

Cost Benefit Analysis for Maintenance Optimization Change

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Cost Benefit Analysis for Maintenance Optimization

TR-107902

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REPORT SUMMARY

The ability to gauge the cost-effectiveness of maintenance tasks is of crucial importance in the increasingly competitive electric utility industry. This report describes a computerized cost benefit module (CBAM) that analyzes maintenance cost at the component, system, unit, and plant levels.

Background

As part of its on-going efforts in the area of preventive maintenance, EPRI has participated in the development of software tools to facilitate the implementation of advanced maintenance methodologies such as Streamlined Reliability Centered Maintenance (SRCM). This software is part of EPRI's Plant Maintenance Optimization (PMO, Target 54 in 1998, and 75 in 1999) development efforts for fossil power plants. The PMO mission is to lead the industry by developing and demonstrating products and services for improved utilization of power plant maintenance resources and increased profitability for generation business units.

Objective

To develop a software package that provides a systematic and quantitative process for estimating and accumulating the cost benefit of performing a modified set of preventive maintenance tasks in preference to the current preventive maintenance tasks.

Approach

The project team developed and tested the Cost Benefit Analysis Module as a user-friendly tool to guide utilities into making consistent cost benefit analyses for modifying a preventive/predictive maintenance program based on recommendations from an SRCM analysis.

Results

The CBAM is a versatile analysis package that allows the user to enter maintenance task data directly or to import data after performing Streamlined Reliability Centered Maintenance analyses. The user can define all of the costs associated with a particular piece of equipment:

-
- The cost of each existing preventive maintenance task
 - The cost of corrective maintenance
 - The cost of each recommended task

The user then assigns values to the factors that determine these costs such as labor, administration, materials, services, failure rates, preventive maintenance frequency, and replacement power. The CBAM uses these inputs to accumulate the cost benefits of alternative maintenance strategies

The CBAM software runs on any PC running under Windows™ 3.0 or higher. As is typical for Windows-based applications, "Copy" and "Paste" functions are available to ensure efficiency and consistency. A complete User's Manual for the CBAM software is included in an Appendix to this report.

EPRI Perspective

This software was originally developed to calculate cost benefits after performance SRCM analysis. However, the software can effectively perform cost calculations and compare maintenance options in a stand alone mode. CBAM can also import the results of SRCM analysis. It is expected that CBAM will be integrated into the SRCM workstation currently in development. Other EPRI work on SRCM is described in EPRI reports TR-106503, TR-105502, and TR-105582.

AP-107902

Interest Categories

Fossil steam plant O&M cost reduction

Keywords

Maintenance optimization
Cost benefit analysis
Software

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1

INTRODUCTION

In an increasingly competitive industry, an area that is of prime concern in minimizing costs is plant maintenance. As resources become more limited, it is crucial to accurately gauge the cost-effectiveness of maintenance tasks. It is vital, therefore, that a mechanism be established to systematically and quantitatively measure the cost benefit of performing a particular maintenance task over another. In the past, this type of comparison has been of a qualitative nature.

The overall objective of this project, therefore, has been to develop a computerized cost benefit model to analyze maintenance cost at varying operational levels (component, system, unit, plant). The Cost Benefit Analysis Module (CBAM) is intended to be a user-friendly tool to guide utilities into making intelligent and consistent cost benefit decisions. CBAM can be used as a "stand-alone" product or in conjunction with the Plant Maintenance Optimization (PMO) software used to perform Streamlined Reliability Centered Maintenance (SRCM) analysis. It is expected that CBAM will be integrated into the SRCM workstation currently under development.

2

DESCRIPTION AND CAPABILITIES

The Cost Benefit Analysis Module (CBAM) is a versatile analysis package that will allow the user to enter maintenance task data directly or to interface with the PMO software during or after performance of an SRCM analysis. The user will then have the capability to ultimately evaluate cost benefits in detail.

The CBAM provides the user with the capability of defining all of the costs associated with a particular piece of equipment:

- the cost of each existing PM task,
- the cost of corrective maintenance, and
- the cost of each recommended task.

The module allows the user to further define these costs by identifying and assigning values to the factors which are inherent to each of these costs. These include Labor, Administration, Materials, Services, Failure Rates, Preventive Maintenance Frequency, Replacement Power, and other miscellaneous costs. A more detailed description of these costs is provided in the Software Functional Specification and User's Manual in the Appendices.

After the user has defined the costs associated with the piece of equipment, the cost benefit is analyzed using a single formula:

$$\text{\$TASK} = (\text{CM} + \text{RP}) \text{FF} + (\text{PM} + \text{RP}) \text{FP} + \text{NRC} / \text{RL}$$

where:

$\text{\$TASK}$ = cost (\$) for a particular maintenance task.

CM = corrective maintenance costs when failure occurs.

RP = replacement power costs (due to unit off-line or curtailment—for CM or PM).

Description and Capabilities

- FF = expected failure frequency per year (one value for case with no preventive maintenance, one for case with existing maintenance program, and one value for case with recommended maintenance program.
- PM = preventive/predictive maintenance costs (all elements) of each task.
- FP = frequency of PM per year.
- NRC = one-time, non-recurring costs to implement optimized maintenance program.
- RL = remaining (planned) life of plant (years).

As analysis is repeated for similar types of equipment, it is reasonable to expect that costs would be the same, or similar. Therefore, as is typical for a Windows-based application, "Copy" and "Paste" functions are available to ensure efficiency and consistency. The User's Manual included in Appendix B identifies and explains these and other program functions, as well as examples of the Menu screens.

3

CONCLUSION

The CBAM has been tested by the developer, EPRI, and an outside consultant. Though no utility has applied the software at this time, the testing performed has demonstrated that the program can be utilized effectively to perform cost calculations and in making informed cost decisions. Whether used stand alone or in conjunction with the PMO SRCM analysis software, the CBAM provides a quantitative element in the maintenance decision-making process.

A

SOFTWARE FUNCTIONAL SPECIFICATION

Section 1 **Introduction**

Large efforts are made to improve maintenance programs at power plants. A major influence driving these efforts is the pressure to reduce costs. Most of the present programs for improved maintenance do not calculate the costs of maintenance tasks that would allow a better comparison between existing tasks and recommended tasks. This is not to say that cost benefit decisions have been totally lacking in cost details. Most decisions are made on qualitative cost benefit analyses.

This project is intended to fill a need for improving cost benefit analysis of decision making in optimizing maintenance programs by providing a computerized cost benefit model. The model will allow the evaluation of cost at various levels (e.g., component, system, unit, plant). The model is intended to be user friendly and provide intelligent choices about costs that will lead to consistent cost benefit analyses.

The model is also intended to be compatible with PMO SRCM analysis software, to allow data input about maintenance analyses already completed.

Section 2 **Functional Requirements**

In order to describe what the Cost Benefit Analysis Module (CBAM) is supposed to do, it is necessary to first provide a general description of its intended functions. This section provides a brief description of the functions of the CBAM that will familiarize the developer with the overall expectations of the CBAM. The module developer will provide the functions as described in this section.

2.1 *Interface with Other Programs*

The CBAM will provide the capability to access, edit, create, view, and print input data from the PMO SRCM analysis. This will allow the user to utilize the CBAM during or after PMO SRCM analysis.

2.2 Direct Data Entry

The CBAM will provide the capability of direct entry of data to allow use of the CBAM without input from a PMO analysis. This direct input will utilize a data entry screen.

2.3 Task Option Comparison

The CBAM will have the capability to analyze the costs between two or more maintenance tasks. This will allow the user to use cost benefit analysis in the decision process for choosing between recommended maintenance tasks. The CBAM will allow the user to “save” the maintenance task cost of the chosen option for use in the total cost calculations.

2.4 Total Cost Calculations

The CBAM will have the capability to total all the maintenance costs by component, system, or plant. This total will be available for existing maintenance tasks, recommended maintenance tasks, or corrective maintenance tasks only (no preventive maintenance). The CBAM will also provide the net difference, or delta, between existing and recommended PM programs. Note that the total costs include the cost of CM's.

For example, for a single component, the total existing PM cost would consist of adding all the individual existing tasks and “existing” CM costs. The total recommended PM cost would be the total of all final task costs. The comparison would then provide a net difference between the existing and recommended tasks. This would be shown as either plus or minus in relation to the existing PM costs.

2.5 Future Costs

The CBAM will have the capability to escalate maintenance costs for determination of future costs. This will allow accounting for escalation factors for labor, materials, and replacement power costs

2.6 Escalation Factors

The CBAM will allow the user to define the escalation factors used in future cost determination.

2.7 Hazardous Waste

The CBAM will allow the calculation and reporting of total annual hazardous wastes (e.g. oils, greases, etc.) produced as a result of the maintenance programs—CM only, existing tasks, or recommended tasks. This will then allow reporting of any increases or decreases of these materials.

2.8 Standardized Values

The CBAM will have the capability to allow the user to input a set of values that will be used throughout the analysis. This will mean that the user only has to enter the various labor rates, material costs, and replacement power costs (rate) one time. The CBAM will then use these rates, where necessary, to calculate maintenance costs and only require the user to enter the time (hrs.) to do each task.

As an option, the user will have the ability to enter fixed maintenance costs, prevention or corrective, if known.

2.9 Storage

The CBAM will have the capability to store an entire cost benefit analysis. This will allow the user to make comparisons at different times for optimizing maintenance costs as feedback is obtained from plant history and evolving technologies.

2.10 Reporting

The CBAM will have the capability of producing various reports. These will include, at a minimum; (1) Total cost comparison by system or plant showing total costs for the existing PM program and for the recommended PM program, with the total difference (or delta) shown, also; (2) Individual component task costs for the existing and recommended PM programs; (3) System data such as labor rates, material costs, escalation factors, etc.; (4) Non-recurring costs per component; and (5) Hazardous material totals per system and plant, including the net change between existing and recommended PM programs.

Section 3

Future Customization Capabilities

The CBAM will be developed in a structured modular form to allow future changes and features to be implemented with minimal difficulty. Future capabilities may include additional modules for special calculations that would determine differences in

maintenance costs due to a new technological development, or access to other databases for input of maintenance tasks.

Section 4

Basic Cost Benefit Analysis Algorithm

The CBAM will be designed around a single formula to simplify the overall process and improve understanding by the user. The basic formula is given below.

$$\$_{TASK} = (CM+RP) FF + (PM+RP) FP + NRC/RL$$

where:

$\$_{TASK}$ $\equiv$ cost (\$) for a particular maintenance task.

CM $\equiv$ corrective maintenance costs when failure occurs.

RP $\equiv$ replacement power costs (due to unit off-line or curtailment—for CM or PM).

FF $\equiv$ expected failure frequency per year (one value for case with no preventive maintenance, one for case with existing maintenance program, and one value for case with recommended maintenance program).

PM $\equiv$ preventive/predictive maintenance costs (all elements) of each task.

FP $\equiv$ frequency of PM per year.

NRC $\equiv$ one-time, non-recurring costs to implement optimized maintenance program.

RL $\equiv$ remaining (planned) life of plant (years).

Note: All costs will be calculated on an annual basis to simplify comparisons.

Section 5

Cost Benefit Analysis Module

The general idea for the layout of the computer screen to perform cost benefit calculations will be structured around the basic algorithm. That is, the basic algorithm will be made into a working screen with “buttons” for each of the formula elements.

As an example, the “ $\$_{TASK}$ ” will be a button that when pushed “pulls-down” a screen to allow the user to enter the component number and task number / description for which

the calculation is being made. Similarly with “CM”, when pushed, “pulls-down” a screen to enter appropriate information on CM costs.

See Section 8 for example screens.

Section 6

Elements of Cost Benefit Calculation

The various elements included in the basic algorithm (formula) are discussed in this section. Included in this section are the definitions of these elements as well as the proposed capabilities of the CBAM for handling these elements.

