $ | 96,804 | 134,298 | 134,622 | 95,040 | 28,512 | | | | 489,276 |
| | OVERHEAD $ | 96,804 | 134,298 | 134,622 | 95,040 | 28,512 | | | | 489,276 |
| TOTAL | HOURS | 159,657 | 233,424 | 235,659 | 160,888 | 70,172 | | | | 859,800 |
| | LABOR $ | 2,264,230 | 3,280,917 | 3,295,131 | 2,314,236 | 1,050,473 | | | | 12,204,987 |
| | OVERHEAD $ | 2,430,759 | 3,561,123 | 3,600,490 | 2,441,552 | 1,050,473 | | | | 13,084,397 |
| MATERIAL & SUBCON. | | 107,856 | 47,632 | 21,560 | | | | | | 177,048 |
| MATERIAL OVERHEAD | | 5,393 | 2,382 | 1,078 | | | | | | 8,853 |
| TRAVEL | | 1,846 | 4,981 | 5,329 | 2,261 | 842 | | | | 15,259 |
| OTHER | | 389,583 | 587,287 | 612,194 | 395,118 | 233,856 | | | | 2,218,038 |
| SUBTOTAL EST. COST | | 5,199,667 | 7,484,322 | 7,535,782 | 5,153,167 | 2,335,644 | | | | 27,708,582 |
| G & A EXPENSE | | 623,960 | 898,119 | 904,294 | 618,380 | 280,277 | | | | 3,325,030 |
| TOTAL EST. COST | | 5,823,627 | 8,382,441 | 8,440,076 | 5,771,547 | 2,615,921 | | | | 31,033,612 |
| GRAND TOTAL | | 5,823,627 | 8,382,441 | 8,440,076 | 5,771,547 | 2,615,921 | | | | 31,033,612 |

| ELEMENTS OF COST | FY - 81 | FY - 82 | FY - 83 | FY - 84 | FY - 85 | FY - 86 | FY - 87 | FY - 88 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| ENGR.    HOURS | 49,577 | 63,485 | 63,449 | 30,648 | 12,465 | | | | 219,624 |
| LABOR $ | 738,698 | 945,927 | 945,389 | 456,654 | 185,729 | | | | 3,272,397 |
| OVERHEAD $ | 738,698 | 945,927 | 945,389 | 456,654 | 185,729 | | | | 3,272,397 |
| MFG.    HOURS | 123 | 3,241 | 22,683 | 20,712 | | | | | 46,759 |
| LABOR $ | 1,108 | 29,252 | 204,374 | 186,616 | | | | | 421,300 |
| OVERHEAD $ | 1,662 | 43,804 | 306,563 | 279,924 | | | | | 631,953 |
| TOOLING HOURS | 73 | 43,643 | 26,629 | | | | | | 70,345 |
| LABOR $ | 623 | 372,276 | 227,145 | | | | | | 600,044 |
| OVERHEAD $ | 935 | 558,416 | 340,719 | | | | | | 900,070 |
| Q&RA    HOURS | 942 | 6,237 | 7,718 | 8,629 | | | | | 23,526 |
| LABOR $ | 10,137 | 66,924 | 82,814 | 92,589 | | | | | 252,434 |
| OVERHEAD $ | 15,162 | 100,387 | 124,222 | 138,885 | | | | | 378,656 |
| TEST    HOURS | 980 | 5,344 | 3,590 | 3,528 | | | | | 13,442 |
| LABOR $ | 10,280 | 56,159 | 37,659 | 37,009 | | | | | 141,007 |
| OVERHEAD $ | 15,420 | 84,290 | 56,489 | 55,514 | | | | | 211,513 |
| OTHER    HOURS | 392 | 392 | 392 | | | | | | 1,176 |
| LABOR $ | 7,056 | 7,056 | 7,056 | | | | | | 21,168 |
| OVERHEAD $ | 7,056 | 7,056 | 7,056 | | | | | | 21,168 |
| TOTAL    HOURS | 52,087 | 122,342 | 124,461 | 63,517 | 12,465 | | | | 374,872 |
| LABOR $ | 767,872 | 1,477,444 | 1,504,437 | 772,868 | 185,729 | | | | 4,708,350 |
| OVERHEAD $ | 778,933 | 1,739,680 | 1,780,438 | 930,977 | 185,729 | | | | 5,415,757 |
| MATERIAL & SUBCON. | 141,603 | 541,582 | 246,356 | 53,172 | | | | | 942,713 |
| MATERIAL OVERHEAD | 7,088 | 25,079 | 12,317 | 2,659 | | | | | 47,135 |
| TRAVEL | 1,749 | 3,572 | 3,822 | 2,143 | 842 | | | | 12,128 |
| OTHER | 119,908 | 129,810 | 107,201 | 84,704 | 68,397 | | | | 510,020 |
| SUBTOTAL EST. COST | 1,817,145 | 3,877,167 | 3,654,571 | 1,846,523 | 440,697 | | | | 11,636,103 |
| G & A EXPENSE | 218,058 | 465,260 | 438,549 | 221,583 | 52,885 | | | | 1,396,335 |
| TOTAL EST. COST | 2,035,203 | 4,342,427 | 4,093,120 | 2,068,106 | 493,582 | | | | 13,032,438 |
| GRAND TOTAL | 2,035,203 | 4,342,427 | 4,093,120 | 2,068,106 | 493,582 | | | | 13,032,438 |

