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THESIS

A USER'S MANUAL FOR THE COST EFFECTIVENESS ANALYSIS SPREADSHEET MODEL FOR AIRCRAFT ENGINES (CEAMOD Version 2.0)

by

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This thesis provides a comprehensive procedures manual and user's guide which will enable both current users and beginners to understand and employ Version 2.0 of the Cost Effectiveness Analysis model (CEAMOD), which is written in EXCEL spreadsheet software, in their service's aircraft engine Component Improvement Programs (CIP). The purpose of the CEAMOD is to project the possible savings which would be achieved from an Engineering Change Proposal's (ECP) implementation. The thesis begins by describing the model's background, basic assumptions, and format. Next, a detailed description of each page and the cell formulas used in each column of the spreadsheet is provided. A "getting started" user's guide was also created to provide the user with the basic information necessary to actually use the CEA Deck/EXCEL spreadsheet software. An example of each page of the CEA model is provided as well as the Standard History File fleet input pages.

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A User's Manual for the Cost Effectiveness Analysis Spreadsheet Model for Aircraft Engines (CEAMOD Version 2.0)

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This thesis provides a comprehensive procedures manual and user's guide which will enable both current users and beginners to understand and employ Version 2.0 of the Cost Effectiveness Analysis model (CEAMOD), which is written in EXCEL spreadsheet software, in their service's aircraft engine Component Improvement Programs (CIP). The purpose of the CEAMOD is to project the possible savings which would be achieved from an Engineering Change Proposal's (ECP) implementation. The thesis begins by describing the model's background, basic assumptions, and format. Next, a detailed description of each page and the cell formulas used in each column of the spreadsheet are provided. A "getting started" user's guide was also created to provide the user with the basic information necessary to actually use the CEA Deck/EXCEL spreadsheet software. An example of each page of the CEA model is provided as well as the Standard History File fleet input pages.

TABLE OF CONTENTS

I. INTRODUCTION

A. OBJECTIVE

This thesis develops a comprehensive procedures manual and user's guide which will enable both current users and beginners to understand and employ the Cost Effectiveness Analysis model (CEAMOD), Version 2.0, in their service's aircraft engine Component Improvement Programs (CIP). The CEAMOD was formally approved by the Joint Services Propulsion Council in 1993 for use in evaluating Engineering Change Proposals (ECP) from contractors as a part of the aircraft engine Component Improvement Programs.

The CIP's main objective is to lower the logistics costs of ownership of an aircraft engine. It is an expensive program which calls for significant investment with the expectation of comparable future lower operational and support costs. The purpose of the CEAMOD is to project the savings are expected to be achieved from an ECP's implementation. The projected savings are the difference between the life cycle costs of implementing the proposed configuration change and the life cycle costs of sustaining the current configuration. Future dollar savings are expressed in net present value (NPV). An estimate of the calendar time or flight hours to achieve the return on investment (ROI) may also be determined.

A contractor may justify the ECP by showing that it increases flight safety, increases the aircraft's mission effectiveness, or decreases aircraft or engine operating or support costs. Justifying CIP investment from an economic standpoint requires a cost effectiveness analysis.

This thesis will continue the evaluation of the CEAMOD begun by Davis [Ref. 1] and Crowder [Ref. 2], and updates the comprehensive descriptive manual developed by Clague [Ref. 3] for the LOTUS 123 version of the CEAMOD. It presents the details of the EXCEL conversion. The model version addressed is Version 2.0.

B. ORGANIZATION OF THE THESIS

Chapter II describes the background of the GE CEA model, basic assumptions of the model and the format of the model.

Chapter III describes the various model input parameters and calculations that make up Page 1 of the model.

Chapter IV describes the columns, formulas, and calculations of the Standard History File that makes up Page 2 of the model.

Chapter V describes the columns, formulas, and calculations of the Current Configuration that make up Page 3a and Page 3b of the model.

Chapter VI describes the columns, formulas, and calculations of the Proposed Configuration that make up Page 4a and Page 4b of the model.

Chapter VII describes the columns, formulas, and calculations used in the comparison of the Current and Proposed Configuration costs that make up Page 5 of the model.

Chapter VIII describes the format, formulas and calculations of the Summary Page that make up Page 6 of the model.

Chapter IX describes the model's Interim Calculations and Summary Equations that make up Page 7 of the model.

Chapter X describes the procedures for getting started with the model. It is intended as a very user friendly introduction to the CEA Deck Version 2.0 software and describes some of its basic functions and features.

Chapter XI contains a summary of the thesis, conclusions and recommendations.

Appendix A provides an example printout of each page of the model.

Appendix B provides an example of the Standard History File engine fleet input pages.

II. THE GE CEA MODEL

A. BACKGROUND OF THE MODEL

Pratt and Whitney originally developed the Cost Effectiveness Analysis (CEA) model using FORTRAN and the early DYNAPLAN spreadsheet methodology on an IBM mainframe computer request of Larry Briskin of the Air Force. At the request of the Air Force, a copy of the DYNAPLAN-based CEA model was given to General Electric (GE). The reason was to have GE develop an IBM personal computer version in a LOTUS 123 spreadsheet format. Recently, the model has been converted to the EXCEL spreadsheet format as requested by the Air Force and the Navy. However, the transition to EXCEL capability by Pratt and Whitney, and General Electric in house has been slowed by the reluctance to purchase the needed hardware/software and DOD budget cutbacks [Ref. 4]. Unfortunately, the conversion was also not without problems. In the process of developing this procedures manual, these problems became quite evident. However, the descriptions are true to what Version 2.0 provides, even if there are some "illogical" steps.

B. FUNDAMENTAL ASSUMPTIONS OF THE MODEL

The goal of the CEA model is to determine the projected value of the changes in the current system, hopefully, these changes are an improvement in the life cycle costs over the engine's remaining life cycle as a consequence of an Engineering Change Proposal (ECP) for an engine component.

The CEA model does not include all engine life cycle costs. Specifically, this model does not include the investment costs associated with implementing the ECP. These ECP investment costs typically include developmental research costs, design and test costs, engineering data costs, and program management costs. The Component Improvement Program uses the RDT&E funding appropriation to fund the continual engineering design changes that are necessary [Ref. 5:p. 42]. In contrast, the expected savings from an ECP must come from operating funds. In addition, the model focuses on the life cycle cost differences between a current and proposed configuration of an aircraft engine component after it becomes operational. Thus, only the logistics support life cycle costs affected by the change are considered.

The model determines the expected life cycle cost differences by using the average annual number of engines receiving the ECP in a given year based on a proposed incorporation schedule. The number of engine component failures in a year are assumed to be Poisson distributed. The mean number of failures over a year is the product of the expected failure rate per engine per flight hour and the expected number of flight hours per year. This Poisson distribution assumption does not allow the engine failure rate to increase as engines wear out and does not consider decreasing failure rates in the early life of an engine [Ref. 3:p. 6].

C. FORMAT OF THE MODEL

The model, as seen in the EXCEL spreadsheet, is comprised of eleven pages (two of which have a part "a" and a part "b"). Nine pages are part of the CEA printout package and the remaining two are included to aid in the calculations of the cell formulas throughout the model. These pages and the corresponding EXCEL spreadsheet columns which make up each page are provided below:

Page 1	Input Parameters and Calculated Costs (Columns B through H)
Calculated Subtotals	(Columns I through M)
Page 2	Standard History File Columns N through W)
Scheduled/Unscheduled Events	(Columns Y through AZ)
Pages 3a and 3b	Current Configuration (Columns BA through CK)
Pages 4a and 4b	Proposed Configuration (Columns CM through DW)
Page 5	Current/Proposed Configuration Comparison (Columns DY through ED)

Page 6	Summary Page (Columns EF through EM)
Page 7	Interim Calculations and Summary Equations (Columns EO through EV)

Appendix A provides an example of each spreadsheet page. Each of these pages will be considered in detail in subsequent chapters.

Appendix B provides an example of the Standard History File fleet input pages.

III. DESCRIPTION OF INPUT PARAMETERS

A. INTRODUCTION

Page 1 of the model, located in EXCEL spreadsheet columns A through G, displays the input parameters that drive the model's cost benefit analysis. It consists of five input categories containing 49 elements and 13 standard input values. The values are either directly input by the contractor or calculated by its particular cell formula [Ref 6]. Category one contains 15 elements which are general data elements. Category two contains 15 scheduled maintenance input elements both for the current and the proposed configurations. Category three contains 17 unscheduled maintenance input elements both for the current and proposed configurations. Category four contains two optional input elements used to show expected improvements through more efficient fuel consumption and improvement in the aircraft loss rate resulting from the proposed configuration. Category five contains 13 input values provided from the standard history file engine fleet input pages which are used on all pages of the model. The five input categories are described below starting with Lines 1.0 through 15.0 which make up Category One. To make it easier to identify the terms in the cell formulas provided, there will be an EXCEL plain language short term provided in parentheses next to each element description.

B. DESCRIPTION OF TASK INCORPORATION INPUT PARAMETERS LINE 1.0 THROUGH LINE 15.0

1. Line 1.0 Incorporation Style (IncorpStyle)

This is cell D9 and determines the rate at which the ECP modification will be introduced into the fleet and consequently determines how quickly modification costs are recouped. The user can select from three different methods of incorporating the modification into the existing fleet. These are:

1 = Attrition - Incorporates the modification only during a "failure" of the engine or old component.

2 = First Opportunity - Incorporates the modification during an engines unscheduled (failure) or scheduled event (scheduled maintenance), whichever occurs first.

3 = Forced Retrofit - Incorporates the modification at a specific rate (kits/month) that is set by the user. The rate is entered in cell D12.

Each incorporation style has its own unique costs which significantly impacts the model's expected costs. It may appear to be advantageous to choose the forced retrofit style in order to maximize the rate of installing the modification. However, the real world has limitations that may inhibit the modification through forced retrofit. For example, a depot's inability to handle the increased workload of a forced retrofit.

First Opportunity is used ninety-nine percent of the time due to its lower expected life cycle costs and the timing of the modification installation. This allows for the modification to take place during an unscheduled failure or during scheduled maintenance when maintenance costs are already incurred [Ref. 2:p 23].

2. Line 2.0 Does Kit Cost Replace Normal Maintenance Material Cost? (KitCostReplaceNormalMaint)

This requires a 1 = "Yes" or 0 = "No" input entered in cell D14.

3. Line 3.0 Delta Production Cost (DeltaProdCost)

This is the difference between the production cost of an engine incorporating the modification and one that does not contain the modification. This factor is used only for those engines still under production. The delta production cost value is determined by the contractor and is input directly into Cell D15.

4. Line 4.0 Kit Hardware Cost - ($) per Engine (KitCost)

This is cell D16 and is the cost to the government of an engine's component modification kit. This cost is provided by the contractor.

5. Line 5.0 Kit Labor Manhours at O&I (KitLaborOI)

This is cell D17 and is the expected time in manhours to install a modification kit at the organizational or the intermediate levels (O&I). This is usually determined by the contractor through logistic support analysis and past history of maintenance actions.

6. Line 6.0 Kit Labor Manhours at Depot (KitLaborDepot)

This is cell D18 and is the expected time in manhours to install a modification kit at the depot level. This is usually determined by the contractor through logistic support analysis and past history of maintenance actions.

For Lines 5.0 and 6.0, for example, General Electric's Aircraft Engine Division maintains a detailed record of all service maintenance performed on General Electric aircraft engines. This data is compiled by their field representatives and is centrally managed at headquarters [Ref. 1:p 27].

7. Line 7.0 Technical Pubs Cost (TechPubsCost)

This is the total cost of any technical publications associated with the proposed engine change. The cost determination is generally based on a count of the number of pages of the technical publications affected by the ECP. This is typically a minor cost and is supplied by the contractor. It is input directly into cell D19.

8. Line 8.0 TCTO Cost (TCTOCost)

This is displayed in cell D20 and is the Time Compliance Technical Order cost estimated by the contractor. A TCTO is issued for important changes when urgency is an issue. These changes usually provide information on field procedures which must be followed in accomplishing forced retrofits or first opportunity changes.

9. Line 9.0 Tooling/Support Equipment Cost (ToolSE.Cost)

This is displayed in cell D21 and includes the contractor's estimate of any special tooling or support equipment required to complete the component's modification. The costs to modify current tooling and support equipment to comply with ECP requirements are also included in this cost. The contractor supplies this cost estimate.

10. Line 10.0 Spare Parts Factor (SparePartFactor)

This is displayed in cell D22 and is the contractor's estimate of the percentage of total installed engines that are spare engines or spare modules which will require the proposed modification. It is calculated by the contractor using an operations and support costs model [Ref 1:p. 28].

11. Line 11.0 Scheduled % Events being Modified (SchPctEvtMod)

This is displayed in cell D24 and provides the contractor's estimate of the expected percentage of scheduled maintenance events during which a modification can be performed. The percentage difference between 100% and the input value represents the percentage of remaining scheduled events per year for which no engine modifications are expected to occur. The only restriction on this percentage value is that it must be greater than or equal to the estimated percentage of units discarded due to the component being beyond economical repair (scheduled percentage scrapped units). This prevents a unit which is beyond economical repair from being replaced by an unmodified component.

12. Line 12.0 Unscheduled % Events being Modified (UnschPctEvtMod)

This is displayed in cell D25 and provides the contractor's estimate of the percentage of unscheduled maintenance events during which a modification can be performed. The percentage difference between 100% and the input value represents the percentage of remaining unscheduled events per year for which no engine modifications are expected to occur. The only restriction on this percentage value is it must be greater than or equal to the expected percentage value of units discarded due to the component being beyond economical repair (unscheduled percentage scrapped units). This prevents a unit which is beyond economical repair from being replaced by an unmodified component.

13. Line 13.0 Unscheduled Event Rate allowing Modification (UnschEvtRateMod)

This is displayed in cell D26 and is the contractor's estimated rate that represents how often some unscheduled event is expected to occur which presents an opportunity to incorporate the proposed modification. This rate may not necessarily have anything to do with the part, assembly, component or module that is being modified.

The definition of "opportunity" used above is closely related to the incorporation style (Line 1.0). For "attrition" changes, the opportunity is usually when the part that is to be modified has a failure. In this case, Line 13.0 will equal Line 17.0. "First Opportunity" changes usually imply that incorporation of the change will occur the next time you can physically get you hands on the part to be modified. Often the part itself has not failed. For these cases, Line 13.0 will usually be a value larger than Line 17.0 and often represents a component, module, or engine removal rate other than a part failure rate. "Forced Retrofit" changes ignore this input.

14. Line 14.0 Production Incorporation Date (ProdIncorpYr)

This is entered into cells D28 and F28 and states the contractor's estimate of the year and month that the ECP will begin being incorporated into the engine production line. This input by the contractor has no impact on field kit modifications.

15. Line 15.0 Field Incorporation Date (FieldIncorpYr)

This is entered into cells D29 and F29 and states the contractor's estimate of the year and month that the modification will begin on engines which have already been produced. The purpose of this input is to allow for the possibility that the initial supply of modified components will go into engines currently on the production line. In that case, field modification normally will not begin until all production line engines are modified.

C. DESCRIPTION OF SCHEDULED INPUT PARAMETERS LINE 16.0 THROUGH LINE 30.0

Input parameters in this section are in a two-column format and require the contractor's information concerning the current and proposed engine component designs. Lines 16.0 through 30.0 account for any variations in repair costs which might result from scheduled inspections, removals, and repairs between the current design and the proposed design.

1. Line 16.0 Scheduled Maintenance Interval (TACs) (CurSchMaintInt or ProSchMaintInt)

These are displayed in cells E32 and F32 and represent the time between scheduled preventative maintenance actions, measured in Total Accumulated Cycles (TAC), during which an engine is expected to be available for component modification. An engine cycle is a measurement of the variation in thrust which an engine endures during operation. The formula used to measure engine cycles places the greatest emphasis on extreme variations in engine thrust and the least emphasis on constant cruise conditions. An engine will normally accumulate multiple cycles during each sortie [Ref 3:p. 17]. This interval drives the scheduled events and the associated costs. The contractor maintains records of each engine which can be used to determine this value.

2. Line 17.0 Calculated Scheduled Maintenance Interval Rate/1000 EFH (CurCalSchMaintInt or ProCalSchMaintInt)

These are not an actual input element. They are derived by dividing the product of the total accumulated cycles per engine flight hours and 1000 by the time between scheduled preventative maintenance actions. This rate represents the scheduled maintenance rate for the engine. An increase to the scheduled maintenance interval (Line 16.0) lowers the calculated rate factor (Line 17.0). The model's Life Cycle Cost formulas use the calculated rate factor in calculating the scheduled maintenance costs. The cell formula for the Current Configuration in cell E33 is

[CurCalSchMaintInt = (TACEFH * 1000)/CurSchMaintInt].

This equals

[Cell E33 = (Cell G23 * 1000)/Cell E32].

The cell formula for the Proposed Configuration in cell F33 is

[ProCalSchMaintInt = (TACEFH * 1000)/ProSchMaintInt].

This equals

[Cell F33 = (Cell G23 * 1000)/Cell F32].

3. Line 18.0 Scheduled Manhours to Inspect at O Level (CurSchMhInspOlev or ProSchMhInspOlev)

These are displayed in cells E34 or F34 and are the contractor's estimate of the number of manhours at the Organizational level which are required to accomplish any scheduled inspections on the component being modified.

4. Line 19.0 Scheduled % Removed at O & I Level (CurSchPctRemOILev or ProSchPctRemOILev)

These are displayed in cells E35 or F35 and are the contractor's estimate of the percentage of total components for which scheduled removal is required and performed at the

Organizational and Intermediate levels. If this percentage is not 100%, the remaining units would be either removed at the Depot level or not removed at all.

5. **Line 20.0 Scheduled Manhours to Remove and Replace at O Level (CurSchMhRrOlev or ProSchMhRrOlev)**

These are displayed in cells E36 or F36 and are the contractor's estimate of the number of manhours needed to remove and replace the component being modified during any scheduled maintenance at the Organizational level.

6. **Line 21.0 Scheduled Manhours at I Level (CurSchMhIlev or ProSchMhIlev)**

These are displayed in cells E37 or F37 and are the contractor's estimate of the average or expected number of manhours required to accomplish any scheduled maintenance on the component being modified at the Intermediate level.

7. **Line 22.0 Scheduled % at O & I Requiring Repair (CurSchPctRepOIlev or ProSchPctRepOIlev)**

These are displayed in cells E38 or F38 and are the contractor's estimate of the expected percentage of total units which require repair during any scheduled maintenance at the Organizational and Intermediate levels.

8. Line 23.0 Scheduled Repair Cost at O & I Level (CurSchRepOIlevCost or ProSchRepOIlevCost)

These are displayed in cells E39 or F39 and are the contractor's expected cost to repair one unit at the Organizational and Intermediate levels.

9. Line 24.0 Scheduled % Returned to Depot (CurSchPctRetDepot or ProSchPctRetDepot)

These are displayed in cells E40 and F40 and are the contractor's estimate of the expected percentage of components which require scheduled maintenance that cannot be performed at the Organizational and Intermediate levels. Scheduled maintenance includes inspections, monitoring, servicing and repair.

10. Line 25.0 Scheduled Manhours at Depot (CurSchMhDepot or ProSchMhDepot)

These are displayed in cells E41 and F41 and are the contractor's estimate of the expected total number of scheduled maintenance manhours required to repair the component at the Depot.

11. Line 26.0 Scheduled % at Depot Requiring Repair (CurSchPctDepotRep or ProSchPctDepotRep)

These are displayed in cells E42 and F42 and are the contractor's estimate of the expected percentage of total components requiring repair during scheduled maintenance at the Depot level. The scheduled repair category is a subset of scheduled maintenance.

12. Line 27.0 Scheduled Repair Cost at Depot (CurSchRepDepotCost or ProSchRepDepotCost)

These are displayed in cells E43 and F43 and are the contractor's estimate of the expected cost to repair one unit at the Depot level.

13. Line 28.0 Scheduled % Scrapped (CurSchPctScrap or ProSchPctScrap)

These are displayed in cells E44 and F44 and are the contractor's estimate of the expected percentage of total components, identified during scheduled maintenance, which must be discarded because the component is beyond economical repair.

14. Line 29.0 Hardware Cost to Scrap (CurSchPartScpCost or ProSchPartScpCost)

These are displayed in cells E45 and F45 and are the contractor's estimate of the expected cost to replace a component scrapped during scheduled maintenance. This assumes that a scrapped component will be replaced by a new unit which is identical to the scrapped one. This cost is not related to the costs of disposing the scrapped component.

15. Line 30.0 Scheduled Engine Test Time (CurSchEngTstTime or ProSchEngTstTime)

These are displayed in cells E46 and F46 and are the contractor's estimate of the expected number of hours of engine test time required for each component undergoing scheduled maintenance at the Depot level.

D. DESCRIPTION OF UNSCHEDULED INPUT PARAMETERS LINE 31.0 THROUGH LINE 47.0

Input parameters in this section are in a two-column format and require information about the current and proposed engine component designs. Lines 31.0 through 47.0 account for any variations in repair costs which might result from unscheduled inspections, removals, and repairs between the current design and the proposed design.

1. Line 31.0 Unscheduled Event Rate/1000 EFH (CurUnschEvtRate or ProUnschEvtRate)

These are displayed in cells E48 and F48 and are the rate that represents how often the pertinent component is expected to fail. The failure will require an expenditure of money to return the system to operational status. To keep the model flexible, the definition of "failure" is intentionally not specific (i.e., what constitutes a failure of component). For each individual CEA, the specific definition of failure must be provided by the contractor. The failure rate may represent inherent or induced failures (or both) and may be applicable to a single part, the entire engine or anything in between. The rate may also include failures discovered at any level of maintenance. The reciprocal of this rate provides the current component's MTBF and the proposed component's predicted MTBF. The current MTBF rate is available from the maintenance data which is maintained by the contractor. The proposed MTBF rate is provided by the contractor's engineering division. This rate drives the component's unscheduled events and associated costs.

2. Line 32.0 Unscheduled Manhours at O Level (CurUnschMhInspOlev or ProUnschMhInspOlev)

These are displayed in cells E49 and F49 and are the contractor's estimate of the expected number of manhours at the Organizational level which are required to accomplish any unscheduled inspections on the component being considered for modification.

3. Line 33.0 Unscheduled % Removed at O & I Level (CurUnschPctRemOILev or ProUnschPctRemOILev)

These are displayed in cells E50 and F50 and are the contractor's estimate of the expected percentage of total components for which unscheduled removal is expected to be able to be performed at the Organizational and Intermediate levels. If this percentage is not 100%, the remaining units would either be removed at the Depot level or not removed at all.

4. Line 34.0 Unscheduled Manhours to Remove and Replace at the O Level (CurUnschMhRrOlev or ProUnschMhRrOlev)

These are displayed in cells E51 and F51 and are the contractor's estimate of the expected number of manhours required to remove and replace the component at the Organizational level in order to perform unscheduled maintenance.

5. **Line 35.0 Unscheduled Manhours at the I Level (CurUnschMhIlev or ProUnschMhIlev)**

These are displayed in cells E52 and F52 and are the contractor's estimate of the expected number of manhours expended at the Intermediate level on the component being modified in order to accomplish any unscheduled maintenance.

6. **Line 36.0 Unscheduled % at O & I Level Requiring Repair (CurUnschPctRepOIlev or ProUnschPctRepOIlev)**

These are displayed in cells E53 and F53 and are the contractor's estimate of the percentage of total components which are expected to require repair at the Organizational and Intermediate levels during any unscheduled maintenance.

7. **Line 37.0 Unscheduled repair Cost at the O & I Level (CurUnschRepOIlevCost or ProUnschRepOIlevCost)**

These are displayed in cells E54 and F54 and are the contractor's estimate of the expected cost to repair one component at the Organizational and Intermediate levels during an unscheduled event.

8. **Line 38.0 Unscheduled % Returned to Depot (CurUnschPctRepDepot or ProUnschPctRepDepot)**

These are displayed in cells E55 and F55 and are the contractor's estimate of the percentage of components which are expected to require repair during unscheduled maintenance that cannot be performed at the Organizational and Intermediate levels.

9. Line 39.0 Unscheduled Manhours at Depot (CurUnschMhDepot or ProUnschMhDepot)

These are displayed in cells E56 and F56 and are the contractor's estimate of the total expected number of manhours required to perform unscheduled maintenance on the component at the Depot.

10. Line 40.0 Unscheduled % at Depot Requiring Repair (CurUnschPctDepotRep or ProUnschPctDepotRep)

These are displayed in cells E57 and F57 and are the contractor's estimate of the percentage of total components expected to require unscheduled repair at the Depot level.

11. Line 41.0 Unscheduled Repair Cost at Depot (CurUnschRepDepotCost or ProUnschRepDepotCost)

These are displayed in cells E58 and F58 and are the contractor's estimate of the expected cost to repair one unit at the Depot level resulting from unscheduled maintenance.

12. Line 42.0 Unscheduled % Scrapped (CurUnschPctScrap or ProUnschPctScrap)

These are displayed in cells E59 and F59 and are the contractor's estimate of the percentage of total components, identified during unscheduled maintenance, which are expected to be discarded because the component is beyond economical repair.

13. Line 43.0 Hardware Cost to Scrap (CurUnschPartScpCost or ProUnschPartScpCost)

These are displayed in cells E60 and F60 and are the contractor's estimate of the cost to replace a component scrapped during unscheduled maintenance. This assumes that a scrapped component will be replaced by a new unit which is identical to the scrapped one. This cost is not related to the costs of disposing the scrapped component.

14. Line 44.0 Unscheduled Engine Test Time (CurUnschEngTstTime or ProUnschEngTstTime)

These are displayed in cells E61 and F61 and are the expected number of hours of engine test time required for each component undergoing unscheduled maintenance at the Depot level. This information is provided by the contractor.

15. Line 45.0 Unscheduled Secondary Damage Costs (CurUnschSecDamCost or ProUnschSecDamCost)

These are displayed in cells E62 and F62 and cover the estimated material costs to fix other damaged components due to the failure of the component being modified. It is assumed that the labor cost associated with correcting the secondary damage would be covered by the labor involved to repair and replace the originally failed component. If this is not the case, all related costs for repairing the secondary damages are included in this input. These inputs are provided by the contractor.

16. Line 46.0 Unscheduled Incidental Costs (CurUnschIncidentalCost or ProUnschIncidentalCost)

These are displayed in cells E63 and F63 and are collective cost elements that accounts for any expected miscellaneous material costs per unscheduled event that are not covered by any other input element. These costs are provided by the contractor.

17. Line 47.0 Number of Part Numbers (CurPartNums or ProPartNums)

These are displayed in cells E64 and F64 and reflect the contractor's estimate of the total number of part number changes relating to the modification. A proposed configuration change which reduces the number of parts in the component will offer lower costs associated with part number maintenance costs.

E. DESCRIPTION OF OPTIONAL INPUT PARAMETERS LINE 48.0 AND LINE 49.0

This section consists of two elements that contain optional input values that indicate an expected improvement from the incorporation of the proposed design. These values are provided by the contractor.

1. Line 48.0 % Improvement in Specific Fuel Consumption from Current to Proposed (PctImpSFC)

This is displayed in cell F66 and is the contractor's estimate of the expected improvement in fuel consumption when the proposed ECP is incorporated and is predicted to decrease the fuel consumption rate of the aircraft.

2. Line 49.0 Aircraft Loss Rate Improvement/1,000,000 EFH (AClossImprove)

This is displayed in cell F67 and indicates the contractor's estimate of the expected improvement in the ratio of aircraft losses per million engine flight hours after the proposed ECP has been incorporated. The losses refer to those which are attributable to the subject component. This frequency is not easy to measure and can best be described as an attempt to incorporate the cost of losing the entire system due to the unscheduled failure of the component.

F. DESCRIPTION OF THE STANDARD INPUT VALUES

This section consists of 13 standard input values to be used by the formulas contained in the model. These input values are provided by the Standard History File engine fleet input pages located in the Std_Hist.xls file. The contractor inputs the information in this file prior to executing the model (see the Chapter X section on setting up and loading a standard history file). Appendix B provides an example of the Standard History File engine fleet input page.

Fiscal Year Dollars (YrDollar) is displayed in cell G8 and is, in reality, the specification of the baseline year from which the net present value of the life cycle costs will be calculated.

NPV Rate (NPVrate) is displayed in cell G9 and is the discount rate of return required to determine the net present value of the projected future cash inflows and outflows anticipated from a proposed component modification that is recommended by an Engineering Change Proposal. The current real discount rate of return used by the Navy is 7% [Ref 7:p. 9].

Labor Cost/Manhour at O & I Level (LaborCostOI) is displayed in cell G11 and represents Organizational and Intermediate level labor costs per manhour which is determined from labor cost data maintained by the military organization that is considering the ECP.

Labor Cost/Manhour at Depot Level (LaborCostDepot) is displayed in cell G12 and represents Depot level labor costs per manhour which is determined from labor cost data maintained by the military organization that is considering the ECP.

Cost to Introduce New Part Numbers - ($) per Part Number (PnIntroCost) is displayed in cell G14 and is the cost of introducing a new part number into the military supply system. This cost is determined by the Inventory Control Point (ICP) responsible for managing the item. There may be numerous new parts for each approved ECP.

Cost to Maintain each Part Number per Year (PnMatinCost) is displayed in cell G15 and is the annual cost of maintaining a part in the military supply system. This cost is determined by the ICP responsible for managing the part.

Fuel Cost per Gallon (FuelCostGal) is displayed in cell G17 and is the cost per gallon of fuel to test the engine after the modification has been accomplished.

Test Fuel - Gallons per Hour (TestFuelGH) is displayed in cell G19 and is the number of gallons per hour of fuel required to test the engine following the modification. This value is obtained from cell S50.

Flight Fuel - Gallons per Hour (FltFuelGH) is displayed in cell G20 and is the operational fuel consumption rate in gallons per hour required to operate the engine after the modification has been accomplished. This value is obtained from cell S51.

EFH per Year (EfhYr) is displayed in cell G22 and is the average number of engine flight hours (EFH) per engine per year. This input is contractor provided and is based on the government's projected total annual flight hours. This value is obtained from cell P50.

TAC per EFH Ratio (TacEfh) is displayed in cell G23 and is the ratio of the expected annual Total Accumulated Cycles (TAC) to the total annual expected number of Engine Flight Hours (EFH). As described earlier, an engine cycle is a measurement of the variation in thrust which an engine endures during operation. The formula used to measure engine cycles places the greatest emphasis on extreme variations in engine thrust and the least emphasis on constant cruise conditions. An engine will normally accumulate multiple cycles per sortie. The TAC/EFH ratio is obtained by the contractor from the standard history file of the engine. This value is obtained from cell P51.

TOT per EFH Ratio (TotEfh) is displayed in cell G24 and is a ratio of total engine hours (TOT) to engine flight hours. Total engine hours include test time, runway warmup, and taxi time. This ratio is provided by the standard history file of the engine being considered. This value is obtained from Cell P52.

Aircraft Cost (AirCraftCost) is displayed in cell G26 and is the current purchase price of the fully equipped aircraft. If this information is unavailable, then the last known purchase price is used and adjusted to current year dollars. This value is obtained from Cell S52. It is an estimate entered by the contractor.

G. CALCULATED SUBTOTALS

This section describes cells which the CEAMOD spreadsheet user sees on the computer screen but are not provided as part of the printed ECP CEA package. These cells display much of the data provided by the model's Interim Calculation Page

(page 7 of the model). This section includes spreadsheet columns I through L.

Kit Cost (KitCost) is displayed in cell J23 and is the purchase price per engine of the component modification kit. The cell formula is KitCost and its value comes from Line 4.0, cell D16 on Page 1 of the model.

Labor Cost to Install the Kit (KitLaborCost) is displayed in cell J24 and is the expected total labor costs of the manhours required to install a modification kit at both the Organizational and Intermediate levels, and at the Depot level. The cell formula is

[KitLaborCost = (KitLaborOI*LaborCostOI) + (KitLaborDepot * LaborCostDepot)].

This equals

[Cell J24 = (Cell D17 * Cell G11) + (Cell D18 * Cell 12)].

KitLaborOI is cell D17 and is the expected time in manhours to install a modification kit at the Organizational and Intermediate levels.

LaborCostOI is cell G11 and is the Organizational and Intermediate levels labor cost per manhour.

KitLabDepot is cell D18 and is the expected time in manhours to install a modification kit at the Depot level.

LaborCostDepot is cell G12 and is the Depot level labor cost per manhour.

Total Cost to Install the Kit (TotCostInstallKit) is displayed in cell J25 and is the sum of the kit cost and the labor costs to install the modification kit. The cell formula is

[TotCostInstallKit = KitCost + KitLaborCost].

This equals

[Cell J25 = Cell D16 + Cell J24].

KitCost is cell D16 and is the purchase price per engine of the component modification kit.

KitLaborCost is cell J24 and is the expected total labor costs of the manhours required to install a modification kit at both the Organizational and Intermediate levels, and at the Depot level.

O & I Labor Cost / Scheduled Event (CurSchOILaborCostEvt and ProSchOILaborCostEvt) is the expected labor cost to repair a component at the Organizational and Intermediate levels. This includes inspecting, removing and replacing the unit during a scheduled event. The cell formula for the Current Configuration in cell K33 is

[CurSchOILaborCostEvt = LaborCostOI * (((CurSchMhILev + CurSchMhRrOLev) * CurSchPctRemOILev) + CurSchMhInspOLev)].

This equals

[Cell K33 = Cell G11 * (((Cell E37 + Cell E36) * Cell E35) + Cell E34)].

The cell formula for the Proposed Configuration in cell L33 is

[ProSchOILaborCostEvt = LaborCostOI * (((ProSchMhILev + ProSchMhRrOLev) * ProSchPctRemOILev) + ProSchMhInspOLev)].

This equals

[Cell L33 = Cell G11*(((Cell F37 + Cell F36) * Cell F35) + Cell
F34)].

LaborCostOI is cell G11 and is the Organizational and Intermediate level labor cost per manhour.

CurSchMhInspOLev is cell E34 and is the number of manhours at the Organizational level which are expected to be required to accomplish any scheduled inspections on the unmodified (current) component.

CurSchPctRemOILev is cell E35 and is the percentage of unmodified components for which scheduled removal is expected to be required and performed at the Organizational and Intermediate levels.

CurSchMhRrOLev is cell E36 and is the number of manhours expected to be needed to remove and replace the unmodified component during any scheduled maintenance at the Organizational level.

CurSchMhILev is cell E37 and is the number of manhours which are expected to be required to accomplish any scheduled maintenance on an unmodified at the Intermediate level.

ProSchMhInspOLev is cell F34 and is the number of manhours at the Organizational level which are expected to be required to accomplish any scheduled inspections on a modified component (i.e., a component having the proposed configuration).

ProSchPctRemOILev is cell F35 and is the percentage of modified components for which scheduled removal will be required to be performed at the Organizational and Intermediate levels.

ProSchMhRrOLev is cell F36 and is the number of manhours expected to be needed to remove and replace a modified component during any scheduled maintenance at the Organizational level.

ProSchMhILev is cell F37 and is the number of manhours expected to be required to accomplish any scheduled maintenance on a modified component at the Intermediate level.

Depot Labor Cost / Scheduled Event (CurSchOILaborCostEvt and ProSchOILaborCostEvt) is the expected labor cost to repair a component at the Depot level during a scheduled event. The cell formula for the Current Configuration in cell K34 is

[CurSchOILaborCostEvt = CurSchPctRetDepot * CurSchMhDepot * LaborCostDepot].

This equals

[Cell K34 = Cell E40 * Cell E41 * Cell G12].

The cell formula for the Proposed Configuration in cell L34 is

[ProSchOILaborCostEvt = ProSchPctRetDepot * ProSchMhDepot * LaborCostDepot]

This equals

[Cell L34 = Cell F40 * Cell F41 * Cell G12].

CurSchPctRetDepot is cell E40 and is the percentage of unmodified components which are expected to require scheduled maintenance that cannot be performed at the Organizational and Intermediate levels.

CurSchMhDepot is cell E41 and is the total number of scheduled maintenance manhours expected to be needed to repair an unmodified component at the Depot level.

ProSchPctRetDepot is cell F40 and is the percentage of modified components which are expected to require scheduled maintenance that cannot be performed at the Organizational and Intermediate levels.

ProSchMhDepot is cell F41 and is the total number of scheduled maintenance manhours which are expected to be needed to repair a modified component at the Depot level.

LaborCostDepot is cell G12 and is the Depot level labor cost per manhour.

Total Labor Cost / Scheduled Event (CurSchTotLaborCostEvt and ProSchTotLaborCostEvt) is the sum of the expected total labor cost to repair a component at the Organizational, Intermediate and Depot levels during a scheduled event. The cell formula for the Current Configuration in cell K35 is

[CurSchTotLaborCostEvt = CurSchOILaborCostEvt + CurSchDepLaborCostEvt].

This equals

[Cell K35 = Cell K33 + Cell K34].

The cell formula for the Proposed Configuration in cell L35 is [ProSchTotLaborCostEvt = ProSchOILaborCostEvt + ProSchDepLaborCostEvt].

This equals

[Cell L35 = Cell L33 + Cell L34].

CurSchOILaborCostEvt is cell K33 and is the expected labor cost to repair a component with the current configuration at the Organizational and Intermediate levels.

CurSchDepLaborCostEvt is cell K34 and is the expected labor cost to repair a component with the current configuration at the Depot level.

ProSchOILaborCostEvt is cell L33 and is the expected labor cost to repair a component with the proposed configuration at the Organizational and Intermediate levels.

ProSchDepLaborCostEvt is cell L34 and is the expected labor cost to repair a component with the proposed configuration at the Depot level.

O & I Repair Cost / Scheduled Event (CurSchOIRepCostEvt and ProSchOIRepCostEvt) is the expected cost to repair the percentage of components which are expected to require repair during any scheduled maintenance at the Organizational and Intermediate levels. The cell formula for the Current Configuration in cell K37 is

[CurSchOIRepCostEvt = CurSchPctRepOILev * CurSchRepOILevCost].

This equals

[Cell K37 = Cell E38 * Cell E39].

The cell formula for the Proposed Configuration in cell L37 is

[ProSchOIRepCostEvt = ProSchPctRepOILev * ProSchRepOILevCost].

This equals

[Cell L37 = Cell F38 * Cell F39].

CurSchPctRepOILev is cell E38 and is the percentage of unmodified components which are expected to require repair during any scheduled maintenance at the Organizational and Intermediate levels.

CurSchRepOILevCost is cell E39 and is the expected cost to repair an unmodified component at the Organizational and Intermediate levels.

ProSchPctRepOILev is Cell F38 and is the percentage of modified components which are expected to require repair during any scheduled maintenance at the Organizational and Intermediate levels.

ProSchRepOILevCost is cell F39 and is the expected cost to repair a modified component at the Organizational and Intermediate levels.

Depot Repair Cost / Scheduled Event (CurSchDepRepCostEvt and ProSchDepRepCostEvt) is the expected cost to repair the percentage of components requiring scheduled repair at the Depot level. The cell formula for the Current Configuration in cell K38 is

[CurSchDepRepCostEvt = CurSchPctDepRep * CurSchRepDepCost].

This equals

[Cell K38 = Cell E42 * Cell E43].

The cell formula for the Proposed Configuration in cell L38 is

[ProSchDepRepCostEvt = ProSchPctDepRep * ProSchRepDepCost].

This equals

[Cell L38 = Cell F42 * Cell F43].

CurSchPctDepRep is cell E42 and is the percentage of unmodified components which are expected to require scheduled repair at the Depot level.

CurSchRepDepCost is cell E43 and is the expected cost to repair an unmodified component at the Depot level.

ProSchPctDepRep is cell F42 and is the percentage of modified components which are expected to require scheduled repair at the Depot level.

ProSchRepDepCost is cell F43 and is the expected cost to repair a modified component at the Depot level.

Scrap Cost / Scheduled Event (CurSchScrapCostEvt and ProSchScrapCostEvt) is the expected cost to replace the percentage of total components, identified during scheduled maintenance, which are expected to be discarded because the component is beyond economical repair. As explained earlier, this cost is not related to the cost of disposing the scrapped component. The cell formula for the Current Configuration in cell K39 is

[CurSchScrapCostEvt = CurSchPctScrap * CurSchPartScpCost].

This equals

[Cell K39 = Cell E44 * Cell E45].

The cell formula for the Proposed Configuration in cell L39 is

[ProSchScrapCostEvt = ProSchPctScrap * ProSchPartScpCost].

This equals

[Cell L39 = Cell F44 * Cell F45].

CurSchPctScrap is cell E44 and is the percentage of unmodified components identified during scheduled maintenance, which are expected to be discarded because the component is beyond economical repair.

CurSchPartScpCost is cell E45 and is the expected cost to replace an unmodified component which was scrapped during scheduled maintenance.

ProSchPctScrap is cell F44 and is the percentage of unmodified components identified during scheduled maintenance, which are expected to be discarded because the component is beyond economical repair.

ProSchPartScpCost is cell F45 and is the expected cost to replace a modified component which was scrapped during scheduled maintenance.

Total Material Cost / Scheduled Event (CurSchTotMatCostEvt and ProSchTotMatCostEvt) is the sum of the total expected costs to repair a component or replace a scrapped component during scheduled maintenance at the Organizational and Intermediate and Depot levels. The cell formula for the Current Configuration in cell K40 is

[CurSchTotMatCostEvt = CurSchOIRepCostEvt + CurSchDepRepCostEvt + CurSchScrapCostEvt].