It should be noted here that the cost benefit calculation will be performed for *each* task identified. Costs for a component, system, or plant will then be the combination of individual task costs as appropriate.

6.1 Maintenance Costs Elements

The maintenance task costs (CM or PM) will be determined either from a fixed amount entered by the user or calculated from its elements with certain values input by the user. These elements will consist of the following:

L = Labor Costs: based on fixed labor rate, times the man-hours to do the maintenance. Labor costs can be defined by the user to include separate amounts for craft personnel, engineering personnel, operations personnel, etc. Labor categories and rates are from a look-up list previously entered by the user-to be used as fixed rates for all calculations.

A = Administrative Costs: based on estimated costs, per task, for planning / scheduling, special work permits, system tag-out (clearance) etc. This could also be developed as a look-up list, as they are determined, for use in other calculations.

M = Material Costs: based on estimated (or known) costs for materials needed for maintenance. This information will be selected from a look-up list for material costs previously entered by the user, to be used as fixed values for all cost calculations.

SS = Special Services Costs: based on estimated (or known) costs of special services required to perform a task. These could include such items as scaffolding needs, outside special analysis (e.g., lube oil), outsourced maintenance (e.g., vendor

rebuilt), etc. This could also be developed as a look-up list, as they are determined, for use in other calculations.

FA = Fixed amount for maintenance task: based on knowledge of costs for routine, recurring tasks as well as CM performed at a facility. This could also be developed as a look-up list for use in other calculations.

6.2 Failure Frequency

Corrective maintenance costs are calculated as costs to perform a CM task. However, to determine overall costs of maintenance tasks, it is necessary to add a factor that accounts for the changing chance of failure due to different maintenance programs. For example, it is easily understood that without any preventive/predictive maintenance, there is some chance that a component is going to fail. For example, it could be expected that a failure occurs once in three years. Then, on an annual basis, the CM cost would be 1/3 the total CM cost.

For varying PM programs, it can also be seen that this chance of failure would change. Therefore, CM costs, on an annual basis, would change also. For example, the CM failure frequency may be one in five years with no PMs, and one in ten years with PMs. This change in the CM FF would affect the total maintenance costs and needs to be accounted for to provide appropriate total costs of various PM programs.

This factor, FF in the basic formula, is intended to account for these CM cost changes with varying PM programs. It is a term that is probably very difficult to determine, but should be used if known. It could at least be chosen from standard failure frequency information, such as, IEEE-500.

6.3 Frequency of PM Per Year

The PM costs are adjusted to an annual value by multiplying the PM task costs by the number of times the PM is performed in a year. For example, if the task is performed every 6 months, this value (FP in the basic formula) would be "2". If the task is performed once every three years, FP would be "0.33". These values would be available in a pull-down list that would include the task frequencies used at a particular facility.

6.4 Replacement Power

An additional cost that may need to be accounted for is Replacement Power (RP) costs. RP costs may be incurred for CM's or PM's. RP cost is calculated using the following formula:

$RP = (\text{Replacement Power Cost per hr.}) \times (\text{Expected curtailment time per failure or PM hrs.}) \times (\text{Curtailment Reduction})$

Curtailment reduction $\equiv 1 = 0\%$ power after failure or PM

.9 = 10% etc.

6.5 Non-Recurring Costs

For any change in the maintenance program there are certain one-time costs that occur. These costs need to be accounted for when determining total maintenance costs. These costs include the following examples:

For each component:

DC $\equiv$ Cost of design changes.

I $\equiv$ Cost of implementing maintenance task changes.

NT $\equiv$ Cost of new technology (e.g. condition monitoring equipment).

T $\equiv$ Cost of training for new tasks / equipment.

W $\equiv$ Cost of warehouse stocking to support new maintenance program

(note that this may be a net negative value for a new program).

The above costs are expected to be made as one-time, non-recurring costs and should then be annualized by dividing by the remaining plant life (RL) in years.

The cost of a PMO analysis will be utilized for determining total system (and plant) costs. This will be done by taking the PMO cost for a system analysis, dividing by the remaining plant life (RL) and adding this value to the total system cost for each system analyzed by PMO.

Section 7 Additional Capabilities

The CBAM, being directly related to individual maintenance tasks, provides a convenient place to maintain information on hazardous consumable materials such as oil, solvent, or paint. This is information that has considerable value for environmental impact analysis.

Therefore, for each task calculation, there will be a place for entering the type and amount of hazardous materials used, resulting in hazardous waste. This information will then be totaled along with maintenance costs by component, system, or plant. As with costs, the hazardous waste amounts will be annualized for consistent comparison.

Section 8 Software Functional Specification

Example Screens:

MAIN SCREEN (FOR EACH COMPONENT)

Comp ID			
<u>Existing Tasks:</u>	<u>Cost*:</u>	<u>Recommended Action:</u>	<u>Recommended Tasks:</u>
Task			
			Task
Total Existing Costs		Total Recommended Cost	
Net Effect (Difference)			

* "Clicking on "Cost" button pulls down CALCULATION SCREEN. After cost is calculated, value shows in "Cost" button.

Example Screens:
CALCULATION SCREEN

Component ID		
Task Number		
Frequency		Recommended Action
Description		
Cost (\$)		(Cost (\$)) will be shown after "\$ _{TASK} " is calculated.

$$\$_{TASK} = \left(\boxed{CM} + \boxed{RP} \right) \cdot \boxed{FF} + \left(\boxed{PM} + \boxed{RP} \right) \cdot \boxed{FP} + \left(\boxed{NRC} / \boxed{RL} \right)$$

"Clicking" on one of the formula buttons will pull down a screen for data entry.

"Double Clicking" in the "Component I.D." or "Task Number" boxes will provide a list of components and tasks in the analysis, or allow entry of this information.

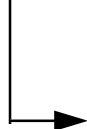
Screen action will be developed to also allow manipulation with the keyboard - left/right/up/down arrows will highlight boxes or buttons, then ENTER will pull down detailed screen. Ctrl "L" will provide lookup lists for highlighted boxes.

Example Screens:

PULL DOWN: \$_{TASK}

Component ID		
Task Number		
Frequency		Recommended Action
Description		
Cost (\$)		(Cost (\$)) will be shown after "\$ _{TASK} " is calculated.

$$\$_{TASK} = ((CM + RP) \cdot FF) + ((PM + RP) \cdot FP) + ((NRC / RL))$$



Component ID:

Task Number:

Description:

Cost (\$):

Consumables:

Paint		gal.
Solvent		gal.
Oil		gal.



This information can be entered here and will be displayed above, or it can be entered above, or it can be entered through Analysis Data screens or direct input from PMO (compare). For existing tasks, the Task Number and Description will be filled in. For recommended tasks, only the Description will be filled in.

Example Screens:

PULL DOWN: CORRECTIVE MAINTENANCE (CM)

Component ID

Task Number

Frequency Recommended Action

Description

Cost (\$) (Cost (\$) will be shown after "\$_{TASK}" is calculated.

$$\$_{TASK} = ((CM + RP) \cdot FF) + ((PM + RP) \cdot FP) + ((NRC / RL))$$

Corrective Maintenance (CM)

Fixed CM Cost (\$)

Labor Cost

Materials Cost

Administrative Cost

Special Services Cost

Frequency of Maintenance*

Task Number

Frequency (per year)

*This may be entered through Analysis Data screens

Labor Cost

	<u>Rate*</u>	<u>Hrs</u>
Craft		
Engineering		
Operator		

*One time entry - will be entered through Analysis Data screens

NOTE: Similar input will be made for PM pull-down.

Example Screens:

PULL DOWN: REPLACEMENT POWER (RP)

Component ID		
Task Number		
Frequency		Recommended Action
Description		
Cost (\$)		(Cost (\$)) will be shown after "\$ _{TASK} " is calculated.

$$\$_{TASK} = ((CM + RP) \cdot FF) + ((PM + RP) \cdot FP) + ((NRC / RL))$$



Replacement Power

Cost per hr.*	
Downtime (hrs.)	
Curtailment (% power after failure)	

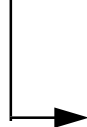
*One time entry - will be entered through Analysis Data screens.

Example Screens:

PULL DOWN: FAILURE FREQUENCY

Component ID		
Task Number		
Frequency		Recommended Action
Description		
Cost (\$)		(Cost (\$)) will be shown after "\$ _{TASK} " is calculated.

$$\$_{TASK} = ((CM + RP) \cdot FF) + ((PM + RP) \cdot FP) + ((NRC / RL))$$



Failure Frequency
(per year)

CM only	
Old PM Program	
New PM Program	

Example Screens:

PULL DOWN: NON-RECURRING COSTS/REMAINING LIFE

Component ID

Task Number

Frequency Recommended Action

Description

Cost (\$) (Cost (\$) will be shown after "\$_{TASK}" is calculated.

$$\$_{TASK} = ((CM + RP) \cdot FF) + ((PM + RP) \cdot FP) + ((NRC / RL))$$

Non-Recurring Costs

PMO - \$PMO per System*	
DC - Design Change Cost	
I - Cost to Change PM Program	
NT - New Technology Cost	
T - New Training Cost	
W - Warehouse Stocking Cost	

*This value is only used at system level. Other values used at component level.

Remaining Life (yrs)*

*One time entry - will be entered through Analysis Data screen.

Example Screens:
ANALYSIS DATA

Component Data

Component ID	
Task Number	
Description	

Labor Data

Labor Rates (\$/Hr)

Craft	
Engineering	
Operations	

Materials/Parts Data

Parts Description	Cost (\$)

Example Screens:

ANALYSIS DATA

Administrative Data

Planning/Scheduling		(\$/hr.)
Special Work Permit		(\$)

Special Services

Scaffolding		(\$)
Lube Oil Analysis		(\$)
Valve Operator Rebuild		(\$)

Non-Recurring Costs

Remaining Life		(yrs)
PMO cost (per system)		(\$)
DC cost (per component)		(\$)
Implementation (I) cost (per component)		(\$)
New Technology (NT) cost (per component)		(\$)
New Training (T) cost (per component)		(\$)
Warehouse (W) stocking cost (per component)		(\$)

Task Frequency (FP)

Task Number		Frequency		(per yr)

Example Screens:
 ESCALATION FACTORS

	Year									
	1	2	3	4	5	6	7	8	9	10
Labor										
Material										
Replacement Power										

Example Screens:
COST COMPARISON - TASK OPTIONS

Comp ID

PM Task A:

Description

Frequency (per year)

Cost* (\$)

PM Task B:

Description

Frequency (per year)

Cost* (\$)

PM Task C:

Description

Frequency (per year)

Cost* (\$)

Embedded in this cost is CM cost.

Example Screens:

TOTAL COST COMPARISON - COMPONENT

Comp ID Year # Existing PM Tasks:

Task		Cost*	

Total Existing Costs Recommended PM Tasks:

Task		Cost*	

Total Recommended Costs

Net Effect (Difference)

*Embedded in this cost is CM cost.

This comparison requires the costs for all existing PM program elements - or only CM if that is the case (basic formula provides for this case). The recommended PM costs requires the costs for all final PM program tasks even for retained tasks, in order to account for all costs. A new (ADD) task cost will take into account changes in CM costs that are intended to be realized, particularly useful for cases where there were originally no PMs (only CM costs). Costs for modified tasks will also account for changes in CM costs.

Example Screens:

TOTAL COST COMPARISON - SYSTEM

System Name

Year #

Existing PM Tasks:

Total Cost*

Recommended PM Tasks:

Total Cost*

Net Effect (Difference)

NOTE: Cost reporting will be available as presetn value or future worth, etc., options selectable by user.

*Total costs are roll-ups of individual component costs.