| ELEMENTS OF COST | | FY - 81 | FY - 82 | FY - 83 | FY - 84 | FY - 85 | FY - 86 | FY - 87 | FY - 88 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| ENGR. | HOURS | 49,577 | 63,485 | 63,949 | 30,648 | 12,465 | | | | 219,624 |
| | LABOR $ | 738,698 | 945,927 | 945,389 | 456,654 | 185,729 | | | | 3,272,397 |
| | OVERHEAD $ | 738,698 | 945,927 | 945,389 | 456,654 | 185,729 | | | | 3,272,397 |
| MFG. | HOURS | 123 | 3,241 | 22,683 | 20,712 | | | | | 46,759 |
| | LABOR $ | 1,108 | 29,202 | 204,374 | 186,616 | | | | | 421,300 |
| | OVERHEAD $ | 1,662 | 43,804 | 306,563 | 279,924 | | | | | 631,953 |
| TOOLING | HOURS | 73 | 43,643 | 26,629 | | | | | | 70,345 |
| | LABOR $ | 623 | 372,276 | 227,145 | | | | | | 600,044 |
| | OVERHEAD $ | 935 | 558,416 | 340,719 | | | | | | 900,070 |
| Q&RA | HOURS | 942 | 6,237 | 7,718 | 8,629 | | | | | 23,526 |
| | LABOR $ | 10,107 | 66,924 | 82,814 | 92,589 | | | | | 252,434 |
| | OVERHEAD $ | 15,162 | 100,387 | 124,222 | 138,885 | | | | | 378,656 |
| TEST | HOURS | 980 | 5,344 | 3,590 | 3,528 | | | | | 13,442 |
| | LABOR $ | 10,280 | 56,659 | 37,659 | 37,009 | | | | | 141,007 |
| | OVERHEAD $ | 15,420 | 84,690 | 56,489 | 55,514 | | | | | 211,513 |
| OTHER | HOURS | 392 | 392 | 392 | | | | | | 1,176 |
| | LABOR $ | 7,056 | 7,056 | 7,056 | | | | | | 21,168 |
| | OVERHEAD $ | 7,056 | 7,056 | 7,056 | | | | | | 21,168 |
| TOTAL | HOURS | 52,087 | 122,342 | 124,461 | 63,517 | 12,465 | | | | 374,872 |
| | LABOR $ | 767,872 | 1,477,444 | 1,504,437 | 772,868 | 185,729 | | | | 4,708,350 |
| | OVERHEAD $ | 778,933 | 1,739,680 | 1,780,438 | 930,977 | 185,729 | | | | 5,415,757 |
| MATERIAL & SUBCON. | | 141,603 | 501,582 | 246,356 | 53,172 | | | | | 942,713 |
| MATERIAL OVERHEAD | | 7,080 | 25,079 | 12,317 | 2,659 | | | | | 47,135 |
| TRAVEL | | 1,749 | 3,572 | 3,822 | 2,143 | 842 | | | | 12,128 |
| OTHER | | 119,908 | 129,810 | 107,201 | 84,704 | 68,397 | | | | 510,020 |
| SUBTOTAL EST. COST | | 1,817,145 | 3,877,167 | 3,654,571 | 1,846,523 | 440,697 | | | | 11,636,103 |
| G & A EXPENSE | | 218,058 | 465,260 | 438,549 | 221,583 | 52,885 | | | | 1,396,335 |
| TOTAL EST. COST | | 2,035,203 | 4,342,427 | 4,093,120 | 2,068,106 | 493,582 | | | | 13,032,438 |
| GRAND TOTAL | | 2,035,203 | 4,342,427 | 4,093,120 | 2,068,106 | 493,582 | | | | 13,032,438 |