This equals

[Cell K40 = Cell K37 + Cell K38 + Cell K39].

The cell formula for the Proposed Configuration in cell L40 is

[ProSchTotMatCostEvt = ProSchOIRepCostEvt + ProSchDepRepCostEvt + ProSchScrapCostEvt].

This equals

[Cell L40 = Cell L37 + Cell L38 + Cell L39].

CurSchOIRepCostEvt is cell K37 and is the expected cost to repair the percentage of unmodified components which are expected to require any scheduled maintenance at the Organizational and Intermediate levels.

CurSchDepRepCostEvt is cell K38 and is the expected cost to repair the percentage of unmodified components requiring scheduled repair at the Depot level.

CurSchScrapCostEvt is cell K39 and is the expected cost to replace the percentage of unmodified components, identified during scheduled maintenance, which are expected to be discarded because the component is beyond economical repair.

ProSchOIRepCostEvt is cell L37 and is the expected cost to repair the percentage of modified components which require repair during any scheduled maintenance at the Organizational and Intermediate levels.

ProSchDepRepCostEvt is cell L38 and is the expected cost to repair the percentage of modified components requiring scheduled repair at the Depot level.

ProSchScrapCostEvt is cell L39 and is the expected cost to replace the percentage of modified components, identified during scheduled maintenance, which are expected to be discarded because the component is beyond economical repair.

Test Labor & Fuel Cost / Scheduled Event (CurSchTestLabFuelCostEvt and ProSchTestLabFuelCostEvt) is the total expected cost, including labor, of the engine test time required for each component which has undergone scheduled maintenance. The cell formula for the Current Configuration in cell K42 is

[CurSchTestLabFuelCostEvt = TestFuelGH * FuelCostGal * CurSchEngTstTime + 2 * LaborCostOI * CurSchEngTstTime].

This equals

[Cell K42 = Cell S50 * Cell G17 * Cell E46 + 2 * Cell G11 * Cell E46].

The cell formula for the Proposed Configuration in cell L42 is [ProSchTestLabFuelCostEvt = TestFuelGH * FuelCostGal * ProSchEngTstTime + 2 * LaborCostOI * ProSchEngTstTime].

This equals

[Cell L42 = Cell S50 * Cell G17 * Cell F46 + 2 * Cell G11 * Cell F46].

TestFuelGH is cell S50 and is the number of gallons per hour of fuel required to test the engine following the modification.

FuelCostGal is cell G17 and is the cost per gallon of fuel to test an engine.

CurSchEngTstTime is cell E46 and is the expected number of hours of engine test time required for an engine having an unmodified component and undergoing scheduled maintenance at the Depot level.

LaborCostOI is cell G11 and represents Organizational and Intermediate level labor cost per manhour which is determined from labor cost data maintained by the military organization that is considering the ECP.

ProSchEngTstTime is cell F46 and is the expected number of hours of engine test time required for an engine having a modified component and undergoing scheduled maintenance at the Depot level.

Note: The "2" in the formula indicates the number of maintenance personnel required to perform the engine testing.

Total Material Cost Including Test Cost / Scheduled Event (CurTotMatCostSchEvt and ProTotMatCostSchEvt) is the sum of the expected costs to test a component before or after modification and to repair a component or replace a scrapped component during scheduled maintenance at the Organizational, Intermediate and Depot levels. The cell formula for the Current Configuration in cell K43 is

[CurTotMatCostSchEvt = CurSchTotMatCostEvt + CurSchTestLabFuelCostEvt].

This equals

[Cell K43 = Cell K40 + Cell K42].

The cell formula for the Proposed Configuration in cell L43 is

[ProTotMatCostSchEvt = ProSchTotMatCostEvt + ProSchTestLabFuelCostEvt].

This equals

[Cell L43 = Cell L40 + Cell L42].

CurSchTotMatCostEvt is cell K40 and is the sum of the expected costs to repair an unmodified component or replace a scrapped component, during scheduled maintenance at the Organizational and Intermediate and Depot levels.

CurSchTestLabFuelCostEvt is cell K42 and is the total expected costs, including labor, of the engine test time required for an engine having an unmodified component which has undergone scheduled maintenance.

ProSchTotMatCostEvt is cell L40 and is the sum of the expected costs to repair a modified component or replace a scrapped component during scheduled maintenance at the Organizational, Intermediate and Depot levels.

ProSchTestLabFuelCostEvt is cell L42 and is the total expected costs, including labor, of the engine test time required for an engine having a modified component which has undergone scheduled maintenance.

O & I Labor Cost / Unscheduled Event (CurUnschOILaborCostEvt and ProUnschOILaborCostEvt) is the expected labor cost to repair one unit at the Organizational and Intermediate levels. This includes inspecting, removing and replacing a component during an unscheduled event. The cell formula for the Current Configuration in cell K49 is

[CurUnschOILaborCostEvt = LaborCostOI*(((CurUnschMhRrOLev + CurUnschMhILev) * CurUnschPctRemOILev) + CurUnschMhOLev0].

This equals

[Cell K49 = Cell G11*(((Cell E51 + Cell E52) * Cell E50) + Cell E49)].

The cell formula for the Proposed Configuration in cell L49 is

[ProUnschOILaborCostEvt = LaborCostOI*(((ProUnschMhRrOLev + ProUnschMhILev) * ProUnschPctRemOILev) + ProUnschMhOLev0].

This equals

[Cell L49 = Cell G11*(((Cell F51 + Cell F52) * Cell F50) + Cell F49)].

LaborCostOI is cell G11 and is the Organizational and Intermediate levels labor cost per manhour.

CurUnschMhOLev is cell E49 and is the expected number of manhours at the Organizational level which are required to accomplish any unscheduled inspections on an unmodified component. CurUnschPctRemOILev is cell E50 and is the percentage of unmodified components for which unscheduled removal is expected to be performed at the Organizational and Intermediate levels.

CurUnschMhRrOLev is cell E51 and is the expected number of manhours needed to remove and replace an unmodified component during any unscheduled maintenance at the Organizational level.

CurUnschMhILev is cell E52 and is the expected number of manhours expended to accomplish any unscheduled maintenance on an unmodified component at the Intermediate level.

ProUnschMhOLev is cell F49 and is the expected number of manhours at the Organizational level which are required to accomplish any unscheduled inspections on a modified component.

ProUnschPctRemOILev is cell F50 and is the percentage of modified components for which unscheduled removal is expected to be performed at the Organizational and Intermediate levels.

ProUnschMhRrOLev is cell F51 and is the expected number of manhours needed to remove and replace the a modified component during any unscheduled maintenance at the Organizational level.

ProUnschMhILev is cell F52 and is the expected number of manhours expended to accomplish any unscheduled maintenance on a modified component at the Intermediate level.

Depot Labor Cost / Unscheduled Event (CurUnschDepLaborCostEvt and ProUnschDepLaborCostEvt) is the expected labor cost to repair a component at the Depot level during an unscheduled event. The cell formula for the Current Configuration in cell K50 is

[CurUnschDepLaborCostEvt = CurUnschPctRetDepot * CurUnschMhDepot * LaborCostDepot].

This equals

[Cell K50 = Cell E55 * Cell E56 * Cell G12].

The cell formula for the Proposed Configuration in cell L50 is

[ProUnschDepLaborCostEvt = ProUnschPctRetDepot * ProUnschMhDepot * LaborCostDepot].

This equals

[Cell L50 = Cell F55 * Cell F56 * Cell G12].

CurUnschPctRetDepot is cell E55 and is the percentage of unmodified components which are expected to require repair during unscheduled maintenance that cannot be performed at the Organizational and Intermediate levels and, therefore, must be performed at the Depot level.

CurUnschMhDepot is cell E56 and is the total expected number of manhours required to repair an unmodified component during unscheduled maintenance at the Depot level.

ProUnschPctRetDepot is cell F55 and is the percentage of modified components which are expected to require repair during unscheduled maintenance that cannot be performed at the Organizational and Intermediate levels and, therefore, must be performed at the Depot level.

ProUnschMhDepot is cell F56 and is the total expected number of manhours required to repair a modified component during unscheduled maintenance at the Depot level.

LaborCostDepot is cell G12 and is the Depot level labor cost per manhour.

Total Labor Cost / Unscheduled Event (CurUnschTotLaborCostEvt and ProUnschTotLaborCostEvt) is the sum of the expected labor costs to repair a component at the Organizational, Intermediate and Depot levels during an unscheduled event.

The cell formula for the Current Configuration in cell K51 is

[CurUnschTotLaborCostEvt = CurUnschOILaborCostEvt + CurUnschDepLaborCostEvt].

This equals

[Cell K51 = Cell K49 + Cell K50].

The cell formula for the Proposed Configuration in cell L51 is

[ProUnschTotLaborCostEvt = ProUnschOILaborCostEvt + ProUnschDepLaborCostEvt].

This equals

[Cell L51 = Cell L49 + Cell L50].

CurUnschOILaborCostEvt is cell K49 and is the expected labor cost to repair an unmodified component at the Organizational and Intermediate levels.

CurUnschDepLaborCostEvt is cell K50 and is the expected labor cost to repair an unmodified component at the Depot level.

ProUnschOILaborCostEvt is cell L49 and is the expected labor cost to repair a modified component at the Organizational and Intermediate levels.

ProUnschDepLaborCostEvt is cell L50 and is the expected labor cost to repair a modified component at the Depot level.

O & I Repair Cost / Unscheduled Event (CurUnschOIRepCostEvt and ProUnschOIRepCostEvt) is the cost to repair the percentage of components which are expected to require repair during any unscheduled maintenance at the

Organizational and Intermediate levels. The cell formula for the Current Configuration in cell K53 is

[CurUnschOIRepCostEvt = CurUnschPctRepOILev * CurUnschRepOILevCost].

This equals

[Cell K53 = Cell E53 * Cell E54].

The cell formula for the Proposed Configuration in cell L53 is

[ProUnschOIRepCostEvt = ProUnschPctRepOILev * ProUnschRepOILevCost].

This equals

[Cell L53 = Cell F53 * Cell F54].

CurUnschPctRepOILev is cell E53 and is the percentage of unmodified components which are expected to require repair during any unscheduled maintenance at the Organizational and Intermediate levels.

CurUnschRepOILevCost is cell E54 and is the expected cost to repair an unmodified component at the Organizational and Intermediate levels.

ProUnschPctRepOILev is cell F53 and is the percentage of modified components which are expected to require repair during any unscheduled maintenance at the Organizational and Intermediate levels.

ProUnschRepOILevCost is cell F54 and is the expected cost to repair a modified component at the Organizational and Intermediate levels.

Depot Repair Cost / Unscheduled Event (CurUnschDepRepCostEvt and ProUnschDepRepCostEvt) is the cost to repair the percentage of components expected to require unscheduled repair at the Depot level. The cell formula for the Current Configuration in cell K54 is

[CurUnschDepRepCostEvt = CurUnschPctDepotRep * CurUnschRepDepotCost].

This equals

[Cell K54 = Cell E57 * Cell E58].

The cell formula for the Proposed Configuration in cell L54 is

[ProUnschDepRepCostEvt = ProUnschPctDepotRep * ProUnschRepDepotCost].

This equals

[Cell L54 = Cell F57 * Cell F58].

CurUnschPctDepRep is cell E57 and is the percentage of unmodified components expected to require unscheduled repair at the Depot level.

CurUnschRepDepCost is cell E58 and is the expected cost to repair an unmodified component resulting from unscheduled maintenance at the Depot level.

ProUnschPctDepRep is cell F57 and is the percentage of modified components which are expected to require unscheduled repair at the Depot level.

ProUnschRepDepCost is cell F58 and is the expected cost to repair a modified component resulting from unscheduled maintenance at the Depot level.

Scrap Cost / Unscheduled Event (CurUnschScrapCostEvt and ProUnschScrapCostEvt) is the expected cost to replace the percentage of components, identified during unscheduled maintenance, which must be discarded because the component is beyond economical repair. This cost is not related to the cost of disposing the scrapped component. The cell formula for the Current Configuration in cell K55 is

[CurUnschScrapCostEvt = CurUnschPctScrap * CurUnschPartScpCost].

This equals

[Cell K55 = Cell E59 * Cell E60].

The cell formula for the Proposed configuration in cell L55 is

[ProUnschScrapCostEvt = ProUnschPctScrap * ProUnschPartScpCost].

This equals

[Cell L55 = Cell F59 * Cell F60].

CurUnschPctScrap is cell E59 and is the percentage of unmodified components, identified during unscheduled maintenance, which are expected to be discarded because the component is beyond economical repair.

CurUnschPartScpCost is cell E60 and is the expected cost to replace an unmodified component which was scrapped during unscheduled maintenance.

ProUnschPctScrap is cell F59 and is the percentage of modified components, identified during unscheduled maintenance, which are expected to be discarded because the component is beyond economical repair.

ProUnschPartScpCost is cell F60 and is the expected cost to replace modified component which was scrapped during unscheduled maintenance.

Total Material Cost / Unscheduled Event (CurUnschTotMatCostEvt and ProUnschTotMatCostEvt) is the sum of the expected material costs to repair a component or replace a scrapped component during unscheduled maintenance at the Organizational, Intermediate and Depot levels. The cell formula for the Current Configuration in cell K56 is

[CurUnschTotMatCostEvt = CurUnschOIRepCostEvt + CurUnschDepRepCostEvt + CurUnschScrapCostEvt].

This equals

[Cell K56 = Cell K53 + Cell K54 + Cell K55].

The cell formula for the Proposed Configuration in cell L56 is

[ProUnschTotMatCostEvt = ProUnschOIRepCostEvt + ProUnschDepRepCostEvt + ProUnschScrapCostEvt].

This equals

[Cell L56 = Cell L53 + Cell L54 + Cell L55].

CurUnschOIRepCostEvt is cell K53 and is the cost to repair the percentage of unmodified components which are expected to require repair during any unscheduled maintenance at the Organizational and Intermediate levels.

CurUnschDepRepCostEvt is cell K54 and is the cost to repair the percentage of unmodified components expected to require unscheduled repair at the Depot level.

CurUnschScrapCostEvt is cell K55 and is the cost to replace the percentage of unmodified components, identified during unscheduled maintenance, which are expected to be discarded because the component is beyond economical repair.

ProUnschOIRepCostEvt is cell L53 and is the cost to repair the percentage of modified components which are expected to require repair during any unscheduled maintenance at the Organizational and Intermediate levels.

ProUnschDepRepCostEvt is cell L54 and is the cost to repair the percentage of modified components requiring unscheduled repair at the Depot level.

ProUnschScrapCostEvt is cell L55 and is the cost to replace the percentage of modified components, identified during unscheduled maintenance, which are expected to be discarded because the component is beyond economical repair.

Test Labor & Fuel Cost / Unscheduled Event (CurUnschTestLabFuelCostEvt and ProUnschTestLabFuelCostEvt) is the total expected cost, including labor, of the engine test time required for each component undergoing unscheduled maintenance. The cell formula for the Current Configuration in cell K58 is

[CurUnschTestLabFuelCostEvt = TestFuelGH * FuelCostGal * CurUnschEngTstTime + 2 * LaborCostOI * CurUnschEngTstTime].

This equals

[Cell K58 = Cell S50 * Cell G17 * Cell E61 + 2 * Cell G11 * Cell E61].

The cell formula for the Proposed Configuration in cell L58 is

[ProUnschTestLabFuelCostEvt = TestFuelGH * FuelCostGal * ProUnschEngTstTime + 2 * LaborCostOI * ProUnschEngTstTime].

This equals

[Cell L58 = Cell S50 * Cell G17 * Cell F61 + 2 * Cell G11 * Cell F61].

TestFuelGH is cell S50 and is the number of gallons per hour of fuel required to test the engine following the modification.

FuelCostGal is cell G17 and is the cost per gallon of fuel to test an engine.

CurUnschEngTstTime is cell E61 and is the expected number of hours of engine test time required for an engine having an unmodified component which has undergone unscheduled maintenance at the Depot level.

LaborCostOI is cell G11 and represents Organizational and Intermediate level labor costs per manhour which are determined from labor cost data maintained by the military organization that is considering the ECP.

ProUnschEngTstTime is cell F61 and is the expected number of hours of engine test time required for an engine having a modified component which has undergone unscheduled maintenance at the Depot level.

Note: The "2" in the formula indicates the number of maintenance personnel required to perform the engine testing.

Total Material Cost Including Test Cost / Unscheduled Event (Cell K59 and Cell L59) is the sum of the expected costs to test an unmodified component and to repair such a component or replace a scrapped component during unscheduled maintenance at the Organizational, Intermediate and Depot levels. The cell formula for the Current Configuration in cell K59 is

[Cell K59 = CurUnschTotMatCostEvt + CurUnschTestLabFuelCostEvt].

This equals

[Cell K59 = Cell K56 + Cell K58].

The cell formula for the Proposed Configuration in cell L59 is

[Cell L59 = ProUnschTotMatCostEvt + ProUnschTestLabFuelCostEvt].

This equals

[Cell L59 = Cell L56 + Cell L58].

CurUnschTotMatCostEvt is cell K56 and is the sum of the expected costs to repair an unmodified component or to replace a scrapped component during unscheduled maintenance at the Organizational and Intermediate, and Depot levels.

CurUnschTestLabFuelCostEvt is cell K58 and is the total expected costs, including labor, of the engine test time required for an unmodified component which has undergone unscheduled maintenance.

ProUnschTotMatCostEvt is cell L56 and is the sum of the expected costs to repair a modified component or to replace a scrapped component during unscheduled maintenance at the Organizational, Intermediate and Depot levels.

ProUnschTestLabFuelCostEvt is cell L58 and is the total expected costs, including labor, of the test time required for an engine having a modified component which has undergone unscheduled maintenance.

Secondary Damage & Incidental Cost / Unscheduled Event (CurUnschSecIncidentalDamCostEvt and ProUnschSecIncidentalDamCostEvt) is the estimated material cost to fix other components due to the failure of the component being considered for modification by the ECP during unscheduled maintenance and any miscellaneous material cost that are not covered by any other input element. The cell formula for the Current Configuration in cell K61 is

[CurUnschSecIncidentalDamCostEvt = CurUnschSecDamCost + CurUnschIncidentalCost].

This equals

[Cell K61 = Cell E62 + Cell E63].

The cell formula for the Proposed Configuration in cell L61 is

[ProUnschSecIncidentalDamCostEvt = ProUnschSecDamCost + ProUnschIncidentalCost].

This equals

[Cell L61 = Cell F62 + Cell F63].

CurUnschSecDamCost is cell E62 and covers the estimated material cost to fix other damaged components due to the failure of an unmodified component.

CurUnschIncidentalCost is cell E63 and is a collective cost element that accounts for any expected miscellaneous material costs that are not covered by any other input element associated with an unscheduled event involving an engine having the unmodified component.

ProUnschSecDamCost is cell F62 and covers the estimated material cost to fix other damaged components due to the failure of a modified component.

ProUnschIncidentalCost is cell F63 and is a collective cost element that accounts for any expected miscellaneous material costs that are not covered by any other input element associated with an unscheduled event involving an engine having the modified component.

Grand Total Material Cost / Unscheduled Event (CurTotMatCostUnschEvt and ProTotMatCostUnschEvt) is the sum of the costs to test an unmodified or modified component, to repair such a component or replace a scrapped component, the estimated material cost to other components due to the failure of the component being considered for modification and any miscellaneous material cost during unscheduled maintenance. The cell formula for the Current Configuration in cell K62 is

[CurTotMatCostUnschEvt = Cell K59 + CurUnschSecIncidentalDamCostEvt].

This equals

[Cell K62 = Cell K59 + Cell K61].

The cell formula for the Proposed Configuration in Cell L62 is

[ProTotMatCostUnschEvt = Cell L59 + ProUnschSecIncidentalDamCostEvt].

This equals

[Cell L62 = Cell L59 + Cell L61].

Cell K59 is the sum of the expected costs to test an unmodified or modified component and to repair such a component or replace a scrapped component during unscheduled maintenance at the Organizational and Intermediate level, and the Depot level.

CurUnschSecIncidentalDamCostEvt is cell K61 and is the sum of the estimated material costs to fix other damaged components due to the failure of an unmodified component during unscheduled maintenance and any expected miscellaneous material costs that are not covered by any other input element.

Cell L59 is the sum of the costs to test a component after modification, to repair such a component or replace a scrapped component during unscheduled maintenance at the Organizational and Intermediate level, and the Depot level.

ProUnschSecIncidentalDamCostEvt is cell L61 and is the sum of the estimated material costs to fix other damaged components due to the failure of a modified component during unscheduled maintenance and any expected miscellaneous material costs that are not covered by any other input element.

Cost to Introduce the New Part Numbers (PnIntroCost) is the cost of introducing a new part number into the military supply system. The cell formula in cell L64 is for the Proposed Configuration only and is

[PnIntroCost = ProPartNums * Cell G14].

This equals

[Cell L64 = Cell F64 * Cell G14].

ProPartNums is cell F64 and reflects the total number of part numbers related to the modification. A proposed configuration change which reduces the number of parts in the component will offer lower costs associated with part number maintenance costs.

Cell G14 is the cost of introducing a new part number into the military supply system.

IV. DESCRIPTION OF STANDARD HISTORY FILE

A. INTRODUCTION

Page 2 is titled "Standard History File" and consists of columns N through AY of the model. The first ten columns encompass the printed portion of the Standard History File Page and includes information that provides yearly expected data for a wide range of categories. This data includes the years covered by the analysis, the number of scheduled months during each year when the modified components will be produced and the number of available months during which the components are to be modified at the field level, the number of new engines delivered to the fleet and the cumulative number of engines in the fleet at the end of the year, the annual average number of fleet engine flight hours and the average engine flight hours per engine during the year, the cumulative whole number of engines expected to be lost through attrition by the end of the year and the number of whole engines lost through attrition during the year. The formulas and data elements for these first ten Standard History File columns are described below. Columns Y through AY, which are described later in this chapter, are not part of the printed Standard History File Page but the user can see them on the computer screen. The calculations found in these columns are used in later calculations of the CEA spreadsheet.

The data displayed in these columns starts in cell 14 of each column. Annual calculations are performed in cells 14 through 46 with some columns containing totals in cell 48. In many columns, cell 13 is used as a starting point for the column's calculations that start in cell 14. The value will always be zero and is not displayed on the computer screen or on the printed CEA page.

B. CALENDAR YEAR - COLUMN N

The Calendar Year column lists the years over which the analysis will be completed. Cell N14, FirstYrStdHistory, contains the first year of the Standard History File and its value is directly input by the contractor. Subsequent years are then calculated by adding one year to the previous year. The cell formula in cell N15 is

[Cell N15 = 1 + FirstYrStdHistory].

This equals

[Cell N15 = 1 + Cell N14].

The formulas for the succeeding cells are similar.

C. NO. OF AVAILABLE MOD MONTHS - COLUMNS O AND P

1. Production (Column O)

This column provides the number of months during each year that modified components are expected to be produced. The cell formula in cell O14, MoAvailProd, is

[MoAvailProd = IF(ProdIncorpYr=FirstYrStdHistory, 13 - ProdIncorpMo, IF(ProdIncorpYr>FirstYrStdHistory, 0, 12))].

This equals

[Cell O14 = IF(Cell D28 = Cell N14, 13 - Cell F28, IF(Cell D28 > Cell N14, 0, 12))].

ProdIncorpYr is an input entered by the contractor in cell D28. This input is the first year that the proposed ECP can be incorporated into the production of new engines.

ProdIncorpMo is an input entered by the contractor in cell F28. This input is the number of the first month of the first year that the proposed ECP can be incorporated into the production of new engines.

The IF statement uses the following logic to determine the number of months during the year that modified components will be produced.

A) The year production is expected to start is compared to the first year of the Standard History. If these two years equal, the number of months during a year that modified components are expected to be produced is 13 minus the number of the first month (1 = January) that production will start.

B) If these two years are not equal, the number of months during the year that modified components are expected to be produced is

1) Zero, if the year production is to start is after (greater than) the first year of the Standard History or the current year of analysis.

2) Twelve, if the year production is to start is less than the first year of the Standard History or the current year of analysis.

The cell formula for the next year is

[Cell O15 = IF(ProdIncorpYr = Cell N15, 13 - ProdIncorpMo, IF(ProdIncorpYr > Cell N15, 0, 12))].

This equals

[Cell O15 = IF(Cell D28 = Cell N15, 13 - Cell F28, IF(Cell D28 > Cell N15, 0, 12))].

The cell formulas for the succeeding years are similar with only the unfrozen cell numbers changing by one.

2. Field (Column P)

This column provides the number of months during a year that components can be modified at the field level. The cell formula in cell P14, MoAvailFieldMod, is

[MoAvailFieldMod = IF(FieldIncorpYr = FirstYrStdHistory, 13 - FieldIncorpMo, IF(FieldIncorpYr > FirstYrStdHistory, 0, 12))].

This equals

[Cell P14 = IF(Cell D29 = Cell N14, 13 - Cell F29, IF(Cell D29 > Cell N14, 0, 12))].

FieldIncorpYr is an input entered by the contractor into cell D29. This is the first year that ECP's can be incorporated into deployed engines.

FieldIncorpMo is an input entered by the contractor into cell F29. This is the first month that the proposed ECP can be incorporated into deployed engines in that first year.

The IF statement uses the following logic to determine the number of months during the year that components can be modified at the field level.

A) The year that field modifications are expected to start is compared to the first year of the Standard History or the current year of analysis. If these two years equal, the number of months during a year that components may be modified at the field level is 13 minus the number of the first month (1 = January) that field modification can start.

B) If these two years are not equal, the number of months during the year that modified components may be modified at the field level is

1) Zero, if the year that field modifications are expected to start is greater than the first year of the Standard History or the current year of analysis.

2) Twelve, if the year that field

modifications are expected to start is less than the first year of the Standard History or the current year of analysis.

The cell formula for the next year is

[Cell P15 = IF(FieldIncorpYr = Cell N15, 13 - FieldIncorpMo, IF(FieldIncorpYr > Cell N15, 0, 12))].

This equals

[Cell P15 = IF(Cell D29 = Cell N15, 13 - Cell F29, IF(Cell D29 > Cell N15, 0, 12))].

The cell formulas for the succeeding years are similar with only the N and P cell numbers increasing by one. Cells P50, P51 and P52 contain the following information from the selected Standard History File engine fleet inputs described in the previous chapter.

EFH per Year (EfhYr) is the average number engine flight hours (EFH) per engine per year. This input is contractor provided and is based on the government's projected total annual flight hours. This value is located in Cell P50.

TAC per EFH Ratio (TacEfh) is the ratio of the expected annual Total Accumulated Cycles (TAC) to the total annual expected number of Engine Flight Hours (EFH). The TAC/EFH ratio is obtained by the contractor from their standard history file for the engine. This value is located in Cell P51.

TOT per EFH Ratio (TotEfh) is a ratio of total engine hours (TOT) to engine flight hours. Total engine hours include test time, runway warmup, and taxi time. This ratio is also obtained from the contractor's standard history file for the engine being considered. This value is located in Cell P52.

D. ENGINE DELIVERIES - COLUMNS Q AND R

1. Annual (Column Q)

This column lists the number of new engines delivered to the fleet or number of engines retired from the fleet each year, and has the short title of CurYrEngDel. The contractor enters these figures directly into the column cells that correspond to the appropriate year, given in column N. These delivery and retirement numbers are provided from engine life cycle management data.

The total sum of all engines delivered to the fleet during the analysis period is the sum of all the Column Q cells and is contained in cell Q48. The formula for this cell is

[TotEngDel = SUM(Cell Q14:Cell Q46)].

2. Cumulative (Column R)

This column calculates the cumulative number of engines delivered by the end of the year minus the number of engines that have attrited in the fleet during each year. The cell formula in cell R14, CurYrEngDelCum, is

[CurYrEngDelCum = IF(PrevYrEngDelCum - PrevYrAttritWholeEng + CurYrEngDel > 1, PrevYrEngDelCum - PrevYrAttritWholeEng + CurYrEngDel, 0)].

This equals

[Cell R14 = IF(Cell R13 - Cell W13 + Cell Q14 > 1, Cell R13 - Cell W13 + Cell Q14, 0)].

PrevYrEngDelCum is cell R13, which is zero and is only used to begin column R calculations, as the second formula implies.

PrevYrAttritWholeEng is cell W13, which is also zero and is used only to begin column W calculations.

CurYrEngDel is cell Q14. Column Q was described above and provides the number of new engines delivered to the fleet or number of engines retired from the fleet for each year.

The IF statement uses the following logic to determine the number of engines in the fleet per year.

A) If the sum of the cumulative number of engines delivered to the fleet by the end of the previous year minus the number of engines lost in the fleet during the previous year plus the engines scheduled to be delivered to the fleet during the year is greater than one, the value displayed in this cell is the sum of the cumulative engines delivered to the fleet by the end of the previous year minus the number of engines lost in the fleet during the previous year plus the engines scheduled to be delivered to the fleet during the year.

B) If the sum of the cumulative number of engines delivered to the fleet by the end of the previous year minus the number of engines lost in the fleet during the previous year plus the engines scheduled to be delivered to the fleet during the year is not greater than one, the value displayed in this cell is zero.

The cell formula for the next year is

[Cell R15 = IF(CurYrEngDelCum - CurYrAttritWholeEng + Cell Q15 > 1, CurYrEngDelCum - CurYrAttritWholeEng + Cell Q15, 0)].

This equals

[Cell R15 = IF(Cell R14 - Cell W14 + Cell Q15 > 1, Cell R14 - Cell W14 + Cell Q15, 0)].

CurYrEngDelCum is cell R14 and is the cumulative number of engines delivered in the previous year.

CurYrAttritWholeEng is cell W14 and is the number of engines that have attrited in the fleet during the previous year.

The cell formulas for the succeeding years are similar with only the cell numbers increasing by one.

E. ANNUAL ENGINE FLIGHT HOURS - COLUMNS S AND T

1. Fleet (Column S)

This column calculates the average total whole number of engine flight hours for each year. The cell formula in cell S14, AnnualFleetEfh, is

[AnnualFleetEfh = TRUNC((PrevYrEngDelCum + CurYrEngDelCum)/2) * EfhYr].

This equals

[Cell S14 = TRUNC((Cell R13 + Cell R14)/2) * Cell P50].

EfhYr was the value entered by the contractor into cell P50 and is the average engine flight hours per engine per year.

PrevYrEngDelCum is cell R13, which is zero and is only used to begin column S calculations.

CurYrEngDelCum is cell R14 and is the cumulative number of engines delivered in the current year.

TRUNC is short for truncation and is a formula function that truncates a number to an integer value by removing the fractional part of the number.

The cell formula for the next year is

[Cell S15 = TRUNC((CurYrEngDelCum + Cell R15)/2) * EfhYr].

This equals

[Cell S15 = TRUNC((Cell R14 + Cell R15)/2) * Cell P50].

The cell formulas for the succeeding years up to cell S47 are similar with only the unfrozen cell numbers increasing by one.

The total sum of all annual engine flight hours over the life cycle analysis period is the sum of all the Column S cells and is contained in cell S48. The formula for this cell is

[Cell S48 = SUM(Cell S14:Cell S46)].

Cells S50, S51 and S52 contain the following information from the selected Standard History File engine fleet inputs.

Test Fuel - Gallons per Hour (TestFuelGH) is the number of gallons per hour of fuel required to test the engine following the modification. This value is located in cell S50.

Flight Fuel - Gallons per Hour (FltFuelGH) is the operational fuel consumption rate in gallons per hour required to operate the engine after the modification has been accomplished. This value is located in cell S51.

Aircraft Cost (AirCraftCost) is the current purchase price of the fully equipped aircraft. If this information is unavailable, then the last known purchase price is used and adjusted to current year dollars. This value is located in cell S52.

2. Average per Engine (Column T)

This column calculates the average whole number of engine flight hours per engine per year and is determined by dividing the cumulative average number of engines remaining after attrition by annual engine flight hours. The cell formula in cell T14, YrEfhPerEng, is

[YrEfhPerEng = IF(CurYrEngDelCum = 0, EfhYr, AnnualFleetEfh/TRUNC((CurYrEngDelCum + PrevYrEngDelCum/2))].

This equals

[Cell T14 = IF(Cell R14 = 0, Cell P50, Cell S14/TRUNC((Cell R14 + Cell R13)/2))].

CurYrEngDelCum is the cumulative number of engines in the fleet by the end of the year.

AnnualFleetEfh is the cumulative annual engine flight hours for the year.

The IF statement uses the following logic to determine the average engine flight hours per engine for the year.

A) If the cumulative engines remaining in the fleet is zero, the value displayed is the average engine flight hours per engine for that year.

B) If cumulative engines remaining in the fleet is greater than zero, the value displayed is the accumulated annual engine flight hours divided by the average number of engines in the fleet during the current year. The cell formula for the next year is

[Cell T15 = IF(Cell R15 = 0, EfhYr, Cell S15/TRUNC((Cell R15 + CurYrEngDelCum)/2))].

This equals

[Cell T15 = IF(Cell R15 = 0, Cell P50, Cell S15/TRUNC((Cell R15 + Cell R14)/2))].

The cell formulas for the succeeding years up to cell T47 are similar with only the unfrozen cell numbers increasing by one.

F. ENGINE ATTRITION - COLUMNS U, V AND W

1. Cumulative Engines (Column U)

This column calculates the cumulative number of engines lost through attrition each year. This number is found by multiplying the Engine Attrition rate per engine flying hour by the annual engine flying hours and adding this product to the prior year's cumulative number of engines lost through attrition.

The cell formula in cell U14, CurYrAttritCumEng, is

[CurYrAttritCumEng = EngAttritEfh * AnnualFleetEfh + PrevYrAttritCumEng].

This equals

[Cell U14 = Cell V50 * Cell S14 + Cell U13].

EngAttritEfh is the engine attrition rate per engine flight hour entered by the contractor into cell V50.

AnnualFleetEfh is the cumulative annual engine flight hours for each year calculated in column S.

PrevYrAttritCumEng is zero and is used only to begin column U calculations.

The cell formula for the next year is

[Cell U15 = EngAttritEfh * Cell S15 + CurYrAttritCumEng].

This equals

[Cell U15 = Cell V50 * Cell S15 + Cell U14].

The cell formulas for the succeeding years up to cell U47 are similar with only the unfrozen cell numbers increasing by one.

2. Cumulative Whole Engines (Column V)

This column calculates the cumulative whole number of engines expected to be lost through attrition by the end of each year. The cell formula in cell V14, CurYrAttritCumWholeEng, is

[CurYrAttritCumWholeEng = TRUNC(CurYrAttritCumEng)].

This equals

[Cell V14 = TRUNC(Cell U14)].

CurYrAttritCumEng is the cumulative number of engines expected to be lost through attrition by the end of each year.

The cell formula for the next year is

[Cell V15 = TRUNC(Cell U15)].

The cell formulas for the succeeding years are similar with only the cell numbers increasing by one.

The following cell also contains data in column V:

Engine Attrition/EFH (EngAttritEfh) is the rate of engines lost through attrition per engine flight hour. This value is located in Cell V50 and is obtained from the standard history file engine fleet input page described in the previous chapter.

3. Annual Whole Engines (Column W)

This column calculates the annual whole number of engines lost through attrition for each year. The cell formula in cell W14, CurYrAttritWholeEng, is

[CurYrAttritWholeEng = IF(CurYrAttritCumWholeEng <> PrevYrAttritCumWholeEng, CurYrAttritCumWholeEng - PrevYrAttritCumWholeEng, 0)].

This equals

[Cell W14 = IF(Cell V14 <> Cell V13, Cell V14 - Cell V13, 0)].

CurYrAttritCumWholeEng is the cumulative whole number of engines lost through attrition in the current year (from column V).

PrevYrAttritCumWholeEng is zero and is used only to begin column W calculations.

This IF statement uses the following logic to determine the annual number of engines lost through attrition.

A) If the cumulative whole number of engines lost through attrition in the current year is less than or greater than the cumulative whole number of engines lost through attrition in the previous year, then the annual number of engines lost through attrition in the current year is the cumulative whole number of engines lost through attrition in the current year minus the cumulative whole number of engines lost through attrition in the previous year. This value will never be negative.

B) If the cumulative whole number of engines lost through attrition in the current year is equal to the cumulative whole number of engines lost through attrition in the previous year, then the annual number of engines lost through attrition in the current year is zero.

The cell formula for the next year is

[Cell W15 = IF(Cell V15 <> CurYrAttritCumWholeEng, Cell V15 - CurYrAttritCumWholeEng, 0)].

This equals

[Cell W15 = IF(Cell V15 <> Cell V14, Cell V15 - Cell V14, 0)].

The cell formulas for the succeeding years up to cell W47 are similar with only the cell numbers increasing by one.

The total number of all the engines lost through attrition during the life cycle analysis period is the sum of all the column W cells and is calculated in cell W48. The formula for this cell is

[Cell W48 = SUM(Cell W14:Cell W46)].

G. UPGRADED ENGINES - COLUMNS Y, Z, AA AND AB

Column W is the last column in the printed portion of the Standard History File (Page 2). Columns Y through AY describe cells which the CEA spreadsheet user sees on the computer screen but are not provided as part of the printed ECP CEA package. The calculations in this section are used in other areas within the CEA spreadsheet.

1. Done by Attrition (Column Y)

This column calculates the expected whole number of engines in each year that will receive the component modification when the attrition incorporation style is selected by the contractor in cell D10.

The cell formula in cell Y14, CurYrEngModAttrit, is

[CurYrEngModAttrit = IF(IncorpStyle = 1, MIN(TRUNC(UnschModYrInt * (MoAvailFieldMod/12) * UnschPctEvtMod + 0.5) + TRUNC(ProSchEvtUnmod * SchPctEvtMod * (MoAvailFieldMod/12) + 0.5), TotEngDel - TotEngModProd - PrevYrCumKitInstl, PrevYrProUnmodEng), 0)].

This equals

[Cell Y14 = IF(Cell D9 = 1, MIN(TRUNC(Cell AW14 * (Cell P14/12) * Cell D25 + 0.5) + TRUNC(Cell CU14 * Cell D24 * (Cell P14/12) + 0.5), Cell Q48 - Cell CN48 - Cell AC13, Cell CO13), 0)].

IncorpStyle is the incorporation style selected by the contractor.

UnschModYrInt is the integer value of annual unscheduled engine failures permitting modifications.

MoAvailFieldMod is the number of months in the year in which engine modifications can occur at the field level.

UnschPctEvtMod is the percentage of unscheduled maintenance events in which a modification can occur. The purpose of the 0.5 is to serve as a rounding value. If, when added to a non-integer number, it increases the decimal fraction to the next integer or higher then it results in a rounding up to that integer. If it does not increase the decimal fraction to the next integer then it results in a rounding down.

ProSchEvtUnmod is the number of scheduled maintenance events for unmodified engines for the proposed configurations.

SchPctEvtMod is the expected percentage of scheduled maintenance events in which a modification can occur.

TotEngDel is the total number of engines expected to be delivered to the fleet during the life cycle analysis period.

TotEngModProd is the total number of engines expected to be modified during the remaining production schedule for the engines.

PrevYrCumKitInstl is the cumulative number of component modification kits installed in the previous year.

PrevYrProUnmodEng is the yearly average number of unmodified engines in the fleet.

The IF statement used the following logic to determine the expected whole number of engines per year which are to receive the component modification under the attrition incorporation style. A) If IncorpStyle equals one, the value displayed is the minimum of the following three choices:

1. The expected whole number of engines in each year which can receive the component modification.

2. The difference between the total number of engines expected to be delivered to the fleet during the life cycle analysis period minus the total number of engines expected to be modified during the remaining production schedule for the engines minus the cumulative number of component modification kits installed in the previous year.

3. The yearly average number of unmodified engines in the fleet.

B) If IncorpStyle does not equal one, a zero is displayed in the cell.

The cell formulas for the succeeding years up to cell Y47 are similar with only the cell numbers increasing by one.

The expected total whole number of engines per year which can receive the component modification when the contractor selects the attrition incorporation style during the life cycle analysis period is the sum of all the Column Y cells and is contained in cell Y48. The formula for this cell is

[Cell Y48 = SUM(Cell Y14:Cell Y46)].

2. Done by First Opportunity (Column Z)

This column calculates the expected annual number of whole engines to receive the component modification when the contractor selects the first opportunity incorporation style. The cell formula in cell Z14, CurYrEngMod1stOpp, is

[CurYrEngMod1stOpp = IF(IncorpStyle = 2, MIN(TRUNC(UnschModYrInt * (MoAvailFieldMod/12) * UnschPctEvtMod + 0.5) + TRUNC(ProSchEvtUnmod * SchPctEvtMod * (MoAvailFieldMod/12) + 0.5), TotEngDel - TotEngModProd - PrevYrCumKitInstl, PrevYrProUnmodEng), 0)].

This equals

[Cell Z14 = IF(Cell D9 = 2, MIN(TRUNC(Cell AW14 * (Cell P14/12) * Cell D25 + 0.5) + TRUNC(Cell CU14 * Cell D24 * (Cell P14/12) + 0.5), Cell Q48 - Cell CN48 - Cell AC13, Cell CO13), 0)].

IncorpStyle is the incorporation style selected by the contractor.

UnschModYrInt is the integer value of annual unscheduled engine failures permitting modifications.

MoAvailFieldMod is the number of months in the year in which engine modifications can occur at the field level.

UnschPctEvtMod is the percentage of unscheduled maintenance events in which a modification can occur. The 0.5 indicates the rounding rule discussed in column Y.

ProSchEvtUnmod is the number of scheduled events for unmodified engines for the proposed configurations.