B

COST BENEFIT ANALYSIS MODULE: USER'S QUICK REFERENCE

SECTION 1

INTRODUCTION

The purpose of this document is to provide the user with a quick reference on how to use the Cost Benefit Analysis Module program.

OVERVIEW

The purpose of the Cost Benefit Analysis Module (CBAM) program is to provide a tool that will assist in the effort to develop improved maintenance programs that are cost effective. It will allow the cost of maintenance tasks to be broken down so that the cost benefits may be evaluated at a detail level.

The following capabilities are provided:

- Import data from PMO for analysis of existing studies
- Direct data input to allow independent analysis
- Comparison of existing PM costs, the costs of a recommended program and the costs of corrective maintenance.
- Total cost comparisons by component and system
- Tracking of consumables (e.g., oil, paint, solvents)
- Cost analysis archiving to allow comparisons of cost analysis histories

A common menu bar will appear on all screens (except Welcome screen) and will allow you to select the processing to be performed. The common toolbar is available on all forms and the print toolbar is available on all reports.

PRODUCT GRADE

CBAM is a research grade product. The primary purpose of the application is to present a technology for users to consider as a methodology for maintenance cost benefit analysis. The application is not intended for use in a critical analysis or study. If the user does apply the application for this purpose, he should independently verify the results.

SECTION 2

GETTING STARTED

Each user should install their own copy of the Cost Benefit Analysis Module software. The software attaches to the individual system data files and conflicts could occur if multiple users attempt to change the attachments while sharing the software. The system data files, however, may be shared by multiple users. The installation process and example screens in this manual model assume the user is in a Windows 3.1 environment with VGA monitor resolution at 640x480.

The general format of this manual uses **bold** for text buttons or icons, ***bold italics*** for menu options, *italics* for references to title bar screens and quotes for input by users. This scheme does not apply to section titles in this manual.

SYSTEM REQUIREMENTS

CBAM has the following system requirements:

- 486/33 Mhz (or greater) Personal Computer (Pentium recommended)
- 16 Mbyte RAM (32 recommended)
- 15 Mbyte hard drive space available
- Windows 3.1 operating system
- VGA compatible monitor

CBAM may also operate in Windows 95 (based on its Windows 3.1 functionality). This research grade product's operation in Windows 95 is not assured.

INSTALLATION

The Cost Benefit Analysis Module software is compressed onto four installation disks. The installation procedure will decompress the software and create a program group and icon for running the software.

To install the Cost Benefit Analysis Module program perform the following steps:

1. Insert installation disk 1 into drive A: (or B:)
2. Run "A:SETUP.EXE" from either the Windows Program Manager (select **Run ...** from the **File** menu) or File Manager (double click on setup.exe). {For Windows 95, press the **Start** button and select **Run...** and then enter "A:\setup.exe".} You will be able to exit the setup procedure without completing the installation at any time before the decompression process begins.
3. The *Welcome* screen will suggest that you close any applications that you may have running. If you have no applications running then press the **OK** button to continue. You may press the **Exit Setup** button to end the setup procedure without completing the installation. The **Help** button will explain how to close other applications without exiting from the setup procedure.
4. The setup procedure will then prompt you for the directory that you want to use for the software. If you do not want to install into the suggested directory then press the **Change Directory** button to select another directory. For this research grade product, select the default directory. If the directory you specify does not exist then it will be created. Press the **OK** button to accept the directory displayed.
5. To complete the installation preparation, press the large **Complete** button. You may still change the installation directory before pressing this button.
6. The setup will prompt you for the program group you want to use for the software. If the group you specify does not already exist then it will be created.
7. Press the **Continue** button. The installation procedure will then install the software into the specified installation directory and create or update your program group with the Cost Benefit Analysis Module icon. The installation procedure prompts for other disks as needed. Simply replace the disk in the drive with the requested disk.

8. When the decompression is complete, a message box will pop up. It will either indicate that Windows will be restarted or that the installation is complete. This depends on the DLLs on your system prior to installation. If it is the former (restart) then press the **Continue** button to restart the computer to complete the installation process. If it is the later (installation complete) press the **OK** button to complete the installation process.
9. You may now start the software by double clicking on the **Cost Benefit Analysis Module** icon in the program group created during installation. {For Windows 95, press **Start**, select the *Cost Benefit Analysis Module* Folder and then click the *Cost Benefit Analysis Module* program.}

SECTION 3

PROGRAM NAVIGATION

The Cost Benefit Analysis Module program is menu driven. A common menu bar appears on all screens (except Welcome screen) that allows you to select the processing to be performed.

COMMON MENU BAR

The common menu bar will allow you to select the processing to be performed. You can access all functionality of the Cost Benefit Analysis Module program from the common menu bar.

If no plant/system has been selected yet then the common menu bar will contain the menus and menu items listed below. The menu items currently not available are grayed out. For example *Undo*, *Undo Current record* and *Paste* menu items are not available until the user makes some change to the record.

File

- | | |
|---------------------------|------------------------------|
| <i>Close</i> | - Close current form. |
| <i>Save Record</i> | - Force current record save. |

Edit

- | | |
|------------------------------------|--|
| <i>Undo (or Can't Undo)</i> | - Undo last change. |
| <i>Undo Current Field</i> | - Undo all changes to current field. |
| <i>Cut</i> | - Cut highlighted data to the clipboard. |
| <i>Copy</i> | - Copy highlighted data to the clipboard. |
| <i>Paste</i> | - Paste data from the clipboard. |
| <i>Delete</i> | - Delete highlighted data. |
| <i>Select Record</i> | - Select current record. |
| <i>Select All Records</i> | - Select all records in the record set. |
| <i>Find</i> | - Search for specific data in a field. |
| <i>Replace</i> | - Search for specific data in a field and replace with specified data. |

Records

<i>Go To</i>	- Go to record.
<i>First</i>	- The cursor goes to the first record in the record set.
<i>Last</i>	- The cursor goes to the last record in the record set.
<i>Next</i>	- The cursor goes to the next record in the record set.
<i>Previous</i>	- The cursor goes to the previous record in the record set .
<i>New</i>	- Add a new record. Only available on data entry screens where a new record may be added
<i>Refresh</i>	- Refresh data on screen.
<i>Quick Sort</i>	
<i>Ascending</i>	- Sort the current record set by the current field in ascending order.
<i>Descending</i>	- Sort the current record set by the current field in descending order.
<i>Edit Filter/Sort</i>	- Define a subset of the record set.
<i>Apply Filter/Sort</i>	- Apply a filter to select a subset of the current record set.
<i>Show All Records</i>	- Display all records in the current record set.

Once a plant/system has been selected then the common menu bar will contain the menus and menu items listed below.

File

- | | |
|-------------------------------|--|
| <i>Plant/System Selection</i> | - Select a plant/system to analyze. |
| <i>Close</i> | - Close current form. |
| <i>Save Record</i> | - Force current record save. |
| <i>Print Setup</i> | - Define print setup. |
| <i>Print Preview</i> | - Preview screen print or report. |
| <i>Print</i> | - Print screen or report. |
| <i>Exit</i> | - Exit Cost Benefit Analysis Module and return to Windows. |

Edit

- | | |
|-----------------------------|--|
| <i>Undo (or Can't Undo)</i> | - Undo last change. |
| <i>Undo Current Field</i> | - Undo all changes to current field. |
| <i>Cut</i> | - Cut highlighted data to the clipboard. |
| <i>Copy</i> | - Copy highlighted data to the clipboard. |
| <i>Paste</i> | - Paste data from the clipboard. |
| <i>Delete</i> | - Delete highlighted data. |
| <i>Select Record</i> | - Select current record. |
| <i>Select All Records</i> | - Select all records in the record set. |
| <i>Find</i> | - Search for specific data in a field. |
| <i>Replace</i> | - Search for specific data in a field and replace with specified data. |

Records

- | | |
|---------------------------------|---|
| <i>Go To</i> | - Go to record. |
| <i>First</i> | - The cursor goes to the first record in the record set. |
| <i>Last</i> | - The cursor goes to the last record in the record set. |
| <i>Next</i> | - The cursor goes to the next record in the record set. |
| <i>Previous</i> | - The cursor goes to the previous record on the record set. |
| <i>New</i> | - Add a new record. Only available on data entry screens where a new record may be added. |
| <i>Refresh</i> | - Refresh data on screen. |
| <i>Quick Sort</i> | |
| <i>Ascending</i> | - Sort the current record set by the current field in ascending order. |
| <i>Descending</i> | - Sort the current record set by the current field in descending order. |
| <i>Edit Filter/Sort</i> | - Define a subset of the record set. |
| <i>Apply Filter/Sort</i> | - Apply a filter to select a subset of the current record set. |
| <i>Show All Records</i> | - Display all records in the current record set. |

Data Entry

- | | |
|-------------------------------------|---|
| <i>Category Element Data</i> | - Define category element data. |
| <i>Component List</i> | - Define the component master list. |
| <i>Task Comparison</i> | - Define the existing PM and recommended tasks. |

System Totals

- | | |
|--|---|
| <i>System Cost Totals</i> | - View current cost analysis system cost totals. |
| <i>System Totals Archive</i> | - Create an archive of the current cost analysis. |
| <i>System Consumable Totals</i> | - View current cost analysis consumable totals. |

Reports

<i>Cost Category Elements</i>	- Print cost category element master list.
<i>Component List</i>	- Print component master list.
<i>Task Comparison</i>	- Print existing PM program and recommended tasks comparison list.
<i>Task Cost Summary</i>	- Print task cost comparison breakdown summary.
<i>Task Cost Breakdown</i>	- Print task cost comparison breakdown including task cost element details.
<i>System Equation Factor Totals</i>	- Print system totals breakdown by cost factors.

Import

<i>Import Component List (COMPONEN.DBF)</i>	- Import the component list from an existing PMO study.
<i>Import Task Comparison (COMPARE.DBF)</i>	- Import the task comparison from an existing PMO study.

COMMON TOOLBAR

The common toolbar provides you with quick mouse access to commands that can assist you with entering or viewing data on screens. Figure B-1 shows the common toolbar.

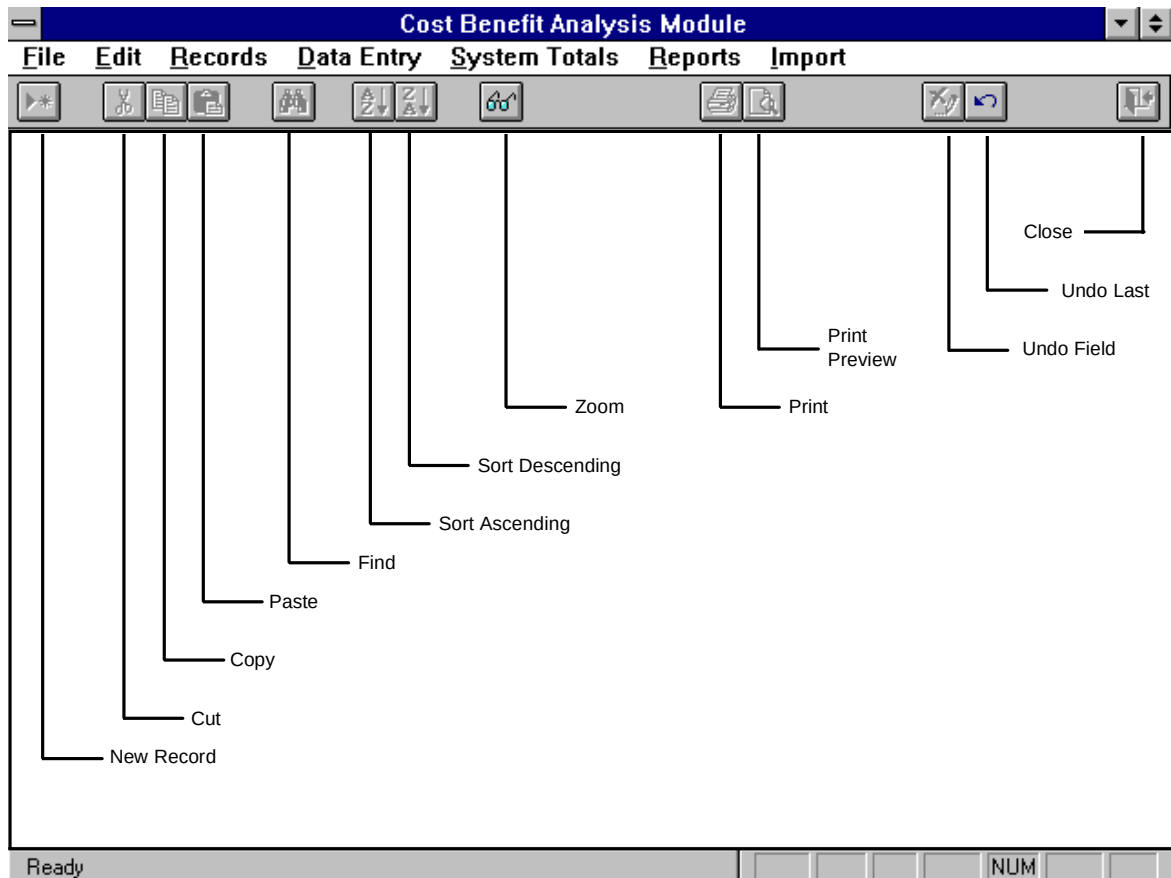


Figure B-1
Common Toolbar

The common toolbar buttons provide the following commands:

New Record - Add a new record.