DATE 19 NOV 77  
WBS 1.4.3.1.1  
PROJECT- PCX PROJECT  
TITLE- PROPELLANT TANKS  
DESIGN-TO-COST-FACTOR = 0.00  
PAGE   18

| ELEMENTS OF COST | | FY - 81 | FY - 82 | FY - 83 | FY - 84 | FY - 85 | FY - 86 | FY - 87 | FY - 88 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| ENGR. | HOURS | 10,547 | 12,270 | 11,896 | 4,016 | 1,568 | | | | 40,297 |
| | LABOR $ | 157,150 | 182,823 | 177,250 | 59,838 | 23,363 | | | | 600,424 |
| | OVERHEAD $ | 157,150 | 182,823 | 177,250 | 59,838 | 23,363 | | | | 600,424 |
| MFG. | HOURS | | 560 | 9,023 | 9,162 | | | | | 18,745 |
| | LABOR $ | | 5,046 | 81,297 | 82,550 | | | | | 168,893 |
| | OVERHEAD $ | | 7,569 | 121,996 | 123,825 | | | | | 253,340 |
| TOOLING | HOURS | | 9,674 | 6,216 | | | | | | 15,890 |
| | LABOR $ | | 82,519 | 53,022 | | | | | | 135,541 |
| | OVERHEAD $ | | 123,779 | 79,533 | | | | | | 203,312 |
| Q&RA | HOURS | 478 | 1,435 | 3,636 | 4,018 | | | | | 9,567 |
| | LABOR $ | 5,129 | 15,398 | 39,014 | 43,113 | | | | | 102,654 |
| | OVERHEAD $ | 7,694 | 23,097 | 58,521 | 64,670 | | | | | 153,982 |
| TEST | HOURS | | 1,194 | 3,590 | 3,528 | | | | | 8,312 |
| | LABOR $ | | 12,525 | 37,659 | 37,009 | | | | | 87,193 |
| | OVERHEAD $ | | 18,788 | 56,489 | 55,514 | | | | | 130,791 |
| OTHER | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| TOTAL | HOURS | 11,025 | 25,133 | 34,361 | 20,724 | 1,568 | | | | 92,811 |
| | LABOR $ | 162,279 | 298,311 | 388,242 | 222,510 | 23,363 | | | | 1,094,705 |
| | OVERHEAD $ | 164,844 | 356,056 | 493,739 | 303,847 | 23,363 | | | | 1,341,849 |
| MATERIAL & SUBCON. | | 683 | 292,322 | 164,943 | | | | | | 457,948 |
| MATERIAL OVERHEAD | | 34 | 14,616 | 8,247 | | | | | | 22,897 |
| TRAVEL | | | | | | | | | | |
| OTHER | | 23,818 | 31,705 | 26,534 | 27,872 | 22,813 | | | | 132,742 |
| SUBTOTAL EST. COST | | 351,658 | 993,010 | 1,081,705 | 554,229 | 69,539 | | | | 3,050,141 |
| G & A EXPENSE | | 42,199 | 119,161 | 129,805 | 66,507 | 8,345 | | | | 366,017 |
| TOTAL EST. COST | | 393,857 | 1,112,171 | 1,211,510 | 620,736 | 77,884 | | | | 3,416,158 |
| GRAND TOTAL | | 393,857 | 1,112,171 | 1,211,510 | 620,736 | 77,884 | | | | 3,416,158 |