SchPctEvtMod is the expected percentage of scheduled maintenance events in which a modification can occur.

TotEngDel is the total number of engines expected to be delivered to the fleet during the life cycle analysis period.

TotEngModProd is the total number of engines expected to be modified during the remaining production schedule for the engines.

PrevYrCumKitInstl is the cumulative number of component modification kits installed in the previous year.

PrevYrProUnmodEng is the yearly average number of unmodified engines in the fleet.

The IF statement used the following logic to determine the expected whole number of engines per year which can receive the component modification under the first opportunity incorporation style.

A) If IncorpStyle equals two, the value displayed is the minimum of the following three choices:

1. The expected whole number of engines in each year which will receive the component modification.

2. The difference between the total number of engines expected to be delivered to the fleet during the life cycle analysis period minus the total number of engines expected to be modified during the remaining production schedule for the engines minus the cumulative number of component modification kits installed in the previous year.

3. The yearly average number of unmodified engines in the fleet.

B) If IncorpStyle does not equal two, a zero is displayed in the cell.

The cell formulas for the succeeding years are similar with only the unfrozen cell numbers increasing by one.

The expected total number of whole engines per year which can receive the component modification when the contractor selects the first opportunity incorporation style during the life cycle analysis period is the sum of all the Column Z cells and is contained in cell Z48. The formula for this cell is

[Cell Z48 = SUM(Cell Z14:Cell Z46)].

3. Done by Forced Retrofit (Column AA)

This column calculates the expected annual number of whole engines that can receive the component modification when the contractor selects the forced retrofit incorporation style. The cell formula in cell AA14, CurYrEngModForce, is

[CurYrEngModForce = IF(IncorpStyle = 3,
MIN(TRUNC(ForcedRetroRate * 12 + 0.5) * (MoAvailFieldMod/12),
MAX(CurYrEngDelCum - CurYrEngModProd - PrevYrCumKitInstl,
0)),0)].

This equals

[Cell AA14 = IF(Cell D9 = 3, MIN(TRUNC(Cell D12 * 12 + 0.5) *
(Cell P14/12), MAX(Cell R14 - Cell AB14 - Cell AC13, 0)),0)].

IncorpStyle is the incorporation style selected by the contractor.

MoAvailFieldMod is the number of months in the year in which engine modifications can occur at the field level.

PrevYrCumKitInstl is the cumulative number of component modification kits installed in the previous year.

ForcedRetroRate is the specific annual rate at which modifications are to be incorporated.

CurYrEngDelCum is the cumulative number of engines delivered by the end of the year minus the number of engines that attrited in the fleet during the year.

CurYrEngModProd is the cumulative number of engine modifications in production completed by the end of the year.

The IF statement used the following logic to determine the expected whole number of engines per year which can receive the component modification under the forced retrofit incorporation style.

A) If IncorpStyle equals three, the value displayed is the minimum of the following two choices:

1. The expected whole number of engines in each year which can receive the component modification.

2. The maximum of the following two choices:

(a) The difference between the cumulative number of engines delivered by the end of the year minus the cumulative number of engines that have attrited in the fleet by the start of the year minus the cumulative number of engine modifications in production completed by the end of the year minus the cumulative number of component modification kits installed in the previous year.

(b) Zero.

B) If IncorpStyle does not equal three, a zero is displayed in the cell.

The cell formulas for the succeeding years are similar with only the cell numbers increasing by one.

The expected total number of whole engines per year which can receive the component modification when the contractor selects the forced retrofit incorporation style during the life cycle analysis period is the sum of all the Column AA cells and is contained in cell AA48. The formula for this cell is

[Cell AA48 = SUM(Cell AA14:Cell AA46)].

4. Done in Production (Column AB)

This column calculates the cumulative number of engine modifications made on engines while they are still in production. The cell formula in cell AB14, CurYrEngModProd, is

[CurYrEngModProd = ProEngModProd + PrevYrEngModProd].

This equals

[Cell AB14 = Cell CN14 + Cell AB13].

ProEngModProd is the number of engine modifications occurring each year during new engine production for the proposed configuration.

PrevYrEngModProd is the cumulative number of engine modifications which occurred during production in the previous year. The value of this cell is zero and is only used to start the column calculations.

The cell formula for the next year is

[Cell AB15 = Cell CN15 + CurYrEngModProd].

This equals

[Cell AB15 = Cell CN15 + Cell AB14].

CurYrEngModProd is the cumulative number of engine modifications which occurred during production in the previous year.

The cell formulas for the succeeding years are similar with only the cell numbers increasing by one.

H. CUMULATIVE KITS INSTALLED (COLUMN AC)

This column calculates the cumulative number of installed engine modification kits. The cell formula in cell AC14, CurYrCumKitInstl, is

[CurYrCumKitInstl = CurYrProEngKitInstal + PrevYrCumKitInstl].

This equals

[Cell AC14 = Cell CY14 + Cell AC13].

CurYrProEngKitInstal is the number of kits expected to be installed for the proposed configuration during the year.

PrevYrCumKitInstl is the cumulative number of engine modification kits installed by the end of the previous year. The value of this cell is zero and is only used to start the column calculations.

The cell formula for the next year is

[Cell AC15 = Cell CY15 + CurYrCumKitInstl].

This equals

[Cell AC15 = Cell CY15 + Cell AC14].

CurYrCumKitInstl is the cumulative number of engine modification kits installed by the end of the previous year.

The cell formulas for the succeeding years are similar with only the cell numbers increasing by one.

I. CUMULATIVE KIT EFH (COLUMN AD)

This column calculates the cumulative annual number of flight hours expected to be accumulated on engines which have had modification kits installed. The cell formula in cell AD14 is

[Cell AD14 = CurYrCumKitInstl * YrEfhPerEng].

This equals

[Cell AD14 = Cell AC14 * Cell T14].

CurYrCumKitInstl is the cumulative number of component kits installed during the current year.

YrEfhPerEng is the average engine flight hours per engine per year.

The cell formulas for the succeeding years are similar with only the cell numbers increasing by one.

J. NUMBER OF KITS OVER AND ABOVE MAX KITS (COLUMN AE)

This column calculates the number of engines above and beyond that which were expected to be modified during the year. This deficiency in engine modifications is due to more engines requiring modification than kits available to make the modification. The cell formula in cell AE14, CurYrKitAboveMaxKit, is

[CurYrKitAboveMaxKit = MAX(CurYrEngModAttrit + CurYrEngMod1stOpp + CurYrEngModForce - MaxKit + PrevYrKitAboveMaxKit, 0)].

This equals

[Cell AE14 = MAX(Cell Y14 + Cell Z14 + Cell AA14 - Cell AE51 + Cell AE13, 0)].

CurYrEngModAttrit is the number of engines that can receive the component modification through attrition during the year.

CurYrEngMod1stOpp is the number of engines that can receive the component modification at the first opportunity during the year.

CurYrEngModForce is the number of engines that can receive the component modification through forced retrofit during the year.

MaxKit is the maximum number of kits per year available for modification.

PrevYrKitAboveMaxKit is the number of engines above and beyond that which were expected to be modified during the previous year. The value of this cell is zero and is only used to start the column calculations.

The cell formula for the next year is

[Cell AE15 = Cell Y15 + Cell Z15 + Cell AA15 - Cell AE51 + CurYrKitAboveMaxKit].

This equals

[Cell AE15 = Cell Y15 + Cell Z15 + Cell AA15 - Cell AE51 + Cell AE14].

CurYrKitAboveMaxKit is the number of engines above and beyond that which were expected to be modified during the previous year.

The cell formulas for the succeeding years are similar with only the unfrozen cell numbers changing by one.

The following cell also contains data in column AE:

Maximum Kit per Year (MaxKit) is displayed in cell AE51 and is the maximum number of kits that can be expected to be installed per year. This number is a direct input by the contractor.

K. UNMODIFIED SCHEDULED AVAILABLE YEAR (COLUMN AF)

This column calculates the year in which scheduled maintenance of unmodified components is expected to begin. The cell formula in cell AF14, UnmodSchAvailYr, is [UnmodSchAvailYr = FirstYrStdHistory + UnmodInspIntYrs - 1].

This equals

[Cell AF14 = Cell N14 + Cell AG53 - 1].

FirstYrStdHistory is the first year being analyzed.

UnmodInspIntYrs is the length of the inspection interval in whole number of years.

The cell formula for the next year is

[Cell AF15 = IF(AnnualFleetEfh = 0, IF(Cell N15 ≤ UnmodSchAvailYr + 2, Cell N15 + UnmodInspIntYrs - 1, UnmodSchAvailYr), UnmodSchAvailYr)].

This equals

[Cell AF15 = IF(Cell S14 = 0, IF(Cell N15 ≤ Cell AF14 + 2, Cell N15 + Cell AG53 - 1, Cell AF14), Cell AF14)].

AnnualFleetEfh is the cumulative annual engine flight hours for each year.

UnmodSchAvailYr is the value from the previous year and is the year in which scheduled maintenance of unmodified components is expected to begin.

UnmodInspIntYrs is the length of the inspection interval in whole number of years.

The IF statement determines the year in which scheduled maintenance of unmodified components is expected to begin.

1. If the cumulative annual engine flight hours for each year is equal to zero, the value displayed is the result of the following IF statement:

A) If the year being analyzed is before (less than) or equal to the year in which scheduled maintenance of unmodified components is expected to begin plus two years, the value displayed is the sum of the year being analyzed plus the length of the inspection interval in whole number of years minus one.

B) If the year being analyzed is after (not less than) or equal to the year in which scheduled maintenance of unmodified components is expected to begin plus two years, the value displayed is the year in which scheduled maintenance of unmodified components is expected to begin.

2. If the cumulative annual engine flight hours for each year is greater than zero, the value displayed is the year in which scheduled maintenance of unmodified components is expected to begin.

The cell formulas for the succeeding years are similar with only the unfrozen cell numbers increasing by one.

L. EFH FOR PROPOSED UNMODIFIED SCHEDULED INSPECTIONS (COLUMN AG)

This column calculates the total number of engine flight hours per year that are expected to be flown on the remaining unmodified engines for the proposed modification inspection schedule. The cell formula in cell AG14, ProUnmodSchInspEfh, is

[ProUnmodSchInspEfh = IF(FirstYrStdHistory < UnmodSchAvailYr + 1, 0, IF(FirstYrStdHistory < ModSchAvailYr + 1, CurSchInspEfh, PrevYrProUnmodEfh * 1000))].

This equals

[Cell AG14 = IF(Cell N14 < Cell AF14 + 1, 0, IF(Cell N14 < Cell AH14 + 1, Cell AJ14, Cell CQ13 * 1000))].

ModSchAvailYr is the year in which scheduled maintenance of modified components will begin under the proposed configuration.

CurSchInspEfh is the total number of engine flight hours per year that will be flown on unmodified engines during the current inspection schedule.

PrevYrProUnmodEfh is the total engine flight hours for the previous year, in thousands of hours, for unmodified engines under the proposed configuration. The value of this cell is zero and is only used to start the column calculations.

This IF statement used the following logic to determine the total number of engine flight hours per year that are expected to be flown on unmodified engines for the proposed modification inspection schedule.

1. If the first year being analyzed is before (less than) the year in which scheduled maintenance of unmodified components is expected to begin under the proposed configuration plus one year, the value displayed is zero.

2. If the first year being analyzed is before (less than) the year in which scheduled maintenance of modified components is expected to begin under the proposed configuration plus one year, the value displayed is the result of the following IF statement:

A) If the first year being analyzed is before (less than) the year in which scheduled maintenance of modified components is expected to begin under the proposed configuration plus one year, the value displayed is the total number of engine flying hours per year that will be flown on unmodified engines during the current inspection schedule.

B) If the first year being analyzed is after (not less than) the year in which scheduled maintenance of modified components is expected to begin under the proposed configuration plus one year, the value displayed is the total engine flight hours for the previous year for unmodified engines under the proposed configuration. Note: It is computed as the total engine flight hours in thousands of hours times 1000.

The cell formulas for the succeeding years are similar with only the cell numbers increasing by one.

The following cells also contains data in column AG:

Unmodified Year per Inspection Interval (UnmodInspIntYrs) is the length of the inspection interval in whole number of years. This is calculated by dividing the unmodified side inspection interval in engine flight hours by the number of engine flight hours per year and then truncating the result. A side inspection is an inspection incident to an unscheduled engine failure. The cell formula in cell AG53 is [UnmodInspIntYrs = TRUNC(CurSchMaintInt * 0.95/TacEfh/EfhYr)].

This equals

[Cell AG53 = TRUNC(Cell AI52/Cell P50)].

CurSchMaintInt is the time between scheduled maintenance actions during which an engine is expected to be available for component modification. An adjustment factor of 0.95 reflects the fact that not all engines can be inspected on time.

TacEfh is the ratio of the expected annual total accumulated cycles to the total annual expected number of engine flight hours.

EfhYr is the average number of engine flight hours per engine per year.

Unmodified Inspection Interval per Year (UnmodInspPerYr) This cell calculates the whole number of engine inspections per year by dividing the number of engine flight hours per year by the unmodified side inspection interval in engine flight hours and then truncating the result. The cell formula for cell AG54 is

[Cell AG54 = TRUNC(EfhYr/CurSchMaintInt * 0.95/TacEfh].

This equals

[Cell AG54 = TRUNC(Cell P50/Cell AI52)].

CurSchMaintInt is the time between scheduled maintenance actions during which an engine is expected to be available for component modification. An adjustment factor of 0.95 reflects the fact that not all engines can be inspected on time.

TacEfh is the ratio of the expected annual total accumulated cycles to the total annual expected number of engine flight hours.

EfhYr is the average number of engine flight hours per engine per year.

M. MODIFIED SCHEDULED AVAILABLE YEAR (COLUMN AH)

This column calculates the year in which scheduled maintenance of modified components is expected to begin under the proposed configuration. The cell formula in cell AH14, ModSchAvailYr, is

[ModSchAvailYr = FirstYrStdHistory + UnmodInspIntYrs - 1].

This equals

[Cell AH14 = Cell N14 + Cell AG53 - 1].

FirstYrStdHistory is the first year being analyzed.

UnmodInspIntYrs - 1 is the length of the inspection interval in whole number of years minus one.

The cell formula for the next year is

[Cell AH15 = IF(UnschPctEvtMod = 0, IF(CurYrProModEfh = 0, IF(Cell N15 ≤ ModSchAvailYr + 2, Cell N15 + UnmodInspIntYrs - 1, ModSchAvailYr), ModSchAvailYr), UnmodSchAvailYr)].

This equals

[Cell AH15 = IF(Cell D25 = 0, IF(Cell CR14 = 0, IF(Cell N15 ≤ Cell AH14 + 2, Cell N15 + Cell AG53 - 1, Cell AH14), Cell AH14), Cell AF14)].

UnschPctEvtMod is the expected percentage of unscheduled maintenance events in which a modification can occur.

CurYrProModEfh is the total annual engine flight hours, in thousands of hours, for modified engines under the proposed configuration.

ModSchAvailYr is the year in which scheduled maintenance of modified components is expected to begin under the proposed configuration.

UnmodInspIntYrs - 1 is the length of the inspection interval in whole number of years minus one.

UnmodSchAvailYr is the value from the previous year and is the year in which scheduled maintenance of unmodified components are expected to begin under the proposed configuration.

The IF statement determines the year in which scheduled maintenance of modified components is expected to begin under the proposed configuration.

1. If the expected percentage of unscheduled maintenance events in which a modification can begin is equal to zero, the value displayed is the result of the following IF statement:

A) If the total annual engine flight hours, in thousands of hours, for modified engines under the proposed configuration is equal to zero, the value displayed is the result of another IF statement:

1) If the year being analyzed is before (less than) or equal to the year in which scheduled maintenance of modified components is expected to begin under the proposed configuration plus two years, the value displayed is the value of the year being analyzed plus the length of the inspection interval in whole number of years minus one.

2) If the year being analyzed is after (greater than) the year in which scheduled maintenance of modified components is expected to begin under the proposed configuration plus two years, the value displayed is the year in which scheduled maintenance is expected to begin under the proposed configuration.

B) If the total annual engine flight hours, in thousands of hours, for modified engines under the proposed configuration is greater than zero, the value displayed is the year in which scheduled maintenance of modified components is expected to begin under the proposed configuration.

2. If the expected percentage of unscheduled maintenance events in which a modification can occur is greater than zero, the value displayed is the year in which scheduled maintenance of unmodified components is expected to begin under the proposed configuration.

The cell formulas for the succeeding years are similar with only the unfrozen cell numbers increasing by one.

N. EFH FOR PROPOSED MODIFIED SCHEDULED INSPECTIONS (COLUMN AI)

This column calculates the total number of engine flight hours per year that will be flown on modified engines for the proposed modification inspection schedule. The cell formula in cell AI14, ProModSchInspEfh, is

[ProModSchInspEfh = IF(FirstStdYrHistory < ModSchAvailYr + 1, 0, PrevYrProModEfh * 1000)].

This equals

[Cell AI14 = IF(Cell N14 < Cell AH14 + 1, 0, Cell CR13 * 1000)].

PrevYrProModEfh is the total annual engine flight hours (in thousands of hours) for modified engines for the proposed configuration in the previous year. This value is zero and is only used to start the column calculations.

The IF statement uses the following logic to determine the total number of engine flight hours per year that will be flown on modified engines under the proposed modification inspection schedule.

1. If the first year being analyzed is before (less than) the first year in which scheduled maintenance of modified components can begin under the proposed configuration plus one year, the value displayed is zero. This indicates that if the calendar year is less than the modification year plus one there will not be any modified engine flight hours in the current calendar year.

2. If the first year being analyzed is after (not less than) the year in which scheduled maintenance of modified components can begin under the proposed configuration plus one year, the value displayed is the total annual flight hours, in thousands of hours, for modified engines for the proposed configuration in the previous year multiplied by 1000.

The cell formula for the next year is

[Cell AI15 = IF(Cell N15 < Cell AH15 + 1, 0, CurYrProModEfh * 1000)].

This equals

[Cell AI15 = IF(Cell N15 < Cell AH15 + 1, 0, Cell CR14 * 1000)].

CurYrProModEfh is the total annual engine flight hours (in thousands of hours) for modified engines for the proposed configuration.

The cell formulas for the succeeding years are similar with only the cell numbers increasing by one.

The following cells also contains data in column AI:

Unmodified Side Inspection Interval in TACs (CurSchMaintInt) is displayed in cell AI51 and is the interval between scheduled maintenance actions in total accumulated cycles (TAC's) during which an engine is expected to be available for component modification. The value in this cell is obtained from cell E32.

Unmodified Side Inspection Interval in EFH is the number (interval) of engine flight hours between scheduled inspections of unmodified engines. The cell formula in cell AI52 is

[Cell AI52 = CurSchMaintInt * 0.95/TacEfh].

This equals

[Cell AI52 = Cell AI51 * 0.95/Cell P51].

CurSchMaintInt is the interval between scheduled maintenance actions in total accumulated cycles during which an engine is expected to be available for component modification. An adjustment factor of 0.95 reflects the fact that not all engines can be inspected on time.

TacEfh is the ratio of the expected annual total accumulated cycles to the total annual expected number of engine flight hours.

O. EFH FOR CURRENT SCHEDULED INSPECTIONS (COLUMN AJ)

This column calculates the total number of engine flight hours per year that will be flown on unmodified engines for the current inspection schedule. The cell formula in cell AJ14, CurSchInspEfh, is

[CurSchInspEfh = IF(FirstYrStdHistory < UnmodSchAvailYr + 1, 0, PrevYrCurUnmodEfh * 1000)].

This equals

[Cell AJ14 = IF(Cell N14 < Cell AF14 + 1, 0, Cell BE13 * 1000)].

UnmodSchAvailYr is the year in which scheduled maintenance of unmodified components is expected to begin under the proposed configuration.

PrevYrCurUnmodEfh is the total engine flight hours for the previous year, in thousands of hours, for unmodified engines under the current configuration. The value of this cell is zero and is only used to start the column calculations.

The IF statement uses the following logic to determine the total number of engine flight hours per year that will be flown on unmodified engines under the current inspection schedule.

1. If the first year being analyzed is before (less than) the year in which scheduled maintenance of unmodified components is expected to begin under the proposed configuration plus one year, the value displayed is zero.

2. If first year being analyzed is after (not less than) the year in which scheduled maintenance of unmodified components is expected to begin under the proposed configuration plus one year, the value displayed is the total engine flight hours, in thousands of hours, for the previous year for unmodified engines under the current configuration multiplied by 1000.

The cell formula for the next year is

[Cell AJ15 = IF(Cell N15 < Cell AF15 + 1, 0, CurYrCurUnmodEfh * 1000)].

This equals

[Cell AJ15 = IF(Cell N15 < Cell AF15 + 1, 0, Cell BE14 * 1000)].

CurYrCurUnmodEfh is the total engine flight hours, in thousands of hours, for unmodified engines under the current configuration.

The cell formulas for the succeeding years are similar with only the cell numbers increasing by one.

P. EVENTS DUE TO UNSCHEDULED EVENT RATE - COLUMNS AK THROUGH AS

1. Current Side Events - Columns AK, AL and AM

a. Cumulative Decimal (Column AK)

This column calculates the cumulative number of unscheduled engine failures which are expected to occur for the current configuration by the end of each year. The cell formula in cell AK14, CurYrCurEvtCumDec, is

[CurYrCurEvtCumDec = PrevYrCurEvtCumDec + CurUnschEvtRate * PrevYrCurUnmodEfh].

This equals

[Cell AK14 = AK13 + Cell E48 * Cell BE13].

PrevYrCurEvtCumDec is the cumulative number of unscheduled engine failures which are expected to occur for the current configuration. The value of this cell is zero and is only used to start the column calculations.

CurUnschEvtRate is rate in number of failures per engine flight hour that represents how often the pertinent part, assembly, component or module is expected to fail under the current configuration.

PrevYrCurUnmodEfh is the number of engine flight hours per year that will be flown on unmodified engines. The value of this cell is zero and is only used to start the column calculations.

The cell formula for the next year is

[Cell AK15 = CurYrCurEvtCumDec + CurUnschEvtRate * CurYrCurUnmodEfh].

This equals

[Cell AK15 = Cell AK14 + Cell E48 * Cell BE14].

CurYrCurEvtCumDec is the cumulative number of unscheduled engine failures which are expected to occur in the previous year for the current configuration.

CurYrCurUnmodEfh is the number of engine flight hours per year that are expected to be flown on unmodified engines.

The cell formulas for the succeeding years are similar with only the unfrozen cell numbers increasing by one.

b. Cumulative Integer (Column AL)

This column calculates the cumulative integer value of unscheduled engine failures which are expected to occur for the current configuration by the end of each year. The cell formula in cell AL14, CurYrCurEvtCumInt, is

[CurYrCurEvtCumInt = TRUNC(CurYrCurEvtCumDec)].

This equals

[Cell AL14 = TRUNC(Cell AK14)].

The cell formulas for the succeeding years are similar with only the cell numbers increasing by one.

c. Annual Integer (Column AM)

This column calculates the annual whole number of unscheduled engine failures which are expected to occur for the current configuration. The cell formula in cell AM14, CurEvtYrInt, is

[CurEvtYrInt = IF(CurYrCurEvtCumInt <> CurYrCurEvtCumInt, CurYrCurEvtCumInt - CurYrCurEvtCumInt, 0)].

This equals

[Cell AM14 = IF(Cell AL14 <> Cell AL14, Cell AL14 - Cell AL14, 0)].

CurYrCurEvtCumInt is the cumulative integer value of unscheduled engine failures which are expected to occur for the current configuration by the end of each year.

The cell formula for the next year is

[Cell AM15 = IF(Cell AL15 <> CurYrCurEvtCumInt, Cell AL15 - CurYrCurEvtCumInt, 0)].

This equals

[Cell AM15 = IF(Cell AL15 <> Cell AL14, Cell AL15 - Cell AL14, 0)].

The IF statement determines the annual whole number of unscheduled engine failures which are expected to occur for the current configuration.

1. If the cumulative integer value of unscheduled engine failures which are expected to occur for the current configuration by the end of the year is less than or greater than the cumulative integer value of unscheduled engine failures which are expected to occur for the current configuration by the end of the previous year, then the value displayed is the difference of the cumulative integer value of unscheduled engine failures which are expected to occur for the current configuration by the end of the year and the cumulative integer value of unscheduled engine failures which are expected to occur for the current configuration by the end of the previous year.

2. If the cumulative integer value of unscheduled engine failures which are expected to occur for the current configuration by the end of the year is equal to the cumulative integer value of unscheduled engine failures which are expected to occur for the current configuration by the end of the previous year, then the value displayed is zero.

The cell formulas for the succeeding years are similar with only the cell numbers increasing by one.

The total annual number of unscheduled engine failures which are expected to occur for the current configuration during the life cycle analysis period is the sum of all the Column AM cells and is contained in cell AM48.

The formula for this cell is

[Cell AM48 = SUM(Cell AM14:Cell AM46)]

2. Proposed Side Unmodified Events - Columns AN, AO and AP

a. *Cumulative Decimal (Column AN)*

This column calculates the cumulative number of unscheduled engine failures which are expected to occur to the remaining unmodified components under the proposed configuration by the end of the year. The cell formula in cell AN14, CurYrProUnmodEvtCumDec, is

[CurYrProUnmodEvtCumDec = PrevYrProUnmodEvtCumDec + CurUnschEvtRate * PrevYrProUnmodEfh].

This equals

[Cell AN14 = Cell AN13 + Cell E48 * Cell CQ13].

PrevYrProUnmodEvtCumDec is the cumulative number of unscheduled failures which are expected to occur to the remaining unmodified engines under the proposed configuration by the end of the previous year. The value of this cell is zero and is only used to start the column calculations.

CurUnschEvtRate is rate in failures per engine flight hours that represents how often the pertinent part, assembly, component or module is expected to fail under the current configuration.

PrevYrProUnmodEfh is the number of engine flight hours per year that are expected to be flown on the remaining unmodified engines under the proposed configuration during the previous year. The value of this cell is zero and is only used to start the column calculations.

The cell formula for the next year is

[Cell AN15 = CurYrProUnmodEvtCumDec + CurUnschEvtRate * CurYrProUnmodEfh].

This equals

[Cell AN15 = Cell AN14 + Cell E48 * Cell CQ14].

CurYrProUnmodEvtCumDec is the cumulative number of unscheduled failures which are expected to occur to unmodified engines for the proposed configuration by the end of the previous year.

CurYrProUnmodEfh is the number of engine flight hours per year that are expected to be flown on the remaining unmodified engines under the proposed configuration during the previous year.

The cell formulas for the succeeding years are similar with only the unfrozen cell numbers increasing by one.

b. Cumulative Integer (Column AO)

This column calculates the cumulative integer value of unscheduled engine failures which are expected to occur for unmodified engines under the proposed configuration by the end of the year. The cell formula in cell AO14, CurYrProUnmodEvtCumInt, is

[CurYrProUnmodEvtCumInt = TRUNC(CurYrProUnmodEvtCumDec)].

This equals

[Cell AO14 = TRUNC(Cell AN14)].

CurYrProUnmodEvtCumDec is the cumulative number of unscheduled failures which are expected to occur to unmodified engines for the proposed configuration by the end of the year.

The cell formulas for the succeeding years are similar with only the cell numbers increasing by one.

c. Annual Integer (Column AP)

This column calculates the annual whole number of unscheduled engine failures which are expected to occur to unmodified engines under the proposed configuration. The cell formula in cell AP14, CurYrProUnmodYrInt, is

[CurYrProUnmodYrInt = IF(CurYrProUnmodEvtCumInt <> CurYrProUnmodEvtCumInt, CurYrProUnmodEvtCumInt - CurYrProUnmodEvtCumInt, 0)].

This equals

[Cell AP14 = IF(Cell AO14 <> Cell AO14, Cell AO14 - Cell AO14, 0)].

CurYrProUnmodEvtCumInt is the cumulative integer value of unscheduled engine failures which are expected to occur by the end of the year for the proposed configuration.

The cell formula for the next year is

[Cell AP15 = IF(Cell AO15 <> CurYrProUnmodEvtCumInt, Cell AO15 - CurYrProUnmodEvtCumInt, 0)].

This equals

[Cell AP15 = IF(Cell AO15 <> Cell AO14, Cell AO15 - Cell AO14, 0)].

CurYrProUnmodEvtCumInt is the cumulative integer value of unscheduled engine failures which are expected to occur by the end of the previous year for the proposed configuration.

The cell formulas for the succeeding years are similar with only the cell numbers changing by one.

The IF statement determines the annual number of unscheduled engine failures which are expected to occur for the proposed configuration.

1. If the cumulative integer value of unscheduled engine failures which are expected to occur for the proposed configuration by the end of the year is less than or greater than the cumulative integer value of unscheduled engine failures which are expected to occur for the proposed configuration by the end of the previous year, then the value displayed is the difference between the cumulative integer value of unscheduled engine failures which are expected to occur for the proposed configuration by the end of the year minus the cumulative integer value of unscheduled engine failures which are expected to occur for the proposed configuration by the end of the previous year.

2. If the cumulative integer value of unscheduled engine failures which are expected to occur for

the proposed configuration by the end of the year is equal to the cumulative integer value of unscheduled engine failures which are expected to occur for the proposed configuration by the end of the previous year, then the value displayed is zero.

The total annual number of unscheduled engine failures which are expected to occur for the proposed configuration during the life cycle analysis period is the sum of all the Column AP cells and is contained in cell AP48. The formula for this cell is

[Cell AP48 = SUM(Cell AP14:Cell AP46)].

3. Proposed Side Modified Events - Columns AQ, AR and AS

a. Cumulative Decimal (Column AQ)

This column calculates the cumulative number of unscheduled failures which are expected to occur to modified engines under the proposed configuration by the end of the year. The cell formula in cell AQ14, CurYrProModEvtCumDec, is

[CurYrProModEvtCumDec = PrevYrProModEvtCumDec + ProUnschEvtRate * PrevYrProModEfh].

This equals

[Cell AQ14 = Cell AQ13 + Cell F48 * Cell CR13].

PrevYrProModEvtCumDec is the cumulative number of unscheduled failures which are expected to occur to modified engines under the proposed configuration by the end of the previous year. The value of this cell is zero and is only used to start the column calculations.

ProUnschEvtRate is rate that represents how often the pertinent part, assembly, component or module fails under the proposed configuration.

PrevYrProModEfh is the number of engine flight hours per year that are expected to be flown on modified engines during the previous year. The value of this cell is zero and is only used to start the column calculations.

The cell formula for the next year is

[Cell AQ15 = CurYrProModEvtCumDec + ProUnschEvtRate * CurYrProModEfh].

This equals

[Cell AQ15 = Cell AQ14 + Cell F48 * Cell CR14].

CurYrProModEvtCumDec is the cumulative number of unscheduled failures which are expected to occur to modified engines for the proposed configuration by the end of the previous year.

CurYrProModEfh is the number of engine flight hours per year that are expected to be flown on modified engines during the year.

The cell formulas for the succeeding years are similar with only the unfrozen cell numbers increasing by one.

b. Cumulative Integer (Column AR)

This column calculates the cumulative integer value of unscheduled engine failures which are expected to occur to modified engines under the proposed configuration by the end of the year. The cell formula in cell AR14, CurYrProModEvtCumInt, is

[CurYrProModEvtCumInt = IF(CurUnschEvtRate = ProUnschEvtRate, CurYrCurEvtCumInt - CurYrProUnmodEvtCumInt, TRUNC(CurYrProModEvtCumDec))].

This equals

[Cell AR14 = IF(Cell E48 = Cell F48, Cell AL14 - Cell AO14, TRUNC(AQ14))].

CurUnschEvtRate is the rate in failures per engine flight hour that represents how often the pertinent component with the current configuration is expected to fail.

ProUnschEvtRate is the rate in failures per engine flight hour that represents how often the pertinent component with the proposed configuration is expected to fail.

CurYrCurEvtCumInt is the cumulative integer value of unscheduled engine failures which are expected to occur by the end of the year for the current configuration.

CurYrProUnmodEvtCumInt is the cumulative integer value of unscheduled engine failures which are expected to occur by the end of the year for the proposed configuration.

CurYrProModEvtCumDec is the cumulative number of unscheduled failures which are expected to occur by the end of the year on modified engines with the proposed configuration.

The IF statement uses the following logic to determine the cumulative integer value of unscheduled engine failures which are expected to occur for the proposed configuration.

1. If the rate in failures per engine flight hours at which the pertinent component with the current configuration is expected to fail is equal to the rate in failures per engine flight hours at which the pertinent component with the proposed configuration is expected to fail, the value displayed is the difference between the cumulative integer value of unscheduled engine failures which are expected to occur for the current configuration and the cumulative integer value of unscheduled engine failures which are expected to occur to the remaining unmodified engines under the proposed configuration.

2. If the rate in failures per engine flight hours at which the pertinent component with the current configuration is expected to fail is not equal to the rate in failures per engine flight hours at which the pertinent component with the proposed configuration is expected to fail, the value displayed is the integer value of the cumulative number of unscheduled failures which are expected to occur to modified engines with the proposed configuration.

The cell formulas for the succeeding years are similar with only the unfrozen cell numbers increasing by one.

c. Annual Integer (Column AS)

This column calculates the annual number of unscheduled engine failures which are expected to occur to modified engines under the proposed configuration by the end of the year. The cell formula in cell AS14, CurYrProModYrInt, is

[CurYrProModYrInt = IF(CurYrProModEvtCumInt <> CurYrProModEvtCumInt, CurYrProModEvtCumInt - CurYrProModEvtCumInt, 0)].

This equals

[Cell AS14 = IF(Cell AR14 <> CellAR14, Cell AR14 - Cell AR14, 0)].

CurYrProModEvtCumInt is the cumulative integer value of unscheduled engine failures which are expected to occur to modified engines under the proposed configuration by the end of the year.

The cell formula for the next year is

[Cell AS15 = IF(Cell AR15 <> CurYrProModEvtCumInt, Cell AR15 - CurYrProModEvtCumInt, 0)].

This equals

[Cell AS15 = IF(Cell AR15 <> Cell AR14, Cell AR15 - Cell AR14, 0)].

The IF statement determines the annual number of unscheduled engine failures which are expected to occur to modified engines under the proposed configuration by the end of the year.

1. If the cumulative integer value of unscheduled engine failures which are expected to occur to

modified engines under the proposed configuration by the end of the year is less than or greater than the cumulative integer value of unscheduled engine failures which are expected to occur to modified engines under the proposed configuration by the end of the previous year, then the value displayed is the difference between the cumulative integer value of unscheduled engine failures which are expected to occur to modified engines under the proposed configuration by the end of the year minus the cumulative integer value of unscheduled engine failures which are expected to occur to modified engines under the proposed configuration by the end of the previous year.

2. If the cumulative integer value of unscheduled engine failures which are expected to occur to modified engines under the proposed configuration by the end of the year is equal to the cumulative integer value of unscheduled engine failures which are expected to occur to modified engines under the proposed configuration by the end of the previous year, then the value displayed is zero.

The cell formulas for the succeeding years are similar with only the cell numbers increasing by one.

The total annual number of unscheduled engine failures which are expected to occur to modified engines under the proposed configuration during the life cycle analysis period is the sum of all the Column AS cells and is contained in cell AS48.

The formula for this cell is

[Cell AS48 = SUM(Cell AS14:Cell AS46)].

Q. YEARS OF INCORPORATION (COLUMN AT)

The purpose of this column is to denote the number of years it is expected to take to incorporate the engine modifications each year. As long as kits are available to be installed, the value displayed is one. If there are not any kits to be installed then the value displayed is zero. The cell formula in cell AT14 is

[Cell AT14 = IF(CurYrProEngKitInstal = 0, 0, 1)].

This equals

[Cell AT14 = IF(Cell CY14 = 0, 0, 1)].

CurYrProEngKitInstal is the number of modification kits which need to be installed each year under the proposed configuration.

The IF statement uses the following logic to determine the number of years it is expected to take to incorporate the engine modifications for each year.

1. If the number of modification kits which need to be installed each year under the proposed configuration is equal to zero, the value displayed is zero.

2. If the number of modification kits which need to be installed each year under the proposed configuration is not equal to zero, the value displayed is one.

The cell formulas for the succeeding years are similar with only the cell numbers increasing by one.

The total number of years it is expected to take to incorporate the engine modifications during the life cycle analysis period is the sum of all the Column AT cells and is contained in cell AT48. The formula for this cell is

[Cell AT48 = SUM(Cell AT14:Cell AT46)]

R. EVENTS DUE TO UNSCHEDULED EVENTS ALLOWING MODIFICATION

1. Unscheduled Incorporation Opportunities - Columns AU, AV and AW

a. *Cumulative Decimal (Columns AU)*

This column calculates the cumulative expected number of unscheduled engine failures by the end of the year which would allow for modification of the component. The cell formula in cell AU14, CurYrUnschModOppCumDec, is

[CurYrUnschModOppCumDec = PrevYrUnschModOppCumDec + UnschEvtRateMod * PrevYrProUnmodEfh].

This equals

[Cell AU14 = Cell AU13 + Cell D26 * Cell CQ13].

PrevYrUnschModOppCumDec is the cumulative expected number of unscheduled engine failures which would allow for modification of the component at the end of the previous year. The value in this cell is zero and is only used to start the column calculations.

UnschEvtRateMod is the rate that represents how often some unscheduled event occurs and presents another opportunity to incorporate the proposed modification. This rate may not necessarily have anything to do with the part, assembly, component or module that is being modified.

PrevYrProUnmodEfh is the expected total annual number of engine flight hours, in thousands of hours, for unmodified engines.

The cell formula for the next year is

[Cell AU15 = CurYrUnschModOppCumDec + UnschEvtRateMod * CurYrProUnmodEfh].

This equals

[Cell AU15 = Cell AU14 + Cell D26 * Cell CQ14].

CurYrUnschModOppCumDec is the cumulative expected number of unscheduled engine failures at the end of the year which would allow for modification of the component.

UnschEvtRateMod is the rate that represents how often some unscheduled event occurs and presents another opportunity to incorporate the proposed modification.

CurYrProUnmodEfh is the total annual engine flight hours, in thousands of hours, for unmodified engines.

The cell formulas for the succeeding years are similar with only the unfrozen cell numbers increasing by one.

b. Cumulative Integer (Column AV)

This column calculates the cumulative integer value of the expected number of unscheduled engine failures by the end of the year which would allow for modification of the component. The cell formula in cell AV14, CurYrUnschModOppCumInt, is

[CurYrUnschModOppCumInt = TRUNC(CurYrUnschModOppCumDec)].

This equals

[Cell AV14 = TRUNC(Cell AU14)].

CurYrUnschModOppCumDec is the cumulative expected number of unscheduled engine failures by the end of the year which would allow for modification of the component.

The cell formulas for the succeeding years are similar with only the cell numbers increasing by one.

c. Annual Integer (Column AW)

This column calculates the integer value of the expected annual number of unscheduled engine failures during the year which would allow for modification of the component. The cell formula in cell AW14, UnschModYrInt, is

[UnschModYrInt = IF(CurYrUnschModOppCumInt <> CurYrUnschModOppCumInt, CurYrUnschModOppCumInt - CumYrUnschModOppCumInt, 0)].

This equals

[Cell AW14 = IF(Cell AV14 <> Cell AV14, Cell AV14 - Cell AV14, 0)].

CurYrUnschModOppCumInt is the cumulative integer value of unscheduled engine failures by the end of the year which would allow for modification of the component.

The cell formula for the next year is

[Cell AW15 = IF(Cell AV15 <> CurYrUnschModOppCumInt, Cell AV15 - CurYrUnschModOppCumInt, 0)].

This equals

[Cell AW15 = IF(Cell AV15 <> Cell AV14, Cell AV15 - Cell AV14, 0)].

The IF statement determines the integer value of the expected annual number of unscheduled engine failures during the year which would allow for modification of the component.

1. If the cumulative integer value of unscheduled engine failures by the end of the year which would allow for modification of the component is less than or greater than the cumulative integer value of unscheduled engine failures by the end of the previous year which would allow for modification of the component, then the value displayed is the difference between the cumulative integer value of unscheduled engine failures by the end of the year which would allow for modification of the component and the cumulative integer value of unscheduled engine failures by the end of the previous year which would allow for modification of the component.

2. If the cumulative integer value of unscheduled engine failures by the end of the year which would allow for modification of the component is equal to the cumulative integer value of unscheduled engine failures by the end of the previous year which would allow for modification of the component, then the value displayed is zero.

The cell formulas for the succeeding years are similar with only the cell numbers increasing by one.

The total expected annual number of unscheduled engine failures which would allow for modification of the component during the life cycle analysis period is the sum of all the Column AW cells and is contained in cell AW48. The formula for this cell is

[Cell AW48 = SUM(Cell AW14:Cell AW46)].

S. KIT INCORPORATION EVENTS - COLUMN AX AND AY

1. Unscheduled (Column AX)

This column calculates the number of unscheduled opportunities for replacement of the unmodified components with modified components that are expected to occur during the year if the proposed design change is accepted. The cell formula in cell AX14 is

[Cell AX14 = IF(CurYrProEngKitInstal > 0, ProUnschEvtUnmod * MoAvailFieldMod/12, 0)].

This equals

[Cell AX14 = IF(Cell CY14 > 0, Cell CS14 * Cell P14/12,0)].

CurYrProEngKitInstal is the number of engine component modification kits that are expected to be available to install during the year.

ProUnschEvtUnmod is the expected annual number of unscheduled component failures on unmodified engines.