Cut - Cut highlighted data to the clipboard.

Copy - Copy highlighted data to the clipboard.

Paste	- Paste data from the clipboard.
Find	- Search for specific data in a field.
Sort Ascending	- Sort the current record set by the current field in ascending order.
Sort Descending	- Sort the current record set by the current field in descending order.
Zoom	- Pop up zoom window to view entire contents of current field.
Print	- Print all screens for this form.
Print Preview	- Preview screen print.
Undo Record	- Undo all changes to current record.
Undo Last	- Undo last change.
Close	- Close the current active screen.

PRINT VIEW TOOLBAR

The print view toolbar provides you with quick mouse access to commands that can assist you with printing reports. Figure B-2 shows the print view toolbar. This toolbar is available only after you select the reports option from the common menu and run one of the reports.

The print view toolbar buttons provide the following commands:

Zoom - Toggle between large and small preview views.

Print - Print report.

Print Setup - Define print setup.

Close - Close the current report.

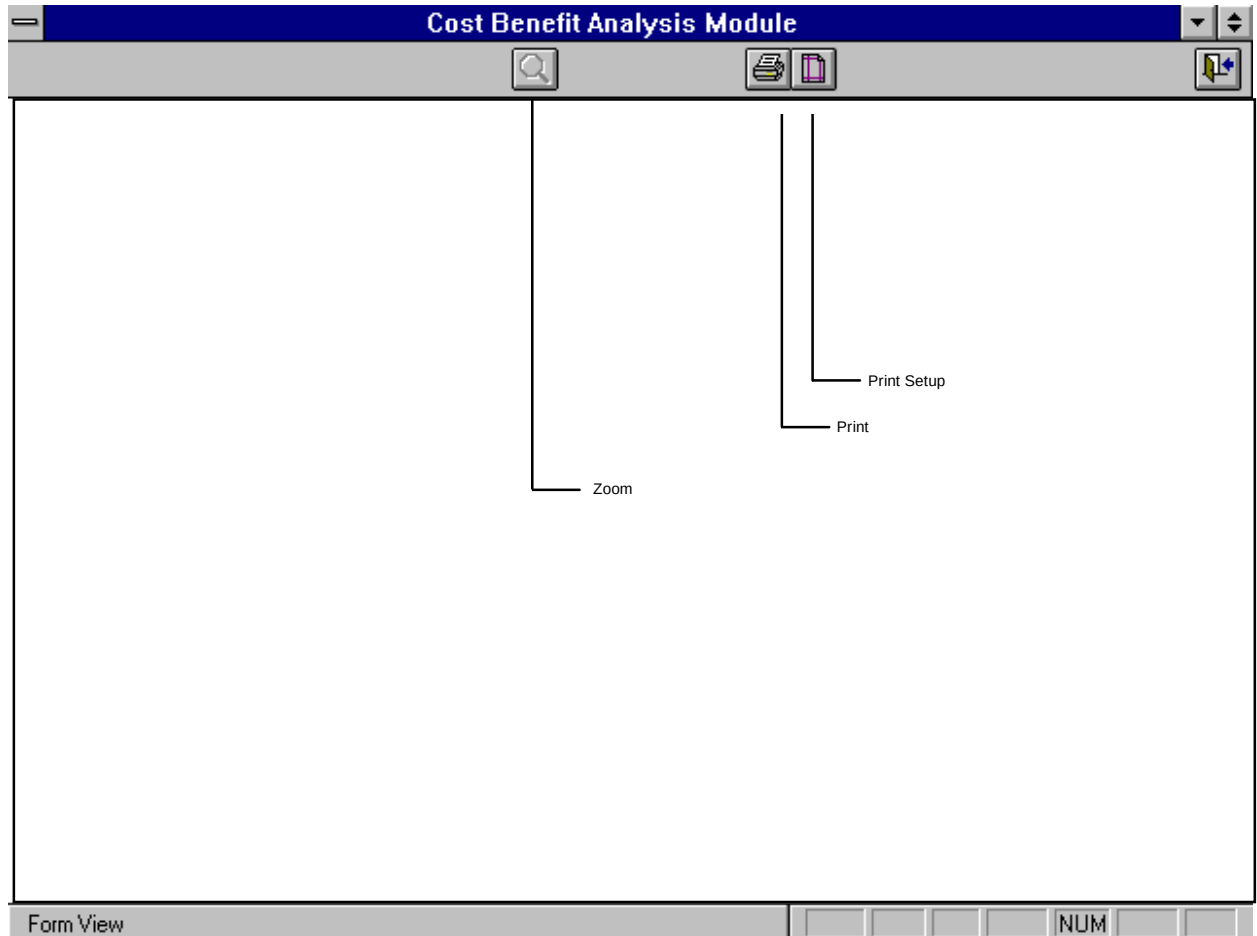


Figure B-2
Print View Toolbar

USING THE PROGRAM FUNCTIONS

Once you have selected the Plant/System to analyze you will be able to select any of the program's functions from the common menu bar.

GETTING STARTED

To start the Cost Benefit Analysis Module program , double click on the **Cost Benefit Analysis Module** icon in the Cost Benefit Analysis Module program group. The first screen to be displayed when the Cost Module Benefit Analysis Module program is started is the banner *Welcome* screen presented in Figure B-3.

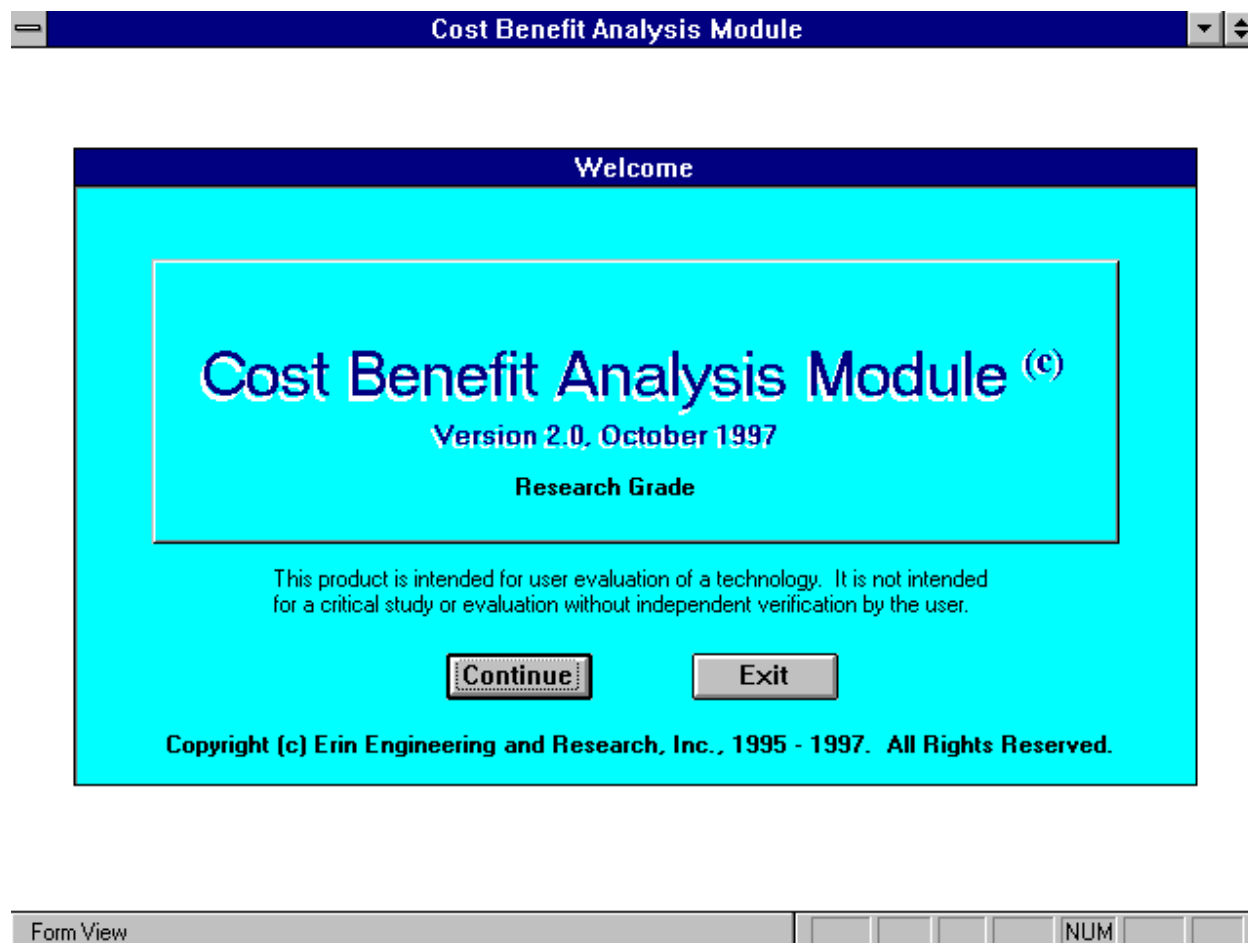


Figure B-3
Welcome Screen

To perform cost analysis functions, press the **Continue** button. No Cost Benefit Analysis functions are available until the **Continue** button has been pressed. Pressing the **Continue** button enters the application and displays the *Plant/System Selection Menu*. To exit the program and return to Windows, press the **Exit** button and at the *Exit Cost Benefit Analysis Model* Screen select the **OK** button.

PLANT/UNIT SELECTION

The *Plant/System Selection Menu* is illustrated in Figure B-4. The common tool bar across the top of the screen allows you to select other processing you may want to perform. These functions are described in section 3.2. The status bar on the lower part of the screen indicates the active field or command and the status of CAPS LOCK, NUM LOCK and SCROLL LOCK keys.

The *Plant/System Selection Menu* screen allows you to add, modify or delete plant and system entries, as well as select the plant and system for subsequent processing.