DATE 19 NOV 77  PROJECT- PCX PROJECT  DESIGN-TO-COST-FACTOR = 0.00  PAGE  19
WBS  1.9.5.1.2  TITLE- THRUST STRUCTURE

| ELEMENTS OF COST | | FY - 81 | FY - 82 | FY - 83 | FY - 84 | FY - 85 | FY - 86 | FY - 87 | FY - 88 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| ENGR. | HOURS | 8,663 | 7,255 | 6,762 | 2,719 | 1,369 | | | | 26,788 |
| | LABOR $ | 129,079 | 108,100 | 100,754 | 40,513 | 20,398 | | | | 398,844 |
| | OVERHEAD $ | 129,079 | 108,100 | 100,754 | 40,513 | 20,398 | | | | 398,844 |
| MFG. | HOURS | | 174 | 2,809 | 2,853 | | | | | 9,836 |
| | LABOR $ | | 1,568 | 25,309 | 25,706 | | | | | 52,583 |
| | OVERHEAD $ | | 2,352 | 37,964 | 38,559 | | | | | 78,879 |
| TOOLING | HOURS | | 1,567 | 1,009 | | | | | | 2,576 |
| | LABOR $ | | 13,367 | 8,607 | | | | | | 21,974 |
| | OVERHEAD $ | | 20,051 | 12,911 | | | | | | 32,962 |
| Q&RA | HOURS | 199 | 598 | 1,515 | 1,675 | | | | | 3,987 |
| | LABOR $ | 2,135 | 6,417 | 16,256 | 17,973 | | | | | 42,781 |
| | OVERHEAD $ | 3,203 | 9,626 | 24,384 | 26,960 | | | | | 64,173 |
| TEST | HOURS | | 186 | | | | | | | 186 |
| | LABOR $ | | 1,951 | | | | | | | 1,951 |
| | OVERHEAD $ | | 2,927 | | | | | | | 2,927 |
| OTHER | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| TOTAL | HOURS | 8,862 | 9,780 | 12,095 | 7,247 | 1,369 | | | | 39,353 |
| | LABOR $ | 131,214 | 131,403 | 150,926 | 84,192 | 20,398 | | | | 518,133 |
| | OVERHEAD $ | 132,282 | 143,056 | 176,013 | 106,032 | 20,398 | | | | 577,781 |
| MATERIAL & SUBCON. | | 47,348 | 44,097 | 11,547 | 8,556 | | | | | 111,548 |
| MATERIAL OVERHEAD | | 2,367 | 2,205 | 577 | 428 | | | | | 5,577 |
| TRAVEL | | | | | | | | | | |
| OTHER | | 16,146 | 21,606 | 18,485 | 19,783 | 15,826 | | | | 91,846 |
| SUBTOTAL EST. COST | | 329,357 | 342,367 | 357,548 | 218,991 | 56,622 | | | | 1,304,885 |
| G & A EXPENSE | | 39,523 | 41,084 | 42,906 | 26,279 | 6,795 | | | | 156,587 |
| TOTAL EST. COST | | 368,880 | 383,451 | 400,454 | 245,270 | 63,417 | | | | 1,461,472 |
| GRAND TOTAL | | 368,880 | 383,451 | 400,454 | 245,270 | 63,417 | | | | 1,461,472 |