MoAvailFieldMod is the number of months during a year that components can be modified at the field level.

The IF statement uses the following logic to determine the number of unscheduled opportunities for replacement of unmodified engine components with modified components that are expected to occur during the year if the proposed design change is accepted.

A) If the number of engine component modification kits that are available to be installed during the year is greater than zero, the value displayed is the expected number of unscheduled unmodified component failures that occur for the year if the proposed component design change is accepted.

B) If the number of engine component modification kits that are available to be installed during the year is not greater than zero, the value displayed is zero.

The cell formulas for the succeeding years are similar with only the unfrozen cell numbers increasing by one.

The total sum of the number of unscheduled opportunities for replacement of unmodified components with modified components that are expected to occur if the proposed design change is accepted over the life cycle analysis period is the sum of all the Column AX cells and is contained in cell AX48. The formula for this cell is

[Cell AX48 = SUM(Cell AX14:Cell AX46)].

2. Scheduled (Column AY)

This column calculates the expected number of scheduled opportunities for replacement of the unmodified components that are expected to occur during the year if the proposed design change is accepted. The cell formula in cell AY14 is

[Cell AY14 = IF(CurYrProEngKitInstal > 0, ProSchEvtUnmod * MoAvailFieldMod/12, 0)].

This equals

[Cell AY14 = IF(Cell CY14 > 0, Cell CU14 * Cell P14/12, 0)].

CurYrProEngKitInstal is the number of engine component modification kits that are expected to be available to be installed during the year.

ProSchEvtUnmod is the expected annual number of scheduled component failures on unmodified engines.

MoAvailFieldMod is the number of months during a year that components can be modified at the field level.

The IF statement uses the following logic to determine the number of scheduled opportunities for replacement of the unmodified components that are expected to occur during the year if the proposed design change is accepted.

A) If the number of engine component modification kits that are expected to be available to be installed during the year is greater than zero, the value displayed is the expected annual number of scheduled engine maintenance events during the year that can allow replacement of unmodified components if the proposed design change is accepted.

B) If the number of engine component modification kits that are expected to be available to be installed during the year is not greater than zero, the value displayed is zero.

The cell formulas for the succeeding years are similar with only the unfrozen cell numbers increasing by one.

The total expected number of scheduled opportunities for replacements of the unmodified components that are expected to occur during the life cycle analysis period if the proposed design change is accepted is the sum of all the Column AY cells and is contained in AY48. The formula for this cell is

[Cell AY48 = SUM(Cell AY14:Cell AY46)].

V. DESCRIPTION OF THE CURRENT CONFIGURATION

A. INTRODUCTION

This section will describe the columns, formulas and calculations which drive the cost analysis associated with maintaining the fleet of engines in their current configuration.

B. CALENDAR YEAR (COLUMN BA)

This column indicates each year over which the CEA analysis will be performed. The first input cell is directly input by the contractor and is the first year of the analysis. Subsequent years are then calculated by adding one year to the previous year. The cell formula in cell BA14, CurYr, is

[CurYr = FirstYrStdHistory].

This equals

[Cell BA14 = Cell N14].

FirstYrStdHistory is the first year being analyzed.

The cell formula for the next year is

[Cell BA15 = 1 + FirstYrStdHistory].

This equals

[Cell BA15 = 1 + Cell N14].

The formulas for the succeeding cells are similar with only the cell numbers increasing by one.

C. AVERAGE NUMBER OF ENGINES - COLUMNS BC AND BD

1. Unmodified Engines (Column BC)

This column calculates the average whole number of unmodified engines in the fleet each year that have the current configuration. The average is rounded down to get an integer. The cell formula in cell BC14, CurAvgUnmodEng, is [CurAvgUnmodEng = TRUNC((CurYrEngDelCum + PrevYrEngDelCum)/2)]

This equals

[Cell BC14 = TRUNC((Cell R14 + Cell R13)/2)].

CurYrEngDelCum is the cumulative number of engines in the fleet each year. This number is the cumulative number of engines delivered minus the cumulative number of engines that have attrited.

PrevYrEngDelCum is the cumulative number of engines in the fleet the previous year. The value of this cell is zero and is only used to start the column calculations.

The cell formula for the next year is

[Cell BC15 = TRUNC((Cell R15 + CurYrEngDelCum)/2)].

This equals

[Cell BC15 = TRUNC((Cell R15 + Cell R14)/2)].

The formulas for the succeeding cells are similar with only the cell numbers increasing by one.

2. Modified Engines (Column BD)

This column calculates the average number of modified engines with the current configuration. This column is blank because in the current configuration there are not any modified components being installed on any engines.

D. YEARLY ENGINE FLIGHT HOURS - COLUMNS BE AND BF

1. Unmodified EFH (Column BE)

This column calculates the average annual engine flight hours, in thousands of hours, for unmodified engines with the current configuration. The cell formula in cell BE14, CurYrCurUnmodEfh, is

[CurYrCurUnmodEfh = YrEfhPerEng * CurAvgUnmodEng/1000].

This equals

[Cell BE14 = Cell T14 * Cell BC14/1000].

YrEfhPerEng is the average engine flight hours per engine per year.

CurAvgUnmodEng is the average number of unmodified engines in the fleet each year that have the current configuration. The formulas for the succeeding cells are similar with only the cell numbers increasing by one.

The total average annual engine flight hours, in thousands of hours, for unmodified engines with the current configuration during the life cycle analysis period is the sum of the Column BE cells and is contained in cell BE48.

The formula for this cell is

[Cell BE48 = SUM(Cell BE14:Cell BE46)].

2. Modified EFH (Column BF)

This column calculates the average annual flight hours, in thousands of hours, for modified engines with the current configuration. This column is blank because in the current engine configuration there are not any modified components being installed on any engines.

E. UNSCHEDULED EVENTS - COLUMNS BG AND BH

1. Unmodified Engines (Column BG)

This column calculates the annual number of unscheduled engine failures for unmodified engines with the current configuration. The cell formula in cell BG14, CurUnschEvtUnmod, is

[CurUnschEvtUnmod = IF(CurYrCurUnmodEfh = 0, 0, MAX(0, CurEvtYrInt))].

This equals

[Cell BG14 = IF(Cell BE14 = 0, 0, MAX(0, Cell AM14))].

CurYrCurUnmodEfh is the average annual engine flight hours, in thousands of hours, for unmodified engines with the current configuration.

CurEvtYrInt is the integer value of the annual number of unscheduled failures which are expected to occur for engines with the current configuration.

The IF statement uses the following logic to determine the annual number of unscheduled engine failures for unmodified engines with the current configuration.

A) If the average annual engine flight hours, in thousands of hours, for unmodified engines with the current configuration is equal to zero, the value displayed is zero.

B) If the average annual engine flight hours, in thousands of hours, for unmodified engines with the current configuration is not equal to zero, the value displayed is the maximum of zero or the integer value of the number of unscheduled failures which are expected to occur during the year for engines with the current configuration.

The formulas for the succeeding cells are similar with only the cell numbers increasing by one.

The total annual number of unscheduled engine failures for unmodified engines with the current configuration during the life cycle analysis period is the sum of all the Column BG cells and is contained in cell BG48. The formula for this cell is

[Cell BG48 = SUM(Cell BG14:Cell BG46)].

2. Modified Engines (Column BH)

This column calculates the annual number of unscheduled engine failures for modified engines with the current configuration. This column is blank because in the current engine configuration there are not any modified components being installed on any engine.

F. SCHEDULED EVENTS - COLUMNS BI AND BJ

1. Unmodified Engines (Column BI)

This column calculates the annual number of scheduled engine maintenance events for unmodified engines with the current configuration. The cell formula in cell BI14, CurSchEvtUnmod, is

[CurSchEvtUnmod = IF(CurYrCurUnmodEfh = 0, 0, IF(CurYr > UnmodSchAvailYr, TRUNC(0.5 + CurCalSchMaintInt * CurSchInspEfh/1000), 0))].

This equals

[Cell BI14 = IF(Cell BE14 = 0, 0, IF(Cell BA14 > Cell AF14, TRUNC(0.5 + Cell E33 * Cell AJ14/1000), 0))].

CurYrCurUnmodEfh is the average annual engine flight hours, in thousands of hours, for unmodified engines with the current configuration.

CurYr is the current year during which the analysis is being performed.

UnmodSchAvailYr is the year during which scheduled maintenance of unmodified components is expected to begin.

CurCalSchMaintInt is the product of the time between scheduled preventative maintenance actions in engine flight hours per year, during which an engine is expected to be available for component modification, and the ratio of Total Accumulated Cycles (TAC) to Engine Flight Hours (EFH).

CurSchInspEfh is the total number of engine flight hours per year in thousands of hours that will be flown on unmodified engines under the current inspection schedule.

The IF statement uses the following logic to determine the annual number of scheduled engine maintenance events for unmodified engines with the current configuration.

A) If the average annual engine flight hours, in thousands of hours, for unmodified engines with the current configuration is equal to zero, the value displayed is zero.

B) If the average annual engine flight hours, in thousands of hours, for unmodified engines with the current configuration is not equal to zero, the value displayed is the result of the following IF statement:

1) If the current year during which the analysis is being performed is after (greater than) the year during which scheduled maintenance of unmodified components is expected to begin, the value displayed is the integer value of the product of the time between scheduled preventative maintenance actions during which an engine is expected to be available for component modification and the ratio of Total Accumulated Cycles (TAC) to Engine Flight Hours (EFH) and the total number of engine flight hours per year that will be

flown on unmodified engines for the current inspection schedule divided by 1000 plus 0.5.

2) If the current year during which the analysis is being performed is before (not greater than) the year during which scheduled maintenance of unmodified components is expected to begin, the value displayed is zero.

The formulas for the succeeding cells are similar with only the unfrozen cell numbers increasing by one.

The total annual number of scheduled engine failures for unmodified engines with the current configuration during the life cycle analysis period for the proposed configuration is the sum of all the Column BI cells and is contained in cell BI48. The formula for this cell is

[Cell BI48 = SUM(Cell BI14:Cell BI46)].

2. Modified Engines (Column BJ)

This column calculates the annual number of scheduled engine maintenance events for modified engines with the current configuration. This column is blank because in the current configuration there are not any modified components being installed on any engine.

G. ENGINE KITS - COLUMNS BM, BN AND BO

1. Number Installed (Column BM)

This column calculates the number of component modification kits installed during the year. This column is blank because in the current configuration there are not any modified components being installed on any engines.

2. Material Cost (Column BN)

This column calculates the cost, in thousands of dollars, of the component modification kits installed in engines during each year. This column is blank because in the current configuration there are not any modified components being installed on any engines.

3. Labor Cost (Column BO)

This column calculates the cost, in thousands of dollars, of the labor used to install the modification kits during each year. This column is blank because in the current configuration there are not any modified components being installed on any engines.

H. SPARE KITS - COLUMNS BP, BQ AND BR

1. Number Installed (Column BP)

This column calculates the number of kits installed in spare engines and components during each year. This column is blank because in the current configuration there are not any modified components being installed on any engines.

2. Material Cost (Column BQ)

This column calculates the cost, in thousands of dollars, of kits installed in spare engines and components during each year. This column is blank because in the current configuration there are not any modified components being installed on any engines.

3. Labor Cost (Column BR)

This column calculates the cost, in thousands of dollars, of labor to install spares in engines during each year. This column is blank because in the current configuration there are not any modified components being installed on any engines.

I. CALENDAR YEAR (COLUMN BT)

This column indicates each year over which the CEA analysis will be performed. The first input cell is directly input by the contractor and is the first year of the analysis. Subsequent years are then calculated by adding one year to the previous year. The cell formula in cell BT14, CurYr1, is

[CurYr1 = FirstYrStdHistory].

This equals

[Cell BT14 = Cell N14].

FirstYrStdHistory is the first year being analyzed.

The cell formula for the next year is

[Cell BT15 = 1 + FirstYrStdHistory].

This equals

[Cell BT15 = 1 + Cell N14].

The formulas for the succeeding cells are similar with only the cell numbers increasing by one.

J. ONE-TIME COSTS (COLUMN BU)

This column calculates the one-time cost, in thousands of dollars, associated with the modification of engines each year. This column is blank because in the current configuration there are not any modified components being installed on any engines.

K. PART MAINTENANCE COST - COLUMNS BW AND BX

1. Unmodified Engines (Column BW)

This column calculates the part number maintenance cost, in thousands of dollars, for unmodified engines with the current configuration. This cost is the annual cost of maintaining spare parts for the unmodified component in the supply system. This cost is determined by the managing Inventory Control Point (ICP) and is provided by the contractor. The cell formula in cell BW14, CurPNMaintCostUnmod, is

[CurPNMaintCostUnmod = IF(CurAvgUnmodEng > 0, CurPartNums * PnMaintCost/1000, 0)].

This equals

[Cell BW14 = IF(Cell BC14 > 0, Cell E64 * Cell G15/1000, 0)].

CurAvgUnmodEng is the average whole number of unmodified engines in the fleet each year that have the current configuration.

CurPartNums is the total number of part numbers relating to the modification which will be required in the supply system to support the new component.

PnMaintCost is the annual cost of maintaining a part in the supply system.

The IF statement uses the following logic to determine the part number maintenance cost, in thousands of dollars, for unmodified engines with the current configuration.

A) If the average number of unmodified engines in the fleet each year that have the current configuration is greater than zero, the value displayed is the product of the total number of part numbers relating to the modification which would be required in the supply system to support the new component and the annual cost of maintaining those part numbers in the supply system divided by 1000.

B) If the average number of unmodified engines in the fleet each year that have the current configuration is not greater than zero, the value displayed is zero.

The formulas for the succeeding cells are similar with only the unfrozen cell numbers increasing by one.

The total part number maintenance costs, in thousands of dollars, for unmodified engines with the current configuration during the life cycle analysis period is the sum of all the Column BW cells and is contained in cell BW48. The formula for this cell is

[Cell BW48 = SUM(Cell BW14:Cell BW46)].

2. Modified Engines (Column BX)

This column calculates the part number maintenance cost, in thousands of dollars, for modified engines with the current configuration. This column is blank because in the current configuration there are not any modified components being installed on any engines.

L. UNMODIFIED UNSCHEDULED COST - COLUMNS BY AND BZ

1. Labor Cost (Column BY)

This column calculates the annual labor costs, in thousands of dollars, associated with unscheduled failures that occur to unmodified engines with the current configuration.

The cell formula in cell BY14 is

[Cell BY14 = (CurUnschOILaborCostEvt + CurUnschDepLaborCostEvt) * CurUnschEvtUnmod/1000].

This equals

[Cell BY14 = (Cell K49 + Cell K50) * Cell BG14/1000].

CurUnschOILaborCostEvt is the expected labor cost for unscheduled failures to repair an unmodified engine with the current configuration at the Organization and Intermediate levels.

CurUnschDepLaborCostEvt is the expected labor cost for unscheduled failures to repair an unmodified engine with the current configuration at the Depot level.

CurUnschEvtUnmod is the annual number of unscheduled engine failures for unmodified engines with the current configuration.

The formulas for the succeeding cells are similar with only the unfrozen cell numbers increasing by one.

The total annual labor costs, in thousands of dollars, associated with unscheduled failures that occur to unmodified engines with the current configuration during the life cycle analysis period is the sum of all the Column BY cells and is contained in cell BY48. The formula for this cell is

[Cell BY48 = SUM(Cell BY14:Cell BY46)].

Cell BY51 computes, in thousands of dollars per event, the average cost of labor required per single unscheduled event on an unmodified engine. This provides a ready reference of the total labor costs per unscheduled event. The formula for this cell is

[Cell BY51 = CurUnschTotLaborCostEvt/1000].

This equals

[Cell BY51 = Cell K51/1000].

2. Material Cost (Column BZ)

This column calculates the annual material costs, in thousands of dollars, for unscheduled failures that occur to unmodified engines with the current configuration. The cell formula in cell BZ14 is

[Cell BZ14 = (CurUnschOIRepCostEvt + CurUnschDepRepCostEvt + CurUnschScrapCostEvt + CurUnschTestLabFuelCostEvt + CurUnschSecIncidentalDamCostEvt) * CurUnschEvtUnmod/1000].

This equals

[Cell BZ14 = (Cell K53 + Cell K54 + Cell K55 + Cell K58 + Cell K61)
* Cell BG14/1000].

CurUnschOIRepCostEvt is the expected material costs for the percentage of total unmodified engines with the current configuration which require repair during any unscheduled maintenance at the Organizational and Intermediate levels.

CurUnschDepRepCostEvt is the expected material costs for the percentage of total unmodified engines with the current configuration requiring unscheduled repair at the Depot level.

CurUnschScrapCostEvt is the expected material costs to replace the percentage of total unmodified components, identified during unscheduled maintenance, which must be discarded because the component is beyond economical repair.

CurUnschTestLabFuelCostEvt is the expected total cost, including labor, of the engine test time required for each unmodified component which has undergone unscheduled maintenance at the Depot level.

CurUnschSecIncidentalDamCostEvt is the sum of the estimated material costs to fix other damaged components due to the failure of the component being modified during unscheduled maintenance and any expected miscellaneous material costs that are not covered by any other input element.

CurUnschEvtUnmod is the annual number of unscheduled engine failures for unmodified engines with the current configuration.

The formulas for the succeeding cells are similar with only the unfrozen cell numbers increasing by one.

The total annual material costs, in thousands of dollars, for unscheduled failures that occur to unmodified engines with the current configuration during the life cycle analysis period is the sum of all the Column BZ cells and is contained in cell BZ48. The formula for this cell is

[Cell BZ48 = SUM(Cell BZ14:Cell BZ46)].

Cell BZ51 computes, in thousands of dollars per event, the average cost of materials used per single unscheduled event on an unmodified engine. This provides a ready reference of the cost per unscheduled event. The formula for this cell is

[Cell BZ51 = CurTotMatCostUnschEvt/1000].

This equals

[Cell BZ51 = Cell K62/1000].

M. UNMODIFIED SCHEDULED COST - COLUMNS CA AND CB

1. Labor Cost (Column CA)

This column calculates the annual labor costs, in thousands of dollars, for scheduled maintenance events that are performed on unmodified engines having the current configuration. The cell formula in cell CA14 is

[Cell CA14 = (CurSchOILaborCostEvt + CurSchDepLaborCostEvt) * CurSchEvtUnmod/1000].

This equals

[Cell CA14 = (Cell K33 + Cell K34) * Cell BI14/1000].

CurSchOILaborCostEvt is the expected labor cost for scheduled maintenance events on an unmodified engine with the current configuration at the Organizational and Intermediate levels.

CurSchDepLaborCostEvt is the expected labor cost for scheduled maintenance events on an unmodified engine with the current configuration at the Depot level.

CurSchEvtUnmod is the annual number of scheduled engine maintenance events for unmodified engines with the current configuration.

The formulas for the succeeding cells are similar with only the unfrozen cell numbers increasing by one.

The total sum of the annual labor costs, in thousands of dollars, for scheduled maintenance events that are performed on unmodified engines with the current configuration during the life cycle analysis period is the sum of all the Column CA cells and is contained in cell CA48. The formula for this cell is

[Cell CA48 = SUM(Cell CA14:Cell CA46)].

Cell CA51 computes, in thousands of dollars per event, the average cost of labor required per single scheduled maintenance event for an unmodified engine. This provides a ready reference of the cost per scheduled event. The formula for this cell is

[Cell CA51 = CurSchTotLaborCostEvt/1000].

This equals

[Cell CA51 = Cell K35/1000].

2. Material Cost (Column CB)

This column calculates the annual material costs, in thousands of dollars, for scheduled maintenance events on unmodified engines with the current configuration. The cell formula in cell CB14 is

[Cell CB14 = (CurSchOIRepCostEvt + CurSchDepRepCostEvt + CurSchScrapCostEvt + CurSchTestLabFuelCostEvt) * CurSchEvtUnmod/1000].

This equals

[Cell CB14 = (Cell K37 + Cell K38 + Cell K39 + Cell K42) * Cell BI14/1000].

CurSchOIRepCostEvt is the expected material costs for the percentage of total unmodified engines with the current configuration which require repair during scheduled maintenance at the Organizational and Intermediate levels.

CurSchDepRepCostEvt is the expected material costs for the percentage of total unmodified engines with the current configuration requiring repair during scheduled maintenance at the Depot level.

CurSchScrapCostEvt is the expected cost to replace the percentage of total unmodified components, identified during scheduled maintenance, which must be discarded because the component is beyond economical repair.

CurSchTestLabFuelCostEvt is the expected total cost, including labor, of the engine test time required for each unmodified component undergoing scheduled maintenance at the Depot level.

CurSchEvtUnmod is the annual number of scheduled engine events for unmodified engines with the current configuration.

The formulas for the succeeding cells are similar with only the unfrozen cell numbers increasing by one.

The total material costs, in thousands of dollars, for scheduled maintenance events on unmodified engines with the current configuration during the life cycle analysis period is the sum of all Column CB cells and is contained in cell CB48. The formula for this cell is

[Cell CB48 = SUM(Cell CB14:Cell CB46)].

Cell CB51 computes, in thousands of dollars per event, the average cost of materials used per single scheduled event on an unmodified engine. This provides a ready reference of the cost per scheduled event. The formula for this cell is

[Cell CB51 = CurTotMatCostSchEvt/1000].

This equals

[Cell CB51 = Cell K43/1000].

N. MODIFIED UNSCHEDULED COST - COLUMNS CC AND CD

1. Labor Cost (Column CC)

This column calculates the annual labor costs, in thousands of dollars, for unscheduled events that occur to modified engines. This column is blank because in the current configuration there are not any modified components being installed on any engines.

2. Material Cost (Column CD)

This column calculates the material costs, in thousands of dollars, for unscheduled events that occur to modified engines. This column is blank because in the current configuration there are not any modified components being installed on any engines.

O. MODIFIED SCHEDULED COST - COLUMNS CE AND CF

1. Labor Cost (Column CE)

This column calculates the annual labor costs, in thousands of dollars, for scheduled events that occur to modified engines. This column is blank because in the current configuration there are not any modified components being installed on any engines.

2. Material Cost (Column CF)

This column calculates the material costs, in thousands of dollars, for scheduled events that occur to modified engines. This column is blank because in the current configuration there are not any modified components being installed on any engines.

P. CURRENT TOTAL COST (COLUMN CG)

This column calculates the expected annual logistics support costs, with the exception of operational fuel, for engines with the current configuration. The cell formula in cell CG14, CurTotCost, is

[CurTotCost = SUM(Cell BW14:Cell CB14)].

The formulas for the succeeding cells similar with only the cell numbers increasing by one.

The total expected logistics support costs, with the exception of operational fuel, for engines with the current configuration during the life cycle analysis period is the sum of all the Column CG cells and is contained in cell CG48. The formula for this cell is

[Cell CG48 = SUM(Cell CG14:Cell CG46)].

Q. OPERATIONAL FUEL - COLUMNS CH AND CI

1. Gallons/Year (Column CH)

This column calculates the expected annual operational fuel consumption, in thousands of gallons per year, for the current configuration. The cell formula in cell CH14, CurOperFuelGalYr, is

[CurOperFuelGalYr = PctImpSFC <> 0, CurYrCurUnmodEfh * FltFuelGH, "N/A")].

This equals

[Cell CH14 = IF(Cell F66 <> 0, Cell BE14 + Cell S51, "N/A")].

PctImpSFC is the expected percentage change in fuel consumption when the proposed Engineering Change Proposal (ECP) is incorporated. Typically, it is predicted to decrease the fuel consumption rate of the aircraft.

CurYrCurUnmodEfh is the average annual engine flight hours, in thousands of hours, for unmodified engines with the current configuration.

FltFuelGH is the expected operational fuel consumption in gallons per hour required to operate the engine under the current configuration.

The IF statement uses the following logic to determine the annual operational fuel consumption in gallons per year.

A) If the expected percentage change in fuel consumption when the proposed Engineering Change Proposal (ECP) is incorporated is less than or greater than zero, the value displayed is the product of the the average annual engine flight hours, in thousands of hours, for unmodified engines with the current configuration and the operational fuel consumption in gallons per hour required to operate the engine.

B) If the expected percentage change in fuel consumption when the proposed Engineering Change Proposal (ECP) is incorporated is equal to zero, the value displayed is "N/A" since there will not be a change in operational fuel consumption after the modification is installed.

The formulas for the succeeding cells are similar with only the cell numbers increasing by one.

The total operational fuel consumption, in thousands of gallons, for the current configuration during the life cycle analysis period is the sum of all the Column CH cells and is contained in cell CH48. The formula for this cell is

[Cell CH48 = SUM(Cell CH14:Cell CH46)].

2. Cost (Column CI)

This column calculates the expected annual operational fuel costs in thousands of dollars. The cell formula in cell CI14, CurOperFuelCost, is

[CurOperFuelCost = IF(PctImpSFC <> 0, CurOperFuelGalYr * FuelCostGal, "N/A")].

This equals

[Cell CI14 = IF(Cell F66 <> 0, Cell CH14 * Cell G17, "N/A")].

PctImpSFC is the expected percentage change in fuel consumption when the proposed Engineering Change Proposal (ECP) is incorporated.

CurOperFuelGalYr is the expected annual operational fuel consumption, in thousands of gallons, for the current configuration.

FuelCostGal is the cost per gallon of fuel.

The IF statement uses the following logic to determine the annual operational fuel costs, in thousands of dollars.

A) If the expected percentage change in fuel consumption when the proposed Engineering Change Proposal (ECP) is incorporated is less than or greater than zero, the value displayed is the product of the annual operational fuel usage, in thousands of gallons, per year for the current configuration and the cost per gallon of fuel to test the engine after the modification has been accomplished.

B) If the expected percentage change in fuel consumption when the proposed Engineering Change Proposal (ECP) is incorporated is equal to zero, the value displayed is "N/A" since there will not be a change in operational fuel costs after the modification is installed.

The formulas for the succeeding cells are similar with only the unfrozen cell numbers increasing by one.

The total annual operational fuel costs, in thousands of dollars, during the life cycle analysis period is the sum of all the Column CI cells and is contained in cell CI48. The formula for this cell is

[Cell CI48 = SUM(Cell CI14:Cell CI46)].

R. TOTAL COST CURRENT CONFIGURATION WITH FUEL (COLUMN CK)

This column calculates the expected annual logistics support costs, including operational fuel, in thousands of dollars, for engines with the current configuration. The cell formula in cell CK14, CurTotCst, is

[CurTotCst = CurTotCost + CurOperFuelCost].

This equals

[Cell CK14 = Cell CG14 + Cell CI14].

CurTotCost is the annual logistics support costs, with the exception of operational fuel, for engines with the current configuration. CurOperFuelCost is the annual operational fuel costs, in thousands of dollars.

The formulas for the succeeding cells are similar with only the cell numbers increasing by one.

The total logistics support costs, including operational fuel, for engines with the current configuration during the life cycle analysis period is the sum of all the Column CK cells and is contained in cell CK48. The formula for this cell is

[Cell CK48 = SUM(Cell CK14:Cell CK46)].

VI. DESCRIPTION OF THE PROPOSED CONFIGURATION

A. INTRODUCTION

This section will describe the columns, formulas and calculations which drive the cost analysis associated with installing the modifications and maintaining the fleet of engines for the proposed configuration.

B. CALENDAR YEAR (COLUMN CM)

This column indicates each year over which the CEA analysis will be performed. The first input cell is directly input by the contractor and is the first year of the analysis. Subsequent years are then calculated by adding one year to the previous year. The cell formula in cell CM14, CurYr2, is

[CurYr2 = FirstYrStdHistory].

This equals

[Cell CM14 = Cell N14].

FirstYrStdHistory is the first year being analyzed.

The cell formula for the next year is

[Cell CM15 = 1 + FirstYrStdHistory].

This equals

[Cell CM15 = 1 + Cell N14].

The formulas for the succeeding cells are similar with only the cell numbers increasing by one.

C. ENGINES MODIFIED IN PRODUCTION (COLUMN CN)

This column calculates the whole number of engines modified during production each year. The cell formula in cell CN14, ProEngModProd, is

[ProEngModProd = IF(CurYrEngDel > 0, TRUNC(CurEngDel * MoAvailProd/12), 0)].

This equals

[Cell CN14 = IF(Cell Q14 > 0, TRUNC(Cell Q14 * Cell O14/12), 0)].

CurYrEngDel is the number of new engines delivered to the fleet, if positive, or number of engines retired from the fleet, if negative, each year. MoAvailProd is the number of months during the year that modified components are expected to be produced.

The IF statement uses the following logic to determine the number engines modified during production each year.

1. If the number of new engines delivered to the fleet each year is greater than zero, the value computed is the integer value of the product of the number of new engines delivered to the fleet or the number of engines retired from the fleet each year and the number of months during the year that modified components are expected to be produced divided by twelve.

2. If the number of new engines delivered to the fleet or number of engines retired from the fleet each year is not greater than zero, the value displayed is zero.

The formulas for the succeeding cells are similar with only the cell numbers increasing by one.

The total number of engines modified during production during the life cycle analysis period is the sum of all the Column CN cells and is contained in cell CN48. The formula for this cell is

[TotEngModProd = SUM(Cell CN14:Cell CN46)].

D. AVERAGE NUMBER OF ENGINES - COLUMNS CO AND CP

1. Unmodified Engines (Column CO)

This column calculates the average number of unmodified engines in the fleet each year. The cell formula in cell CO14, CurYrProUnmodEng (Note: the model also uses ProAvgUnmodEng to denote cell CO14), is

[CurYrProUnmodEng = MAX(TRUNC(CurAvgUnmodEng - ProAvgModEng), 0)].

This equals

[Cell CO14 = MAX(TRUNC(Cell BC14 - Cell CP14), 0)].

CurAvgUnmodEng is the average number of unmodified engines in the fleet each year.

ProAvgModEng is the average number of modified engines in the fleet which are modified each year.

The MAX statement determines the average number of unmodified engines in the fleet each year with the current configuration by displaying the maximum of either

A) The integer value of the average number of unmodified engines in the fleet each year with the current configuration minus the average number of modified engines in the fleet which are modified each year or

B) zero.

The formulas for the succeeding cells are similar with only the cell numbers increasing by one.

2. Modified Engines (Column CP)

This column calculates the average number of engines in the fleet which are expected to be modified each year. The cell formula in cell CP14, ProAvgModEng, is

[ProAvgModEng = MIN(TRUNC((CurYrEngModProd + CurYrCumKitInstl + PrevYrEngModProd + PrevYrCumKitInstl)/2), CurAvgUnmodEng)].

This equals

[Cell CP14 = MIN(TRUNC((Cell AB14 + Cell AC14 + Cell AB13 + Cell AC13)/2), Cell BC14)].

CurYrEngModProd is the cumulative number of engine modifications to be made during production by the end of the year.

CurYrCumKitInstl is the cumulative number of engine modification kits expected to be installed in the field by the end of the year.

PrevYrEngModProd is the cumulative number of engine modifications expected to be made during production by the end of the previous year. This cell value is zero and is used only to start the column calculations.

PrevYrCumKitInstl is the cumulative number of engine modification kits expected to be installed in the field by the end of the previous year. This cell value is zero and is used only to start the column calculations.

CurAvgUnmodEng is the average number of unmodified engines in the fleet each year with the current configuration.

The MIN statement determines the average number of modified engines in the fleet each year by displaying the minimum of one of the following two choices:

A) The sum of the cumulative number of engine modifications in production plus the cumulative number of engine modification kits installed in the field plus the cumulative number of engine modifications in production the previous year plus the cumulative number of engine modification kits installed the previous year divided by two, or

B) The value of the average number of unmodified engines in the fleet each year with the current configuration.

The cell formula for the next year is

[Cell CP15 = MIN(TRUNC((Cell AB15 + Cell AC15 + CurYrEngModProd + CurYrCumKitInstl)/2), Cell BC15)].

This equals

[Cell CP15 = MIN(TRUNC((Cell AB15 + Cell AC15 + Cell AB14 + Cell AC14)/2), Cell BC15)].

CurYrEngModProd is the cumulative number of engine modifications expected to be made during production by the end of the previous year.

CurYrCumKitInstl is the cumulative number of engine modification kits expected to be installed in the field by the end of the previous year.

The formulas for the succeeding cells are similar with only the cell numbers increasing by one.

E. YEARLY ENGINE FLIGHT HOURS - COLUMNS CQ AND CR

1. Unmodified EFH (Column CQ)

This column calculates the annual engine flight hours, in thousands of hours, for unmodified engines. The cell formula in cell CQ14, CurYrProUnmodEfh, is

[CurYrProUnmodEfh = ProAvgUnmodEng * YrEfhPerEng/1000].

This equals

[Cell CQ14 = Cell CO14 * Cell T14/1000].

ProAvgUnmodEng is the average number of unmodified engines in the fleet each year.

YrEfhPerEng is the average engine flight hours per engine per year.

The formulas for the succeeding cells are similar with only the unfrozen cell numbers increasing by one.

The total engine flight hours, in thousands of hours, for unmodified engines during the life cycle analysis period is the sum of all the Column CQ cells and is contained in cell CQ48. The formula for this cell is

[Cell CQ48 = SUM(Cell CQ14:Cell CQ46)].

2. Modified Engines (Column CR)

This column calculates the annual engine flight hours, in thousands of hours, for modified engines. The cell formula in cell CR14, CurYrProModEfh, is

[CurYrProModEfh = ProAvgModEng * YrEfhPerEng/1000].

This equals

[Cell CR14 = Cell CP14 * Cell T14/1000].

ProAvgModEng is the average number of engines in the fleet which are modified each year.

YrEfhPerEng is average engine flight hours per engine per year.

The formulas for the succeeding cells are similar with only the cell numbers increasing by one.

The total engine flight hours, in thousands of hours, for modified engines during the life cycle analysis period is the sum of all Column CR cells and is contained in cell CR48. The formula for this cell is

[Cell CR48 = SUM(Cell CR14:Cell CR46)].

Cell CR49 computes, in thousands of hours, the sum of all annual engine flight hours for all unmodified and modified engines.

The formula for this cell is

[Cell CR49 = Cell CQ48 + Cell CR48].

F. UNSCHEDULED EVENTS - COLUMNS CS AND CT

1. Unmodified Engines (Column CS)

This column calculates the expected annual whole number of unscheduled component failures for unmodified engines. The cell formula in cell CS14, ProUnschEvtUnmod, is

[ProUnschEvtUnmod = IF(CurYrProUnmodEfh = 0, 0, MAX(0, CurYrProUnmodYrInt))].

This equals

[Cell CS14 = IF(Cell CQ14 = 0, 0, MAX(0, Cell AP14))].

CurYrProUnmodEfh is the annual engine flight hours, in thousands of hours, for unmodified engines.

CurYrProUnmodYrInt is the annual number of unscheduled failures which are expected to occur on unmodified components with the proposed configuration.

The IF statement uses the following logic to determine the annual number of unscheduled component failures for unmodified engines.

A) If the annual engine flight hours, in thousands of hours, for unmodified engines is equal to zero, the value displayed is zero.

B) If the annual engine flight hours, in thousands of hours, for unmodified engines is not equal to zero, the value displayed is the maximum of zero or the the annual number of unscheduled failures which are expected to occur on unmodified components with the proposed configuration.

The formulas for the succeeding cells are similar with only the cell numbers increasing by one.

The total number of unscheduled component failures for unmodified engines during the life cycle analysis period is the sum of all Column CS cells and is contained in cell CS48. The formula for this cell is

[Cell CS48 = SUM(Cell CS14:Cell CS46)].

2. Modified Engines (Column CT)

This column calculates the expected annual whole number of unscheduled component failures for modified engines. The cell formula in cell CT14, ProUnschEvtMod, is

[ProUnschEvtMod = IF(CurYrCurUnmodEfh = 0, 0, MAX(0, CurYrProModYrInt))].

This equals

[Cell CT14 = IF(Cell BE14 = 0, 0, MAX(0, Cell AS14))].

CurYrCurUnmodEfh is the average annual engine flight hours, in thousands of hours, for unmodified engines with the current configuration.

CurYrProModYrInt is the annual number of unscheduled failures which are expected to occur to modified components on engines with the proposed configuration.

The IF statement uses the following logic to determine the annual number of unscheduled component failures for modified engines.

A) If the average annual engine flight hours for unmodified engines with the current configuration is equal to zero, the value displayed is zero.

B) If the average annual engine flight hours for unmodified engines with the current configuration is not equal to zero, the value displayed is the maximum of either zero or the annual number of unscheduled failures which are expected to occur to modified components on engines with the proposed configuration.

The formulas for the succeeding cells are similar with only the cell numbers increasing by one.

The total number of unscheduled component failures for modified engines during the life cycle analysis period is the sum of all the Column CT cells and is contained in cell CT48. The formula for this cell is

[Cell CT48 = SUM(Cell CT14:Cell CT46)].

Cell CT49 computes the sum of the annual number of unscheduled component failures for both unmodified and modified engines. The formula for this cell is

[Cell CT49 = Cell CS48 + Cell CT48].

G. SCHEDULED EVENTS - COLUMNS CU AND CV

1. Unmodified Engines (Column CU)

This column calculates the annual number of scheduled engine maintenance events for unmodified engines. The cell formula in cell CU14, ProSchEvtUnmod, is

[ProSchEvtUnmod = IF(CurYr2 > UnmodSchAvailYr, MIN((TotEngDel - TotEngModProd - PrevYrCumKitInstl) * (1 + UnmodInspPerYr), TRUNC(0.5 + CurCalSchMaintInt * ProUnmodSchInspEfh/1000)), 0)].

This equals

[Cell CU14 = IF(Cell CM14 > Cell AF14, MIN((Cell Q48 - Cell CN48 - Cell AC13) * (1 + Cell AG54), TRUNC(0.5 + Cell E33 * Cell AG14/1000)), 0)].

CurYr2 is the first year for which the CEA analysis will be conducted.

UnmodSchAvailYr is the year during which scheduled maintenance of unmodified components is expected to begin under the proposed configuration.

TotEngDel is the number of new engines delivered to the fleet or the number of engines retired from the fleet each year.

TotEngModProd the number of engines produced each year with modifications.

PrevYrCumKitInstl is the cumulative number of engine modification kits installed in the field by the end of the previous year. This cell value is zero and is used only to start the column calculations.

UnmodInspPerYr the average number of engine inspections per year per unmodified engine.

CurCalSchMaintInt is the product of the time between scheduled preventative maintenance actions during which an engine is expected to be available for component modification and the ratio of Total Accumulated Cycles (TAC) to Engine Flight Hours (EFH).

ProUnmodSchInspEfh is the total number of engine flight hours per year that are expected to be flown on unmodified engines for the proposed modification inspection schedule.

The IF statement uses the following logic to determine the annual number of scheduled engine maintenance events for unmodified engines.

A) If the year for which the analysis will be conducted is greater than the year during which scheduled maintenance of unmodified components is expected to begin under the proposed configuration the value displayed is the minimum of either

1) The product of the difference of the number of new engines delivered to the fleet or the number of engines retired from the fleet each year minus the number of engines produced each year with modifications minus the cumulative number of engine modification kits installed the previous year and the sum of one plus the average number of engine inspections per year per unmodified engine or

2) The integer value of the product of the sum of 0.5 plus the sum of the time between scheduled preventative maintenance actions during which an engine is expected to be available for component modification and the ratio of Total Accumulated Cycles to Engine Flight Hours and the total number of engine flight hours per year that are expected to be flown on unmodified engines for the proposed modification inspection schedule divided by 1000.

B) If the year for which the analysis will be conducted is not greater than the year during which scheduled maintenance of unmodified components is expected to begin under the proposed configuration the value displayed is zero.

The cell formula for the next year is

```
[Cell CU15 = IF(Cell CM15 > Cell AF15, MIN((TotEngDel -
TotEngModProd - CurYrCumKitInstl) * ( 1 + UnmodInspPerYr),
TRUNC(0.5 + CurCalSchMaintInt * Cell AG15/1000)), 0)].
```

This equals

```
[Cell CU15 = IF(Cell CM15 > Cell AF15, MIN((Cell Q48 - Cell
CN48 - Cell AC14) * ( 1 + Cell AG54), TRUNC(0.5 + Cell E33 *
Cell AG15/1000)), 0)].
```

CurYrCumKitInstl is the cumulative number of engine modification kits installed the previous year.

The formulas for the succeeding cells are similar with only the unfrozen cell numbers increasing by one.

The total number of scheduled engine maintenance events for unmodified engines during the life cycle analysis period is the sum of all the Column CU cells and is contained in cell CU48.

The formula for this cell is

[Cell CU48 = TRUNC(SUM(Cell CU14:Cell CU46)].

2. **Modified Engines (Column CV)**

This column calculates annual number of scheduled engine maintenance events for modified engines. The cell formula in cell CV14, ProSchEvtMod, is

[ProSchEvtMod = IF(ProAvgEng ≤ 0, 0, IF(CurYr2 > ModSchAvailYr, IF(CurSchMaintInt = ProSchMaintInt, TRUNC(CurSchEvtUnmod - ProSchEvtUnmod + 0.5), ProCalSchMaintInt * ProModSchInspEfh/1000), IF(ProSchEvtUnmod = 0, 0, TRUNC(CurSchEvtUnmod - ProSchEvtUnmod + 0.5))))].

This equals

[Cell CV14 = IF(Cell CP14 ≤ 0, 0, IF(Cell CM14 > Cell AH14, IF(Cell E32 = Cell F32, TRUNC(Cell BI14 - Cell CU14 + 0.5), Cell F33 * Cell AI14/1000), IF(Cell CU14 = 0, 0, TRUNC(Cell BI14 - Cell CU14 + 0.5))))].