Plant ID	Plant Name	System ID	System Name	Data File Location
CR4	CRYSTAL RIVER UNIT 4	CIRC	CIRCULATING WAT	C:\COSTMOD\CR4CIRC.MDB
CR4	CRYSTAL RIVER UNIT 4	FH	FUEL HANDLING	C:\COSTMOD\CR4FH.MDB
McNA	McNARY HYDRO STATION	TUR	TURBINE - KAPLAN	C:\COSTMOD\MCNATUR.MDB

Buttons: Select, Add, PMO Import

Plant ID: NUM

Figure B-4
Plant/System Selection Menu

The functions to select, add and import Plant/Systems are initiated by pressing buttons on the screen. The functions to modify and delete Plant/System information displayed are performed directly in the *Plant/System Selection Menu* screen. These features are detailed in the following sections.

4.2.1 Select a Plant/System

An arrow on the record selector button will indicate the current record. To select a plant and system, press the record selector button for the plant and system you want to select and then press the **Select** button. Only one plant/system may be open at a time.

When a plant and system are selected the software will open the system's data MDB and attach to the data tables. Once the tables have been successfully attached, the *Main Screen* (Figure B-5.) will be presented. You must select a plant/system in order to access the *Main Screen*. If a new plant/system has been added and then selected, a notice will be presented to alert the user that the *Main Screen* will remain blank until component and task comparison data have been entered.

4.2.2 Add a Plant/System

To add a plant and system, press the **Add** button. A pop-up form will allow you to enter the Plant ID, Plant Name, System ID and System Name for the new plant/system. Press the **OK** button to accept the new information or the **Cancel** button to cancel the add.

When you press the **OK** button, a pop-up box will prompt you for the location of the system's data MDB. The default data MDB file name will be a concatenation of the Plant ID and the System ID with a ".MDB" extension. When you specify a file name and location the software will look to see if the data MDB already exists. If it does not, a new one will be created. If the file does exist, the new plant/system will inherit the same file. Note you should not name the file COSTSRC.MDB. This will produce an invalid table.

4.2.3 Import PMO Studies

To perform PMO Import, PMO should already be installed on the computer or the file DEFAULT.DBF should be copied on the computer running the cost analysis. To import data from existing PMO studies, press the **PMO Import** button. A pop-up box will prompt you for the location of the PMO system list (DEFAULT.DBF). The example in Figure B-5 shows the initial pop-up in the C:\COSTMOD directory. Select the DEFAULT.DBF file in the C:\COSTMOD\PMODEMO directory. This copy of the file is for demonstration purposes only. PMO must be installed on the same computer as the Cost Benefit Analysis Model in order to use this function. In actual application, select the system list (DEFAULT.DBF) from the installed PMO directory and press **OK**.

When you specify the location, the contents of DEFAULT.DBF will be used to create a selection menu to allow you to choose the systems you want to import. The *PMO System Selection* Menu will list all PMO system studies that have not been imported into the Cost Benefit Analysis Module.

Figure B-6. shows a sample *PMO Systems Selection Menu* screen. This screen, displayed after selection of the DEFAULT.DBF provided with this installation, shows one system available from the PMO study. Additional fields would be presented if more systems were included. This feature allows PMO users to rapidly apply cost benefits analysis of their PMO studies without having to recreate the studies. Imported PMO studies are not affected by the parent study.

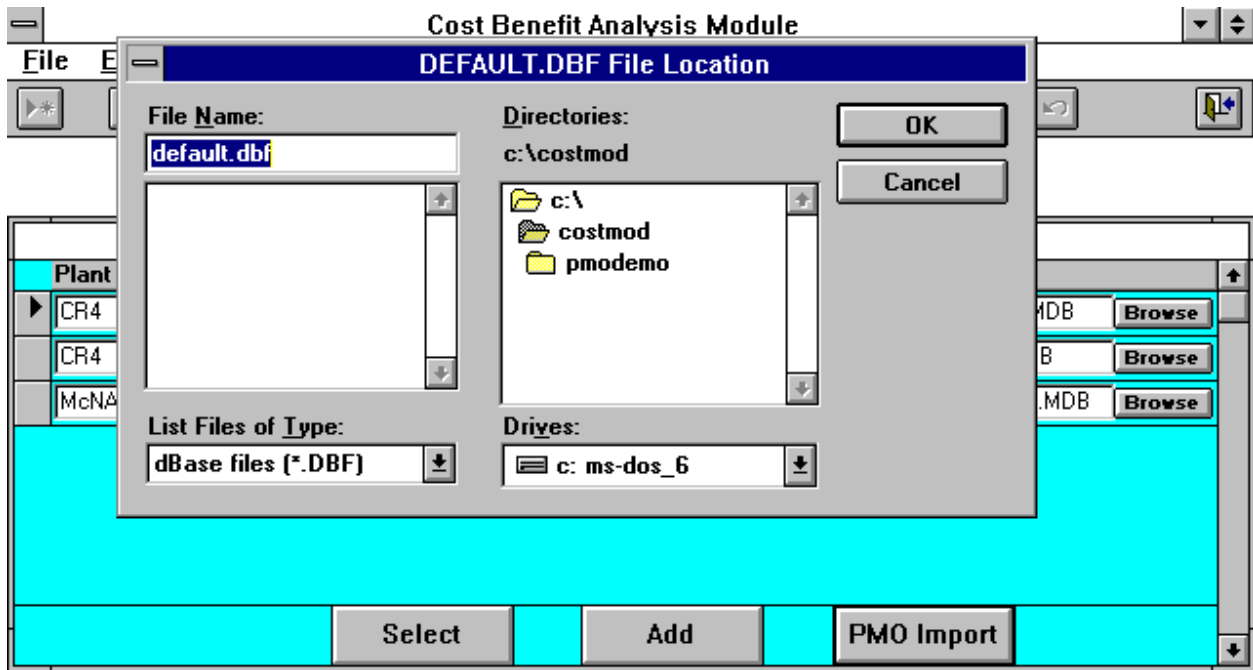


Figure B-5
PMO Import DEFAULT.DBF Location Dialog

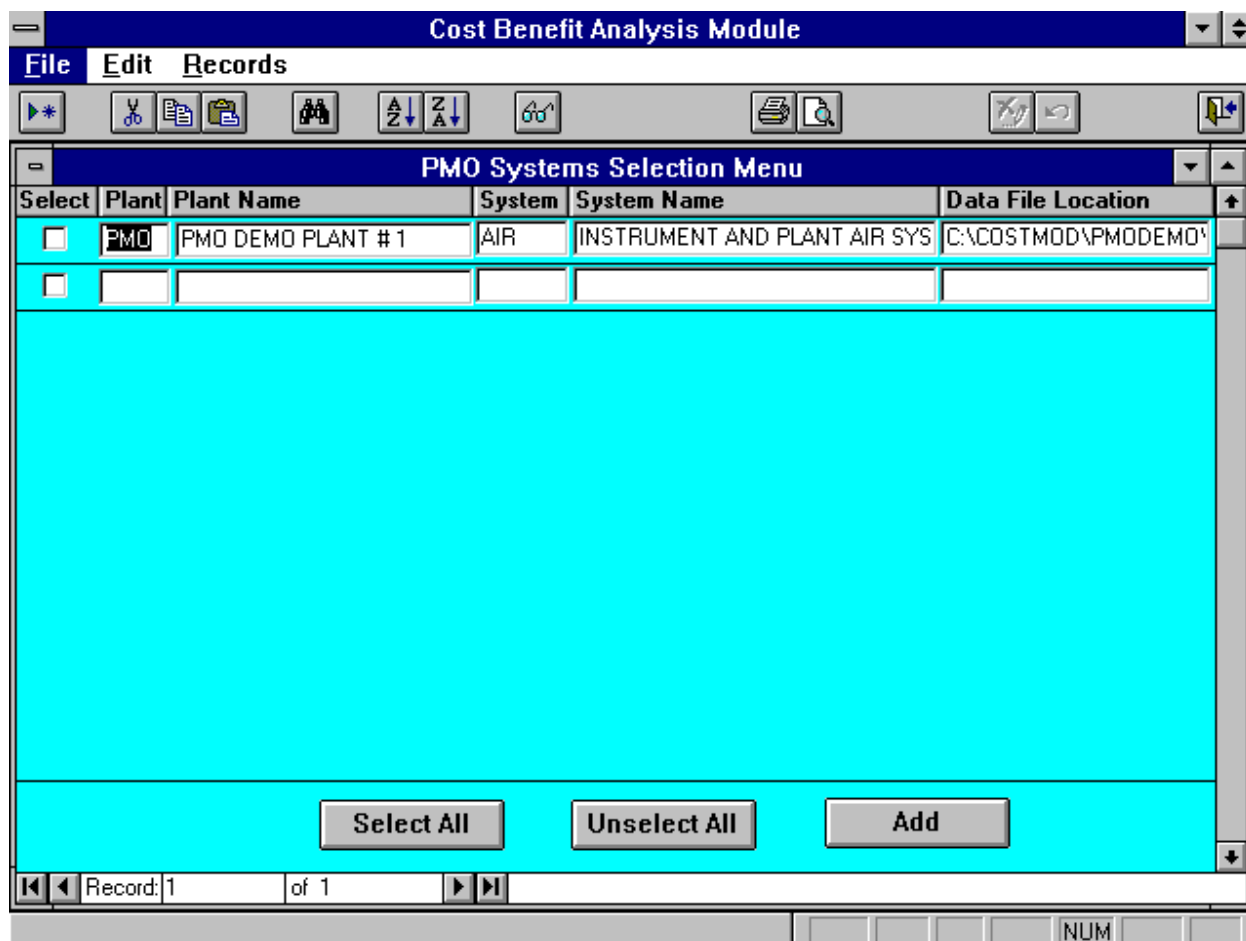


Figure B-6
PMO Systems Selection Menu

The Data File Location indicates where the new system data file will be created. To modify the data file location place the cursor in the data file location field and type the new information.

To select all existing PMO studies for import, press the **Select All** button. To de-select all selected PMO studies, press the **Unselect All** button. To toggle the selection indicator for an individual study, place the cursor in the Select check box field and click the mouse. This will reverse the selection indicator.

When you have selected all of the systems you want to import, press the **Add** button. The software will then create new system MDBs for each selected system and import the existing data from the PMO dBase III files. The time required to add all of the systems will vary depending on the number of systems to be added and the size of the studies.

4.2.4 Modify Plant/System Entry

To modify the Plant ID, Plant Name, System ID or System Name place the cursor in the field you want to change and type the new information. The **Browse** button will pop up a prompt box to allow you to search for the location of the system's data MDB file.

4.2.5 Delete a Plant/System Entry

To delete a plant/system entry, click on the entry's record selector button and press the delete key on your keyboard.

Note: Deleting a plant/system entry does not delete the plant/system data file (.MDB). It only removes the entry from the Plant/System Selection Menu. The plant/system may be re-entered to view the analysis at a later time.

COST BENEFIT ANALYSIS

Once you have selected a plant and system for analysis you will be able to define the component master list, enter the existing PM program and job recommendations, define standard element cost values to be used throughout the analysis, enter cost calculation element details and print system reports.

Main Screen

To go to the *Main Screen* select a plant and system from the Plant/System Selection Menu, press the record selector button for the plant and system you want to select and then press the **Select** button. Only one plant/system may be open at a time. The main screen, illustrated in Figure B-7 will display the task cost comparisons by component. The selected plant/system is indicated in the title bar of the window. You can use the record navigation buttons at the bottom of the screen to scroll through the comparisons component by component or go directly to the component you want to view by selecting the component ID in the Component ID list box.

NOTE: The *Main Screen* will remain blank until a **Component List** and **Task Comparison** entries have been defined. If you cannot view all the information on the screen, expand the window using the cursor.

The Net Effect (Difference) is calculated as the Total Annual Recommended Costs minus the Total Annual Existing Costs. In other words, a negative Net Effect indicates a reduction of annual maintenance costs if the recommended maintenance program is implemented.