| ELEMENTS OF COST | | FY - 81 | FY - 82 | FY - 83 | FY - 84 | FY - 85 | FY - 86 | FY - 87 | FY - 88 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| ENGR. | HOURS | 9,373 | 11,740 | 11,348 | 5,106 | 1,640 | | | | 39,207 |
| | LABOR $ | 139,658 | 174,926 | 169,085 | 76,079 | 24,436 | | | | 584,184 |
| | OVERHEAD $ | 139,658 | 174,926 | 169,085 | 76,079 | 24,436 | | | | 584,184 |
| MFG. | HOURS | | 413 | 6,663 | 6,766 | | | | | 13,842 |
| | LABOR $ | | 3,721 | 60,034 | 60,962 | | | | | 124,717 |
| | OVERHEAD $ | | 5,582 | 90,051 | 91,443 | | | | | 187,076 |
| TOOLING | HOURS | | 8,420 | 5,423 | | | | | | 13,843 |
| | LABOR $ | | 71,823 | 46,258 | | | | | | 118,081 |
| | OVERHEAD $ | | 107,735 | 69,387 | | | | | | 177,122 |
| Q&RA | HOURS | 265 | 794 | 2,012 | 2,233 | | | | | 5,304 |
| | LABOR $ | 2,843 | 8,520 | 21,589 | 23,960 | | | | | 56,912 |
| | OVERHEAD $ | 4,265 | 12,780 | 32,384 | 35,940 | | | | | 85,369 |
| TEST | HOURS | | 1,122 | | | | | | | 1,122 |
| | LABOR $ | | 11,770 | | | | | | | 11,770 |
| | OVERHEAD $ | | 17,655 | | | | | | | 17,655 |
| OTHER | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| TOTAL | HOURS | 9,638 | 22,489 | 25,446 | 14,105 | 1,640 | | | | 73,318 |
| | LABOR $ | 142,501 | 270,760 | 296,966 | 161,001 | 24,436 | | | | 895,664 |
| | OVERHEAD $ | 143,923 | 318,678 | 360,907 | 203,462 | 24,436 | | | | 1,051,406 |
| MATERIAL & SUBCON. | | 42,494 | 91,085 | 23,799 | 24,811 | | | | | 182,189 |
| MATERIAL OVERHEAD | | 2,125 | 4,554 | 1,190 | 1,241 | | | | | 9,110 |
| TRAVEL | | | | | | | | | | |
| OTHER | | 20,159 | 26,965 | 23,079 | 24,699 | 19,824 | | | | 114,726 |
| SUBTOTAL EST. COST | | 351,202 | 712,042 | 705,941 | 415,214 | 68,696 | | | | 2,253,095 |
| G & A EXPENSE | | 42,144 | 85,445 | 84,713 | 49,826 | 8,244 | | | | 270,372 |
| TOTAL EST. COST | | 393,346 | 797,487 | 790,654 | 465,040 | 76,940 | | | | 2,523,467 |
| GRAND TOTAL | | 393,346 | 797,487 | 790,654 | 465,040 | 76,940 | | | | 2,523,467 |

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DATE 19 NOV 77          PROJECT- PCX PROJECT                    DESIGN-TO-COST-FACTOR = 0.00          PAGE   21
WBS  1.9.3.1.4          TITLE- ORBITER INTERFACE STRUCTURES

| ELEMENTS OF COST | | FY - 81 | FY - 82 | FY - 83 | FY - 84 | FY - 85 | FY - 86 | FY - 87 | FY - 88 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| ENGR. | HOURS | 3,962 | 6,894 | 4,038 | 2,008 | 612 | | | | 17,514 |
| | LABOR $ | 59,034 | 102,721 | 60,166 | 29,919 | 9,119 | | | | 260,959 |
| | OVERHEAD $ | 59,034 | 102,721 | 60,166 | 29,919 | 9,119 | | | | 260,959 |
| MFG. | HOURS | | 118 | 2,181 | 1,931 | | | | | 4,230 |
| | LABOR $ | | 1,063 | 19,651 | 17,398 | | | | | 38,112 |
| | OVERHEAD $ | | 1,595 | 29,477 | 26,097 | | | | | 57,169 |
| TOOLING | HOURS | | 21,624 | 13,927 | | | | | | 35,551 |
| | LABOR $ | | 184,453 | 118,797 | | | | | | 303,250 |
| | OVERHEAD $ | | 276,680 | 178,196 | | | | | | 454,876 |
| Q&RA | HOURS | | 3,410 | 312 | | | | | | 3,722 |
| | LABOR $ | | 36,589 | 3,348 | | | | | | 39,937 |
| | OVERHEAD $ | | 54,884 | 5,022 | | | | | | 59,906 |
| TEST | HOURS | | 2,842 | | | | | | | 2,842 |
| | LABOR $ | | 29,813 | | | | | | | 29,813 |
| | OVERHEAD $ | | 44,720 | | | | | | | 44,720 |
| OTHER | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| TOTAL | HOURS | 3,962 | 34,888 | 20,458 | 3,939 | 612 | | | | 63,859 |
| | LABOR $ | 59,034 | 354,639 | 201,962 | 47,317 | 9,119 | | | | 672,071 |
| | OVERHEAD $ | 59,034 | 480,600 | 272,861 | 56,016 | 9,119 | | | | 877,630 |
| MATERIAL & SUBCON. | | 18,380 | 39,124 | 35,524 | 19,362 | | | | | 112,390 |
| MATERIAL OVERHEAD | | 919 | 1,956 | 1,776 | 968 | | | | | 5,619 |
| TRAVEL | | | | | | | | | | |
| OTHER | | 5,040 | 6,733 | 5,770 | 6,175 | 4,967 | | | | 28,685 |
| SUBTOTAL EST. COST | | 142,407 | 883,052 | 517,893 | 129,838 | 23,205 | | | | 1,696,395 |
| G & A EXPENSE | | 17,089 | 105,966 | 62,147 | 15,581 | 2,785 | | | | 203,568 |
| TOTAL EST. COST | | 159,496 | 989,018 | 580,040 | 145,419 | 25,990 | | | | 1,899,963 |
| GRAND TOTAL | | 159,496 | 989,018 | 580,040 | 145,419 | 25,990 | | | | 1,899,963 |