ProAvgEng is the average number of engines in the fleet which are modified each year.

CurYr2 is the first year for which the CEA analysis will be conducted.

ModSchAvailYr is the year during which scheduled maintenance of modified components is expected to begin under the proposed configuration.

CurSchMaintInt is the time between scheduled preventative maintenance actions for the current configuration, measured in Total Accumulated Cycles (TAC), during which an engine is expected to be available for component modification.

ProSchMaintInt is the time between scheduled preventative maintenance actions for the proposed configuration, measured in Total Accumulated Cycles (TAC), during which an engine is expected to be available for component modification.

CurSchEvtUnmod is the annual number of scheduled engine maintenance events on unmodified engines with the current configuration.

ProSchEvtUnmod is the annual number of scheduled engine maintenance events for unmodified engines for the proposed configuration.

ProCalSchMaintInt is the product of the time between scheduled preventative maintenance actions during which an engine is expected to be available for component modification and the ratio of Total Accumulated Cycles (TAC) to Engine Flight Hours (EFH).

ProModSchInspEfh is the total number of engine flight hours per year that are expected to be flown on modified engines for the proposed modification inspection schedule.

The IF statement uses the following logic to determine the annual number of scheduled engine maintenance events for modified engines.

A) If the average number of engines in the fleet which are modified each year is less than or equal to zero, the value displayed is zero.

B) If the average number of engines in the fleet which are modified each year is greater than zero, the value displayed is the result of the following IF statement:

1) If the the year for which the analysis will be conducted is greater than the year during which scheduled maintenance of modified components is expected to begin under the proposed configuration, the value displayed is the result of the following IF statement:

a. If the time between scheduled preventative maintenance actions for the current configuration, measured in Total Accumulated Cycles (TAC), during which an engine is expected to be available for component modification is equal to the time between scheduled preventative maintenance actions for the proposed configuration, measured in Total Accumulated Cycles (TAC), during which an engine is expected to be available for component modification, the value displayed is the integer value of the difference between the annual number of scheduled engine maintenance events on unmodified engines with the current configuration and the annual number of scheduled engine maintenance events for unmodified engines for the proposed configuration.

b. If the time between scheduled preventative maintenance actions for the current configuration, measured in Total Accumulated Cycles (TAC), during which an engine is expected to be available for component modification does not equal to the time between scheduled preventative maintenance actions for the proposed configuration, measured in Total Accumulated Cycles (TAC), during which an engine is expected to be available for component modification, the value displayed is the product of the sum of the time between scheduled preventative maintenance actions during which an engine is expected to be available for component modification and the ratio of Total Accumulated Cycles to Engine Flight Hours and the total number of engine flight hours per year that are expected to be flown on modified engines for the proposed modification inspection schedule divided by 1000.

2) If the year for which the analysis will be conducted is not greater than the year during which scheduled maintenance of modified components is expected to begin under the proposed configuration, the value displayed is the result of the following IF statement:

a. If the annual number of scheduled engine maintenance events for unmodified engines is equal to zero, the value displayed is zero.

b. If the annual number of scheduled engine maintenance events for unmodified engines is not equal to zero, the value displayed is the integer value of the difference between the annual number of scheduled engine maintenance events on unmodified engines with the current configuration minus the annual number of scheduled engine maintenance events for unmodified engines for the proposed configuration.

The formulas for the succeeding cells are similar with only the unfrozen cell numbers increasing by one.

The total of scheduled engine maintenance events for modified engines during the life cycle analysis period is the sum of all the Column CV cells and is contained in cell CV48. The formula for this cell is

[Cell CV48 = TRUNC(SUM(Cell CV14:Cell CV46)].

Cell CV49 computes the sum of the annual number of scheduled engine failures for both unmodified and modified engines. The formula for this cell is

[Cell CV49 = Cell CU48 + Cell CV48].

H. AIRCRAFT LOSS EVENTS - COLUMNS CW AND CX

1. Cumulative (Column CW)

This column calculates the cumulative number of aircraft losses resulting from the loss of an entire system due to the unscheduled failure of a component. The cell formula in cell CW14, CurYrProACLEvtCum, is

[CurYrProACLEvtCum = (CurYrProModEfh * AClossImprove)/1000 + PrevYrProACLEvtCum].

This equals

[Cell CW14 = (Cell CR14 * Cell F67)/1000 + Cell CW13].

CurYrProModEfh is the annual engine flight hours, in thousands of hours, for modified engines.

AClossImprove is the expected improvement in the ratio of aircraft losses per million engine flight hours after the proposed ECP has been incorporated.

PrevYrProACLEvtCum is the cumulative number of aircraft losses from the previous year resulting from the loss of an entire system due to the unscheduled failure of a component. The value of this cell is zero and is only used to start the column calculations.

The cell formula for the next year is

[Cell CW15 = (Cell CR15 * AClossImprove)/1000 + CurYrProACLEvtCum].

This equals

[Cell CW15 = (Cell CR15 * Cell F67)/1000 + Cell CW14].

CurYrProACLEvtCum is the cumulative number of aircraft losses from the previous year resulting from the loss of an entire system due to the unscheduled failure of a component.

The formulas for the succeeding cells are similar with only the unfrozen cell numbers increasing by one.

2. Annual (Column CX)

This column calculates the annual whole number of aircraft losses resulting from the loss of an entire system due to the unscheduled failure of a component. The cell formula in cell CX14, ProACLossPerYr, is

[ProACLossPerYr = TRUNC(CurYrProACLEvtCum)].

This equals

[Cell CX14 = TRUNC(CW14)].

CurYrProACLEvtCum is the cumulative number of aircraft losses from the previous year resulting from the loss of an entire system due to the unscheduled failure of a component.

The cell formula for the next year is

[Cell CX15 = IF(TRUNC(Cell CW15) <> TRUNC(CurYrProACLEvtCum), TRUNC(Cell CW15) - TRUNC(CurYrProACLEvtCum), 0)].

This equals

[Cell CX15 = IF(TRUNC(Cell CW15) <> TRUNC(Cell CW14), TRUNC(Cell CW15) - TRUNC(Cell CW14), 0)].

The IF statement uses the following logic to determine the annual number of aircraft losses resulting from the loss of an entire system due to the unscheduled failure of a component.

A) If the integer value of the cumulative number of aircraft losses from the current year resulting from the loss of an entire system due to the unscheduled failure of a component is less than or greater than the integer value of the cumulative number of aircraft losses from the previous year resulting from the loss of an entire system due to the unscheduled failure of a component, the value displayed is difference of the integer value of the cumulative number of aircraft losses from the current year resulting from the loss of an entire system due to the unscheduled failure of a component minus the integer value of the cumulative number of aircraft losses from the previous year resulting from the loss of an entire system due to the unscheduled failure of a component.

B) If the integer value of the cumulative number of aircraft losses from the current year resulting from the loss of an entire system due to the unscheduled failure of a component is not less than or greater than the integer value of the cumulative number of aircraft losses from the previous year resulting from the loss of an entire system due to the unscheduled failure of a component, the value displayed is zero.

The formulas for the succeeding cells are similar with only the cell numbers increasing by one.

The total sum of the number of aircraft losses resulting from the loss of an entire system due to the unscheduled failure of a component during the life cycle analysis period is the sum of all the Column CX cells and is contained in cell CX48. The formula for this cell is

[Cell CX48 = SUM(Cell CX14:Cell CX46)].

I. ENGINE KITS - COLUMNS CY, CZ AND DA

1. Number Installed (Column CY)

This column calculates the number of modification kits which need to be installed each year with the proposed configuration. The cell formula in cell CY14, CurYrProEngKitInstal, is

[CurYrProEngKitInstal = IF(CurYrEngDelCum - PrevYrCumKitInstl > 0, MIN((CurYrEngModAttrit + CurYrEngMod1stOpp + CurYrEngModForce + PrevYrKitAboveMaxKit), MaxKit, PrevYrProUnmodEng, CurYrEngDelCum - PrevYrCumKitInstl), 0)].

This equals

[Cell CY14 = IF(Cell R14 - Cell AC13 > 0, MIN((Cell Y14 + Cell Z14 + Cell AA14 + Cell AE13), Cell AE51, Cell CO13, Cell R14 - Cell AC13), 0)].

CurYrEngDelCum is the cumulative number of engines delivered minus the cumulative number of engines that have attrited in the fleet each year.

PrevYrCumKitInstl is the cumulative number of installed engine modification kits installed the previous year. The value in this cell is zero and is only used to start the column calculations.

CurYrEngModAttrit is the whole number of engines in each year that can receive the component modification through attrition.

CurYrEngMod1stOpp is the annual number of whole engines to receive the component modification through the first opportunity method of incorporation.

CurYrEngModForce is the annual number of whole engines to receive the component modification through the forced retrofit incorporation method.

PrevYrKitAboveMaxKit is the number of engines above and beyond that which were expected to be modified during the year. The value in this cell is zero and is only used to start the column calculations.

MaxKit is the maximum number of kits available to be installed per year.

PrevYrProUnmodEng is the yearly average number of unmodified engines in the fleet from the previous year. The value in this cell is zero and is only used to start the column calculations.

The IF statement uses the following logic to determine the number of modification kits which need to be installed each year with the proposed configuration.

A) If the difference of the cumulative number of engines delivered minus the cumulative number of engines that have attrited in the fleet each year minus the cumulative number of installed engine modification kits installed the previous year is greater than zero, the value displayed is the minimum of the following:

1) The sum of the whole number of engines in each year that can receive the component modification through attrition plus the annual number of whole engines expected to receive the component modification through the first opportunity method of incorporation plus the annual number of whole engines expected to receive the component modification through the forced retrofit incorporation method plus the expected number of engines above and beyond that which were expected to be modified during the year;

2) The maximum number of kits available per year;

3) The the yearly average number of unmodified engines in the fleet from the previous year;

4) The difference of the cumulative number of engines delivered minus the cumulative number of engines that have attrited in the fleet each year minus the cumulative number of engine modification kits installed the previous year.

B) If the difference of the cumulative number of engines delivered minus the cumulative number of engines that have attrited in the fleet each year minus the cumulative number of installed engine modification kits installed the previous year is not greater than zero, the value displayed is zero.

The cell formula for the next year is

[Cell CY15 = IF(Cell R15 - CurYrCumKitInstl > 0, MIN((Cell Y15 + Cell Z15 + Cell AA15 + CurYrKitAboveMaxKit), Maxkit, ProAvgUnmodEng, Cell R15 - CurYrCumKitInstl), 0)].

This equals

[Cell CY15 = IF(Cell R15 - Cell AC14 > 0, MIN((Cell Y15 + Cell Z15 + Cell AA15 + Cell AE14), MaxKit, Cell CO14, Cell R15 - Cell AC14), 0)].

CurYrCumKitInstl is the cumulative number of installed engine modification kits installed by the end of the previous year.

ProAvgUnmodEng is the yearly average number of unmodified engines in the fleet from the previous year.

CurYrKitAboveMaxKitis the number of engines above and beyond that which were expected to be modified during the year.

The formulas for the succeeding cells are similar with only the unfrozen cell numbers increasing by one.

The total number of modification kits which need to be installed each year with the proposed configurationduring the life cycle analysis period is the sum of all the Column CY cells and is contained in cell CY48. The formula for this cell is

[Cell CY48 = SUM(Cell CY14:Cell CY46)].

2. Material Cost (Column CZ)

This column calculates the cost, in thousands of dollars, of the component modification kits installed in engines during each year. The cell formula in cell CZ14, ProEngKitMatCost, is

[ProEngKitMatCost = KitCost * CurYrProEngKitInstal/1000].

This equals

[Cell CZ14 = Cell D16 * Cell CY14/1000].

KitCost is the cost to the government of an engine's component modification kit.

CurYrProEngKitInstal is the number of modification kits which are expected to be installed each year with the proposed configuration.

The formulas for the succeeding cells are similar with only the unfrozen cell numbers increasing by one.

The total costs, in thousands of dollars, of the component modification kits installed in engines during the life cycle analysis period is the sum of all the Column CZ cells and is contained in cell CZ48. The formula for this cell is

[Cell CZ48 = SUM(Cell CZ14:Cell CZ46)].

3. **Labor Cost (Column DA)**

This column calculates the cost, in thousands of dollars, of the labor used to install the modification kits during each year. The cell formula in cell DA14, ProEngKitLabCost, is

[ProEngKitLabCost = IF(KitLaborCost * CurYrProEngKitInstal > 1, KitLaborCost * CurYrProEngKitInstal/1000, 0)].

This equals

[Cell DA14 = IF(Cell J24 * Cell CY14 > 1, Cell J24 * Cell CY14/1000, 0)].

KitLaborCost is the expected cost of the manhours required to install a modification kit at both the Organization and Intermediate levels, and at the Depot level.

CurYrProEngKitInstal is the number of modification kits which are expected to be installed each year with the proposed configuration.

The IF statement uses the following logic to determine the cost, in thousands of dollars, of the labor used to install the modification kits during each year.

A) If the product of the expected cost of the manhours required to install a modification kit at both the Organization and Intermediate level, and at the Depot level and the number of modification kits which are expected to be installed each year with the proposed configuration is greater than one, the value displayed is the above product divided by 1000.

B) If the product of the expected cost of the manhours required to install a modification kit at both the Organization and Intermediate levels, and at the Depot level and the number of modification kits which are expected to be installed each year with the proposed configuration is not greater than one, the value displayed is zero.

The formulas for the succeeding cells are similar with only the cell numbers increasing by one.

The total costs, in thousands of dollars, of the labor used to install the modification kits during the life cycle analysis period is the sum of all the Column DA cells and is contained in cell DA48. The formula for this cell is

[Cell DA48 = SUM(Cell DA14:Cell DA46)].

Cell DA51 computes the total number of modification kits and spare kits installed under the proposed configuration.

The formula for this cell is

[Cell DA51 = Cell CY48 + Cell DB48].

Cell DA52 computes the total material costs of modification kits and spare kits installed under the proposed configuration. The formula for this cell is

[Cell DA52 = Cell CZ48 + Cell DC48].

Cell DA53 computes the total labor costs to install modification kits and spare kits under the proposed configuration. The formula for this cell is

[Cell DA53 = Cell DA48 + Cell DD48].

J. SPARE KITS - COLUMNS DB, DC AND DD

1. Number Installed (Column DB)

This column calculates the number of kits installed in spare engines and spare components during each year. The cell formula in cell DB14, ProSpareKitInstalled, is

[ProSpareKitInstalled = TRUNC(SparePartFactor * (CurYrProEngKitInstal + ProEngModProd))].

This equals

[Cell DB14 = TRUNC(Cell D22 * (Cell CY14 + Cell CN14))].

SparePartFactor is an estimate of the percentage of total installed/modified engines that are spare engines or spare components which will require the proposed modification.

CurYrProEngKitInstal is the number of modification kits which are expected to be installed each year with the proposed configuration.

ProEngModProd is the expected number engines modified during production each year.

The formulas for the succeeding cells are similar with only the unfrozen cell numbers increasing by one.

The total number of kits installed in spare engines and spare components during the life cycle analysis period is the sum of all the Column DB cells and is contained in cell DB48. The formula for this cell is

[Cell DB48 = SUM(Cell DB14:Cell DB46)].

Cell DB51 is associated with the cost per kit for the number of kits installed. It is apparently not needed and, therefore, "N/A" is displayed in this cell.

Cell DB52 computes the material cost per kit, in thousands of dollars, of all modification kits and spare kits installed under the proposed configuration. The formula for this cell is

[Cell DB52 = KitCost/1000].

This equals

[Cell DB52 = Cell J23/1000].

Cell DB53 computes the cost per kit of labor, in thousands of dollars, required to install modification kits and spare kits under the proposed configuration. The formula for this cell is

[Cell DB53 = KitLaborCost/1000].

This equals

[Cell DB53 = Cell J24/1000].

2. Material Cost (Column DC)

This column calculates the cost, in thousands of dollars, of kits installed in spare engines and components during each year. The cell formula in cell DC14, ProSpareKitMatC..., is

[ProSpareKitMatC... = KitCost * ProSpareKitInstalled/1000].

This equals

[Cell DC14 = Cell D16 * Cell DB14/1000].

KitCost is the cost to the government of an engine's component modification kit.

ProSpareKitInstalled is the number of kits installed in spare engines and components during each year.

The formulas for the succeeding cells are similar with only the unfrozen cell numbers increasing by one.

The total costs, in thousands of dollars, of kits installed in spare engines and components during the life cycle analysis period is the sum of all the Column DC cells and is contained in cell DC48. The formula for this cell is

[Cell DC48 = SUM(Cell DC14:Cell DC46)].

3. Labor Cost (Column DD)

This column calculates the cost, in thousands of dollars, of labor to install kits in engines and components during each year.

The cell formula in cell DD14, ProSpareKitLabC..., is

[ProSpareKitLabC... = IF(KitLaborCost * ProSpareKitInstalled > 0.01, KitLaborCost * ProSpareKitInstalled/1000, 0)].

This equals

[Cell DD14 = IF(Cell J24 * Cell DB14 > 0.01, Cell J24 * Cell DB14/1000, 0)].

KitLaborCost is the expected cost of the manhours required to install a modification kit at both the Organization and Intermediate levels, and at the Depot level.

ProSpareKitInstalled is the number of kits installed in spare engines and components during each year.

The IF statement uses the following logic to determine the cost, in thousands of dollars, of labor to install spares in engines during each year.

A) If the product of the expected cost of the manhours required to install a modification kit at both the Organizational and Intermediate levels, and at the Depot level, and the number of kits installed in spare engines and components during each year is greater than 0.01, the value displayed is the above product divided by 1000.

B) If the product of the expected cost of the manhours required to install a modification kit at both the Organizational and Intermediate levels, and at the Depot level, and the number of kits installed in spare engines and components during each year is not greater than 0.01, the value displayed is zero.

The formulas for the succeeding cells are similar with only the unfrozen cell numbers increasing by one.

The total costs, in thousands of dollars, of labor to install kits in spare engines and components during the life cycle analysis period is the sum of all the Column DD cells and is contained in cell DD48. The formula for this cell is

[Cell DD48 = SUM(Cell DD14:Cell DD46)].

K. CALENDAR YEAR (COLUMN DF)

This column indicates each year over which the CEA analysis will be performed. The first input cell is directly input by the contractor and is the first year of the analysis. Subsequent years are then calculated by adding one year to the previous year. The cell formula in cell DF14 is

[Cell DF14 = FirstYrStdHistory].

This equals

[Cell DF14 = Cell N14].

FirstYrStdHistory is the first year being analyzed.

The cell formula for the next year is

[Cell DF15 = 1 + FirstYrStdHistory].

This equals

[Cell DF15 = 1 + Cell N14].

The formulas for the succeeding cells are similar with only the cell numbers increasing by one.

L. ONE-TIME COSTS (COLUMN DG)

This column calculates the one-time cost, in thousands of dollars, associated with the modification of engines each year. One-time costs include the tooling and support equipment costs, technical publication costs, time-compliance technical order costs, and the cost of introducing new part number(s) into the supply system. As the name implies, these will only occur in the first year that modifications are made. The cell formula in cell DG14, CurYrPro1TimeCost, is

```
[CurYrPro1TimeCost = IF(SUM(PrevYrPro1TimeCost) > 0, 0,
IF(MoAvailProd + MoAvailFieldMod > 0, (ToolSE.Cost +
TechPubsCost + TctoCost + PnIntro)/1000, 0)].
```

This equals

```
[Cell DG14 = IF(SUM(Cell DG13) > 0, 0, IF(Cell O14 + Cell P14
> 0, (Cell D21 + Cell D19 + Cell D20 + Cell L64)/1000, 0))].
```

PrevYrPro1TimeCost is the one time cost associated with the modification of engines the previous year. The value in this cell is zero and is only used to start the column calculations.

MoAvailProd is the number of months during a year that modified components are expected to be produced.

MoAvailFieldMod is the number of months during a year that components are expected to be modified at the field level.

ToolSE.Cost is the cost associated with any special tooling or support equipment required to complete the component's modification.

TechPubsCost is the total cost of any technical publication cost associated with the proposed engine change.

TctoCost is the time-compliance technical order cost.

PnIntroCost is the cost of introducing a new part number into the military supply system.

The IF statement uses the following logic to determine the one-time cost, in thousands of dollars, associated with the modification of engines each year.

1) If the sum of the one-time costs associated with the modification of engines during the previous year is greater than zero, the value displayed is zero.

2) If the sum of the one-time costs associated with the modification of engines during the previous year is not greater than zero, the value displayed is the result of the following IF statement:

A) If the sum of the number of months during a year that modified components are expected to be produced plus the number of months during a year that components are expected to be modified at the field level is greater than zero, the value displayed is the sum of the cost associated with any special tooling or support equipment required to complete the component's modification plus the total cost of any technical publication cost associated with the proposed engine change plus the time-compliance technical order cost plus the cost of introducing a new part number into the military supply system divided by 1000.

B) If the sum of the number of months during a year that modified components are expected to be produced plus the number of months during a year that components are expected to be modified at the field level is not greater than zero, the value displayed is zero.

The cell formula for the next year is

[Cell DG15 = IF(SUM(Cell DG13:Cell DG14) > 0, 0, IF (Cell O15 + Cell P15 > 0, (ToolSE.Cost + TechPubsCost + PnIntroCost)/1000, 0))].

This equals

[Cell DG15 = IF(SUM(Cell DG13:Cell DG14) > 0, 0, IF(Cell O15 + Cell P15 > 0, (Cell D21 + Cell D19 + Cell D20 + Cell L64)/1000, 0))].

SUM(Cell DG$13:Cell DG14) is the cumulative one-time cost associated with the proposed engine modification.

The formulas for the succeeding cells are similar with only the unfrozen cell numbers increasing by one.

The total one-time costs, in thousands of dollars, associated with the modification of engines during the life cycle analysis period is the sum of all the Column DG cells and is contained in cell DG48. The formula for this cell is

[Cell DG48 = SUM(Cell DG14:Cell DG46)].

M. DELTA PRODUCTION COST (COLUMN DH)

This column calculates the difference in the annual cost, in thousands of dollars, between the annual production costs of new modified engines and the production costs of the new engines without the modification. The cell formula in cell DH14 is

[Cell DH14 = ProEngModProd * DeltaProdCost/1000].

This equals

[Cell DH14 = Cell CN14 * Cell D15/1000].

ProEngModProd is the number of engines modified during production each year.

DeltaProdCost is the difference between the production cost of an engine incorporating the modification and one that does not contain the modification.

The formulas for the succeeding cells are similar with only the unfrozen cell numbers increasing by one.

The total difference in the annual costs, in thousands of dollars, between the annual production costs of new modified engines and the production costs of the new engines without the modification during the life cycle analysis period is the sum of all the Column DH cells and is contained in cell DH48. The formula for this cell is

[Cell DH48 = SUM(Cell DH14:Cell DH46)].

N. PART MAINTENANCE COST - COLUMNS DI AND DJ

1. Unmodified Engines (Column DI)

This column calculates the annual part number maintenance costs, in thousands of dollars, for unmodified engines.

The cell formula in cell DI14 is

[Cell DI14 = IF(ProAvgUnmodEng > 0, CurPartNums * PnMaintCost/1000, 0)].

This equals

[Cell DI14 = IF(Cell CO14 > 0, Cell E64 * Cell G15/1000, 0)].

ProAvgUnmodEng is the average number of unmodified engines in the fleet each year.

CurPartNums is the total number of part numbers in an unmodified component relating to the part numbers of a modified component.

PnMaintCost is the annual cost of maintaining a part in the military supply system.

The IF statement uses the following logic to determine the annual part number maintenance costs, in thousands of dollars, for unmodified engines.

A) If the average number of unmodified engines in the fleet each year is greater than zero, the value displayed is the product of the total number of part numbers in an unmodified component relating to the part numbers of a modified component and the annual cost of maintaining a part in the military supply system divided by 1000.

B) If the average number of unmodified engines in the fleet each year is not greater than zero, the value displayed is zero.

The formulas for the succeeding cells are similar with only the unfrozen cell numbers increasing by one.

The total part number maintenance costs, in thousands of dollars, for unmodified engines during the life cycle analysis period is the sum of all the Column DI cells and is contained in cell DI48. The formula for this cell is

[Cell DI48 = SUM(Cell DI14:Cell DI46)].

2. Modified Engines (Column DJ)

This column calculates the annual part number maintenance cost, in thousands of dollars, for modified engines. The cell formula in cell DJ14 is

[Cell DJ14 = IF(ProAvgModEng > 0, ProPartNums * PnMaintCost/1000, 0)].

This equals

[Cell DJ14 = IF(Cell CP14 > 0, Cell F64 * Cell G15/1000, 0)].

ProAvgModEng is the average number of engines in the fleet which are modified each year.

ProPartNums is the total number of part number changes relating to the modifications done each year.

PnMaintCost is the annual cost of maintaining a part in the military supply system.

The IF statement uses the following logic to determine the annual part number maintenance cost, in thousands of dollars for modified engines.

A) If the average number of engines in the fleet which are modified each year is greater than zero, the value displayed is the product of the annual number of part number changes relating to the modification and the annual cost of maintaining a part in the military supply system divided by 1000.

B) If the average number of engines in the fleet which are modified each year is not greater than zero, the value displayed is zero.

The formulas for the succeeding cells are similar with only the unfrozen cell numbers increasing by one.

The total part number maintenance costs, in thousands of dollars, for modified engines during the life cycle analysis period is the sum of all the Column DJ cells and is contained in cell DJ48. The formula for this cell is

[Cell DJ48 = SUM(Cell DJ14:Cell DJ46)].

Cell DJ49 computes the sum of the annual part number maintenance cost for both unmodified and modified engines under the proposed configuration. The formula for this cell is

[Cell DJ49 = Cell DI48 + Cell DJ48].

O. UNMODIFIED UNSCHEDULED MAINTENANCE COST, MINUS KIT INSTALLATION - COLUMNS DK AND DL

1. Labor Cost (Column DK)

This column calculates the annual labor costs, in thousands of dollars, for unscheduled events for unmodified engines.

The cell formula in cell DK14 is

[Cell DK14 = ProUnschEvtUnmod * CurUnschTotLaborCostEvt/1000].

This equals

[Cell DK14 = Cell CS14 * Cell K51/1000].

ProUnschEvtUnmod is the annual number of unscheduled component failures for unmodified engines.

CurUnschTotLaborCostEvt is the sum of the total labor cost at the Organizational, Intermediate and Depot levels during an unscheduled event on an engine with the current configuration.

The formulas for the succeeding cells are similar with only the unfrozen cell numbers increasing by one.

The total labor costs, in thousands of dollars, for unscheduled events for unmodified engines during the life cycle analysis period is the sum of all the Column DK cells and is contained in cell DK48. The formula for this cell is

[Cell DK48 = SUM(Cell DK14:Cell DK46)].

Cell DK51 computes the labor costs, in thousands of dollars, required per single unscheduled event for unmodified engines. This provides a ready reference of the cost per unscheduled event. The formula for this cell is

[Cell DK51 = CurUnschTotLaborCostEvt/1000].

This equals

[Cell DK51 = Cell K51/1000].

2. Material Cost (Column DL)

This column calculates the annual material cost, in thousands of dollars, for unscheduled events for unmodified engines. The cell formula in cell DL14 is

[Cell DL14 = IF(ProAvgModEng = 0, CurUnmodUnschLabCost, (MAX(IF(KitCostReplaceNormalMaint = 0, ProUnschEvtUnmod * CurTotMatCostUnschEvt, ProUnschEvtUnmod * CurTotMatCostUnschEvt - UnschModYrInt * MoAvailFieldMod/12 * CurUnschTotMatCostEvt * UnschPctEvtMod), ProUnschEvtUnmod * (CurUnschTestLabFuelCostEvt + CurUnschSecIncidentalDamCostEvt))/1000))].

This equals

[Cell DL14 = IF(Cell CP14 = 0, Cell BZ14, (MAX(IF(Cell D14 = 0, Cell CS14 * Cell K62, Cell CS14 * Cell K62 - Cell AW14 * Cell P14/12 * Cell K56 * Cell D25), Cell CS14 * (Cell K58 + Cell K61))/1000))].

ProAvgModEng is the average number of engines in the fleet which are modified each year.

CurUnmodUnschLabCost is the annual material costs, in thousands of dollars, for unscheduled failures that occur to unmodified engines with the current configuration.

KitCostReplaceNormalMaint is the difference between the modification kit cost and the maintenance cost of the current component.

ProUnschEvtUnmod is the annual number of unscheduled engine maintenance events for unmodified engines.

CurTotMatCostUnschEvt is the sum of the total costs to test a component after modification, to repair a component or replace a scrapped component, the estimated material cost to other components due to the failure of the component being modified and any expected miscellaneous material cost during unscheduled maintenance.

UnschModYrInt is the integer value of the expected annual number of unscheduled engine failures which would allow for modification of the component.

MoAvailFieldMod is the number of months during a year that engines are expected to be modified at the field level.

CurUnschTotMatCostEvt is the sum of the total costs to repair a component or replace a scrapped component, during unscheduled maintenance, at the Organization and Intermediate, and Depot levels.

CurUnschTestLabFuelCostEvt is the total cost, including labor, of the engine test time required for each component undergoing unscheduled maintenance.

CurUnschSecIncidentalDamCostEvt is the sum of the total estimated material costs to fix other damaged components due to the failure of the component being modified during unscheduled maintenance and any expected miscellaneous material costs that are not covered by any other input element.

UnschPctEvtUnmod is the percentage of unscheduled maintenance events during which a modification can be performed.

The IF statement uses the following logic to determine the annual material cost, in thousands of dollars, for unscheduled events for unmodified engines.

A) If the average number of engines in the fleet which are modified each year is equal to zero, the value displayed is the the annual material costs, in thousands of dollars, for unscheduled failures that occur to unmodified engines with the current configuration.

B) If the average number of engines in the fleet which are modified each year is not equal to zero, the value displayed is the maximum value resulting from the following:

1) The outcome of the following IF statement:

(a) If the difference between the modification kit cost and the maintenance cost of the current component is equal to zero, the value displayed is the product of the annual number of unscheduled engine maintenance events for unmodified engines and the sum of the total costs to test a component after modification, to repair a component or replace a scrapped component, the estimated material cost to other components due to the failure of the component being modified and any expected miscellaneous material costs during unscheduled maintenance

(b) If the difference between the modification kit cost and the maintenance cost of the current component is not equal to zero, the value displayed is the difference between the products of the annual number of unscheduled engine maintenance events for unmodified engines and the sum of the total costs to test a component after modification, to repair a component or replace a scrapped component, the estimated material cost to other components due to the failure of the component being modified and any expected miscellaneous material cost during unscheduled maintenance minus the products of the integer value of the expected annual number of unscheduled engine failures which would allow for modification of the component and the number of months during a year that engines are expected to be modified at the field level divided by 12 and the product of the sum of the total costs to repair a component or replace a scrapped component, during unscheduled maintenance, at the Organization and Intermediate, and Depot levels and the percentage of unscheduled maintenance events during which a modification can be performed.

2) The product of the annual number of unscheduled engine maintenance events for unmodified engines and the sum of the total cost, including labor, of the engine test time required for each component undergoing unscheduled maintenance plus the sum of the total estimated material costs to fix other damaged components due to the failure of the component being modified during unscheduled maintenance and any expected miscellaneous material costs that are not covered by any other input element divided by 1000.

The formulas for the succeeding cells are similar with only the unfrozen cell numbers increasing by one.

The total material costs, in thousands of dollars, for unscheduled events for unmodified engines during the life cycle analysis period is the sum of all the Column DL cells and is contained in cell DL48. The formula for this cell is

[Cell DL48 = SUM(Cell DL14:Cell DL46)].

Cell DL49 computes the sum of the annual labor and material costs, in thousands of dollars, for unscheduled events for unmodified engines. The formula for this cell is

[Cell DL49 = SUM(Cell DK48:Cell DL48)].

Cell DL51 computes the material costs, in thousands of dollars, per single unscheduled event for unmodified engines. This provides a ready reference of the total material costs per unscheduled event. The formula for this cell is

[Cell DL51 = CurTotMatCostUnschEvt/1000].

This equals

[Cell DL51 = Cell K62/1000].

P. UNMODIFIED SCHEDULED MAINTENANCE COST, MINUS KIT INSTALLATION - COLUMNS DM AND DN

1. Labor Cost (Column DM)

This column calculates the annual labor costs, in thousands of dollars, for scheduled events for unmodified engines. The cell formula in cell DM14 is

[Cell DM14 = ProSchEvtUnmod * CurSchTotLaborCostEvt/1000].

This equals

[Cell DM14 = Cell CU14 * Cell K35/1000].

ProSchEvtUnmod is the annual number of scheduled engine maintenance events for unmodified engines.

CurSchTotLaborCostEvt is the combined labor cost to repair one unit at Organizational, Intermediate and Depot levels during a scheduled event.

The formulas for the succeeding cells are similar with only the unfrozen cell numbers increasing by one.

The total annual labor costs, in thousands of dollars, for scheduled events for unmodified engines during the life cycle analysis period is the sum of all the Column DM cells and is contained in cell DM48. The formula for this cell is

[Cell DM48 = SUM(Cell DM14:Cell DM46)].

Cell DM51 computes the labor costs, in thousands of dollars, required per scheduled event for unmodified engines. this provides a ready reference of the expected labor costs per scheduled event. The formula for this cell is

[Cell DM51 = CurSchTotLaborCostEvt/1000].

This equals

[Cell DM51 = Cell K35/1000].

2. Material Cost (Column DN)

This column calculates the annual material cost, in thousands of dollars, for scheduled events for unmodified engines. The cell formula in cell DN14 is

[Cell DN14 = IF(ProAvgModEng ≤ 0, CurUnmodSchMatCost,
ProSchEvtUnmod * MAX(IF(KitCostReplaceNormalMaint = 0,
CurTotMatCostSch, CurTotMatCostSch - CurSchTotMatCostEvt *
MoAvailFieldMod/12 * SchPctEvtMod),
CurSchTestLaborFuelCostEvt)/1000)].

This equals

[Cell DN14 IF(Cell CP14 ≤ 0, Cell CB14, Cell CU14 * MAX(IF(Cell D14 = 0, Cell K43, Cell K43 - Cell K40 * Cell P14/12 * Cell D24), Cell K42)/1000)].

ProAvgModEng is the average number of engines in the fleet which are modified each year.

CurUnmodSchMatCost is the annual material costs, in thousands of dollars, for scheduled events that occur to unmodified engines with the current configuration.

ProSchEvtUnmod is the annual number of scheduled engine maintenance events for unmodified engines.

KitCostReplaceNormalMaint is the difference between the modification kit cost and the maintenance cost of the current component.

CurTotMatCostSch is the sum of the total costs associated with repairing a component or replacing a scrapped component, and testing a component after modification, during scheduled maintenance at the Organizational and Intermediate levels, and the Depot level.

CurSchTotMatCostEvt is the sum of the total material costs associated with repairing a component or replacing a scrapped component during scheduled maintenance at the Organizational and Intermediate levels, and the Depot level.

MoAvailFieldMod is the number of months during a year that engines are expected to be modified at the field level.

SchPctEvtMod is the percentage of scheduled maintenance events during which a modification can occur.

CurSchTestLaborFuelCostEvt is the total cost, including labor, of the engine test time required for each component undergoing scheduled maintenance.

The IF statement uses the following logic to determine the annual material cost, in thousands of dollars, for scheduled events for unmodified engines.

A) If the average number of engines in the fleet which are modified each year is less than or equal to zero, the value displayed is the annual material costs, in thousands of dollars, for scheduled events that occur to unmodified engines with the current configuration.

B) If the average number of engines in the fleet which are modified each year is greater than zero, the value displayed is the product of the annual number of scheduled engine maintenance events for unmodified engines and the maximum of the following results:

1) If the difference between the modification kit cost and the maintenance cost of the current component is equal to zero, the second part of the above product is the sum of the total costs to repair a component or replace a scrapped component and to test a component after modification during scheduled maintenance at the Organizational and Intermediate levels, and the Depot level.

2) If the difference between the modification kit cost and the maintenance cost of the current component is not equal to zero, the second part of the above product is the

products of the difference between the sum of the total costs to repair a component or replace a scrapped component and to test a component after modification during scheduled maintenance at the Organizational and Intermediate levels, and the Depot level minus the sum of the total costs to repair a component or replace a scrapped component and to test a component after modification during scheduled maintenance at the Organizational and Intermediate levels, and the Depot level and the number of months during a year that engines are expected to be modified at the field level divided by 12 and the percentage of scheduled maintenance events during which a modification can occur.

3) The total cost, including labor, of the engine test time required for each component undergoing scheduled maintenance.

The results in items 1, 2, and 3 above are divided by 1000 to ensure the units are in thousands of dollars.

The formulas for the succeeding cells are similar with only the unfrozen cell numbers increasing by one.

The total material cost, in thousands of dollars, for scheduled events for unmodified engines during the life cycle analysis period is the sum of all the Column DN cells and is contained in cell DN48. The formula for this cell is

[Cell DN48 = SUM(Cell DN14:Cell DN46)].

Cell DN49 computes the sum of the annual labor and material costs, in thousands of dollars, for scheduled events for unmodified engines. The formula for this cell is

[Cell DN49 = SUM(Cell DM48:Cell DN48)].

Cell DN51 computes the material costs per single scheduled event for unmodified engines. This provides a ready reference of the material costs per scheduled event for unmodified engines for the proposed configuration. The formula for this cell is

[Cell DN51 = CurTotMatCostSch/1000].

This equals

[Cell DN51 = Cell K43/1000].

Q. MODIFIED UNSCHEDULED MAINTENANCE COST - COLUMNS DO AND DP

1. Labor Cost (Column DO)

This column calculates the annual labor costs, in thousands of dollars, for unscheduled events for modified engines. The cell formula in cell DO14 is

[Cell DO14 = (ProUnschOILaborCostEvt + ProUnschDepLaborCostEvt) * ProUnschEvtMod/1000].

This equals

[Cell DO14 = (Cell L49 + Cell L50) * Cell CT14/1000].

ProUnschOILaborCostEvt is the expected cost to repair the percentage of total units which are expected to require repair during any unscheduled maintenance at the Organizational and Intermediate levels.

ProUnschDepLaborCostEvt is the cost to repair the percentage of total units expected to require unscheduled repair at the Depot level.

ProUnschEvtMod is the annual number of unscheduled component failures for modified engines.

The formulas for the succeeding cells are similar with only the unfrozen cell numbers increasing by one.

The total labor costs, in thousands of dollars, for unscheduled events for modified engines during the life cycle analysis period is the sum of all the Column DO cells and is contained in cell DO48. The formula for this cell is

[Cell DO48 = *SUM*(Cell DO14:Cell DO46)].

Cell DO51 computes the expected labor costs, in thousands of dollars, per single unscheduled event for modified engines. This provides a ready reference of the total labor costs per unscheduled event for modified engines. The formula for this cell is

[Cell DO51 = ProUnschTotLaborCostEvt/1000].

This equals

[Cell DO51 = Cell L51/1000].

2. Material Cost (Column DP)

This column calculates the expected annual material costs, in thousands of dollars, for unscheduled events for modified engines. The cell formula in cell DP14 is

[Cell DP14 = (ProUnschScrapCostEvt + ProUnschOIRepCostEvt + ProUnschDepRepCostEvt + ProUnschTestLabFuelCostEvt + ProUnschSecIncidentalDamCostEvt) * ProUnschEvtMod/1000].

This equals

[Cell DP14 = (Cell L55 + Cell L53 + Cell L54 + Cell L61) * Cell CT14/1000].

ProUnschScrapCostEvt is the cost to replace the percentage of total components, identified during unscheduled maintenance, which are expected to be discarded because the component is beyond economical repair.

ProUnschOIRepCostEvt is the cost to repair the percentage of total units which are expected to require repair during any unscheduled maintenance at the Organizational and Intermediate levels.

ProUnschDepRepCostEvt is the cost to repair the percentage of total units which are expected to require unscheduled repair at the Depot level.

ProUnschTestLabFuelCostEvt is the expected total cost, including labor, of the engine test time required for each component undergoing unscheduled maintenance.

ProUnschSecIncidentalDamCostEvt is the sum of the total estimated material costs to fix other damaged components due to the failure of the component being modified during unscheduled maintenance and any expected miscellaneous material costs that are not covered by any other input element.

ProUnschEvtMod is the expected annual number of unscheduled component failures for modified engines.

The formulas for the succeeding cells are similar with only the unfrozen cell numbers increasing one.

The total material costs, in thousands of dollars, for unscheduled events for modified engines during the life cycle analysis period is the sum of all the Column DP cells and is contained in cell DP48. The formula for this cell is

[Cell DP48 = SUM(Cell DP14:Cell DP46)].

Cell DP49 computes the sum of the annual labor and material costs, in thousands of dollars, for unscheduled events for modified engines. The formula for this cell is

[Cell DP49 = SUM(Cell DO48:Cell DP48)].

Cell DP51 computes the annual material costs per single unscheduled event for a modified engine. This provides a ready reference of the total material costs per unscheduled event for a modified engine. The formula for this cell is

[Cell DP51 = ProTotMatCostUnschEvt/1000].

This equals

[Cell DP51 = Cell L62/1000].

R. MODIFIED SCHEDULED MAINTENANCE COST - COLUMNS DQ AND DR

1. Labor Cost (Column DQ)

This column calculates the annual labor costs, in thousands of dollars, for scheduled events for modified engines. The cell formula in cell DQ14 is

[Cell DQ14 = (ProSchOILaborCostsEvt + ProSchDepLaborCostEvt) * ProSchEvtMod/1000].