Cost Benefit Analysis Module /Plant: McNA /System: TUR

File Edit Records Data Entry System Totals Reports Import

Main Screen

Component ID 13-03 **Consumables** **Annual CM Only Cost*** \$0.00

Component Name WICKET GATE (CENTRAL) LUBRICATION SYSTEM

Task Comparison List

Existing Task	Cost*	Action	Recommended Task	Cost*
CHECK GEAR CASE OIL AND CHANGE AS I	\$40.00	RETAIN		\$40.00
CHECK OPERATION OF PLUNGERS ON AL	\$400.00	RETAIN		\$400.00
CLEAN GREASE PUMP AND GREASE POT	\$0.00	RETAIN		\$0.00
Corrective Maintenance (Existing)	\$425.00	N/A	Corrective Maintenance (Recommended)	\$0.00
INSPECT GREASE LINES FOR LEAKS	\$0.00	RETAIN		\$0.00
VISUAL INSPECT GREASE PIN POSITION	\$0.00	RETAIN		\$0.00
VISUAL INSPECT MOTOR BEARINGS, CON	\$0.00	RETAIN	RETAIN DUE TO AGE OF COMPONENT	\$0.00

Total Annual Existing Costs \$865.00 **Total Annual Recommended Costs** \$440.00

Consumables **Consumables**

Net Effect (Difference) (\$425.00)

Record: 1 of 46

Select a Unique Component Identifier

Figure B-7
Main Screen

A "Corrective Maintenance (existing)" and "Corrective Maintenance (recommended)" task record will be automatically added to the task comparison list (see Figure B-7.) for each component to allow the costs of corrective maintenance to be explicitly defined. The tasks are sorted alphabetically in the list. The new corrective maintenance tasks will appear in the correct alphabetical order.

The costs for each task item operates independently. In application, the user may want to first develop the Annual CM Only Cost as the benchmark. This represents a program where no preventive maintenance (PM) maintenance is done and only corrective maintenance (CM) is performed. Then the user would enter the existing program maintenance tasks in the left column. Each task may have a PM cost and a CM cost (cost due to failures introduced by performing that particular maintenance task). In addition, there is a CM cost that does not result from performing a PM (simply a random failure not associated with performing a maintenance activity) . These are the "Corrective Maintenance (existing)" and "Corrective Maintenance (recommended)" costs.

Once the existing program is developed, each task is evaluated for an action. An example of an action is deciding to retain the existing PM. In this case, the user would add the task to the recommended PM program in the column to the immediate right of the existing task. An other action maybe to delete the task. In this case, the user would not add the task in the recommended task column. The user may also decide the appropriate action is to modify the task. In this case the user would add the new task (and any elements of the existing task) into the recommended column next to this task.

Note that there are no automatic functions operations by the code (e.g., deciding to retain a task does not automatically copy it to the recommended field. The only automated operations are (1) calculations after changing costs, (2) expected life of the plant (same for all tasks) and (3) CM costs in the task comparison table automatically default to the last input value. The later may appear deceiving in that if you click the any of the CM cost buttons (discussed later), the value changes to the last input. However, if you print the task comparison costs, the value associated with the button is properly displayed.

Enter or View Cost Calculation Details

On the *Main Screen*, the component's Annual CM Only Cost, each task's existing PM task cost and each task's recommended task cost fields are indicated by an asterisk (*). Placing the cursor on the desired cost field (indicated by an asterisk(*)) and clicking on the field will open the *Cost Calculation Screen*. This will allow you to enter or view the cost calculation details for the selected cost.

Enter or View Consumable Tracking Information

On the *Main Screen*, you can enter or view the consumables required for corrective maintenance only, the existing PM tasks or the recommended PM tasks. To access the consumables detail information, press the **Consumables** button closest to the cost field of the task type for which you want details. The consumables listed represent all the consumables for either corrective maintenance only, the existing PM tasks or the recommended PM tasks.

Cost Calculation Screen

The *Cost Calculation Screen* is illustrated in Figure B-8. This screen is displayed after clicking the mouse cursor in one of the cost fields (indicated by *) in the task comparison list. Note that if you select the Annual CM Only cost field, only the component ID and Component name is displayed at the top of the screen since no task is selected. The cost calculation screen shows the total maintenance cost in the form of an equation (middle of screen). The equation consists of buttons and mathematical operators. Each button represents a cost type. Pressing the button for a cost type allows you to enter or view the detail information for that cost type. The acronyms on the buttons representing each cost type are described on the bottom of the screen.

Cost Benefit Analysis Module /Plant: McNA /System: TUR

File Edit Records Data Entry System Totals Reports Import

Cost Calculation Screen

Component ID: 13-03

Component Name: WICKET GATE (CENTRAL) LUBRICATION SYSTEM

Existing PM ID: P329MM Existing Frequency: 1A

Existing PM Task: CHECK GEAR CASE OIL AND CHANGE AS REQUIRED

Recommended Task:

Recommended Action: RETAIN Recommended Frequency: 1A

Existing PM Cost

\$Task = (CM + CM RP) * FF + (PM + PM RP) * FP + (NRC / RL)

\$40.00 \$0.00 \$0.00 0.00 \$40.00 \$0.00 1.00 \$0.00 15.00

\$Task = Cost (\$) for a particular maintenance task
 CM = Corrective Maintenance costs when failure occurs
 FF = Expected failure frequency per year (one value for case with no preventive maintenance, one for case with existing maintenance program, and one value for case with recommended maintenance program)
 FP = Frequency of PM per year
 NRC = One-time, non-recurring costs to implement optimized maintenance program
 PM = Preventive/predictive maintenance costs (all elements) of each task
 RL = Remaining (planned) life of plant (years)
 RP = Replacement power costs (due to unit off-line or curtailment for CM or PM)

Display the Task Consumables Breakdown

NUM

Figure B-8
Cost Calculation Screen

Each of the buttons will allow you to enter cost breakdown details for each cost type. Each of the cost types is broken into categories and each category is broken into elements. When you press one of the cost buttons (CM, CM RP, PM, or NRC) a screen will pop-up listing the totals for each of the categories within that cost type.

Cost Calculation - \$ Task Maintenance Task

The **\$Task** button on the *Cost Calculation Screen* will allow you to enter the consumable information for the current task. Press **\$Task** button to display the *Cost Calculation - \$Task Screen* (Figure B-9). Add Consumable Type to be included by pressing the arrow in the list box below the title. The units for the consumable are automatically displayed. For the selected consumable type. Enter the number of units of the consumable that are used on an annual basis. Click in the next empty list box field under Consumable Type to add another consumable. Note these consumables are displayed (view only) when you press the **Consumables** button under the relevant

Cost Benefit Analysis Module /Plant: McNA /System: TUR

File Edit Records Data Entry System Totals Reports Import

Cost Calculation - \$Task Screen

Component ID 13-03

Existing PM Task CHECK GEAR CASE OIL AND CHANGE AS REQUIRED

Recommended Task

Existing PM Cost \$40.00 Recommended PM Cost \$40.00

Consumables

Consumable Type	Units Required	Units
8	8	gallons
*		

Record: 1 of 1

CM = Corrective Maintenance costs when failure occurs
 FF = Expected failure frequency per year (one value for case with no preventive maintenance, one for case with existing maintenance program, and one value for case with recommended maintenance program)
 FP = Frequency of PM per year
 NRC = One-time, non-recurring costs to implement optimized maintenance program
 PM = Preventive/predictive maintenance costs (all elements) of each task
 RL = Remaining (planned) life of plant (years)
 RP = Replacement power costs (due to unit off-line or curtailment for CM or PM)

Consumable Element Type

Figure B-9
Cost Calculation - \$Task Screen

task in the main screen (Figure B-7). The **Consumables** button displays all relevant consumables for the topic selected (existing PM, recommended PM or CM only). The costs for consumables do not affect the calculated maintenance program costs. If including consumables cost is desired, then these should be included separately as part of the CM or PM cost.

You must select elements from the list box. To delete a record, use the record selector arrow and press **Del**. You are prompted to verify what you want to delete. Press **OK** to delete or **Cancel** to abort deleting record. Note other data fields in the program function in a similar manner.

Cost Calculation - Corrective Maintenance

Press the **CM** button on the *Cost Calculation Screen* to enter Corrective Maintenance costs (displayed in Figure B-10.).

Cost Benefit Analysis Module /Plant: McNA /System: TUR

File Edit Records Data Entry System Totals Reports Import

Cost Calculation - CM Screen

Component ID 13-03

Existing PM Task CHECK GEAR CASE OIL AND CHANGE AS REQUIRED

Recommended Task

CM Cost Breakdown

Cost Category	Description	Cost*
A	Administrative	
FC	Fixed CM Cost (\$)	
L	Labor	
M	Materials	
NC	Non-Compliance	
SS	Special Services	

Record: 1 of 6

Total CM Cost

Clicking in the Cost* field will open the Cost Calculation Screen. After the cost for each item is calculated, the value will show in the Cost* field

PM = Preventive/predictive maintenance costs (all elements) of each task
 RL = Remaining (planned) life of plant (years)
 RP = Replacement power costs (due to unit off-line or curtailment for CM or PM)

Cost Category Code (L = Labor, etc). (Not editable)

Figure B-10
Cost Calculation - CM Screen

The CM cost category contains a unique cost element used to define fixed costs. The unit cost of this element is \$1.00. To define a fixed cost, select the Fixed CM Cost (\$) category, select the Fixed Costs element and then specify the number of dollars required in the Units Required field.

Place the cursor on the **Cost*** field of the *Cost Calculation - CM Screen* (in the row A - Administrative, for example) and click to get a pop-up screen which allows you to enter element details for the category.

4.3.2.2.1 Cost Calculation - Corrective Maintenance Details

The *CM Cost - CM Cost Screen* is displayed in Figure B-11. This screen will allow you to select an element screen will allow you to select an element from the list box (under Element) that contains all of the valid elements for the selected cost category. When you select an element, the pre-defined unit of measure and cost per unit will be displayed. You can then enter the number of element units required to perform the current task. To delete an element, highlight the row and press delete key.

Cost Benefit Analysis Module /Plant: McNA /System: TUR

File Edit Records Data Entry System Totals Reports Import

Cost Calculation - CM Costs Screen

Component ID 13-03

Existing PM Task CHECK GEAR CASE OIL AND CHANGE AS REQUIRED

Recommended Task

Category A Administrative

Recurring Costs Breakdown

Element	Units Required	Unit Cost	Units	Annualized Cost
	0			\$0.00

Total Recurring Costs

PM = Preventive/predictive maintenance costs (all elements) of each task
 RL = Remaining (planned) life of plant (years)
 RP = Replacement power costs (due to unit off-line or curtailment for CM or PM)

Recurring Cost Element Type

Figure B-11
Cost Calculation - CM Costs Screen

4.3.2.3 Cost Calculation - Replacement Power (CM)

The *Cost Calculation - RP Screen* for Corrective Maintenance comes up when the user presses **CM RP** button on the *Cost Calculation Screen*. The *Cost Calculation RP Screen* is displayed in Figure B-12. Enter in this dialog the downtime expected as a result of the CM task and the amount of power curtailment. For example, if the maintenance caused a need for 1 hour of replacement power with the plant completely shutdown (100 in the Curtailment field), the cost would be the product of the cost per percent - hour times the number of hours times the numeric percent of power decrease. If 100 percent, then the plant is shutdown.