| ELEMENTS OF COST | | FY - 81 | FY - 82 | FY - 83 | FY - 84 | FY - 85 | FY - 86 | FY - 87 | FY - 88 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| ENGR. | HOURS | 2,215 | 1,847 | 2,299 | 490 | 392 | | | | 7,243 |
| | LABOR $ | 33,004 | 27,520 | 34,255 | 7,301 | 5,841 | | | | 107,921 |
| | OVERHEAD $ | 33,004 | 27,520 | 34,255 | 7,301 | 5,841 | | | | 107,921 |
| MFG. | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| TOOLING | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| Q&RA | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| TEST | HOURS | 980 | | | | | | | | 980 |
| | LABOR $ | 10,280 | | | | | | | | 10,280 |
| | OVERHEAD $ | 15,420 | | | | | | | | 15,420 |
| OTHER | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| TOTAL | HOURS | 3,195 | 1,847 | 2,299 | 490 | 392 | | | | 8,223 |
| | LABOR $ | 43,284 | 27,520 | 34,255 | 7,301 | 5,841 | | | | 118,201 |
| | OVERHEAD $ | 48,424 | 27,520 | 34,255 | 7,301 | 5,841 | | | | 123,341 |
| MATERIAL & SUBCON. | | 5,499 | 4,936 | 4,961 | | | | | | 15,396 |
| MATERIAL OVERHEAD | | 275 | 247 | 248 | | | | | | 770 |
| TRAVEL | | | | | | | | | | |
| OTHER | | 24,250 | 6,733 | 5,770 | 6,175 | 4,967 | | | | 47,895 |
| SUBTOTAL EST. COST | | 121,732 | 66,956 | 79,489 | 20,777 | 16,649 | | | | 305,603 |
| G & A EXPENSE | | 14,608 | 8,035 | 9,539 | 2,493 | 1,998 | | | | 36,673 |
| TOTAL EST. COST | | 136,340 | 74,991 | 89,028 | 23,270 | 18,647 | | | | 342,276 |
| GRAND TOTAL | | 136,340 | 74,991 | 89,028 | 23,270 | 18,647 | | | | 342,276 |