This equals

[Cell DQ14 = (Cell L33 + Cell L34) * Cell CV14/1000].

ProSchOILaborCostEvt is the expected labor cost to repair one unit at the Organizational and Intermediate levels.

ProSchDepLaborCostEvt is the expected labor cost to repair one unit at the Depot level during a scheduled event.

ProSchEvtMod is expected annual number of scheduled engine maintenance events for modified engines.

The formulas for the succeeding cells are similar with only the unfrozen cell numbers increasing by one.

The total labor costs, in thousands of dollars, for scheduled events for modified engines during the life cycle analysis period is the sum of all the Column DQ cells and is contained in cell DQ48. The formula for this cell is

[Cell DQ48 = SUM(Cell DQ14:Cell DQ46)].

Cell DQ51 computes the annual labor costs, in thousands of dollars, per single scheduled event for modified engines. This provides a ready reference of the total labor costs per scheduled event.

The formula for this cell is

[Cell DQ51 = ProSchTotLaborCostEvt/1000].

This equals

[Cell DQ51 = Cell L35/1000].

2. Material Cost (Column DR)

This column calculates the annual material costs, in thousands of dollars, for scheduled events for modified engines. The cell formula in cell DR14, ProModSchMatC..., is

[ProModSchMatC... = (ProSchOIRepCostEvt + ProSchDepRepCostEvt + ProSchScrapCostEvt + ProSchTestLabFuelCostEvt) * ProSchEvtMod/1000].

This equals

[Cell DR14 = (Cell L37 + Cell L38 + Cell L39 + Cell L42) * Cell CV14/1000].

ProSchOIRepCostEvt is the cost to repair the percentage of total units which are expected to require repair during any scheduled maintenance at the Organizational and Intermediate levels.

ProSchDepRepCostEvt is the cost to repair the percentage of total units which are expected to require scheduled repair at the Depot level.

ProSchScrapCostEvt is the cost to replace the percentage of total components, identified during scheduled maintenance, which are expected to be discarded because the component is beyond economical repair.

ProSchTestLabFuelCostEvt is the expected total cost, including labor, of the engine test time required for each component which has undergone scheduled maintenance at the Depot level.

ProSchEvtMod is annual number of scheduled engine maintenance events for modified engines.

The formulas for the succeeding cells are similar with only the unfrozen cell numbers increasing by one.

The total material costs, in thousands of dollars, for scheduled events for modified engines during the life cycle analysis period is the sum of all the Column DR cells and is contained in cell DR48. The formula for this cell is

[Cell DR48 = SUM(Cell DR14:Cell DR46)].

Cell DR49 computes the sum of the annual labor and material costs, in thousands of dollars, for scheduled events for modified engines. The formula for this cell is

[Cell DR49 = SUM(Cell DQ48:Cell DR48)].

Cell DR51 computes the expected material costs, in thousands of dollars, per single scheduled event for modified engines. This provides a ready reference of the material costs per scheduled event for modified engines. The formula for this cell is

[Cell DR51 = ProTotMatCostSch/1000].

This equals

[Cell DR51 = Cell L43/1000].

S. PROPOSED TOTAL COST (COLUMN DS)

This column calculates the annual logistics support costs, less operational fuel costs, in thousands of dollars, for the proposed engine configuration. The cell formula in cell DS14, ProTotCost, is

[ProTotCost = SUM(Cell DG14:Cell DR14) + SUM(Cell CZ14:Cell DA14) + SUM(Cell DC14:Cell DD14)].

The formulas for the succeeding cells are similar with only the cell numbers increasing by one.

The total logistics support costs, less fuel, in thousands of dollars, for the proposed engine configuration during the life cycle analysis period is the sum of all the Column DS cells and is contained in cell DS48. The formula for this cell is

[Cell DS48 = SUM(Cell DS14:Cell DS46)].

T. OPERATIONAL FUEL - COLUMNS DT AND DU

1. Gallons per Year (Column DT)

This column calculates the annual operational fuel consumption, in gallons per year (provided there is a variance in the fuel consumption between the current and proposed configurations). The cell formula in cell DT14, ProOperGalYr is

[ProOperGalYr = IF(PctImpSFC <> 0, (CurYrProUnmodEfh + CurYrProModEfh * (1 - PctImpSFC)) * FltFuelGH, "N/A")].

This equals

[Cell DT14 = IF(Cell F66 <> 0, (Cell CQ14 + Cell CR14 * (1 - Cell F66)) * Cell S51, "N/A")].

PctImpSFC is the expected change in fuel consumption when the proposed ECP is incorporated.

CurYrProUnmodEfh is the annual engine flight hours in thousands of hours for unmodified engines.

CurYrProModEfh is the annual engine flight hours, in thousands of hours, for modified engines.

FltFuelGH is the operational fuel consumption rate in gallons per hour.

The IF statement uses the following logic to determine the annual operational fuel usage, in gallons per year (provided there is a variance in the fuel consumption between the current and proposed configurations).

A) If the expected change in fuel consumption when the proposed ECP is incorporated is predicted to change the fuel consumption rate of the engine, the value displayed is the product of the sum of the annual engine flight hours, in thousands of hours, for unmodified engines plus the product of the annual engine flight hours, in thousands of hours, for modified engines, the difference (one minus the expected improvement in fuel consumption when the proposed ECP is incorporated) and the operational fuel consumption rate in gallons per hour.

B) If the expected change in fuel consumption when the proposed ECP is incorporated is not predicted to change the fuel consumption rate of the engine (ie. is equal to zero), the value displayed is "N/A" because there is no expected change in fuel consumption after the engine modification.

The formulas for the succeeding cells are similar with only the unfrozen cell numbers increasing by one.

The total operational fuel consumption (provided there is a variance in the fuel consumption between the current and proposed configurations) during the life cycle analysis period is the sum of all the Column DT cells and is contained in cell DT48. The formula for this cell is

[Cell DT48 = SUM(Cell DT14:Cell DT46)].

2. Cost (Column DU)

This column calculates the annual expected operational fuel cost, in thousands of dollars (provided there is a variance in the fuel cost between the current and proposed configurations). The cell formula in cell DU14, ProOperFuelCost, is

[ProOperFuelCost = IF(PctImpSFC <> 0, ProOperGalYr * FuelCostGal, "N/A")].

This equals

[Cell DU14 = IF(Cell F66 <> 0, Cell DT14 * Cell G17, "N/A")].

PctImpSFC is the expected change in fuel consumption when the proposed ECP is incorporated.

ProOperGalYr is the annual operational fuel consumption for the proposed configuration, in gallons per year (provided there is a variance in the fuel consumption between the current and proposed configurations).

FuelCostGal is the cost per gallon of operational fuel.

The IF statement uses the following logic to determine the annual operational fuel cost, in thousands of dollars, (provided there is a variance in the fuel cost between the current and proposed configurations).

A) If there is an expected change in fuel consumption when the proposed ECP is incorporated, the value displayed is the product of the annual operational fuel consumption for engines under the proposed configuration in gallons per year (provided there is a variance in the fuel consumption between the current and proposed configurations) and the cost per gallon of fuel.

B) If no expected change in fuel consumption when the proposed ECP is incorporated is expected, the value displayed is "N/A" because the operational fuel costs will not be affected by the engine modification.

The formulas for the succeeding cells are similar with only the unfrozen cell numbers increasing by one.

The total operational fuel costs, in thousands of dollars, (provided there is a variance in the fuel cost between the current and proposed configurations) during the life cycle analysis period is the sum of all Column DU cells and is contained in cell DU48. The formula for this cell is

[Cell DU48 = SUM(Cell DU14:Cell DU46)].

U. AIRCRAFT LOSS DELTA (COLUMN DV)

This column calculates the change in the annual cost, in thousands of dollars, of the change in the number of aircraft losses before and after the ECP is implemented resulting from the loss of an entire system due to the unscheduled failure of a modified component. The cell formula in cell DV14, ProACLossDelta, is

[ProACLossDelta = -ProACLossPerYr * AirCraftCost/1000].

This equals

[Cell DV14 = -Cell CX14 * Cell S52/1000].

ProACLossPerYr is the expected annual reduction in the number of aircraft losses resulting from the loss of an entire system due to the unscheduled failure of a modified component.

AirCraftCost is the current purchase price of the fully equipped aircraft.

The formulas for the succeeding cells are similar with only the unfrozen cell numbers increasing by one.

The total of the annual cost deltas, in thousands of dollars, of the number of aircraft losses before and after the

ECP is implemented, resulting from the loss of an entire system due to the unscheduled failure of a component, during the life cycle analysis period is the sum of all the Column DV cells and is contained in cell DV48. The formula for this cell is

[Cell DV48 = SUM(Cell DV14:Cell DV46)].

V. TOTAL COST FOR PROPOSED CONFIGURATION WITH FUEL AND AIRCRAFT LOSS (COLUMN DW)

This column calculates the total annual logistics support costs, including fuel and aircraft loss, for the proposed engine configuration. The cell formula in cell DW14, TotCurCostPlusACLoss, is

[TotCurCostPlusACLoss = ProTotCost + ProOperFuelCost + ProACLossDelta].

This equals

[Cell DW14 = Cell DS14 + Cell DU14 + Cell DV14].

ProTotCost is the annual logistics support costs, less fuel, in thousands of dollars, for the proposed engine configuration.

ProOperFuelCost is the annual operational fuel cost, in thousands of dollars (provided there is a variance in the fuel cost between the current and proposed configurations).

ProACLossDelta is the annual cost, in thousands of dollars, of the change in the number of aircraft losses resulting from the loss of an entire system due to the unscheduled failure of a component.

The formulas for the succeeding cells are similar with only the cell numbers increasing by one.

The total logistics support costs, including fuel and aircraft loss, for the proposed engine configuration during the life cycle analysis period is the sum of all the Column DW cells and is contained in cell DW48. The formula for this cell is

[Cell DW48 = SUM(Cell DW14:Cell DW46)].

VII. COMPARISON OF CURRENT AND PROPOSED CONFIGURATION COSTS

A. INTRODUCTION

This section consists of columns DY through ED and uses the expenditures on current and proposed configurations, the delta cashflow that provides yearly savings and the cumulative savings and the cumulative annual Net Present Value (NPV) to compare the costs of the current and proposed engine configurations.

B. CALENDAR YEAR (COLUMN DY)

This column indicates each year over which the CEA analysis will be performed. The first input cell is directly input by the contractor and is the first year of the analysis. Subsequent years are then calculated by adding one year to the previous year. The cell formula in cell DY14 is

[Cell DY14 = FirstYrStdHistory].

This equals

[Cell DY14 = Cell N14].

FirstYrStdHistory is the first year being analyzed.

The cell formula for the next year is

[Cell DY15 = 1 + FirstYrStdHistory].

This equals

[Cell DY15 = 1 + Cell N14].

The formulas for the succeeding cells are similar with only the cell numbers increasing by one.

C. EXPENDITURES - COLUMNS DZ AND EA

1. Current Configuration (Column DZ)

This column calculates the total annual logistic support costs, in thousands of dollars, if the proposed ECP is not incorporated into the fleet of engines. The cell formula in cell DZ14, CurExpenditures, is

[CurExpenditures = CurTotCost].

This equals

[Cell DZ14 = Cell CK14].

CurTotCost is the annual logistics support cost, including fuel, for engines with the current configuration.

The formulas for the succeeding cells are similar with only the cell numbers increasing by one.

The total annual logistics support costs, in thousands of dollars, if the proposed ECP is not incorporated into the fleet of engines during the life cycle analysis period is the sum of all the Column DZ cells and is contained cell DZ48. The formula for this cell is

[Cell DZ48 = SUM(Cell DZ14:Cell DZ46)].

Cell DZ50 computes the cumulative net present value for the total annual logistics support costs (current expenditures), in thousands of dollars, if the proposed ECP is not incorporated into the fleet of engines. The formula for this cell is

[Cell DZ50 = NPV(NPVrate, Cell DZ14:Cell DZ46) * (1 + NPVrate) ^ (YrDollar - Cell DY14 + 1)].

This equals

[Cell DZ50 = NPV(Cell G9, Cell DZ14:Cell DZ46) * (1 + Cell G9) ^ (Cell G8 - Cell DY14 + 1)].

Cell DZ52 is the value displayed in cell G8 and is the specification of the baseline year from which the net present value of the life cycle costs will be calculated.

Cell DZ53 is the value displayed in cell G9 and is the discount rate of return required to determine the present value of all future cash inflows and outflows anticipated from a proposed modification.

2. Proposed Configuration (Column EA)

This column calculates the total annual logistics support costs, in thousands of dollars, if the proposed ECP is incorporated into the fleet of engines. The cell formula in cell EA14, ProExpenditures, is

[ProExpenditures = TotCurCostPlusACLoss].

This equals

[Cell EA14 = Cell DW14].

TotCurCostPlusACLoss is the total annual logistic support costs, including fuel and aircraft loss, for the proposed engine configuration.

The formulas for the succeeding cells are similar with only the cell numbers increasing by one.

The total logistics support costs, in thousands of dollars, if the proposed ECP is incorporated into the fleet of engines during the life cycle analysis period is the sum of all the Column EA cells and is contained in cell EA48. The formula for this cell is

[Cell EA48 = SUM(Cell EA14:Cell EA46)].

Cell EA50 computes the cumulative net present value for the total annual logistic support costs (proposed expenditures), in thousands of dollars, if the proposed ECP is incorporated into the fleet of engines. The formula for this cell is

[Cell EA50 = NPV(NPVrate, Cell EA14:Cell EA46) * (1 + NPVrate) ^ (YrDollar - Cell DY14 + 1)].

This equals

[Cell EA50 = NPV(Cell G9, Cell EA14:Cell EA46) * (1 + Cell G9) ^ (Cell G8 - Cell DY14 + 1)].

D. DELTA CASHFLOW - COLUMNS EB AND EC

1. Yearly Savings (Column EB)

This column calculates the annual cashflow difference, in thousands of dollars, between the total annual logistic support costs if the proposed ECP is incorporated and if the ECP is not incorporated. The cell formula in cell EB14, CurYrDeltaCashYrSav, is

[CurYrDeltaCashYrSav = CurExpenditures - ProExpenditures].

This equals

[Cell EB14 = Cell DZ14 - Cell EA14].

CurExpenditures is the total annual logistics support costs, in thousands of dollars, if the proposed ECP is not incorporated into the fleet of engines.

ProExpenditures is the total annual logistics support costs, in thousands of dollars, if the proposed ECP is incorporated into the fleet of engines.

The formulas for the succeeding cells are similar with only the cell numbers increasing by one.

The total sum of the annual cashflow difference, in thousands of dollars, between the total annual logistics support costs if the proposed ECP is incorporated and if the ECP is not incorporated during the life cycle analysis period is the sum of all the Column EB cells and is contained in cell EB48. The formula for this cell is

[Cell EB48 = SUM(Cell EB14:Cell EB46)].

Cell EB50 computes the cumulative net present value for the total annual cashflow variance, in thousands of dollars, between the total annual logistic support costs if the proposed ECP is incorporated and if the ECP is not incorporated into the fleet of engines. The formula for this cell is

[Cell EB50 = NPV(NPVrate, Cell EB14:Cell EB46) * (1 + NPVrate) ^ (YrDollar - Cell DY14 + 1)].

This equals

[Cell EB50 = NPV(Cell G9, Cell EB14:Cell EB46) * (1 + Cell G9) ^ (Cell G8 - Cell DY14 + 1)].

2. Cumulative Savings (Column EC)

This column calculates the cumulative cash flow difference, in thousands of dollars, between the total annual logistics support costs if the proposed ECP is incorporated and if the proposed ECP is not incorporated. The cell formula in cell EC14 is

[Cell EC14 = CurYrDeltaCashYrSav + PrevYrDeltaCashCumSav].

This equals

[Cell EC14 = Cell EB14 + Cell EC13].

CurYrDeltaCashYrSav is the annual cashflow difference, in thousands of dollars, between the total annual logistics support costs if the proposed ECP is incorporated and if the ECP is not incorporated.

PrevYrDeltaCashCumSav is cumulative cash flow difference, from the previous year, in thousands of dollars, between the total annual logistics support costs if the proposed ECP is incorporated and if the proposed ECP is not incorporated. The value of this cell is zero and is only used to start the column calculations.

The formulas for the succeeding cells are similar with only the cell numbers increasing by one.

E. CUMULATIVE NPV AT __ (COLUMN ED)

This column calculates the discounted net present value of the cumulative cash flow difference, in thousands of dollars, between the total annual logistics support costs if the proposed ECP is incorporated and if the proposed ECP is not incorporated. The cell formula in cell ED14 is

[Cell ED14 = NPV(NPVrate, CurYrDeltaCashYrSav) * (1 + NPVrate) ^ (YrDollar - Cell DY14 + 1)].

This equals

[Cell ED14 = NPV(Cell G9, Cell EB14) * (1 + Cell G9) ^ (Cell G8 - Cell DY14 + 1)].

NPVrate is the discount rate of return required to determine the present value of all future cash inflows anticipated from a proposed modification.

CurYrDeltaCashYrSav is the annual cashflow difference, in thousands of dollars, between the total annual logistics support costs if the proposed ECP is incorporated and if the ECP is not incorporated.

YrDollar is, in reality, the specification of the baseline year from which the net present value of the life cycle costs will be calculated.

The formulas for the succeeding cells are similar with only the unfrozen cell numbers increasing by one.

The following cell also contains data in column ED:

Cell ED11, NPVrate, is the discounted net present value rate used in the column ED calculations. This value for this cell is obtained from cell G9.

VIII. SUMMARY PAGE

A. INTRODUCTION

This section can be used as a cover sheet for the printed output of the previous pages and is not assigned a page number by the model. It furnishes a task description area that allows the user to provide an explanation as to why the Engineering Change Proposal (ECP) should be implemented. It also performs the final calculations and provides the final costs and savings associated with the ECP incorporation and the assumptions used to develop the ECP proposal. The page is separated into three sections that encompass the task description area and fiscal year calculations, nine costs and savings categories with net dollar impact and final net present value calculations, and the assumptions used to develop the ECP proposal.

B. TASK DESCRIPTION AREA

This area provides ten lines for the contractor to furnish written justification as to why the ECP should be accepted or rejected. The justification can either be increased reliability or maintainability, or due to a decrease in life cycle logistics support costs.

Fiscal Year Dollars is the specification of the baseline year from which the net present value of the life cycle costs will be calculated. The value of this cell is generated from cell G8 on the Input Parameters Page (page 1).

C. SUMMARY COSTS AND SAVINGS

This area calculates the summary of costs (increased expenditures) and savings (decreased expenditures), in thousands of dollars, resulting from the cost variances between the current and the proposed configurations.

1. Production Engine Cost

These costs, in thousands of dollars, are taken directly from the input section and represents the difference in price between a new engine incorporating the modification and one not incorporating the modification. This category could represent a savings if the new engine production costs are less than the old engine production costs. The production engine cost will only be a factor if there are engines still in production.

A) Cost is the increase in costs which will be incurred during the incorporation of the ECP change during engine production. The cell formula in cell EI25 is

[Cell EI25 = IF(DeltaProdCost > 0, Cell DH48, " ")].

This equals

[Cell EI25 = IF(Cell D15 > 0, Cell DH48, " ")].

DeltaProdCost is the difference between the production cost of an engine incorporating the modification and one that does not contain the modification.

Cell DH48 is the sum total of all the annual differences in production costs associated with the proposed ECP.

The IF statement uses the following logic to determine the increase in costs which will be incurred during the incorporation of the ECP change during engine production.

1) If the difference between the production cost of an engine incorporating the modification and one that does not contain the modification is greater than zero, the value displayed is value of cell DH48.

2) If the difference between the production cost of an engine incorporating the modification and one that does not contain the modification is not greater than zero, a value is not displayed and that cell in the "Cost Column" is blank.

B. Savings is the decrease in costs which will be incurred during the incorporation of the ECP change during engine production. The production engine cost will only be a factor if there are engines still in production. The cell formula in cell EL25 is

[Cell EL25 = IF(DeltaProdCost < 0, -Cell DH48, " ")].

This equals

[Cell EL25 = IF(Cell D15 < 0, -Cell DH48, " ")].

DeltaProdCost is the difference between the production cost of an engine incorporating the modification and one that does not contain the modification.

Cell DH48 is the sum total of all the annual differences in production costs associated with the proposed ECP.

The IF statement uses the following logic to determine the decrease in costs which will be incurred during the incorporation of the ECP change during engine production.

1) If the difference between the production cost of an engine incorporating the modification and one that does not contain the modification is less than zero, the value displayed is the negative of the value of cell DH48.

2) If the difference between the production cost of an engine incorporating the modification and one that does not contain the modification is not less than zero, a value is not displayed and that cell in the "Savings Column" is blank.

2. Operational Engine Modification Cost

This element is the total of the kit purchase costs plus the kit installation costs over the life cycle of the engine (when the kit costs do not replace the maintenance costs), in thousands of dollars. If the kit costs replace the maintenance costs then those maintenance costs (unscheduled, scheduled, and hardware scrapping costs) are subtracted from the engine modification costs. These engine modification costs relate to the costs, or savings which are expected to occur from incorporating the modification.

A. Cost is the increase in costs incurred with the incorporation of the proposed ECP change in operational engines. The cell formula in cell EI27 is

[Cell EI27 = IF (Cell EN27 > 0, Cell EN27, " ")].

The IF statement uses the following logic to determine the increase in costs incurred with the incorporation of the proposed ECP change in operational engines.

1) If cell EN27 is greater than zero, the value displayed is the value computed in cell EN27.

2) If cell EN27 is not greater than zero, a value is not displayed and that cell in the "Cost Column" is blank.

Cell EN27 computes the increase or decrease in the costs of implementing the proposed ECP into operational engines. The cell formula in cell EN27 is

[Cell EN27 = (Cell CZ48 + Cell DA48 + Cell DC48 + Cell DD48) - KitCostReplaceNormalMaint * ((UnschPctEvtMod * CurUnschTotMatCostEvt * Cell AX48/1000) + (SchPctEvtMod * CurSchTotMatCostEvt * Cell AY48/1000))].

This equals

[Cell EN27 = (Cell CZ48 + Cell DA48 + Cell DC48 + Cell DD48) - Cell D14 * ((Cell D25 * Cell K56 * Cell AX48/1000) + (Cell D24 * Cell K40 * Cell AY48/1000))].

Cell CZ48 is the total costs, in thousands of dollars, of the component modification kits installed in engines during each year during the life cycle analysis period.

Cell DA48 the total costs, in thousands of dollars, of the labor used to install the modification kits during each year during the life cycle analysis period.

Cell DC48 is the total costs, in thousands of dollars, of spares installed in engines during each year during the life cycle analysis period.

Cell DD48 is the total costS, in thousands of dollars, of labor to install spares in engines during each year during the life cycle analysis period.

Cell D14, KitCostReplaceNormalMaint, is the difference between the modification kit cost and the maintenance cost of the current component.

Cell D24, SchPctEvtMod, provides an estimate of the expected percentage of scheduled maintenance events during which a modification can be performed.

Cell D25, UnschPctEvtMod, determines the percentage of unscheduled maintenance events during which a modification can be performed.

Cell K56, CurUnschTotMatCostEvt, is the total expected material costs to repair a component or replace a scrapped component, during unscheduled maintenance, at the Organizational and Intermediate levels, and the Depot level.

Cell AX48, is the total number of unscheduled replacements of engine components that are expected to occur if the proposed design change is accepted over the life cycle analysis period.

Cell K40, CurSchTotMatCostEvt, is the total expected costs to repair a component or replace a scrapped component, during scheduled maintenance, at the Organizational and Intermediate, and Depot levels.

Cell AY48, The total expected number of scheduled replacements of engine components that occur if the proposed design change is accepted during the life cycle analysis period.

B. Savings is the decrease in costs incurred with the incorporation of the proposed ECP change in operational engines. The cell formula in cell EL27 is

[Cell EL27 = IF(Cell EN27 < 0, -Cell EN27, " ")].

The IF statement uses the following logic to determine the decrease in costs incurred with the incorporation of the proposed ECP change in operational engines.

1) If cell EN27 is less than zero, the value displayed is the negative of the value computed in cell EN27 (which was defined above).

2) If cell EN27 is not less than zero, a value is not displayed and that cell in the "Savings Column" is blank.

3. FOLLOW-ON MAINTENANCE MATERIAL COST

These costs, in thousands of dollars, are equal to the difference between the follow-on material costs for the proposed component and those for the current component over the remaining life cycle, in thousands of dollars. Both scheduled and unscheduled maintenance actions are included. The calculations depend on the input section to determine the total number of maintenance hours and material which will be required. Differences in maintenance requirements and material costs between the proposed and current configurations will account for the savings or costs associated with this category.

A) Cost is the increase in costs, in thousands of dollars, of follow-on maintenance for a fleet of modified engines. The cell formula in cell EI29 is

[Cell EI29 = IF(Cell EN29 > 0, Cell EN29, " ")].

The IF statement uses the following logic to determine the increase in costs of follow-on maintenance for a fleet of modified engines.

1) If cell EN29 is greater than zero, the value displayed is the value computed in cell EN29.

2) If cell EN29 is not greater than zero, a value is not displayed and that cell in the "Cost Column" is blank.

Cell EN29 computes the cost of follow-on maintenance for a fleet of modified engines. The cell formula in cell EN29 is

[Cell EN29 = (Cell DL48 + Cell DN48 + Cell DP48 + Cell DR48) + KitCostReplaceNormalMaint * ((UnschPctEvtMod * CurUnschTotMatCostEvt * Cell AX48/1000) + (SchPctEvtMod * CurSchTotMatCostEvt * Cell AY48/1000)) - (Cell BZ48 + Cell CB48)].

This equals

[Cell EN29 = (Cell DL48 + Cell DN48 + Cell DP48 + Cell DR48) + Cell D14 * ((Cell D25 * Cell K56 * Cell AX48/1000) + (Cell D24 * Cell K40 * Cell AY48/1000)) - (Cell BZ48 + Cell CB48)].

Cell DL48 is the total material cost, in thousands of dollars, for unscheduled events for unmodified engines during the life cycle analysis period.

Cell DN48 is the total material cost, in thousands of dollars, for scheduled events for unmodified engines during the life cycle analysis period.

Cell DP48 is the total material costs, in thousands of dollars, for unscheduled events for modified engines during the life cycle analysis period.

Cell DR48 is the total material costs, in thousands of dollars, for scheduled events for modified engines during the life cycle analysis period.

Cell D14, KitCostReplaceNormalMaint, is the difference between the modification kit cost and the maintenance cost of the current component.

Cell D24, SchPctEvtMod, provides an estimate of the expected percentage of scheduled maintenance events during which a modification can be performed.

Cell D25, UnschPctEvtMod, determines the percentage of unscheduled maintenance events during which a modification can be performed.

Cell K56, CurUnschTotMatCostEvt, is the total expected material costs to repair a component or replace a scrapped component, during unscheduled maintenance, at the Organizational and Intermediate levels, and the Depot levels.

Cell AX48, is the total number of unscheduled replacements of engine components that are expected to occur if the proposed design change is accepted over the life cycle analysis period.

Cell K40, CurSchTotMatCostEvt, is the total expected costs to repair a component or replace a scrapped component, during scheduled maintenance, at the Organizational and Intermediate, and Depot levels.

Cell AY48, The total expected number of scheduled replacements of engine components that occur if the proposed design change is accepted during the life cycle analysis period.

Cell BZ48 is the total material costs, in thousands of dollars, for unscheduled failures that occur to unmodified engines with the current configuration during the life cycle analysis period.

Cell CB48 is the total material costs, in thousands of dollars, for scheduled events that occur to unmodified engines with the current configuration during the life cycle analysis period.

B. Savings is the decrease in costs, in thousands of dollars, of follow-on maintenance for a fleet of modified engines. The cell formula in cell EL29 is

[Cell EL29 = IF(Cell EN29 < 0, -Cell EN29, " ")].

The IF statement uses the following logic to determine the decrease in costs of follow-on maintenance for a fleet of modified engines.

1) If cell EN29 is less than zero, the value displayed is the negative of the value computed in cell EN29 (which was defined above).

2) If cell EN29 is not less than zero, a value is not displayed and that cell in the "Savings Column" is blank.

4. FOLLOW-ON MAINTENANCE LABOR COST

These costs, in thousands of dollars, are equal to the difference between the follow-on material labor costs for the proposed and the current configuration over the remaining life cycle of the engine, in thousands of dollars. Both scheduled and unscheduled maintenance actions are included.

A) Cost is the increase in maintenance labor costs, in thousands of dollars, associated with modifying the fleet of engines. The cell formula in cell EI31 is

[Cell EI31 = IF((Cell DK48 + Cell DM48 + Cell DO48 + Cell DQ48) > (Cell BY48 + Cell CA48), (Cell DK48 + Cell DM48 + Cell DO48 + Cell DQ48) - (Cell BY48 + Cell CA48), " ")].

Cell DK48 is the sum of the annual labor costs, in thousands of dollars, for unscheduled events that occur to unmodified engines with the proposed configuration.

Cell DM48 is the sum of the annual labor costs, in thousands of dollars, for scheduled events that occur to unmodified engines with the proposed configuration.

Cell DO48 is the sum of the annual labor costs, in thousands of dollars, for unscheduled events that occur to modified engines with the proposed configuration.

Cell DQ48 is the sum of the annual labor costs, in thousands of dollars, for scheduled events that occur to modified engines with the proposed configuration.

Cell BY48 is the sum of the annual labor costs, in thousands of dollars, for unscheduled events that occur to unmodified engines with the current configuration.

Cell CA48 is the sum of the annual labor costs for scheduled events that occur to unmodified engines with the current configuration.

The IF statement uses the following logic to determine the increase in maintenance labor costs associated with modifying the fleet of engines.

1) If the sum of the annual labor costs for unscheduled events that occur to unmodified engines with the proposed configuration plus the sum of the annual labor costs for scheduled events that occur to unmodified engines with the proposed configuration plus the sum of the annual labor costs for unscheduled events that occur to modified engines with the proposed configuration plus the sum of the annual labor costs for scheduled events that occur to modified engines with the

proposed configuration (which is the total labor costs of maintenance under the proposed configuration) is greater than the sum of the annual labor costs for unscheduled events that occur to unmodified engines with the current configuration plus the sum of the annual labor costs for scheduled events that occur to unmodified engines with the current configuration (which is the total labor costs of maintenance under the current configuration), the value displayed is the difference of the sum of the annual labor costs for unscheduled events that occur to unmodified engines with the proposed configuration plus the sum of the annual labor costs for scheduled events that occur to unmodified engines with the proposed configuration plus the sum of the annual labor costs for unscheduled events that occur to modified engines with the proposed configuration plus the sum of the annual labor costs for scheduled events that occur to modified engines with the proposed configuration minus the sum of the annual labor costs for unscheduled events that occur to unmodified engines with the current configuration plus the sum of the annual labor costs for scheduled events that occur to unmodified engines with the current configuration.

2) If the sum of the annual labor costs for unscheduled events that occur to unmodified engines with the proposed configuration plus the sum of the annual labor costs for scheduled events that occur to unmodified engines with the proposed configuration plus the sum of the annual labor costs

for unscheduled events that occur to modified engines with the proposed configuration plus the sum of the annual labor costs for scheduled events that occur to modified engines with the proposed configuration (which is the total labor costs of maintenance under the proposed configuration) is not greater than the sum of the annual labor costs for unscheduled events that occur to unmodified engines with the current configuration plus the sum of the annual labor costs for scheduled events that occur to unmodified engines with the current configuration (which is the total labor costs of maintenance under the current configuration), a value is not displayed and that cell in the "Cost Column" is blank.

B. Savings is the decrease in maintenance labor costs, in thousands of dollars, associated with modifying the fleet of engines. The cell formula in cell EL31 is

[Cell EL31 = IF((Cell DK48 + Cell DM48 + Cell DO48 + Cell DQ48) < (Cell BY48 + Cell CA48), (Cell BY48 + Cell CA48) - (Cell DK48 + Cell DM48 + Cell DO48 + Cell DQ48), " ")].

Cell DK48 is the sum of the annual labor costs, in thousands of dollars, for unscheduled events that occur to unmodified engines with the proposed configuration.

Cell DM48 is the sum of the annual labor costs, in thousands of dollars, for scheduled events that occur to unmodified engines with the proposed configuration.

Cell DO48 is the sum of the annual labor costs, in thousands of dollars, for unscheduled events that occur to modified engines with the proposed configuration.

Cell DQ48 is the sum of the annual labor costs, in thousands of dollars, for scheduled events that occur to modified engines with the proposed configuration.

Cell BY48 is the sum of the annual labor costs for unscheduled events that occur to unmodified engines with the current configuration.

Cell CA48 is the sum of the annual labor costs for scheduled events that occur to unmodified engines with the current configuration.

The IF statement uses the following logic to determine the decrease in maintenance labor costs associated with modifying the fleet of engines.

1) If the sum of the annual labor costs for unscheduled events that occur to unmodified engines with the proposed configuration plus the sum of the annual labor costs for scheduled events that occur to unmodified engines with the proposed configuration plus the sum of the annual labor costs for unscheduled events that occur to modified engines with the proposed configuration plus the sum of the annual labor costs for scheduled events that occur to modified engines with the proposed configuration (which is the total labor costs of maintenance under the proposed configuration) is less than the sum of the annual labor costs for unscheduled events that occur to unmodified engines with the current configuration plus the sum of the annual labor costs for scheduled events that occur to unmodified engines with the current

configuration (which is the total labor costs of maintenance under the current configuration), the value displayed is the difference of the sum of the annual labor costs for unscheduled events that occur to unmodified engines with the current configuration plus the sum of the annual labor costs for scheduled events that occur to unmodified engines with the current configuration minus the sum of the annual labor costs for unscheduled events that occur to unmodified engines with the proposed configuration plus the sum of the annual labor costs for scheduled events that occur to unmodified engines with the proposed configuration plus the sum of the annual labor costs for unscheduled events that occur to modified engines with the proposed configuration plus the sum of the annual labor costs for scheduled events that occur to modified engines with the proposed configuration.

2) If the sum of the annual labor costs for unscheduled events that occur to unmodified engines with the proposed configuration plus the sum of the annual labor costs for scheduled events that occur to unmodified engines with the proposed configuration plus the sum of the annual labor costs for unscheduled events that occur to modified engines with the proposed configuration plus the sum of the annual labor costs for scheduled events that occur to modified engines with the proposed configuration (which is the total labor costs of maintenance under the proposed configuration) is not less than the sum of the annual labor costs for unscheduled events that

occur to unmodified engines with the current configuration plus the sum of the annual labor costs for scheduled events that occur to unmodified engines with the current configuration (which is the total labor costs of maintenance under the current configuration), a value is not displayed and that cell in the "Savings Column" is blank.

5. PUBLICATIONS COST

These costs, in thousands of dollars, are the costs associated with any technical publication needed for the proposed engine configuration. This input is supplied directly by the contractor into the input parameter section and is usually a minor cost. The cost determination is generally based on a page count. **A) Cost** is the increase in technical publication costs, in thousands of dollars, associated with modifying the fleet of engines. The cell formula in cell EI33 is

[Cell EI33 = (TechPubsCost + TctoCost)/1000].

This equals

[Cell EI33 = (Cell D19 + Cell D20)/1000].

TechPubsCost is the total cost of any technical publication associated with the proposed engine change.

TctoCost is the Time-Compliance Technical Order cost. It is issued for important changes when urgency is an issue. These changes usually provide information on field procedures which must be followed in accomplishing forced retrofits or first opportunity changes.

B) Savings on the technical publications cost due to a proposed configuration change are not possible and therefore cell EL33 in the "Savings Column" is blank.

6. SUPPORT EQUIPMENT COST

These costs, in thousands of dollars, are associated with any special tooling or support equipment that is required to complete the component modification. This cost also includes the cost to modify existing tooling and support equipment to meet the ECP requirements. This cost is incorporated from the input parameter section and is a direct input from the contractor.

A) Cost is the increase in costs, in thousands of dollars, associated with any special tooling or support equipment that is required to complete the engine modification. The cell formula in cell EI35 is

[Cell EI35 = IF(ToolSE.Cost ≥ 0, ToolSE.Cost/1000, " ")].

This equals

[Cell EI35 = IF(Cell D21 ≥ 0, Cell D21/1000, " ")].

ToolSE.Cost is the costs associated with any special tooling or support equipment that is required to complete the component modification.

The IF statement uses the following logic to determine the increase in costs associated with any special tooling or support equipment that is required to complete the component modification.

1) If the costs associated with any special tooling or support equipment that is required to complete the component modification is greater than or equal to zero, the value displayed is the cost associated with any special tooling or support equipment that is required to complete the component modification divided by 1000.

2) If the costs associated with any special tooling or support equipment that is required to complete the component modification is less than zero, a value is not displayed and that cell in the "Cost Column" is blank.

B) Savings is the decrease in costs, in thousands of dollars, associated with any special tooling or support equipment that is required to complete the component modification. The cell formula in cell EL35 is

[Cell EL35 = IF(ToolSE.Cost ≤ 0, -ToolSE.Cost/1000, " ")].

This equals

[Cell EL35 = IF(Cell D21 ≤ 0, -Cell D21/1000, " ")].

ToolSE.Cost is the costs associated with any special tooling or support equipment that is required to complete the component modification.

The IF statement uses the following logic to determine the decrease in costs associated with any special tooling or support equipment that is required to complete the component modification.

1) If the costs associated with any special tooling or support equipment that is required to complete the component modification is less than or equal to zero, the value displayed is the negative of the value of ToolSE.Cost (Cell D21) divided by 1000.

2) If the costs associated with any special tooling or support equipment that is required to complete the component modification is greater than zero, a value is not displayed and that cell in the "Savings Column" is blank.

7. PART NUMBER COST

These costs, in thousands of dollars, are the fixed costs associated with introducing new parts into the supply system as a consequence of the proposed component modification. These costs include the life cycle costs of part number maintenance in the supply system.

A) Cost is the increase in costs, in thousands of dollars, associated with introducing new part numbers into the supply system as a consequence of the proposed configuration change. The cell formula in cell EI37 is

[Cell EI37 = IF(Cell DI48 + Cell DJ48 + PnIntroCost/1000 ≥ Cell BW48, Cell DI48 + Cell DJ48 + PnIntroCost/1000 - Cell BW48, " ")].

This equals

[Cell EI37 = IF(Cell DI48 + Cell DJ48 + Cell L64/1000 ≥ Cell BW48, Cell DI48 + Cell DJ48 + Cell L64/1000 - Cell BW48, " ")].

Cell DI48 is the sum of the annual part number maintenance costs, in thousands of dollars, for unmodified engines with the proposed engine configuration.

Cell DJ48 is the sum of the annual part number maintenance costs, in thousands of dollars, for modified engines with the proposed engine configuration.

Cell L64, PnIntroCost, is the cost of introducing a new part number into the military supply system.

Cell BW48 is the sum of the annual part number maintenance costs, in thousands of dollars, for unmodified engines with the current engine configuration.

The IF statement uses the following logic to determine the increase in costs associated with introducing new part numbers into the supply system as a consequence of the proposed configuration change.

1) If the sum of the annual part number maintenance costs for unmodified engines with the proposed engine configuration plus the sum of the annual part number maintenance costs for modified engines with the proposed engine configuration plus the cost of introducing a new part number into the military supply system divided by 1000 is greater than or equal to the sum of the annual part number maintenance costs for unmodified engines with the current

engine configuration, the value displayed is the difference of the sum of the annual part number maintenance costs for unmodified engines with the proposed engine configuration plus the sum of the annual part number maintenance costs for modified engines with the proposed engine configuration plus the cost of introducing a new part number into the military supply system divided by 1000 minus the sum of the annual part number maintenance costs for unmodified engines with the current engine configuration.

2) If the sum of the annual part number maintenance costs for unmodified engines with the proposed engine configuration plus the sum of the annual part number maintenance costs for modified engines with the proposed engine configuration plus the cost of introducing a new part number into the military supply system divided by 1000 is less than the sum of the annual part number maintenance costs for unmodified engines with the current engine configuration, a value is not displayed and that cell in the "Cost Column" is blank.

B) Savings is the decrease in costs, in thousands of dollars, associated with introducing new part numbers into the supply system as a consequence of the proposed configuration change. The cell formula in cell EL37 is

[Cell EL37 = IF(Cell DI48 + Cell DJ48 + PnIntroCost/1000 < Cell BW48, Cell BW48 - Cell DI48 - Cell DJ48 - PnIntroCost/1000, " ")].

This equals

[Cell EL37 = IF(Cell DI48 + Cell DJ48 + Cell L64/1000 < Cell BW48, Cell BW48 - Cell DI48 - Cell DJ48 - Cell L64/1000, " ")].

Cell DI48 is the sum of the annual part number maintenance costs, in thousands of dollars, for unmodified engines with the proposed engine configuration.

Cell DJ48 is the sum of the annual part number maintenance costs, in thousands of dollars, for modified engines with the proposed engine configuration.

Cell L64, PnIntroCost, is the cost of introducing a new part number into the military supply system.

Cell BW48 is the sum of the annual part number maintenance costs, in thousands of dollars, for unmodified engines with the current engine configuration.

The IF statement uses the following logic to determine the decrease in costs associated with introducing new part numbers into the supply system as a consequence of the proposed configuration change.