Cost Benefit Analysis Module /Plant: McNA /System: TUR

File Edit Records Data Entry System Totals Reports Import

Cost Calculation - RP Screen

Component ID 13-03

Existing PM ID P329MM

Existing PM Frequency 1A

Existing PM Task CHECK GEAR CASE OIL AND CHANGE AS REQUIRED

Recommended Task

Recommended Frequency 1A

Cost per hour (100% power) \$41,666.00

Downtime (hrs) 0

Curtailment (% power reduction after failure) 0

CM Replacement Power \$0.00

case with existing maintenance program, and one value for case with recommended maintenance program
 FP = Frequency of PM per year
 NRC = One-time, non-recurring costs to implement optimized maintenance program
 PM = Preventive/predictive maintenance costs (all elements) of each task
 RL = Remaining (planned) life of plant (years)
 RP = Replacement power costs (due to unit off-line or curtailment for CM or PM)

Number of Down Time Hours Required FLTR NUM

Figure B-12
Cost Calculation - RP Screen

4.3.2.4 Cost Calculation - Failure Frequency

To go to the *Cost Calculation - FF Screen* (Figure B-13.) press the **FF** button on the *Cost Calculation Screen*. This screen allows you to enter the failure frequency per year that results from the existing PM program. This frequency is a single value that is applied in all existing PM task equations. The frequency of the corrective maintenance multiplied by the corrective maintenance cost per occurrence (the maintenance itself and any replacement power) represents total cost of corrective maintenance.

Cost Benefit Analysis Module /Plant: McNA /System: TUR

File Edit Records Data Entry System Totals Reports Import

Cost Calculation Screen

Cost Calculation - FF Screen

Component ID 13-03

Current PM ID P329MM

Existing PM Frequency 1A

ExistingPM Task CHECK GEAR CASE OIL AND CHANGE AS REQUIRED

Recommended Task

Recommended Frequency 1A

Failure Frequency (per year) (Existing PM Program)

\$40.00	\$0.00	\$0.00	0.00	\$40.00	\$0.00	1.00	\$0.00	15.00
---------	--------	--------	------	---------	--------	------	--------	-------

\$Task = Cost (\$) for a particular maintenance task
 CM = Corrective Maintenance costs when failure occurs
 FF = Expected failure frequency per year (one value for case with no preventive maintenance, one for case with existing maintenance program, and one value for case with recommended maintenance program)
 FP = Frequency of PM per year
 NRC = One-time, non-recurring costs to implement optimized maintenance program
 PM = Preventive/predictive maintenance costs (all elements) of each task
 RL = Remaining (planned) life of plant (years)
 RP = Replacement power costs (due to unit off-line or curtailment for CM or PM)

Number of Times this Component Fails per Year NUM

Figure B-13
Cost Calculation - FF Screen

4.3.2.5 Cost Calculation - Preventive/Proactive Maintenance

To go to the *Cost Calculation - PM Screen* (Figure B-14.) the press the **PM** button on the *Cost Calculation Screen*. This screen allows you to enter costs associated with preventive/proactive maintenance for the specific task under evaluation. The top of the dialog indicates the component and maintenance task being evaluated. Available cost categories are listed with their description and cost. The cost is only listed if cost elements with some associated have been added for that category.

Cost Benefit Analysis Module /Plant: McNA /System: TUR

File Edit Records Data Entry System Totals Reports Import

Cost Calculation - PM Screen

Component ID 13-03

Existing PM Task CHECK GEAR CASE OIL AND CHANGE AS REQUIRED

Recommended Task

PM Cost Breakdown

Cost Category	Description	Cost*
A	Administrative	
L	Labor	\$40.00
M	Materials	
NC	Non-Compliance	
SS	Special Services	

Record: 1 of 5

Total PM Cost \$40.00

Clicking in the Cost* field will open the Cost Calculation Screen. After the cost for each item is calculated, the value will show in the Cost* field

PM = Preventive/proactive maintenance costs (all elements) of each task
 RL = Remaining (planned) life of plant (years)
 RP = Replacement power costs (due to unit off-line or curtailment for CM or PM)

Cost Category Code (L = Labor, etc). (Not editable)

Figure B-14
Cost Calculation - PM Screen

Place the cursor on the **Cost*** field of the Cost Calculation - PM Screen and click to get a pop-up screen which allows you to enter element details for the category. The element screen will allow you to select an element from a list box that contains all of the valid elements for the selected cost type and category.

4.3.2.5.1 Cost Calculation - Preventive/Proactive Maintenance Details

Clicking the **Cost*** field on the *Cost Calculation - PM Screen* enters the *Cost Calculation PM Costs screen* illustration in Figure B-15. Enter cost elements by selecting the element from the list box. Unit costs and units are automatically entered for the selected cost element. Enter the number of units required per year. Select the last (blank) list box field under element to add another element. To delete an element, select the row using the record selector to the far left and pressing Del. You will be prompted to confirm deleting record. Press the **Exit** button in this dialog to return to previous window.

Cost Benefit Analysis Module /Plant: McNA /System: TUR

File Edit Records Data Entry System Totals Reports Import

Cost Calculation - PM Costs Screen

Component ID: 13-03

Existing PM Task: CHECK GEAR CASE OIL AND CHANGE AS REQUIRED

Recommended Task:

Category: L Labor

Recurring Costs Breakdown

	Element	Units Required	Unit Cost	Units	Annualized Cost
▶	Craft	1	\$40.00	hour	\$40.00
*		0			\$0.00

Total Recurring Costs: \$40.00

PM = Preventive/proactive maintenance costs (all elements) of each task
 RL = Remaining (planned) life of plant (years)
 RP = Replacement power costs (due to unit off-line or curtailment for CM or PM)

Recurring Cost Element Type: NUM

Figure B-15
 Cost Calculation - PM Costs Screen

4.3.2.6 Cost Calculation - Replacement Power

To view the *Cost Calculation - RP Screen* for Preventive/Proactive Maintenance (Figure B-16), press the **PM RP** button on the *Cost Calculation Screen*. Enter in this dialog the downtime expected as a result of the PM task and the amount of power curtailment. For example, if the maintenance caused a need for 1 hour of replacement power with the plant completely shutdown (100 in the Curtailment field), the cost would be the product of the cost per percent - hour times the number of hours times the numeric percent of power decrease. If 100 percent, then the plant is shutdown.

Cost Benefit Analysis Module /Plant: McNA /System: TUR

File Edit Records Data Entry System Totals Reports Import

Cost Calculation - RP Screen

Component ID 13-03

Existing PM ID P329MM

Existing PM Frequency 1A

Existing PM Task CHECK GEAR CASE OIL AND CHANGE AS REQUIRED

Recommended Task

Recommended Frequency 1A

Cost per hour (100% power) \$35,000.00

Downtime (hrs)

Curtailment (% power reduction after failure) 0

PM Replacement Power \$0.00

case with existing maintenance program, and one value for case with recommended maintenance program
 FP = Frequency of PM per year
 NRC = One-time, non-recurring costs to implement optimized maintenance program
 PM = Preventive/predictive maintenance costs (all elements) of each task
 RL = Remaining (planned) life of plant (years)
 RP = Replacement power costs (due to unit off-line or curtailment for CM or PM)

Number of Down Time Hours Required FLTR NUM

Figure B-16
Cost Calculation - RP Screen

4.3.2.7 Cost Calculation - FP PM Frequency

To view the *Cost Calculation - FP Screen* (Figure B-17) press the **FP** button on the *Cost Calculation Screen*. Enter the frequency of preventive maintenance in the field Frequency of Maintenance (per year). This value is multiplied by the cost to perform the maintenance task (the task itself and any replacement power required) to calculate the preventive maintenance cost.

Cost Benefit Analysis Module /Plant: McNA /System: TUR

File Edit Records Data Entry System Totals Reports Import

Cost Calculation Screen

Cost Calculation - FP Screen

Component ID 13-03

Existing PM ID P329MM

Existing PM Frequency 1A

Existing PM Task CHECK GEAR CASE OIL AND CHANGE AS REQUIRED

Recommended Task

Recommended Frequency 1A

Frequency of Maintenance (per year)

\$Task = Cost (\$) for a particular maintenance task
 CM = Corrective Maintenance costs when failure occurs
 FF = Expected failure frequency per year (one value for case with no preventive maintenance, one for case with existing maintenance program, and one value for case with recommended maintenance program)
 FP = Frequency of PM per year
 NRC = One-time, non-recurring costs to implement optimized maintenance program
 PM = Preventive/predictive maintenance costs (all elements) of each task
 RL = Remaining (planned) life of plant (years)
 RP = Replacement power costs (due to unit off-line or curtailment for CM or PM)

of Times this Preventive/Predictive Maintenance Task is Performed each Year

Figure B-17
Cost Calculation - FP Screen

4.3.2.8 Cost Calculation - Non-Recurring Costs

To view the *Cost Calculation - NRC Screen* (Figure B-18), press the **NRC** button on the *Cost Calculation Screen*. This screen displays the cost categories associated with non-recurring costs. These are cost that are not incurred specifically when the task is performed, but are costs associated with implementing the program to perform the maintenance. Examples are costs for any design changes necessary and training on the maintenance task.

Cost Benefit Analysis Module /Plant: McNA /System: TUR

File Edit Records Data Entry System Totals Reports Import

Cost Calculation - NRC Screen

Component ID: 13-03

Existing PM Task: CHECK GEAR CASE OIL AND CHANGE AS REQUIRED

Recommended Task:

Non-Recurring Cost Breakdown

Cost Category	Description	Cost*
DC	Design Change Cost	
I	Implementation Cost	
NT	New Technology (NT) Cost	
T	New Training (T) Cost	
W	Warehouse Stocking Cost	

Record: 1 of 5

Total NRC Cost

Clicking in the Cost* field will open the Cost Calculation Screen. After the cost for each item is calculated, the value will show in the Cost* field

PM = Preventive/predictive maintenance costs (all elements) of each task
 RL = Remaining (planned) life of plant (years)
 RP = Replacement power costs (due to unit off-line or curtailment for CM or PM)

Cost Category Code (L = Labor, etc). (Not editable)

Figure B-18
Cost Calculation - NRC Screen

Place the cursor on the **Cost*** field of the *Cost Calculation - NRC Screen* and click to get a pop-up screen which allows you to enter element details for the category. The element screen will allow you to select an element from a list box that contains all of the valid elements for the selected cost type and category.

4.3.2.9 Cost Calculation - Non-Recurring Cost Details

Clicking the **Cost*** field on the NRC Screen enters the *Cost Calculation - NRC Screen* illustrated in Figure B-19. Enter cost elements by selecting the element from the list box. Unit costs and units are automatically entered for the selected cost element. Enter the number of units required per year. Select the last (blank) list box field under element to add another element. To delete an element, select the row using the record selector to the far left and pressing Del. You will be prompted to confirm deleting record. Press the **Exit** button in this dialog to return to previous window.

Figure B-19
Cost Calculation - NRC Costs Screen

To view the *Cost Calculation - RL Screen* the press the **RL** button on the *Cost Calculation Screen*. This displays the pop-up illustrated in Figure B-20. Enter in the text field the remaining life of the plant in years. Press the exit button to return to the *Cost Calculation Screen*.

Cost Benefit Analysis Module /Plant: McNA /System: TUR

File Edit Records Data Entry System Totals Reports Import

Cost Calculation Screen

Component ID 13-03

Component Name WICKER

Existing PM ID P329M

Existing PM Task CHECK

Recommended Task

Recommended Action RETAIN

Cost Calculation - RL Screen

Remaining Life of Plant 15

Existing PM Cost

\$Task = (CM + CM RP) * FF + (PM + PM RP) * FP + (NRC / RL)

\$40.00 \$0.00 \$0.00 0.00 \$40.00 \$0.00 1.00 \$0.00 15.00

\$Task = Cost (\$) for a particular maintenance task
 CM = Corrective Maintenance costs when failure occurs
 FF = Expected failure frequency per year (one value for case with no preventive maintenance, one for case with existing maintenance program, and one value for case with recommended maintenance program)
 FP = Frequency of PM per year
 NRC = One-time, non-recurring costs to implement optimized maintenance program
 PM = Preventive/predictive maintenance costs (all elements) of each task
 RL = Remaining (planned) life of plant (years)
 RP = Replacement power costs (due to unit off-line or curtailment for CM or PM)

Remaining Life of the Plant NUM

Figure B-20
Cost Calculation - RL Screen

Define Standard Element Cost Values

You can define various labor rates, material costs and per occurrence costs to be used throughout the analysis. Once the element cost values have been defined you only need to enter the actual quantity of each element used and the software will use the standard cost values to calculate the actual cost.