| ELEMENTS OF COST | | FY - 81 | FY - 82 | FY - 83 | FY - 84 | FY - 85 | FY - 86 | FY - 87 | FY - 88 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| ENGR. | HOURS | 19,817 | 23,479 | 27,186 | 16,309 | 6,884 | | | | 88,575 |
| | LABOR $ | 220,773 | 349,837 | 403,879 | 243,004 | 102,572 | | | | 1,320,065 |
| | OVERHEAD $ | 220,773 | 349,837 | 403,879 | 243,004 | 102,572 | | | | 1,320,065 |
| MFG. | HOURS | 123 | 1,976 | 2,007 | | | | | | 4,106 |
| | LABOR $ | 1,108 | 17,804 | 18,083 | | | | | | 36,995 |
| | OVERHEAD $ | 1,662 | 26,706 | 27,125 | | | | | | 55,493 |
| TOOLING | HOURS | 73 | 2,358 | 54 | | | | | | 2,485 |
| | LABOR $ | 623 | 20,114 | 461 | | | | | | 21,198 |
| | OVERHEAD $ | 935 | 30,171 | 692 | | | | | | 31,798 |
| Q&RA | HOURS | | | 243 | 703 | | | | | 946 |
| | LABOR $ | | | 2,607 | 7,543 | | | | | 10,150 |
| | OVERHEAD $ | | | 3,911 | 11,315 | | | | | 15,226 |
| TEST | HOURS | | | | | | | | | |
| | LABOR $ | | | | | | | | | |
| | OVERHEAD $ | | | | | | | | | |
| OTHER | HOURS | 392 | 392 | 392 | | | | | | 1,176 |
| | LABOR $ | 7,056 | 7,056 | 7,056 | | | | | | 21,168 |
| | OVERHEAD $ | 7,056 | 7,056 | 7,056 | | | | | | 21,168 |
| TOTAL | HOURS | 15,405 | 28,205 | 29,882 | 17,012 | 6,884 | | | | 97,388 |
| | LABOR $ | 229,560 | 374,811 | 432,086 | 250,547 | 102,572 | | | | 1,409,576 |
| | OVERHEAD $ | 230,426 | 413,770 | 442,663 | 254,319 | 102,572 | | | | 1,443,750 |
| MATERIAL & SUBCON. | | 27,199 | 30,518 | 5,582 | 443 | | | | | 63,242 |
| MATERIAL OVERHEAD | | 1,360 | 1,501 | 279 | 22 | | | | | 3,162 |
| TRAVEL | | 1,749 | 3,572 | 3,822 | 2,143 | 842 | | | | 12,128 |
| OTHER | | 30,495 | 36,668 | 27,563 | | | | | | 94,126 |
| SUBTOTAL EST. COST | | 520,789 | 879,740 | 911,995 | 507,474 | 205,986 | | | | 3,025,984 |
| G & A EXPENSE | | 62,495 | 105,569 | 109,439 | 60,897 | 24,718 | | | | 363,118 |
| TOTAL EST. COST | | 583,284 | 985,309 | 1,021,434 | 568,371 | 230,704 | | | | 3,389,102 |
| GRAND TOTAL | | 583,284 | 985,309 | 1,021,434 | 568,371 | 230,704 | | | | 3,389,102 |

DATE 19 NOV 77                    PROJECT- PCX PROJECT                        DESIGN-TO-COST-FACTOR = 0.00                PAGE    1
WBS  1                           TITLE-

                                              ESCALATION RATES

ELEMENTS OF COST    FY - 81      FY - 82      FY - 83      FY - 84      FY - 85      FY - 86      FY - 87      FY - 88

MATERIAL & SUBCON.   .000         .000         .000         .000         .000         .000         .000         .000

TRAVEL               .000         .000         .000         .000         .000         .000         .000         .000

OTHER                .000         .000         .000         .000         .000         .000         .000         .000

# APPENDIX C

# ERROR MESSAGES

## ERROR MESSAGES

| Error Code | Reason for Error | Correction |
|---|---|---|
| 01 | Invalid Transaction Type | Transaction Type Code must be a 10, 20, 30, 40 or 50. |
| 02 | Invalid Activity Code | Activity code on 20 card must be ENG, MFG, TLG, QRA, TST, OTH, MAT or GA. |
| 03 | Invalid Rate | Labor rate on 20 card must be numeric 99v99 (i.e., 12.50). |
| 04 | Invalid Overhead Rate | Overhead rate on 20 card must be numeric 999v9 (i.e., 130.0). |
| 05 | Invalid Fiscal Year | Fiscal year on 50 card must be numeric 2 digit (i.e., '77', '78' etc.). |
| 06 | Invalid WBS Number | WBS number on 40 & 50 card must be numeric with decimals (i.e. 1.5.2). |
| 07 | Invalid - Must be Numeric | Hours for each category on 50 card must be numeric. |
| 08 | Invalid Year | Years on 10 card must be numeric 4 digits(i.e. 1977, 1978, ect.) |
| 09 | Invalid WBS Title | Title must be present. |
| 10 | Invalid Category | Category on 30 card must be MAT, TRV or ODR. |
| 11 | Invalid Percentage Factor | Percentage factor on 30 card must be numeric numeric v999 (i.e., 0.020) |
| 12 | Invalid Fee Percentage | Contractor Fee % on 10 card must be numeric 2 digit. |
| 13 | Invalid D-T-C Factor | Design to cost factor on 10 card must be numeric 3 digits maximum. ex: 105 is 5% increase, 095 is 5% decrease. |