1) If the sum of the annual part number maintenance costs for unmodified engines with the proposed engine configuration plus the sum of the annual part number maintenance costs for modified engines with the proposed engine configuration plus the cost of introducing a new part number into the military supply system divided by 1000 is less than the sum of the annual part number maintenance costs for unmodified engines with the current engine configuration, the

value displayed is the difference of the sum of the annual part number maintenance costs for unmodified engines with the current engine configuration minus the sum of the annual part number maintenance costs for unmodified engines with the proposed engine configuration plus the sum of the annual part number maintenance costs for modified engines with the proposed engine configuration plus the cost of introducing a new part number into the military supply system divided by 1000.

2) If the sum of the annual part number maintenance costs for unmodified engines with the proposed engine configuration plus the sum of the annual part number maintenance costs for modified engines with the proposed engine configuration plus the cost of introducing a new part number into the military supply system divided by 1000 is not less than the sum of the annual part number maintenance costs for unmodified engines with the current engine configuration, a value is not displayed and that cell in the "Savings Column" is blank.

8. OPERATIONAL FUEL COST

These are the operational fuel consumption costs, in thousands of dollars, or savings which are attributable to the ECP over the life cycle of the engine.

A) Cost is the increase in operational fuel costs, in thousands of dollars, associated with modifying the fleet of engines. The cell formula in cell EI39 is

[Cell EI39 = IF(Cell DU48 > Cell CI48, Cell DU48 - Cell CI48, " ")].

Cell DU48 is the sum of the annual operational fuel cost, in thousands of dollars, for the fleet of engines with the proposed engine configuration.

Cell CI48 is the sum of the annual operational fuel cost, in thousands of dollars, for the fleet of engines with the current engine configuration.

The IF statement uses the following logic to determine the increase in operational fuel costs associated with modifying the fleet of engines.

1) If the sum of the annual operational fuel cost for the fleet of engines with the proposed configuration is greater than the sum of the annual operational fuel cost for the fleet of engines with the current configuration, the value displayed is the difference of the sum of the annual operational fuel cost for the fleet of engines with the proposed engine configuration minus the sum of the annual operational fuel cost for the fleet of engines with the current engine configuration.

2) If the sum of the annual operational fuel cost for the fleet of engines with the proposed configuration is not greater than the sum of the annual operational fuel cost

for the fleet of engines with the current configuration, a value is not displayed and that cell in the "Cost Column" is blank.

B) **Savings** is the decrease in operational fuel costs, in thousands of dollars, associated with modifying the fleet of engines. The cell formula in cell EL39 is

[Cell EL39 = IF(Cell CI48 > Cell DU48, Cell CI48 - Cell DU48, " ")].

Cell DU48 is the sum of the annual operational fuel costs, in thousands of dollars, for the fleet of engines with the proposed engine configuration.

Cell CI48 is the sum of the annual operational fuel costs, in thousands of dollars, for the fleet of engines with the current engine configuration.

The IF statement uses the following logic to determine the decrease in operational fuel costs associated with modifying the fleet of engines.

1) If the sum of the annual operational fuel cost for the fleet of engines with the current configuration is greater than the sum of the annual operational fuel cost for the fleet of engines with the proposed configuration, the value displayed is the difference of the sum of the annual operational fuel costs for the fleet of engines with the current configuration minus the sum of the annual operational fuel cost for the fleet of engines with the proposed configuration.

2) If the sum of the annual operational fuel cost for the fleet of engines with the current configuration is not greater than the sum of the annual operational fuel costs for the fleet of engines with the proposed configuration, a value is not displayed and that cell in the "Savings Column" is blank.

9. AIRCRAFT LOSS COSTS

These are the cost differences, in thousands of dollars, associated with the loss of aircraft due to the unscheduled failure of a component before and after modification.

A) Cost is the increase in the costs, in thousands of dollars, associated with aircraft losses resulting from the loss of an entire system due to the unscheduled failure of a component. The cell formula in cell EI41 is

[Cell EI41 = IF(Cell DV48 > 0, -Cell DV48, " ")].

Cell DV48 is the sum of the annual cost, in thousands of dollars, associated with aircraft losses resulting from the loss of an entire system due to the unscheduled failure of a component.

The IF statement uses the following logic to determine the increase in the sum of the annual costs associated with aircraft losses resulting from the loss of an entire system due to the unscheduled failure of a component.

1) If the sum of the annual costs associated with aircraft losses resulting from the loss of an entire system due to the unscheduled failure of a component is greater than zero, the value displayed is the negative of the value of the sum of annual costs associated with aircraft losses resulting from the loss of an entire system due to the unscheduled failure of a component.

2) If the sum of the annual costs associated with aircraft losses resulting from the loss of an entire system due to the unscheduled failure of a component is not greater than zero, a value is not displayed and that cell in the "Cost Column" is blank.

B) Savings is the decrease in the sum of the annual costs, in thousands of dollars, associated with aircraft losses resulting from the loss of an entire system due to the unscheduled failure of a component. The cell formula in cell EL41 is

[Cell EL41 = IF(Cell DV48 < 0, -Cell DV48, " ")].

Cell DV48 is the sum of the annual costs, in thousands of dollars, associated with aircraft losses resulting from the loss of an entire system due to the unscheduled failure of a component.

The IF statement uses the following logic to determine the decrease in the sum of the annual costs associated with aircraft losses resulting from the loss of an entire system due to the unscheduled failure of a component.

1) If the sum of the annual costs associated with aircraft losses resulting from the loss of an entire system due to the unscheduled failure of a component is less than zero, the value displayed is the negative of the value of the sum of the annual costs associated with aircraft losses resulting from the loss of an entire system due to the unscheduled failure of a component.

2) If the sum of the annual costs associated with aircraft losses resulting from the loss of an entire system due to the unscheduled failure of a component is not less than zero, a value is not displayed and that cell in the "Savings Column" is blank.

10. TOTALS

These elements consist of the sum of the Costs column and the sum of the Savings column associated with modifying the fleet of engines.

A) Cost is the sum of all additional costs, in thousands of dollars, associated with modifying the fleet of engines. The cell formula in cell EI42 is

[Cell EI42 = SUM(Cell EI25:Cell EI41)].

B) Savings is the sum of all additional savings, in thousands of dollars, associated with modifying the fleet of engines. The cell formula in cell EL42 is

[Cell EL42 = SUM(Cell EL25:Cell EL41)].

11. NET DELTA DOLLAR IMPACT

This section provides the difference between the total life cycle savings and the total life cycle costs, in thousands of dollars, which are attributable to a proposed configuration change.

A) Cost is the net increase in total life cycle costs, in thousands of dollars, associated with modifying the fleet of engines. The cell formula in EI45 is

[Cell EI45 = IF(Cell EL42 < Cell EI42, Cell EI42 - Cell EL42, " ")].

Cell EI42 is the sum of all additional life cycle costs, in thousands of dollars, associated with modifying the fleet of engines.

Cell EL42 is the sum of all additional life cycle cost savings, in thousands of dollars, associated with modifying the fleet of engines.

The IF statement uses the following logic to determine the net increase in costs associated with modifying the fleet of engines.

1) If the sum of all additional life cycle cost savings associated with modifying the fleet of engines is less than the sum of all additional life cycle costs associated with modifying the fleet of engines, the value displayed is the difference of the sum of all additional life cycle cost savings associated with modifying the fleet of engines minus

the sum of all additional life cycle costs associated with modifying the fleet of engines.

2) If the sum of all additional life cycle cost savings associated with modifying the fleet of engines is not less than the sum of all additional life cycle costs associated with modifying the fleet of engines, a value is not displayed and that cell in the "Cost Column" is blank.

B) **Savings** is the net decrease in total life cycle costs, in thousands of dollars, associated with modifying the fleet of engines. The cell formula in cell EL45 is

[Cell EL45 = IF(Cell EL42 > Cell EI42, Cell EL42 - Cell EI42, " ")].

Cell EI42 is the sum of all additional life cycle costs, in thousands of dollars, associated with modifying the fleet of engines.

Cell EL42 is the sum of all additional life cycle cost savings, in thousands of dollars, associated with modifying the fleet of engines.

The IF statement uses the following logic to determine the net decrease in costs associated with modifying the fleet of engines.

1) If the sum of all additional life cycle cost savings associated with modifying the fleet of engines is greater than the sum of all additional life cycle costs associated with modifying the fleet of engines, the value displayed is the difference of the sum of all additional life

cycle cost savings associated with modifying the fleet of engines minus the sum of all additional life cycle costs associated with modifying the fleet of engines.

2) If the sum of all additional life cycle cost savings associated with modifying the fleet of engines is not greater than the sum of all additional life cycle costs associated with modifying the fleet of engines, a value is not displayed and that cell in the "Savings Column" is blank.

12. NET PRESENT VALUE

This element provides the present value of net future cash flows anticipated from the incorporation of the new ECP configuration at a given discount rate (A discount rate of 7 percent is currently specified by DOD). The discount rate is a direct input item by the contractor into cells G9 and EH48.

A) "Cost Column" The cell formula in cell EI48 for the net present value at the currently specified rate from Cell G9 is

[Cell EI48 = IF(Cell EB50 > 0, " ", Cell EB50)].

Cell EB50 is the net present value, in thousands of dollars, at the specified rate, of the sum of the yearly savings (the difference between the proposed expenditures and current expenditures) from Column EB.

The IF statement uses the following logic to determine the present value of net future cash flows anticipated from the incorporation of the new ECP configuration at a given discount rate.

1) If the net present value, at the specified rate, of the sum of the yearly savings is greater than zero, a value is not displayed and that cell in the "Cost Column" is blank.

2) If the net present value, at the specified rate, of the sum of the yearly savings is not greater than zero, the value displayed is the value computed in cell EB50.

If there is a value in this cell the net present value of the yearly savings is a negative number which means the proposal should not be accepted.

B) "Savings Column" The cell formula in cell EL48 for the net present value, in thousands of dollars, at the specified rate, contained in cells G9 and EH48 is

[Cell EL48 = IF(Cell EB50 > 0, Cell EB50, " ")].

Cell EB50 is the net present value, in thousands of dollars, at the specified rate, of the sum of the yearly savings (the difference between the proposed expenditures and current expenditures) from Column EB.

The IF statement uses the following logic to determine the present value of net future cash flows anticipated from the incorporation of the new ECP configuration at a given discount rate.

1) If the net present value, at the specified rate, of the sum of the yearly savings is greater than zero, the value displayed is the value computed in cell EB50.

2) If the net present value, at the specified rate, of the sum of the yearly savings is not greater than zero, a value is not displayed and that cell in the "Savings Column" is blank . If there is a value in this cell the net present value of the yearly savings is a positive number which means the proposal should be accepted.

D. ASSUMPTIONS

This area of the Summary Page provides the various assumptions that were used by the contractor during the generation of the cost effectiveness analysis.

1. "Incorporation in Production engines will begin in"

This assumes that the ECP change will be incorporated into the production schedule of unmodified engines in a particular month and year. The cell formula in cell EJ52 for the determination of the incorporation month is

[Cell EJ52 = IF(TotEngModProd = 0, " ", IF(ProdIncorpYr > Cell N46, " ", Choose(ProdIncorpMo, Cell EN51, Cell EN52, Cell EN53, Cell EN54, Cell EN55, Cell EN56, Cell EN57, Cell EN58, Cell EN59, Cell EN60, Cell EN61, Cell EN62)))].

This equals

[Cell EJ52 = IF(Cell CN48 = 0, " ", IF(Cell D28 > Cell N46, " ", Choose(Cell F28, Cell EN51, Cell EN52, Cell EN53, Cell EN54, Cell EN55, Cell EN56, Cell EN57, Cell EN58, Cell EN59, Cell EN60, Cell EN61, Cell EN62)))].

TotEngModProd is the sum total of engines expected to be modified over production during the CEA analysis period.

ProdIncorpYr is the year that the ECP is expected to be incorporated into the engine production line.

ProdIncorpMo is the month that the ECP is expected to be incorporated into the engine production line.

Cell N46 is the last year of the CEA analysis period.

Cells EN51 through cell EN62 correspond to the months of year, January through December, respectively.

"Choose" is an EXCEL function that uses an index value to choose the appropriate formula value. In the above formula, the index value is cell F28 which is the month that the ECP is expected to be incorporated into the engine production line. Cell F28 designates that month by a number, for example, if the month that the ECP is expected to be incorporated into the engine production line is January, cell F28 would be a 1. Therefore, the above formula chooses a written out month designated by one of the cells from EN51 to EN62 that corresponds to the numbered month displayed in cell F28.

The IF statement uses the following logic to determine the month that the ECP is expected to be incorporated into the engine production line.

A) If the sum total of engines expected to be modified during production over the CEA analysis period is equal to zero, a value is not displayed and cell EJ52 is blank.

B) If the sum total of engines expected to be modified during production over the CEA analysis period is not equal to zero, the value displayed is the result of the following IF statement:

1) If the year that the ECP is expected to be incorporated into the engine production line is greater than the last year of the CEA analysis period, a value is not displayed and cell EJ52 is blank.

2) If the year that the ECP is expected to be incorporated into the engine production line is not greater than the last year of the CEA analysis period, the value displayed is the choice of the month that the ECP is expected to be incorporated into the engine production line or one of cells EN51 through EN62 which are the twelve months of the year.

The cell formula in cell EK52 for the determination of the incorporation year is

[Cell EK52 = IF(TotEngModProd = 0, NA(), IF(ProdIncorpYr > Cell N46, NA(), ProdIncorpYr))].

This equals

[Cell EK52 = IF(Cell CN48 = 0, NA(), IF(Cell D28 > Cell N46, NA(), Cell D28))].

TotEngModProd is the sum total of engines expected to be modified during production during the CEA analysis period.

ProdIncorpYr is the year that the ECP is expected to be incorporated into the engine production line.

Cell N46 is the last year of the CEA analysis period.

The IF statement uses the following logic to determine the year that the ECP is expected to be incorporated into the engine production line.

A) If the sum total of engines expected to be modified during production over the CEA analysis period is equal to zero, the value displayed is N/A.

B) If the sum total of engines expected to be modified during production over the CEA analysis period is not equal to zero, the value displayed is the result of the following IF statement:

1) If the year that the ECP is expected to be incorporated into the engine production line is greater than the last year of the CEA analysis period, the value displayed is N/A.

2) If the year that the ECP is expected to be incorporated into the engine production line is not greater than the last year of the CEA analysis period, the value displayed is the year that the ECP is expected to be incorporated into the engine production line. Its value is contained in cell D28.

2. **"Number of engines produced with this change is"**

This assumes that a particular number of engines will be produced with the ECP change incorporated. The cell formula in cell EK53 is

[Cell EK53 = TotEngModProd].

This equals

[Cell EK53 = Cell CN48].

TotEngModProd is the sum total of engines expected to be modified during production over the CEA analysis period.

3. **"Number of spare units incorporating this change is"**

This assumes that a particular number of modification kits will be installed on spare engines and components after incorporating the ECP change. The cell formula in cell EK54 is

[Cell EK54 = ProSpareKitInstalled].

This equals

[Cell EK54 = Cell DB48].

ProSpareKitInstalled is the sum total of modification kits installed on spare engines and components over the CEA analysis period.

4. **"Modification of operational engines can begin"**

This assumes that the ECP change will be incorporated into the unmodified, operational engines at the field level in a particular month and year in a manner prescribed by the formula below for cell EG55.

[Cell EG55 = IF(Cell D24 + Cell D25 = 0, "No Retrofit", "Modification of operational engines can begin in")].

Cell D24 is the "Scheduled % Events being Modified" which determines the expected percentage of scheduled maintenance events during which a modification can occur.

Cell D25 is the "Unscheduled % Events being Modified" which determines the expected percentage of unscheduled maintenance events during which a modification can occur.

The IF statement uses the following logic to assume when modification of operational engines can begin.

A) If the sum of the expected percentage of scheduled maintenance events during which a modification can occur plus the expected percentage of unscheduled maintenance events during which a modification can occur is equal to zero, there will be no retrofit of operational engines and the words "No Retrofit" will be displayed in the cell.

B) If the sum of the expected percentage of scheduled maintenance events during which a modification can occur plus the expected percentage of unscheduled maintenance events during which a modification can occur is not equal to zero, the words "Modification of operational engines will begin" will be displayed in the cell and the month and year will be determined by the below formulas.

The cell formula in cell EJ55 for the determination of the field incorporation month is

[Cell EJ55 = IF(SchPctEvtMod + UnschPctEvtMod = 0, " ", Choose(FieldIncorpMo, Cell EN51, Cell EN52, Cell EN53, Cell EN54, Cell EN55, Cell EN56, Cell EN57, Cell EN58, Cell EN59, Cell EN60, Cell EN61, Cell EN62))].

This equals

[Cell EJ55 = IF(Cell D24 + Cell D25 = 0, " ", Choose(Cell F29, Cell EN51, Cell EN52, Cell EN53, Cell EN54, Cell EN55, Cell EN56, Cell EN57, Cell EN58, Cell EN59, Cell EN60, Cell EN61, Cell EN62))].

SchPctEvtMod is the expected percentage of scheduled maintenance events during which a modification can occur.

UnschPctEvtMod is the expected percentage of unscheduled maintenance events during which a modification can occur.

FieldIncorpMo is the month that the ECP change can be incorporated into the unmodified, operational engines at the field level.

Cells EN51 through EN62 correspond to the months of year, January through December, respectively.

The IF statement uses the following logic to assume the month when modification of operational engines can begin.

A) If the sum of the expected percentage of scheduled maintenance events during which a modification can occur plus the expected percentage of unscheduled maintenance events during which a modification can occur is equal to zero, a value is not displayed and cell EJ55 is blank because modification will not occur at the field level.

B) If the sum of the expected percentage of scheduled maintenance events during which a modification can occur plus the expected percentage of unscheduled maintenance events during which a modification can occur is not equal to zero, the value displayed is the choice of the month that the ECP change can be incorporated into the unmodified, operational engines at the field level (the value is one of cells EN51 through EN62 which corresponds to the twelve months of the year). The cell formula in cell EK55 for the determination of the field incorporation year is

[Cell EK55 = IF(SchPctEvtMod + UnschPctEvtMod = 0, " ", FieldIncorpYr)].

This equals

[Cell EK55 = IF(Cell D24 + Cell D25 = 0, " ", Cell D29)].

FieldIncorpYr is the year that the ECP change can be incorporated into the unmodified, operational engines at the field level.

The IF statement uses the following logic to assume the year when modification of operational engines can begin.

A) If the sum of the expected percentage of scheduled maintenance events during which a modification can occur plus the expected percentage of unscheduled maintenance events during which a modification can occur is equal to zero, a value is not displayed and cell EK55 is blank because modification will not occur at the field level.

B) If the sum of the expected percentage of scheduled maintenance events during which a modification can occur plus the expected percentage of unscheduled maintenance events during which a modification can occur is not equal to zero, the value displayed is the year that the ECP change is expected to be incorporated into the unmodified, operational engines at the field level.

5. "Incorporation of this change in operational engines will be accomplished by"

This assumes that the ECP change will be incorporated into the unmodified, operational engines using a particular incorporation style at either the Organizational and Intermediate levels or at the Depot level in a manner prescribed by the formula below for cell EG57.

[Cell EG57 = Incorporation of this change in operational...IF(Cell D24 + Cell D25 = 0, "engines will not occur", "engines will be accomplished by -->"].

Cell D24 is the "Scheduled % Events being Modified" which determines the expected percentage of scheduled maintenance events during which a modification can occur.

Cell D25 is the "Unscheduled % Events being Modified" which determines the expected percentage of unscheduled maintenance events during which a modification can occur.

The IF statement uses the following logic to assume which incorporation style, if any, will be necessary to incorporate the ECP change into operational engines.

A) If the sum of the expected percentage of scheduled maintenance events during which a modification can occur plus the expected percentage of unscheduled maintenance events during which a modification can occur is equal to zero, "Incorporation of this change in operational engines will not occur" will appear in cell EG57 and an incorporation style is not needed.

B) If the sum of the expected percentage of scheduled maintenance events during which a modification can occur plus the expected percentage of unscheduled maintenance events during which a modification can occur is not equal to zero, "Incorporation of this change in operational engines will be accomplished by" will appear in cell EG57 and the formulas below will provide the assumed incorporation style that is to be used.

The cell formula in cell EI57 to determine the incorporation style is

[Cell EI57 = IF(SchPctEvtMod + UnschPctEvtMod = 0, " ", IF(IncorpStyle = 1, "Attrition", IF(IncorpStyle = 2, "1stOpportunity", (IF(IncorpStyle = 3, "ForcedRet", "See ECP")))))].

This equals

[Cell EI57 = IF(Cell D24 + Cell D25 = 0, " ", IF(Cell D9 = 1, "Attrition", IF(Cell D9 = 2, "1stOpportunity", (IF(Cell D9 = 3, "ForcedRet", "See ECP")))))].

The IF statement uses the following logic to present which incorporation style will be used to incorporated the ECP change into operational engines.

A) If the sum of the expected percentage of scheduled maintenance events during which a modification can occur plus the expected percentage of unscheduled maintenance events during which a modification can occur is equal to zero, a value is not displayed and the cell EI57 will be blank because incorporation of this change in operational engines will not occur and an incorporation style is not needed.

B) If the sum of the expected percentage of scheduled maintenance events during which a modification can occur plus the expected percentage of unscheduled maintenance events during which a modification can occur is not equal to zero, the results of the following IF statements will be displayed.

1) If the Incorporation Style is equal to one, the incorporation style displayed is "attrition", indicating that the attrition incorporation style was assumed for the ECP change. 2) If Incorporation Style is not equal to one, the results of the following IF statements will be displayed.

(A) If Incorporation Style is equal to two, the incorporation style displayed is "first opportunity", indicating that the first opportunity incorporation style was assumed for the ECP change.

(B) If Incorporation Style is not equal to two, the results of the following IF statement will be displayed.

(1) If Incorporation Style is equal to three, the incorporation style displayed is "forced ret", indicating that the forced retrofit incorporation style was assumed for the ECP change.

(2) If Incorporation Style is not equal to three, "See ECP" will be displayed.

The maintenance level at which the ECP change is assumed to be incorporated into the unmodified, operational engines using the above specified incorporation style is determined by the following formula located in cell EK57.

[Cell EK57 = IF(SchPctEvtMod + UnschPctEvtMod = 0, " ", IF(KitLaborDepot > 0, "Depot", IF(KitLaborOI > 0, "O & I", "See ECP")))].

This equals

[Cell EK57 = IF(Cell D24 + Cell D25 = 0, " ", IF(Cell D18 > 0, "Depot", IF(Cell D17 > 0, "O & I", "See ECP")))].

Cell D24 is the "Scheduled % Events being Modified" which determines the expected percentage of scheduled maintenance events during which a modification can occur.

Cell D25 is the "Unscheduled % Events being Modified" which determines the expected percentage of unscheduled maintenance events during which a modification can occur.

KitLaborOI is the expected time in manhours to install a modification kit at the Organizational and Intermediate levels (O&I).

KitLaborDepot is the expected time in manhours to install a modification kit at the Depot level.

The IF statement uses the following logic to determine the location at which the ECP change is assumed to be incorporated into the unmodified, operational engines.

A) If the sum of the expected percentage of scheduled maintenance events during which a modification can occur plus the expected percentage of unscheduled maintenance events during which a modification can occur is equal to zero, a value is not displayed and cell EK57 will be blank because incorporation of this change in operational engines will not occur and a no maintenance level is needed to perform the incorporation.

B) If the sum of the expected percentage of scheduled maintenance events during which a modification can occur plus the expected percentage of unscheduled maintenance events during which a modification can occur is not equal to zero, the results of the following IF statement will be displayed.

1) If the expected time in manhours to install a modification kit at the Depot level is greater than zero, "Depot" will be displayed to indicate that incorporation was assumed to be performed at the Depot level.

2) If the expected time in manhours to install a modification kit at the Depot level is not greater than zero, the results of the following IF statement will be displayed.

(A) If the expected time in manhours to install a modification kit at the Organizational and Intermediate levels (O&I) is greater than zero, "O&I" will be displayed to indicate that incorporation was assumed to be performed at the Organizational and Intermediate levels.

(B) If the expected time in manhours to install a modification kit at the Organizational and Intermediate levels (O&I) is not greater than zero, "See ECP" will be displayed.

In relation to the assumption of the incorporation style and the assumption of the maintenance level to perform the incorporation, the following conjunctive formula is used in cell EJ55 between the above two cells

[Cell EJ55 = IF(Cell D24 + Cell D25 = 0, " ", "at")].

Cell D24 is the "Scheduled % Events being Modified" which determines the expected percentage of scheduled maintenance events during which a modification can occur.

Cell D25 is the "Unscheduled % Events being Modified" which determines the expected percentage of unscheduled maintenance events during which a modification can occur.

The IF statement uses the following logic to determine if cell EJ55 will display a value.

A) If the sum of the expected percentage of scheduled maintenance events during which a modification can occur plus the expected percentage of unscheduled maintenance events during which a modification can occur is equal to zero, a value is not displayed and cell EJ57 is blank because incorporation of this change in operational engines will not occur.

B) If the sum of the expected percentage of scheduled maintenance events during which a modification can occur plus the expected percentage of unscheduled maintenance events during which a modification can occur is not equal to zero, "at" will be displayed to join the incorporation style with the incorporation maintenance level.

6. "Total kits installed out of total engines not modified in production is"

This assumes that a number of modification kits will be installed into the remaining engines that were delivered but were not modified during production. The cell formula in cell EI59 for the total number of kits expected to be installed is

[Cell EI59 = CurYrProEngKitInstal].

This equals

[Cell EI59 = Cell CY48].

CurYrProEngKitInstal is the sum total of all the modification kits which need to be installed each year for the proposed configuration.

The cell formula in cell EK59 for the total number of engines not modified in production is

[Cell EK59 = TotEngDel - TotEngModProd].

This equals

[Cell EK59 = Cell Q48 - Cell CN48].

TotEngDel is the sum total of new engines delivered to the fleet or the sum total of engines retired from the fleet over the CEA analysis period.

TotEngModProd is the sum total of engines modified during production over the CEA analysis period.

7. **"Total engines lost to attrition is"**

This assumes that the ECP change will not be incorporated into some engines due to their loss to attrition. The cell formula in cell EK60 is

[Cell EK60 = Cell W48].

Cell W48 is the total number of all the engines lost through attrition during the life cycle analysis period.

8. **"Total engines retired unmodified is"**

This assumes that the ECP change will not be incorporated into some engines. This amount is determined by the following cell formula in cell EK61.

[Cell EK61 = MAX(Cell EK59 - Cell EI59 - Cell EK60, 0)].

Cell EK59 is the total number of engines not modified in production.

Cell EI59 is the total number of engine kits installed.

Cell EK60 is the total number of engines lost through attrition.

The cell formula uses the following MAX statement to determine the total number of engines retired unmodified.

A) The value displayed is the maximum of either

1) The difference of the total number of engines not modified in production minus the total number of engine kits installed minus the total number of engines lost through attrition or

2) Zero.

9. **"Estimated yearly flying hours"**

This assumes an average number of engine flight hours (EFH) per engine per year. The value for Cell EI62 is based on the government's projected total annual flight hours and is contractor provided in Cell P50.

[Cell EI62 = Cell P50].

IX. INTERIM CALCULATIONS AND SUMMARY PAGE EQUATIONS

A. INTRODUCTION

This final section of the model consists of spreadsheet columns EO through EV and provides the Engineering Change Proposal (ECP) approval authority with an easy-to-read format of the current and proposed (modified and unmodified) configuration cost comparisons. It also provides the equations used to determine the nine Summary Costs and Savings values on the Summary Page.

To make it easier to follow the equations and calculations, it provides, where applicable, a reference of how each cost was calculated by using the Line Number from the Input Parameter Page (page 1 of the model) or the indicated row of the Interim Calculations Page.

There are six sections on the Interim Calculations and Summary Page Equations printed page. This chapter will describe each of the six sections and provide the formulas and equations involved with each calculation.

B. SUMMARY PAGE INPUT PARAMETERS (ROWS A THROUGH F)

This section is untitled on the printed page of the model, however, it contains the input parameters for the calculations performed in the Summary Costs and Savings section of the Summary Page.

1. Delta Production Cost (Row A)

Cell EQ9 is the difference between the production cost of an engine incorporating the modification and one that does not contain the modification. This factor is used only for those engines still under production. The delta production cost value is determined by the contractor and is incorporated directly into cell D15.

2. Kit Cost (Row B)

Cell EQ10 is the cost to the government of an engine's component modification kit. This cost is provided by the contractor directly into cell D16.

3. Labor Cost to Install the Kit (Row C)

Cell EQ11 is the total cost of the expected time in manhours to install a modification kit at the Organizational and Intermediate levels (O&I), and at the Depot level. This is usually determined by the contractor through logistic support analysis. The cell formula in cell EQ11 is

[Cell EQ11 = (KitLaborOI * LaborCostOI) + (KitLaborDepot * LaborCostDepot)].

This equals

[Cell EQ11 = (Cell D17 * Cell G11) + (Cell D18 * Cell G12)].

KitLaborOI is the expected time in manhours to install a modification kit at the Organizational and Intermediate levels (O&I).

KitLaborDepot is the expected time in manhours to install a modification kit at the Depot level.

LaborCostOI is the Organizational and Intermediate level labor cost per manhour which is determined from labor cost data maintained by the military organization that is considering the ECP.

LaborCostDepot is the Depot level cost per manhour which is determined from labor cost data maintained by the military organization that is considering the ECP.

4. Publication Cost (Row D)

Cell EU9 is the total sum of the costs of any technical publication associated with the proposed engine change and the Time-Compliance Technical Order cost which is issued for important changes when urgency is an issue. The cost determination is generally based on a count of the number of pages affected by the ECP. This is normally a minor cost and is supplied by the contractor. The cell formula in cell EU9 is

[Cell EU9 = (TechPubsCost + TctoCost)].

This equals

[Cell EU9 = (Cell D19 + Cell D20)].

TechPubsCost is the total cost of any technical publications associated with the proposed engine change. The cost determination is generally based on a count of the number of pages affected by the ECP.

TctoCost is the Time-Compliance Technical Order cost which is issued for important changes when urgency is an issue.

5. Support Equipment (Row E)

Cell EU10 includes the cost of any special tooling or support equipment required to complete the component modification. The costs to modify current tooling and support equipment to comply with ECP requirements are included in this cost. The contractor supplies this cost estimate directly into cell D21.

6. Aircraft Cost (Row F)

Cell EU11 is the current purchase price of the fully equipped aircraft. This value is the same as cell G26 and cell S52.

C. MODIFICATION EVENTS

This section consists of two items; the number of Engines Modified in Production and the number of Retrofit Events (modifications at the field level).

1. Engines Modified in Production (Row G)

Cell EU14 is the total number of engines modified during production. This cell input is transferred from cell CN48.

2. Retrofit Events (Row H)

This row provides the total number of engines modified at the field level. This total consists of modifications that occur to operational engines during unscheduled or scheduled events and modifications to spare engines and components.

The cell formula in cell EQ15 for unscheduled retrofit events is

[Cell EQ15 = (UnschPctEvtMod * Cell AX48)].

This equals

[Cell EQ15 = (Cell D25 * Cell AX48)].

UnschPctEvtMod determines the expected percentage of unscheduled maintenance events during which a modification can occur.

Cell AX48 is the total sum of the number of unscheduled opportunities for replacement of unmodified engine components with modified engine components that are expected to occur if the proposed design change is implemented during the CEA life cycle analysis period.

The cell formula in cell ER15 for scheduled retrofit events is

[Cell ER15 = (SchPctEvtMod * Cell AY48)].

This equals

[Cell ER15 = (Cell D24 * Cell AY48)].

SchPctEvtMod determines the expected percentage of scheduled maintenance events during which a modification can occur.

Cell AY48 is the total sum of the number of scheduled opportunities for replacements of the unmodified components that are expected to occur during the CEA life cycle analysis period if the proposed design change is accepted.

The input for the cell formula for spare unit retrofits, cell ES15, is the number of kits installed on spare engines or components during the CEA life cycle analysis period which is computed in cell DB48.

The cell formula in cell EU15 for the sum total of retrofit events is

[Cell EU15 = (Cell CY48 + Cell DB48)].

Cell CY48 is the sum total of modification kits which are expected to be installed with the proposed configuration during the CEA life cycle analysis period.

Cell DB48 is the sum total of kits installed on engines and components during the CEA life cycle analysis period.

D. OPERATIONAL EVENTS & EFH

This section consists of four items; Scheduled Events, Unscheduled Events, Engine Flight Hours (In thousands) and Aircraft Losses Delta.

1. Scheduled Events (Row J)

Cell EQ19 is the sum total of scheduled engine events for unmodified engines with the current configuration during the CEA life cycle analysis period. This cell input is from cell BI48.

Cell ER19 is the sum total of scheduled engine events for unmodified engines for the proposed configuration during the CEA life cycle analysis period. This cell input is from cell CU48.

Cell ES19 is the sum total of scheduled engine maintenance events for modified engines for the proposed configuration during the CEA life cycle analysis period. This cell input is from cell CV48.

2. Unscheduled Events (Row K)

Cell EQ20 is the sum total of unscheduled engine failures for unmodified engines with the current configuration during the CEA life cycle analysis period. This cell input is from cell BG48.

Cell ER20 is the sum total of unscheduled component failures for unmodified engines for the proposed configuration during the CEA life cycle analysis period. This cell input is from cell CS48.

Cell ES20 is the sum total of unscheduled component failures for modified engines for the proposed configuration during the CEA life cycle analysis period. This cell input is from cell CT48.

3. Engine Flight Hours (Row L)

Cell EQ21 is the sum total of annual engine flight hours, in thousands of hours, for unmodified engines with the current configuration during the CEA life cycle analysis period. This cell input is from cell BE48.

Cell ER21 is the sum total of annual engine flight hours, in thousands of hours, for unmodified engines for the proposed configuration during the CEA life cycle analysis period. This cell input is from cell CQ48.

Cell ES21 is the total sum of annual engine flight hours, in thousands of hours, for modified engines for the proposed configuration during the CEA life cycle analysis period. This cell input is from cell CR48.

4. Aircraft Losses Delta (Row M)

Cell ES22 is the sum total of the change in aircraft losses resulting from the loss of an entire system due to the unscheduled failure of a component between the current and the proposed configurations during the CEA life cycle analysis period. This cell input is from cell CX48.

E. SCHEDULED COSTS PER EVENTS

This section describes scheduled maintenance costs per event on a component under the current and proposed configurations. It consists of six input categories and three totals figures.

1. O & I Labor

A) Current calculates the cost of manhours expended during a scheduled event at the Organizational and Intermediate levels for an engine with the current configuration by using the following cell formula in cell EQ26.

[Cell EQ26 = LaborCostOI * (((CurSchMhIlev + CurSchMhRrOLev) * CurSchPctRemOILev) + CurSchMhInspOlev)].

This equals

[Cell EQ26 = Cell G11 * (((Cell E37 + Cell E36) * Cell E35) + Cell E34)].

LaborCostOI represents Organizational and Intermediate level labor costs per manhour which is determined from labor cost data maintained by the military organization that is considering the ECP.

CurSchMhInspOlev is the number of manhours at the Organizational level which are required to accomplish any scheduled inspections on the component with the current configuration being modified.

CurSchPctRemOILev is the percentage of total components with the current configuration for which scheduled removal is expected to be required and performed at the Organizational and Intermediate levels. If this percentage is not 100%, the remaining units would be either removed at the Depot level or not removed at all.

CurSchMhRrOLev is the expected number of manhours needed to remove and replace a component with the current configuration that is being modified during any scheduled maintenance at the Organizational level.

CurSchMhIlev is the expected number of manhours required to accomplish any scheduled maintenance on a component with the current configuration that is being modified at the Intermediate level.

B) Proposed Unmodified is cell ER26 which transfers the calculations from cell EQ26 (Current Organizational and Intermediate Labor) and displays the same value.

C) Proposed Modified calculates the cost of manhours expended during a scheduled event at the Organizational and

Intermediate levels for an engine with the proposed configuration by using the following cell formula in cell ES26

[Cell ES26 = LaborCostOI * (((ProSchMhRrOlev + ProSchMhILev) * ProSchPctRemOILev) + CurSchMhInspOlev)].

This equals

[Cell ES26 = Cell G11 * (((Cell F36 + Cell F37) * Cell F35) + Cell F34)].

LaborCostOI represents Organizational and Intermediate level labor cost per manhour which is determined from labor cost data maintained by the military organization that is considering the ECP.

ProSchMhInspOlev is the number of manhours at the Organizational level which are required to accomplish any scheduled inspections on the component with the proposed configuration.

ProSchPctRemOILev is the percentage of total components with the proposed configuration for which scheduled removal is expected to be required and performed at the Organizational and Intermediate levels. If this percentage is not 100%, the remaining units would be either removed at the Depot level or not removed at all.

ProSchMhRrOLev is the number of manhours needed to remove and replace a component with the proposed configuration during any scheduled maintenance at the Organizational level.

ProSchMhIlev is the average or expected number of manhours required to accomplish any scheduled maintenance on a component with the proposed configuration at the Intermediate level.

2. Depot Labor

A) Current calculates the cost of manhours expended during a scheduled event at the Depot level for an engine with the current configuration by using the following cell formula in cell EQ27.

[Cell EQ27 = (CurSchPctRetDepot * CurSchMhDepot * LaborCostDepot)].

This equals

[Cell EQ27 = (Cell E40 * Cell E41 * Cell G12)].

CurSchPctRetDepot is the percentage of components with the current configuration which are expected to require scheduled maintenance that cannot be performed at the Organizational and Intermediate levels. Scheduled maintenance includes inspections, monitoring, servicing and repair.

CurSchMhDepot is the expected total number of scheduled maintenance manhours required to repair a component with the current configuration at the Depot level.

LaborCostDepot represents the Depot level cost per manhour which is determined from labor cost data maintained by the military organization that is considering the ECP.

B) Proposed Unmodified is cell ER27 which transfers the calculations from cell EQ27 (Current Depot Labor) and displays the same value.

C) Proposed Modified calculates the cost of manhours expended during a scheduled event at the Depot level for an engine with the proposed configuration by using the following cell formula in cell ES27.

[Cell ES27 = (ProSchPctRetDepot * ProSchMhDepot * LaborCostDepot)].

This equals

[Cell ES27 = (Cell F40 * Cell F41 * Cell G12)].

ProSchPctRetDepot is the percentage of components with the proposed configuration which are expected to require scheduled maintenance that cannot be performed at the Organizational and Intermediate levels. Scheduled maintenance includes inspections, monitoring, servicing and repair.

ProSchMhDepot is the expected total number of scheduled maintenance manhours required to repair a component with the proposed configuration at the Depot level.

LaborCostDepot represents the Depot level cost per manhour which is determined from labor cost data maintained by the military organization that is considering the ECP.

3. Total Labor (Row N)

A) Current calculates the total cost of manhours expended during a scheduled event at both the Organizational and Intermediate levels, and the Depot level for an engine with the current configuration by using the following cell formula in cell EQ28.

[Cell EQ28 = Cell EQ26 + Cell EQ27].

B) Proposed Unmodified is cell ER28 which transfers the calculations from cell EQ28 (Current Total Labor Cost) and displays the same value.

C) Proposed Modified calculates the total cost of manhours expended during a scheduled event at both the Organizational and Intermediate levels, and the Depot level for an engine with the proposed configuration by using the following cell formula in cell ES28.

[Cell ES28 = Cell ES26 + Cell ES27].

4. O & I Repair

A) Current calculates the cost of material used at the Organizational and Intermediate levels for the scheduled removal and replacement of an engine with the current configuration using the following cell formula in cell EQ30.

[Cell EQ30 = CurSchPctRepOIlev * CurSchRepOIlevCost].

This equals

[Cell EQ30 = Cell E38 * Cell E39].

CurSchPctRepOIlev is the percentage of total units with the current configuration which are expected to require repair during any scheduled maintenance at the Organizational and Intermediate level.

CurSchRepOIlevCost is the expected material cost to repair a component with the current configuration at the Organizational and Intermediate levels.

B) Proposed Unmodified is cell ER30 which transfers the calculations from cell EQ30 (Current Organizational and Intermediate Repair) and displays the same value.

C) Proposed Modified calculates the cost of material used at the Organizational and Intermediate levels for the scheduled removal and replacement of an engine with the proposed configuration using the following cell formula in cell ES30.

[Cell ES30 = ProSchPctRepOIlev * ProSchRepOIlevCost].

This equals

[Cell ES30 = Cell F38 * Cell F39].

ProSchPctRepOIlev is the percentage of total units with the proposed configuration which are expected to require repair during any scheduled maintenance at the Organizational and Intermediate levels.

ProSchRepOIlevCost is the expected material cost to repair one unit with the proposed configuration at the Organizational and Intermediate levels.

5. Depot Repair

A) Current calculates the cost of material used at the Depot level for the scheduled removal and replacement of an engine with the current configuration using the following cell formula in cell EQ31.

[Cell EQ31 = CurSchPctDepotRep * CurSchRepDepotCost].

This equals

[Cell EQ31 = Cell E42 * Cell E43].

CurSchPctDepotRep is the percentage of total components with the current configuration which are expected to require scheduled repair at the Depot level.

CurSchRepDepotCost is the expected cost to repair a component with the current configuration at the Depot level.

B) Proposed Unmodified is cell ER31 which transfers the calculations from cell EQ31 (Current Depot Repair) and displays the same value.

C) Proposed Modified calculates the cost of material used at the Depot level for the scheduled removal and replacement of an engine with the proposed configuration using the following cell formula in cell ES31.