Category Element Data Screen

Each of the cost types is broken into categories and each category is broken into elements. To define the cost elements and standard values, *select Category Element Data* under *Data Entry* in the common menu bar. This displays the Cost Category Elements screen in Figure B-21.

The cost category element data entry screen displays cost category elements by cost type and category. To scroll through the cost types, use the record navigation buttons at the bottom of the screen. Use the Category Code list box to select one of the valid categories for the current cost type. The Elements box will list the cost elements that have been defined for the current cost type category. You can add additional cost elements by entering the cost category element, units and unit cost for the new record. Adding cost elements makes the available for selection in that cost category. Deleting a cost element automatically removes the cost from all records.

Cost Benefit Analysis Module /Plant: McNA /System: TUR

File Edit Records Data Entry System Totals Reports Import

Main Screen

Cost Category Elements

Cost Type: CM Category Code: Administrative

Elements			Cost*
Cost Category Element	Units	Unit Cost	
Planning/Scheduling	task	\$50.00	\$40.00
Special Work Permit	task	\$100.00	\$400.00
*		\$0.00	\$0.00
			\$0.00
			\$0.00
			\$0.00

Record: 1 of 2

Record: 1 of 5

Net Effect (Difference): (\$425.00)

Record: 1 of 46

Cost Category Code: NUM

Figure B-21
Cost Category Elements Screen

Define Components

You can add components to the component list by selecting the *Component List* under *Data Entry* in the common menu bar. This displays the dialog in Figure B-22. To scroll through the components, use the record navigation buttons at the bottom of the screen

or the scroll bar on the right side of the screen. To add a component, enter the component ID and Name. Note that simply adding a component does make it available for analysis from the main screen. You must complete a task comparison for the component before it becomes available for analysis.

Cost Benefit Analysis Module /Plant: McNA /System: TUR

File Edit Records Data Entry System Totals Reports Import

Component List

Component ID	Component Name
13-03	WICKET GATE (CENTRAL) LUBRICATION SYSTEM
13-03-T30	WICKET GATE GREASE FAILURE ALARM RELAY
20-08-11	TURBINE BEARING OIL PUMP AC
20-08-12	TURBINE BEARING OIL PUMP DC
20-08-12-T13	TURBINE LOW BEARING OIL LEVEL SWITCH (63 DEVICE)
20-08-21	TURBINE HEAD COVER SUMP PUMP 1 (TOP PLATE)
20-08-22	TURBINE HEAD COVER SUMP PUMP 2 (TOP PLATE)
20-08-22-SWITCH-	TURBINE HEAD COVER SUMP HIGH LEVEL FLOAT SWITCH
20-08-22-SWITCH-	TURBINE HEAD COVER SUMP PUMP FLOAT SWITCH LAG
20-08-22-SWITCH-	TURBINE HEAD COVER SUMP PUMP FLOAT SWITCH LEAD
22-02-4WAY	4-WAY SOLENOID VALVE FOR INTAKE GATE HYDRAULICS
22-20-04-BREAKER	HYDRAULIC PUMP MOTOR BREAKER FOR INTAKE GATE HYDRAULICS (2 EACH))
22-20-04-MOTOR	HYDRAULIC PUMP MOTOR FOR INTAKE GATE HYDRAULICS (3)
22-20-04-PUMP	HYDRAULIC PUMP FOR INTAKE GATE HYDRAULICS (3)
22-30	HYDRAULIC FLUID TANK FOR INTAKE GATE HYDRAULICS (4)
22-ALARM-LEVEL	INTAKE GATE TROUBLE ANNUNCIATION - LOW OIL LEVEL
22-ALARM-PRESS	INTAKE GATE TROUBLE ANNUNCIATION - LOW OIL PRESSURE

Record: 1 of 48

Consumables

Net Effect (Difference) (\$425.00)

Record: 1 of 46

The unique identifier of the component

NUM

Figure B-22
Component List Screen

Define Tasks for Comparison

You can add tasks to the task comparison list by selecting the *Task Comparison* under *Data Entry* in the common menu bar. To scroll through the tasks, use the record navigation buttons at the bottom of the screen. To add a task comparison, select the desired component from the Component ID list box. Enter the existing PM ID, task description and the existing frequency (occurrences per year). Select the action taken from the Action list box. These options include:

ADD - add an additional task as entered in the recommended task field

DELETE - deleting the existing maintenance task

MODIFY - replace the existing task with the task in the recommended task

NO REC - no recommendation

RETAIN - retain the existing maintenance task in the recommended PM program

The field in the task comparison are freeform (there are no logic constraints in his dialog with regard to action). That is, for example a user may add a new task even though the action selected was no recommendation.

Cost Benefit Analysis Module /Plant: McNA /System: TUR

File Edit Records Data Entry System Totals Reports Import

Task Comparison

Component ID: 113-03

Component Name: WICKET GATE (CENTRAL) LUBRICATION SYSTEM

PM Program

Existing PM ID: ROUNDS

Existing Task: VISUAL INSPECT GREASE PIN POSITION

Existing Frequency: DAILY

Action: RETAIN

Recommended Task:

Recommended Frequency: DAILY

Record: 1 of 6

Net Effect (Difference): (\$425.00)

Record: 1 of 46

Select the Unique Component Identifier.

NUM

Figure B-23
Task Comparison Screen

View System Totals

You can view total costs, total cost archives and total consumables for the plant/system currently selected.

View System Cost Totals

You can view the system cost totals by selecting the *System Cost Totals* under *System Totals* in the common menu bar. This presents the dialog in Figure B-24. The totals represent the total cost of all maintenance tasks for all components that are members of the selected plant/system.

Cost Benefit Analysis Module /Plant: McNA /System: TUR

File Edit Records Data Entry System Totals Reports Import

Main Screen

System Cost Totals

Component Name

Component Name

Total Annual CM Only Costs \$0.00
 Total Annual Existing PM Costs \$1,261.41
 Total Annual Recommended PM Costs \$520.00
 Annual Net Effect (Difference) (\$741.41)

Archive

Cost*
\$40.00
\$400.00
\$0.00
ended) \$0.00
\$0.00
\$0.00
ONENT \$0.00

Total Annual Existing Costs \$865.00
 Total Annual Recommended Costs \$440.00
 Net Effect (Difference) (\$425.00)

Record: 1 of 46

Close Form

Figure B-24
System Cost Totals Screen

You may add the cost totals currently shown to the system totals archive by pressing the **Archive** button.

View System Totals Archive

You can view the system cost totals archive by selecting the *System Totals Archive* under *System Totals* in the common menu bar. This presents the dialog in Figure B-25.

Cost Benefit Analysis Module /Plant: McNA /System: TUR

File Edit Records Data Entry System Totals Reports Import

Main Screen

System Totals Archive

Archive ID	Date/Time Stamp	Total Annual CM Only Cost	Total Annual Existing Cost	Total Annual Recommended Cost
	10/31/97 8:48:36 PM	\$0.00	\$0.00	\$0.00

Remarks

Record: 1 of 1

Total Annual Existing Costs \$865.00 **Total Annual Recommended Costs** \$440.00

Consumables **Consumables**

Net Effect (Difference) (\$425.00)

Record: 1 of 46

User defined unique archive entry ID

Figure B-25
System Totals Archive Screen

View System Consumables Totals

You can view the system cost totals archive by selecting the *System Consumables Totals* under *System Totals* in the common menu bar. This presents the dialog in Figure B-26.

Cost Benefit Analysis Module /Plant: McNA /System: TUR

File Edit Records Data Entry System Totals Reports Import

System Consumable Totals

Annual CM Only Consumables

Consumable	Units Required	Units
Oil	8	gallons

Record: 1 of 1

Annual Existing PM Consumables

Consumable	Units Required	Units
Oil	8	gallons

Record: 1 of 1

Annual Recommended PM Consumables

Consumable	Units Required	Units
------------	----------------	-------

Record: of

Net Effect (Difference) (\$425.00)

Record: 1 of 46

Close Form NUM

Figure B-26
System Consumables Totals Screen

Reports

The reports generated by the Cost Benefit Analysis Model are shown in appendix A. To print reports, select the desired report under **Reports** in the common menu bar. Report available include:

<u>Report Type</u>	<u>Description</u>
Cost Category Elements	cost type, cost category, associated cost element(s) and unit cost

Component List	component ID, component description and CM only cost
Task Comparison	component, existing task information, action and recommended task information
Task Cost Summary	existing PM cost formula, recommended action and existing PM cost comparison
Task Cost Breakdown	detailed cost categories and elements
System Equation Factor Totals	summarized the values of each formula element for tasks

Selecting the report presents a print preview of the report. You may use the page selection arrows or page up/page down keys to scroll through pages of the report. You may also adjust the margins or print the report from the print preview toolbar (see section 3.3).

Import PMO Components and Task Comparison

You can import the components and task comparison data from an existing PMO study by selecting either ***Import Component List (COMPONEN.DBF)*** or ***Import Task Comparison (COMPARE.DBF)*** from the **Import** menu. When you select either one of these options, a file browse dialog will be presented to allow you to specify the location of the requested PMO data file. Figure B-5 shows an example of the file browse dialog. There are sample COMPONEN.DBF and COMPARE.DBF files in the C:\COSTMOD directory. These are for demonstration purposes only. PMO must be installed on the same computer as the Cost Benefit Analysis Model in order to use this function. Select the specified PMO component or task comparison .DBF file from the PMO directory and the import process will execute automatically.

Section 5

PROGRAM FILES

Creates Windows folder:

Cost Benefit Analysis Module

Creates shortcut(s)

Cost Benefit Analysis Module

Creates directories:

C:\COSTMOD\

Creates file(s)

in C:\COSTMOD:

COSTSRC.MDB

CR4CIRC.MDB

CR4FH.MDB

ERIN_LIB.MDA

MCNATUR.MDB

MSAFIN.DLL

MSAIN200.DLL

MSAJU200.DLL

MSAOLE20.DLL

MSAU200.DLL

MSARN200.EXE

in C:\WINDOWS:

COSTMOD.INI

in C:\WINDOWS\SYSTEM:

DAO2016.DLL

MSABC200.DLL

MSAEXP20.DLL

CMSTOOLBR.DLL

COMPOBJ.DLL

MSAJT200.DLL

MSJETINT.DLL

MSJETERR.DLL

OLE2CONV.DLL

SOA200.DLL	OLE2DISP.DLL
SYSTEM.MDA	OLE2PROX.DLL
SYSTMPLT.MDB	OLE2NLS.DLL
UTILITY.MDA	STDOLE.DLL
<u>in C:\COSTMOD \PMODEMO:</u>	TYPELIB.DLL
COMPARE.DBF	OLE2.DLL
COMPONEN.DBF	STORAGE.DLL
DEFAULT.DBF	XBS200.DLL
	VER.DLL
	VSHARE.386

Note that LDB are created for the ACCESS for MD* files during application use.

Section 6

ACRONYMS/DEFINITIONS

1. CBAM - Cost Benefit Analysis Module
2. Consumables - Materials used during maintenance that are consumed in the process (e.g., oil, paint ..etc.).
3. CM - Corrective Maintenance. Maintenance resulting from unplanned equipment failures.
4. PM - Preventive Maintenance. Also referred to as proactive maintenance. Maintenance that is that is planned on a periodic basis to prevent equipment failure.
5. PMO - Preventive Maintenance Optimization. A separate application that evaluates and recommends maintenance task based on functions and functional failures.