| Error Code | Reason for Error | Correction |
|---|---|---|
| 14 | More-than-1-Type 10 Card | Only one 10 card allowed. |
| 15 | Excessive Type 20 Card | Only eight type 20 cards allowed. |
| 16 | Duplicate Act Code on 20 Card | An Activity code can only be used once on 20 card. |
| 17 | Duplicate Act code on 30 Card | An Activity code can only be used once on 30 card. |
| 18 | Duplicate WBS Number | Duplicate WBS # with same FY are not allowed. |
| 19 | FY on 50 card out of range | Fiscal year on 50 card does not match years on 10 card. |

# APPENDIX D

# SENSITIVE RUN PROCEDURE

# PROCEDURES FOR PROCESSING SENSITIVE SEB
## JOBS BY COMPUTER SERVICES OFFICE

## PURPOSE

The following paragraphs establish responsibilities and outline procedures
for punching of input data and receipt, scheduling, processing, control and
disposition of computer jobs, program card decks, and printed materials
which pertain to sensitive SEB information processed through the Computer
Services Office.

## INPUT

Input data will be punched and controlled by the requesting activity.

## SCHEDULING COMPUTER TIME

The office requiring sensitive computer runs must contact Mr. C. L. Cozelos,
AH23, 453-3347, or Mr. J. T. Felder, AH21, 453-3341. An approximate
"Start Time" will be agreed upon for starting the sensitive run. In the event
that there is a priority problem, the requesting activity will contact Mr.
Clayton McGee, or Mr. John D. Gibbons, AH32, 453-4181, for establishment
of priority and definite "Start Time."

## DELIVERY TO COMPUTER

The requester will be responsible for the delivery of all necessary program
decks, data, and any other material required for processing of sensitive
material to the U-9300 remote terminal in Building 4610, Room 303. The
requester is to remain at the remote site until the completion of the sensitive
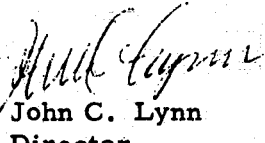run.

## COMPUTER PROCESSING

The requester, upon arrival at the U-9300 remote terminal, will inform the
operator that he has a sensitive run. The operator will place an opaque mask
over the printer. The operator will remain in the remote terminal room to
operate the U-9300 and assist the requester. The operator must not handle
the computer printout or otherwise read any of the sensitive data of information.
The operator will contact the central computer room and arrange to expedite
execution of the sensitive computer job. The mass storage files used in
processing of the sensitive run can only be accessed by the requester through
the use of read and write security keys which are changed by the requester
for each sensitive run. Upon completion of the job, all mass storage files

will be cleared by "FASCLR" and the requester is responsible for assuring that all input material, printouts, and printer ribbons are removed from the terminal area.

In case of emergency program debugging during a production run of sensitive material, contact Mr. Clayton McGee or Mr. John D. Gibbons, AH32, 453-4181, who will contact contractor programmer personnel for corrective action. All reproduction of sensitive outputs will be the responsibility of the requesting activity.

Storage and transportation of sensitive information will be the responsibility of the requesting activity.
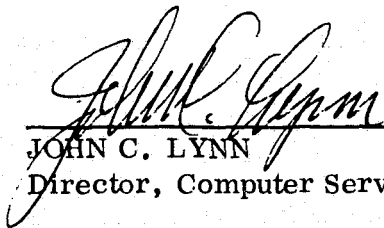
John C. Lynn
Director
Computer Services Office

# APPROVAL
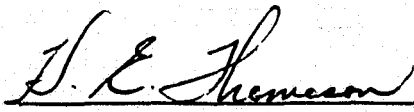
# PACE II

## PRICING AND COST ESTIMATING HANDBOOK

Prepared by
Systems Analysis and Integration Laboratory
and
Computer Services Office

The information in this report has been reviewed for security classifi-
cation. Review of any information concerning Department of Defense or Atomic
Energy Commission programs has been made by the MSFC Security Classifica-
tion Officer. This report, in its entirety, has been determined to be unclassi-
fied.

This document has also been reviewed and approved for technical
accuracy.


JOHN C. LYNN
Director, Computer Services Office


H. E. THOMASON
Director, Systems Analysis and Integration Laboratory