[Cell ES31 = ProSchPctDepotRep * ProSchRepDepotCost].

This equals

[Cell ES31 = Cell F42 * Cell F43].

ProSchPctDepotRep is the percentage of total components with the proposed configuration which are expected to require scheduled repair at the Depot level.

ProSchRepDepotCost is the expected cost to repair a component with the proposed configuration at the Depot level.

6. **Scrap Cost**

A) Current calculates the cost to replace a component with the current configuration that has been discarded during scheduled maintenance because the component is beyond economical repair using the following cell formula in cell EQ32.

[Cell EQ32 = CurSchPctScrap * CurSchPartScpCost].

This equals

[Cell EQ32 = Cell E44 * Cell E45].

CurSchPctScrap is the percentage of total components with the current configuration, identified during scheduled maintenance, which are expected to be discarded because the component is beyond economical repair.

CurSchPartScpCost is the cost to replace a component with the current configuration scrapped during scheduled maintenance. This assumes that all scrapped components will be replaced by newly produced components. This cost the cost of the new component and is not related to the costs of disposing the scrapped component.

B) Proposed Unmodified is cell ER32 which transfers the calculations from cell EQ32 (Current Scrap Cost) and displays the same value.

C) Proposed Modified calculates the cost to replace a component with the proposed configuration that has been discarded during scheduled maintenance because the component is beyond economical repair using the following cell formula in cell ES32.

[Cell ES32 = ProSchPctScrap * ProSchPartScpCost].

This equals

[Cell ES32 = Cell F44 * Cell F45].

ProSchPctScrap is the percentage of total components with the proposed configuration, identified during scheduled maintenance, which are expected to be discarded because the component is beyond economical repair.

ProSchPartScpCost is the cost to replace a component with the proposed configuration scrapped during scheduled maintenance. This assumes that all scrapped components will be replaced by newly produced components. This cost is the cost of a new component and is not related to the costs of disposing the scrapped component.

7. Total Material Cost (Row P)

A) Current calculates the total cost of material used at the Organizational and Intermediate levels, and the Depot level for the scheduled removal and replacement of an engine with the current configuration and the cost to replace a component that has been discarded during scheduled maintenance because the component is beyond economical repair using the following cell formula in cell EQ33.

[Cell EQ33 = Cell EQ30 + Cell EQ31 + Cell EQ32].

B) Proposed Unmodified is cell ER33 which transfers the calculations from cell EQ33 (Current Total Material Cost) and displays the same value.

C) Proposed Modified calculates the total cost of material used at the Organizational and Intermediate levels, and the Depot level for the scheduled removal and replacement of an engine with the proposed configuration and the cost to replace a component that has been discarded during scheduled maintenance because the component is beyond economical repair using the following cell formula in cell ES33.

[Cell ES33 = Cell ES30 + Cell ES31 + Cell ES32].

8. Test Labor & Fuel Cost

A) Current calculates the cost of engine test time and operational fuel that is required after undergoing scheduled maintenance on an engine with the current configuration at the Depot level using the following cell formula in cell EQ35.

[Cell EQ35 = TestFuelGH * FuelCostGal * CurSchEngTstTime + 2 * LaborCostOI * CurSchEngTstTime].

This equals

[Cell EQ35 = Cell S50 * Cell G17 * Cell E46 + 2 * Cell G11 * Cell E46].

TestFuelGH is the number of gallons per hour of fuel required to test the engine following the modification.

FuelCostGal is the cost per gallon of fuel to test the engine after the modification has been accomplished.

CurSchEngTstTime is the expected number of hours of engine test time required for a component with the current configuration undergoing scheduled maintenance at the Depot level.

LaborCostOI represents Organizational and Intermediate level labor cost per manhour which is determined from labor cost data maintained by the military organization that is considering the ECP. The "2" in the formula represents the number of personnel required to conduct engine tests.

B) Proposed Unmodified is cell ER35 which transfers the calculations from cell EQ35 (Current Test Labor & Fuel Cost) and displays the same value.

C) Proposed Modified calculates the cost of test time and fuel that is required after undergoing scheduled maintenance on an engine with the proposed configuration at the Depot level using the following cell formula in cell ES35.

[Cell ES35 = TestFuelGH * FuelCostGal * ProSchEngTstTime + 2 * LaborCostOI * ProSchEngTstTime].

This equals

[Cell ES35 = Cell S50 * Cell G17 * Cell F46 + 2 * Cell G11 * Cell F46].

TestFuelGH is the number of gallons per hour of fuel required to test the engine following the modification.

FuelCostGal is the cost per gallon of fuel to test the engine after the modification has been accomplished.

ProSchEngTstTime is the expected number of hours of engine test time required for a component with the proposed configuration undergoing scheduled maintenance at the Depot level.

LaborCostOI represents Organizational and Intermediate level labor cost per manhour which is determined from labor cost data maintained by the military organization that is considering the ECP. The "2" in the formula represents the number of personnel required to conduct engine tests.

9. **Total Material Including Test Labor & Fuel (Row Q)**

A) Current calculates the total material costs per scheduled maintenance event for an engine with the current configuration. This includes Organizational and Intermediate level Material Repair costs, Depot Material Cost, Depot Scrap Cost, and Total Scheduled Test Labor and Fuel Cost. The cell formula in cell EQ36 is

[Cell EQ36 = CellEQ33 + Cell EQ35].

B) Proposed Unmodified is cell ER36 which transfers the calculations from cell EQ36 (Current Total Material Including Test Labor & Fuel Cost) and displays the same value.

C) Proposed Modified calculates the total material cost per scheduled maintenance event for an engine with the proposed configuration. This includes Organizational and Intermediate level Material Repair costs, Depot Material Cost, Depot Scrap Cost, and Total Scheduled Test Labor and Fuel Cost. The cell formula in cell ES36 is

[Cell ES36 = Cell ES33 + Cell ES35].

F. UNSCHEDULED COSTS PER EVENTS

This section describes unscheduled maintenance costs per event on a component under the current and proposed configurations. It consists of seven input categories and four totals figures.

1. O & I Labor

A) Current calculates the cost of manhours expended during an unscheduled event at the Organizational and Intermediate levels for an engine with the current configuration by using the following cell formula in cell EQ40.

[Cell EQ40 = LaborCostOI * (((CurUnschMhRrOlev + CurUnschMhIlev) * CurUnschPctRemOILev) + CurUnschMhInspOlev)].

This equals

[Cell EQ40 = Cell G11 * (((Cell E51 + Cell E52) * Cell E50) + Cell E49)].

LaborCostOI represents Organizational and Intermediate level labor cost per manhour which is determined from labor cost data maintained by the military organization that is considering the ECP.

CurUnschMhInspOlev is the expected number of manhours at the Organizational level which are required to accomplish any unscheduled inspections on the component with the current configuration.

CurUnschPctRemOILev is the percentage of total components with the current configuration for which unscheduled removal is expected to be required and performed at the Organizational and Intermediate levels. If this percentage is not 100%, the remaining units would be either removed at the Depot level or not removed at all.

CurUnschMhRrOLev is the expected number of manhours needed to remove and replace a component with the current configuration that is being modified during any unscheduled maintenance at the Organizational level.

CurUnschMhIlev is the expected number of manhours required to accomplish any unscheduled maintenance on a component with the current configuration at the Intermediate level.

B) Proposed Unmodified is cell ER40 which transfers the calculations from cell EQ40 (Current Organizational and Intermediate Labor) and displays the same value.

C) Proposed Modified calculates the cost of manhours expended during a unscheduled event at the Organizational and Intermediate levels for an engine with the proposed configuration by using the following cell formula in cell ES40.

[Cell ES40 = LaborCostOI * (((ProUnschMhRrOlev + ProUnschMhIlev) * ProUnschPctRemOILev) + ProUnschMhInspOlev)].

This equals

[Cell ES40 = Cell G11 * (((Cell F51 + Cell F52) * Cell F50) + Cell F49)].

LaborCostOI represents Organizational and Intermediate level labor cost per manhour which is determined from labor cost data maintained by the military organization that is considering the ECP.

ProUnschMhInspOlev is the expected number of manhours at the Organizational level which are required to accomplish any unscheduled inspections on the component with the proposed configuration.

ProUnschPctRemOILev is the percentage of total components with the proposed configuration for which unscheduled removal is expected to be required and performed at the Organizational and Intermediate levels. If this percentage is not 100%, the remaining units would be either removed at the Depot level or not removed at all.

ProUnschMhRrOLev is the expected number of manhours needed to remove and replace a component with the proposed configuration that is being modified during any unscheduled maintenance at the Organizational level.

ProUnschMhIlev is the expected number of manhours required to accomplish any unscheduled maintenance on a component with the proposed configuration that is being modified at the Intermediate level.

2. Depot Labor

A) Current calculates the cost of manhours expended during a unscheduled event at the Depot level for an engine with the current configuration by using the following cell formula in cell EQ41.

[Cell EQ41 = CurUnschPctRetDepot * CurUnschMhDepot * LaborCostDepot].

This equals

[Cell EQ41 = Cell E55 * Cell E56 * Cell G12].

CurUnschPctRetDepot is the percentage of components with the current configuration which are expected to require unscheduled maintenance that cannot be performed at the Organizational and Intermediate levels.

CurUnschMhDepot is the total expected number of unscheduled maintenance manhours required to repair a component with the current configuration at the Depot level.

LaborCostDepot represents the Depot level cost per manhour which is determined from labor cost data maintained by the military organization that is considering the ECP.

B) Proposed Unmodified is cell ER41 which transfers the calculations from cell EQ41 (Current Depot Labor) and displays the same value.

C) Proposed Modified calculates the cost of manhours expended during a unscheduled event at the Depot level for an engine with the proposed configuration by using the following cell formula in cell ES41.

[Cell ES41 = ProUnschPctRetDepot * ProUnschMhDepot * LaborCostDepot].

This equals

[Cell ES41 = Cell F55 * Cell F56 * Cell G12].

ProUnschPctRetDepot is the percentage of components with the proposed configuration which are expected to require unscheduled maintenance that cannot be performed at the Organizational and Intermediate levels.

ProUnschMhDepot is the total expected number of unscheduled maintenance manhours required to repair a component with the proposed configuration at the Depot level.

LaborCostDepot represents the Depot level cost per manhour which is determined from labor cost data maintained by the military organization that is considering the ECP.

3. Total Labor (Row R)

A) Current calculates the total cost of manhours expended during an unscheduled event at both the Organizational and Intermediate levels, and the Depot level for an engine with the current configuration by using the following cell formula in cell EQ42.

[Cell EQ42 = Cell EQ40 + Cell EQ41].

B) Proposed Unmodified is cell ER42 which transfers the calculations from cell EQ42 (Current Total Labor Cost) and displays the same value.

C) Proposed Modified calculates the total cost of manhours expended during a unscheduled event at both the Organizational and Intermediate levels, and the Depot level for an engine with the proposed configuration by using the following cell formula in cell ES42.

[Cell ES42 = Cell ES40 + Cell ES41].

4. O & I Repair

A) Current calculates the cost of material used at the Organizational and Intermediate levels for the unscheduled removal and replacement of an engine with the current configuration using the following cell formula in cell EQ44.

[Cell EQ44 = CurUnschPctRepOIlev * CurUnschRepOIlevCost].

This equals

[Cell EQ44 = Cell E53 * Cell E54].

CurUnschPctRepOIlev is the percentage of total units with the current configuration which are expected to require repair during any unscheduled maintenance at the Organizational and Intermediate levels.

CurUnschRepOIlevCost is the expected material cost to repair one unit with the current configuration at the Organizational and Intermediate levels.

B) Proposed Unmodified is cell ER44 which transfers the calculations from cell EQ44 (Current Organizational and Intermediate Repair) and displays the same value.

C) Proposed Modified calculates the cost of material used at the Organizational and Intermediate level for the unscheduled removal and replacement of an engine with the proposed configuration using the following cell formula in cell ES44.

[Cell ES44 = ProUnschPctRepOIlev * ProUnschRepOIlevCost].

This equals

[Cell ES44 = Cell F53 * Cell F54].

ProUnschPctRepOIlev is the percentage of total units with the proposed configuration which are expected to require repair during any unscheduled maintenance at the Organizational and Intermediate levels.

ProUnschRepOIlevCost is the expected material cost to repair one unit with the proposed configuration at the Organizational and Intermediate levels.

5. Depot Repair

A) Current calculates the cost of material used at the Depot level for the unscheduled removal and replacement of an engine with the current configuration using the following cell formula in cell EQ45.

[Cell EQ45 = CurUnschPctDepotRep * CurUnschRepDepotCost].

This equals

[Cell EQ45 = Cell E57 * Cell E58].

CurUnschPctDepotRep is the percentage of total components with the current configuration which are expected to require unscheduled repair at the Depot level.

CurUnschRepDepotCost is the expected cost to repair one unit with the current configuration at the Depot level.

B) Proposed Unmodified is cell ER45 which transfers the calculations from cell EQ45 (Current Depot Repair) and displays the same value.

C) Proposed Modified calculates the cost of material used at the Depot level for the unscheduled removal and replacement of an engine with the proposed configuration using the following cell formula in cell ES45.

[Cell ES45 = ProUnschPctDepotRep * ProUnschRepDepotCost].

This equals

[Cell ES45 = Cell F57 * Cell F58].

ProUnschPctDepotRep is the percentage of total components with the proposed configuration which are expected to require unscheduled repair at the Depot level.

ProUnschRepDepotCost is the expected cost to repair one unit with the proposed configuration at the Depot level.

6. Scrap Cost

A) Current calculates the cost to replace a component with the current configuration that has been discarded during unscheduled maintenance because the component is beyond economical repair using the following cell formula in cell EQ46.

[Cell EQ46 = CurUnschPctScrap * CurUnschPartScpCost].

This equals

[Cell EQ46 = Cell E59 * Cell E60].

CurUnschPctScrap is the percentage of total components with the current configuration, identified during unscheduled maintenance, which are expected to be discarded because the component is beyond economical repair.

CurUnschPartScpCost is the expected cost to replace a component with the current configuration scrapped during unscheduled maintenance. This assumes that all scrapped components will be replaced by newly produced components. This cost is the cost of a new component and is not related to the costs of disposing the scrapped component.

B) Proposed Unmodified is cell ER46 which transfers the calculations from cell EQ46 (Current Scrap Cost) and displays the same value.

C) Proposed Modified calculates the cost to replace a component with the proposed configuration that has been discarded during unscheduled maintenance because the component is beyond economical repair using the following cell formula in cell ES46.

[Cell ES46 = ProUnschPctScrap * ProUnschPartScpCost].

This equals

[Cell ES46 = Cell F59 * Cell F60].

ProUnschPctScrap is the percentage of total components with the proposed configuration, identified during unscheduled maintenance, which are expected to be discarded because the component is beyond economical repair.

ProUnschPartScpCost is the expected cost to replace a component with the proposed configuration scrapped during unscheduled maintenance. This assumes that all scrapped components will be replaced by newly produced components. This cost is the cost of a new component and is not related to the costs of disposing the scrapped component.

7. Total Material Cost (Row S)

A) Current calculates the total cost of material used at the Organizational and Intermediate levels, and the Depot level for the unscheduled removal and replacement of an engine with the current configuration and the cost to replace a component that has been discarded during unscheduled maintenance because the component is beyond economical repair using the following cell formula in cell EQ47.

[Cell EQ47 = Cell EQ44 + Cell EQ45 + Cell EQ46].

B) Proposed Unmodified is cell ER47 which transfers the calculations from cell EQ47 (Current Total Material Cost) and displays the same value.

C) Proposed Modified calculates the total cost of material used at the Organizational and Intermediate levels, and the Depot level for the unscheduled removal and replacement of an engine with the proposed configuration and the cost to replace a component that has been discarded during unscheduled maintenance because the component is beyond economical repair using the following cell formula in cell ES47.

[Cell ES47 = Cell ES44 + Cell ES45 + Cell ES46].

8. Test Labor & Fuel Cost

A) Current calculates the cost of engine test time and fuel that is required after undergoing unscheduled maintenance on an engine with the current configuration at the Depot level using the following cell formula in cell EQ49.

[Cell EQ49 = TestFuelGH * FuelCostGal * CurUnschEngTstTime + 2 * LaborCostOI * CurUnschEngTstTime].

This equals

[Cell EQ49 = Cell S50 * Cell G17 * Cell E61 + 2 * Cell G11 * Cell E61].

TestFuelGH is the number of gallons per hour of fuel required to test the engine following the modification.

FuelCostGal is the cost per gallon of fuel to test the engine after the modification has been accomplished.

CurUnschEngTstTime is the expected number of hours of engine test time required for a component with the current configuration undergoing unscheduled maintenance at the Depot level.

LaborCostOI represents Organizational and Intermediate level labor cost per manhour which is determined from labor cost data maintained by the military organization that is considering the ECP. The "2" in the formula is the number of personnel required to test the engine.

B) Proposed Unmodified is cell ER49 which transfers the calculations from cell EQ49 (Current Test Labor & Fuel Cost) and displays the same value.

C) Proposed Modified calculates the cost of engine test time and fuel that is required after undergoing unscheduled maintenance on an engine with the proposed configuration at the Depot level using the following cell formula in cell ES49.

[Cell ES49 = TestFuelGH * FuelCostGal * ProUnschEngTstTime + 2 * LaborCostOI * ProUnschEngTstTime].

This equals

[Cell ES49 = Cell S50 * Cell G17 * Cell F61 + 2 * Cell G11 * Cell F61].

TestFuelGH is the number of gallons per hour of fuel required to test the engine following the modification.

FuelCostGal is the cost per gallon of fuel to test the engine after the modification has been accomplished.

ProUnschEngTstTime is the expected number of hours of engine test time required for a component with the proposed configuration undergoing unscheduled maintenance at the Depot level.

LaborCostOI represents Organizational and Intermediate level labor cost per manhour which is determined from labor cost data maintained by the military organization that is considering the ECP. The "2" in the formula is the number of personnel required to test the engine.

9. Total Material Including Test Labor & Fuel (Row T)

A) Current calculates the total material costs per unscheduled maintenance event for an engine with the current configuration. This includes Organizational and Intermediate level Material Repair costs, Depot Material Cost, Depot Scrap Cost, and Total Unscheduled Test Labor and Fuel Cost. The cell formula in cell EQ50 is

[Cell EQ50 = Cell K56 + Cell K58].

B) Proposed Unmodified is cell ER50 which transfers the calculations from cell EQ50 (Current Total Material Including Test Labor & Fuel Cost) and displays the same value.

C) Proposed Modified calculates the total material costs per unscheduled maintenance event for an engine with the proposed configuration. This includes Organizational and Intermediate level Material Repair costs, Depot Material Cost, Depot Scrap Cost, and Total Unscheduled Test Labor and Fuel Cost. The cell formula in cell ES50 is

[Cell ES50 = Cell L56 + Cell L58].

10. Secondary Damage & Incidental Cost

A) Current calculates the estimated material costs of other damaged components due to the unscheduled failure of an engine component with the current configuration and the miscellaneous material costs of an unscheduled event that are not covered by any other input element. The cell formula in cell EQ52 is

[Cell EQ52 = CurUnschSecDamCost + CurUnschIncidentalCost].

This equals

[Cell EQ52 = Cell E62 + Cell E63].

CurUnschSecDamCost covers the estimated material cost to other components due to the failure of the component being modified. It is assumed that the labor cost associated with correcting the secondary damage would be covered by the labor involved to repair and replace the originally failed component. If this is not the case, all related costs for repairing the secondary damages are included in this input.

CurUnschIncidentalCost is a collective cost element that accounts for any expected miscellaneous material costs per unscheduled event that are not covered by any other input element.

B) Proposed Unmodified is cell ER52 which transfers the calculations from cell EQ52 (Current Secondary Damage & Incidental Cost) and displays the same value.

C) Proposed Modified calculates the estimated material costs of other damaged components due to the unscheduled failure of an engine component with the proposed configuration and the miscellaneous material costs of an unscheduled event that are not covered by any other input element. The cell formula in cell ES52 is

[Cell ES52 = ProUnschSecDamCost + ProUnschIncidentalCost].

This equals

[Cell ES52 = Cell F62 + Cell F63].

ProUnschSecDamCost covers the estimated material cost to other components due to the failure of the component being modified. It is assumed that the labor cost associated with correcting the secondary damage would be covered by the labor involved to repair and replace the originally failed component. If this is not the case, all related costs for repairing the secondary damages are included in this input.

ProUnschIncidentalCost is a collective cost element that accounts for any expected miscellaneous material costs per unscheduled event that are not covered by any other input element.

11. Grand Total Material Costs (Row U)

A) Current calculates the grand total material costs of an unscheduled maintenance event on an engine with the current configuration. These costs include Organizational and Intermediate level Material Repair costs, Depot Material Repair costs, Depot Scrap costs, Unscheduled Test Labor & Fuel costs, and Secondary Damage and Incidental costs. The cell formula in cell EQ53 is

[Cell EQ53 = Cell EQ50 + Cell EQ52].

B) Proposed Unmodified is cell ER53 which transfers the calculations from cell EQ53 (Current Grand Total Material Costs) and displays the same value.

C) Proposed Modified calculates the grand total material costs of an unscheduled maintenance event on an engine with the proposed configuration. These costs include Organizational and Intermediate level Material Repair costs, Depot Material Repair costs, Depot Scrap costs, Unscheduled Test Labor & Fuel costs, and Secondary Damage and Incidental costs. The cell formula in cell ES53 is

[Cell ES53 = Cell ES50 + Cell ES52].

G. SUMMARY PAGE EQUATIONS

This final section consists of the direct inputs, equations and formulas used to calculate the values displayed in the nine categories of the "Summary of Costs and Savings" area located on the Summary Page (page 6 of the model).

1. Production Engine Cost

This cost, in thousands of dollars, represents the difference in price between a new engine incorporating the modification and one not incorporating the modification. This category could represent a savings if the new engine production costs are less than the old engine production costs. The production engine cost will only be a factor if there are engines still in production. The equation, located in cell ER58, is

[(Row A + Row G)].

This equals

[Cell ER58 = Cell D15 + Cell CN48].

Row A is cell EQ9 with direct input from cell D15 which is the Delta Production Cost. It is the difference between the production cost of an engine incorporating the modification and one that does not contain the modification.

Row G is cell EU14 with direct input from cell CN48 which is the total number of engines modified during production during the CEA life cycle analysis period.

2. Operational Engine Modification Cost

This cost, in thousands of dollars, is the total of the kit purchase costs plus the kit installation costs over the life cycle of the engine (when the kit costs do not replace the maintenance costs). If the kit costs replace the maintenance costs then those maintenance costs (unscheduled, scheduled, and hardware scrapping costs) are subtracted from the engine modification costs. These engine modification costs relate to the costs, or savings which are expected to occur from incorporating the modification. The equation, located in cell ER60, is

[Cell ER60 = IF(Cell D14 = 0, "(Row H Total * (Row B + Row C))", "(Row H Total * (Row B + Row C) - (Row H Unsch * Row T + Row H Sch * Row P))")].

Cell D14 is the KitCostReplaceNormalMaint which is the difference between the modification kit cost and the maintenance cost of the current component.

Row H Total, cell EU14, is the total number of engines modified at the field level. This total consists of modifications that occur to operational engines during unscheduled or scheduled events and modifications to spare units.

Row B, cell EQ10, is the KitCost which is the cost to the government of an engine's component modification kit. This cost is provided by the contractor directly into Cell D16.

Row C, cell EQ11, is the labor cost to install the kit and is the total cost of the expected time in manhours to install a modification kit at the Organization and Intermediate levels (O&I), and at the Depot level.

Row H Unsch, cell EQ15, is the total number of engines modified at the field level during unscheduled events.

Row T, cell EQ50, is the total material cost per unscheduled maintenance event for an engine with the current configuration. This includes Organizational and Intermediate level Material Repair costs, Depot Material Cost, Depot Scrap Cost, Total Unscheduled Test Labor and Fuel Cost.

Row H Sch, cell ER15, is the total number of engines modified at the field level during scheduled events.

Row P, cell EQ33, is the total cost of material used at the Organizational and Intermediate levels, and the Depot level for the scheduled removal and replacement of an engine with the current configuration and the cost to replace a component that has been discarded during scheduled maintenance because the component is beyond economical repair.

The IF statement uses the following logic to determine the total of the kit purchase costs plus the kit installation costs over the life cycle of the engine (when the kit costs do not replace the maintenance costs).

A) If the difference between the modification kit cost and the maintenance cost of the current component is equal to zero, the value displayed is the product of the total number of engines modified at the field level and the sum of the cost to the government of an engine's component modification kit plus the cost of labor to install the kit.

B) If the difference between the modification kit cost and the maintenance cost of the current component is not equal to zero, the value displayed is the difference of the product of the total number of engines modified at the field level and the sum of the cost to the government of an engine's component modification kit plus the cost of labor to install the kit minus the sum of the product of the total number of engines modified at the field level during unscheduled events and the total material cost per unscheduled maintenance event for an engine with the current configuration plus the product of the total number of engines modified at the field level during scheduled events and the total cost of material used at the Organizational and Intermediate levels, and the Depot level for the scheduled removal and replacement of an engine with the current configuration and the cost to replace a component that has been discarded during scheduled maintenance because the component is beyond economical repair.

3. Follow-on Maintenance Material Cost

This cost, in thousands of dollars, is equal to the difference between the follow-on material costs for the proposed component and those for the current component over the remaining life cycle.

The equation, located in cells ER62 and ER63, is

[Cells ER62 and ER63 = ((Row K Cur * Row U Cur + Row J Cur * Row Q Cur) - (Row K ProUnmod * Row U ProUnmod + Row J ProUnmod + Row Q ProUnmod) + IF(Cell D15 = 0, "Row K ProMod * Row U ProMod + Row J ProMod * Row Q ProMod)","Row K ProMod * Row U ProMod + Row J ProMod * Row Q ProMod) - (Row H Unsch * Row T + Row H Sch * Row P))")].

Row K Cur, cell EQ20, is the sum total of unscheduled engine failures for unmodified engines with the current configuration during the CEA life cycle analysis period. This cell input is from cell BG48.

Row U Cur, cell EQ53, is the grand total material costs of an unscheduled maintenance event on an engine with the current configuration.

Row J Cur, cell EQ19, is the sum total of scheduled engine events for unmodified engines with the current configuration during the CEA life cycle analysis period. This cell input is from cell BI48.

Row Q Cur, cell EQ36, is the total material cost per scheduled maintenance event for an engine with the current configuration.

Row K ProUnmod, cell ER20, is the sum total of unscheduled component failures for unmodified engines with the proposed configuration during the CEA life cycle analysis period. This cell input is from cell CS48.

Row U ProUnmod, cell ER53, is the grand total material costs of an unscheduled maintenance event on an unmodified engine with the proposed configuration.

Row J ProUnmod, cell ER19, is the sum total of scheduled engine events for unmodified engines with the proposed configuration during the CEA life cycle analysis period. This cell input is from cell CU48.

Row Q ProUnmod, cell ER36, is the total material cost per scheduled maintenance event for an unmodified engine with the proposed configuration.

Cell D15 is the Delta Production Cost. It is the difference between the production cost of an engine incorporating the modification and one that does not contain the modification. This factor is used only for those engines still under production.

Row K ProMod, cell ES20, is the sum total of unscheduled component failures for modified engines with the proposed configuration during the CEA life cycle analysis period. This cell input is from cell CT48.

Row U ProMod, cell ES53, is the grand total material costs of an unscheduled maintenance event on a modified engine with the proposed configuration.

Row J ProMod, cell ES19, is the sum total of scheduled engine maintenance events for modified engines with the proposed configuration during the CEA life cycle analysis period. This cell input is from cell CV48.

Row Q ProMod, cell ES36, is the total material cost per scheduled maintenance event for a modified engine with the proposed configuration.

Row H Unsch, cell EQ15, is the total number of engines modified at the field level during an unscheduled event.

Row T, cell EQ50, is the total material cost per unscheduled maintenance event for an engine with the current configuration.

Row H Sch, cell ER15, is the total number of engines modified at the field level during a scheduled event.

Row P, cell EQ33, is the total cost of material used at the Organizational and Intermediate levels, and the Depot level for the scheduled removal and replacement of an engine with the current configuration and the cost to replace a component that has been discarded during scheduled maintenance because the component is beyond economical repair

The IF statement that finishes the equation uses the following logic to determine the difference between the follow-on material costs for the proposed component and those for the current component over the remaining life cycle.

A) If the Delta Production Cost is equal to zero, the value added to the equation is the sum of the product of the total of unscheduled component failures for modified engines with the proposed configuration and the grand total of material costs of an unscheduled maintenance event on a modified engine with the proposed configuration plus the product of the total of scheduled component failures for modified engines with the proposed configuration and the total material cost per scheduled maintenance event for a modified engine with the proposed configuration.

B) If the Delta Production Cost is not equal to zero, the value added to the equation is the difference of the sum of the product of the total of unscheduled component failures for modified engines with the proposed configuration and the grand total of material costs of an unscheduled maintenance event on a modified engine with the proposed configuration plus the product of the total of scheduled component failures for modified engines with the proposed configuration and the total material cost per scheduled maintenance event for a modified engine with the proposed configuration minus the sum of the product of the total number of engines modified at the field level during an unscheduled event and the total material cost per unscheduled maintenance event for an engine with the current configuration plus the product of the total number of engines modified at the field level during a scheduled event and the total cost of material used at the Organizational and Intermediate levels, and the Depot level for the scheduled removal and replacement of an engine with the current configuration and the cost to replace a component that has been discarded during scheduled maintenance because the component is beyond economical repair.

4. Follow-On Maintenance Labor Cost

This cost is the difference, in thousands of dollars, between the follow-on material labor costs for the proposed and the current configuration over the remaining life cycle of the engine. Both scheduled and unscheduled maintenance actions are included. The equation, located in cells ER65 and ER66, is

[Cells ER65 and ER66 = ((Row K Cur * Row R Cur + Row J Cur * Row N Cur) - (Row K ProUnmod * Row R ProUnmod + Row J ProUnmod * Row N ProUnmod + Row K ProUnmod * Row R ProMod + Row J ProMod * Row N ProMod))].

Row K Cur, cell EQ20, is the sum total of unscheduled engine failures for unmodified engines with the current configuration during the CEA life cycle analysis period. This cell input is from cell BG48.

Row R Cur, cell EQ42, is the total cost of manhours expended during an unscheduled event at both the Organizational and Intermediate levels, and the Depot level for an engine with the current configuration.

Row J Cur, cell EQ19, is the sum total of scheduled engine events for unmodified engines with the current configuration during the CEA life cycle analysis period. This cell input is from cell BI48.

Row N Cur, cell EQ28, is the total cost of manhours expended during a scheduled event at both the Organizational and Intermediate levels, and the Depot level for an engine with the current configuration.

Row K ProUnmod, cell ER20, is the sum total of unscheduled component failures for unmodified engines with the proposed configuration during the CEA life cycle analysis period. This cell input is from cell CS48.

Row R ProUnmod, cell ER42, is the total cost of manhours expended during a unscheduled event at both the Organizational and Intermediate levels, and the Depot level for an unmodified engine with the proposed configuration.

Row J ProUnmod, cell ER19, is the sum total of scheduled engine events for unmodified engines with the proposed configuration during the CEA life cycle analysis period. This cell input is from cell CU48.

Row N ProUnmod, cell ER28, is the total cost of manhours expended during a scheduled event at both the Organizational and Intermediate levels, and the Depot level for an unmodified engine with the proposed configuration.

Row K ProMod, cell ES20, is the sum total of unscheduled component failures for modified engines with the proposed configuration during the CEA life cycle analysis period. This cell input is from cell CT48.

Row R ProMod, cell ES42, is the total cost of manhours expended during a unscheduled event at both the Organizational and Intermediate levels, and the Depot level for a modified engine with the proposed configuration.

Row J ProMod, cell ES19, is the sum total of scheduled engine maintenance events for modified engines with the proposed configuration during the CEA life cycle analysis period. This cell input is from cell CV48.

Row N ProMod, cell ES28, is the total cost of manhours expended during a scheduled event at both the Organizational and Intermediate levels, and the Depot level for a modified engine with the proposed configuration.

5. Publications Cost

This cost is the total sum of the costs, in thousands of dollars, of any technical publication associated with the proposed engine change and the Time Compliance Technical Order cost which is issued for important changes when urgency is an issue. The equation, located in cell ER68, comes from Row D and is

[Cell ER68 = TechPubsCost + TctoCost].

This equals

[Cell ER68 = Cell D19 + Cell D20].

TechPubsCost is the total cost of any technical publication associated with the proposed engine change. The cost determination is generally based on a count of the number of pages affected by the ECP.

TctoCost is the Time-Compliance Technical Order cost which is issued for important changes when urgency is an issue.

6. Support Equipment Cost

This cost, in thousands of dollars, includes any special tooling or support equipment required to complete the component modification. The costs to modify current tooling and support equipment to comply with ECP requirements are included in this cost. The equation, located in cell ER70, is supplied directly from the contractor in cell D21.

7. Part Number Cost

This cost, in thousands of dollars, is the fixed costs, in thousands of dollars, associated with introducing new parts into the supply system as a consequence of the proposed component modification. These costs include the life cycle costs of part number maintenance in the supply system. The equation, located in cell ER72, is

[Cell ER72 = (Cell DI48 + Cell DJ48 + Cell L64/1000) - (Cell BW48)].

Cell DI48 is the annual part number maintenance costs, in thousands of dollars, for unmodified engines.

Cell DJ48 is the annual part number maintenance cost, in thousands of dollars, for modified engines.

Cell L64 is the cost of introducing a new part number into the military supply system.

Cell BW48 is the part number maintenance cost, in thousands of dollars, for unmodified engines with the current configuration. This cost is the annual cost of maintaining a part in the supply system. This cost is determined by the managing Inventory Control Point (ICP) and is provided by the contractor.

8. Operational Fuel Cost

This cost, in thousands of dollars, is associated with the fuel consumption costs or savings which are attributable to the ECP over the life cycle of the engine. The equation, located in cell ER74, is

[Cell ER74 = (Row L Cur * Cell G17 * Cell G20) - (Row L ProUnmod + Row L ProMod * (1 - 48)) * Cell G17 * Cell G20].

Row L Cur, cell EQ21, is the sum total of annual engine flight hours, in thousands of hours, for unmodified engines with the current configuration during the CEA life cycle analysis period. This cell input is from cell BE48.

Cell G17 is the cost per gallon of fuel to test the engine after the modification has been accomplished.

Cell G20 is the operational fuel, per gallon per hour, required to operate the engine after the modification has been accomplished. This value is calculated in cell S51.

Row L ProUnmod, cell ER21, is the sum total of annual engine flight hours, in thousands of hours, for unmodified engines with the proposed configuration during the CEA life cycle analysis period. This cell input is from cell CQ48.

Row L ProMod, cell ES21, is the total sum of annual engine flight hours, in thousands of hours, for modified engines with the proposed configuration during the CEA life cycle analysis period. This cell input is from cell CR48.

9. Aircraft Loss Cost

This cost, in thousands of dollars, is associated with the loss of aircraft due to the unscheduled failure of a component. The equation, located in cell ER76, is

[(Row F * Row M)].

Row F is cell EU11, and is the current purchase price of a fully equipped aircraft. This value is transferred to cell G26 from Cell S52.

Row M is cell ES22 and is the sum total of aircraft losses resulting from the loss of an entire system due to the unscheduled failure of a component with the proposed configuration during the CEA life cycle analysis period. This cell input is from cell CX48.

X. GETTING STARTED

A. INTRODUCTION

This chapter is an introduction to the CEA Deck Version 2.0 software and provides some of its basic functions and features. The CEA Deck is a tool for evaluating the cost effectiveness of proposed engineering changes to an aircraft engine. The software is a spreadsheet written in EXCEL 4.0 and comes complete with macros to perform a variety of useful tasks. It will be advantageous for new users to read through this chapter before attempting to use the model.

B. SYSTEM REQUIREMENTS

To use the CEA Deck you need:

1. An Industry Standard Architecture (ISA) computer, such as an IBM PC/AT or compatible, or a Micro Channel Architecture (MCA) computer, such as an IBM Personal System/2 or compatible with a 3.5" disk drive, either as an internal device or as an external peripheral attachment.

2. A graphics card compatible with Microsoft Windows Version 3.0 or later; such as an IBM VGA, EGA, or Hercules graphics card.

3. At least 2 megabytes (MB) of random-access memory (RAM).

4. MS-DOS Version 3.1 or later, Microsoft Windows Version 3.0 or later and Excel Version 4.0 running in standard or 386 enhanced mode.

5. A printer and mouse are optional but recommended.

C. SETUP INSTRUCTIONS

The CEA Deck Version 2.0 software comes on a single 3.5" high density diskette which contains all of the files needed to get started. The diskette contains a file named SETUP.EXE which copies all of the necessary files to all the appropriate directories on the hard drive. To run the setup, first insert the diskette into the 3.5" drive. From the Windows Program Manager menu select "FILE" and then select the "RUN" option. A dialog box will appear in the middle of the screen. Assuming the 3.5" drive is the "A" drive, type **A:\setup** in the space provided under "Command Line". If the 3.5" drive is the "B" drive, type **B:\setup** in the space provided under "Command Line". Then tab twice to highlight the "OK" button and press enter or using a mouse click the "OK" button.

The setup program will ask for the name of the directory in which to place some of the CEA Deck files. It will default to C:\CEA. However, any valid directory name will suffice. The directory does not need to exist prior to executing setup. Setup will automatically create the directory that is chosen.

The setup program will copy the CEADECK.XLT and CEATOOLS.XLA files to the C:\EXCEL\XLSTART directory. The

CEADECK.XLT file is a template for the actual CEA Deck spreadsheet. The CEATOOLS.XLA file is an "Add-in" macro that will assist in performing some of the necessary functions used in the model.

The files STD_HIST.XLS, CEAINPT.XLS, and CEADECK.ICO are copied to the C:\CEA directory or whatever directory the user specified during the setup. The STD_HIST.XLS file contains the formats to input up to 12 sets of standard fleet parameters. The parameters for the 12th fleet are currently set to the CEA Deck test fleet. The CEAINPT.XLS is a sample CEA input file for use in testing. The CEADECK.ICO file contains the CEA Deck icon that will be displayed under the Program Manager section of Microsoft Windows.

Additionally, the setup program initially copies the files SETUP.EXE and CEASETUP.EXE to the Windows directory and files VER.DLL, VBRUN200.DLL, SETUPKIT.DLL to the Windows\System directory. These files are necessary to run the setup program and may be deleted after the completion of setup.

D. USING THE CEA DECK

This section will provide you with the basic information necessary to actually use the CEA Deck software. It provides brief instructions on accessing the model, loading a standard history file, loading CEA input, saving the input, printing the results, and closing the CEA Deck. Further information may be found in the EXCEL 4.0 User's Guide.

1. Starting a CEA

Getting started is accomplished in one of two ways. One is to double click the CEA Deck icon located in the Program Manager's Application section of Microsoft Windows. The other is to double click the EXCEL icon located in the Program Manager's Application section of Microsoft Windows (or wherever the EXCEL icon is located). Once in EXCEL, select the File menu and select the New command. A listing of the available templates is displayed and CEADECK should be selected. Opening the CEA Deck using either of these two methods results in an EXCEL spreadsheet titled CEADECKx where x is a counter of the different CEADECK files opened. These spreadsheets are copies of the template. Opening the CEA Deck in this manner does not effect the original template. Several CEA spreadsheets may be opened at the same time by selecting the File menu and selecting the New command as was accomplished above. This process is repeated for as many spreadsheets as are needed.

Once a CEA spreadsheet is opened, there are four steps in performing a CEA analysis. The four steps are: loading a fleet from the standard history file; loading the input data; saving the input data; and printing the results.

2. Setting Up and loading the Standard History File

Before the standard history file is loaded, the standard fleet ground rules must be entered into the STD_HIST.XLS file which is located in the C:\CEA directory or whichever directory was initially setup when the CEA software was loaded. Once in EXCEL the user should choose the File menu and select the Open command. This displays an Open Dialog box in the middle of the screen. In the box beneath "File Name" set the directory to C:\CEA or the directory that was initially set up and press enter. Double click on the STD_HIST.XLS file name or tab to the STD_HIST.XLS file name and press enter. When EXCEL activates, the STD_HIST.XLS file will not appear. (NOTE: Make sure that the "List Files of Type" box in the bottom left hand corner of the dialog box is selected to Worksheets (*.XLS) or the STD_HIST.XLS file will not appear.) In the Open Dialog Box the Cancel button will cancel any changes input into the dialog box. This will close out the dialog box and return the user to the EXCEL spreadsheet. The Help button provides additional information on the Open Dialog Box. The Text... button is not applicable.

The STD_HIST.XLS file has been saved as a hidden file. Use the Windows menu and select the Unhide command (if the Windows menu is not shown, the Unhide command will be available under the File menu). This opens an Unhide Dialog Box. Double click on the STD_HIST.XLS file, click the OK button or press enter. In the Open Dialog Box the Cancel button will cancel any changes input into the dialog box. This will close out the dialog box and return the user to the EXCEL spreadsheet. The Help button will provides additional information on the Unhide Dialog Box.

Twelve data sections will appear to allow twelve different sets of standard fleet ground rules to be entered (see Appendix B). The twelfth fleet is currently the CEA Deck test fleet.

The next step is to enter the fleet data into the appropriate places. Simply type over the values shown in magenta. The green input is the text that will be used as the description for that fleet when this data is desired to be loaded into the spreadsheet. Before saving the changes, use the Windows menu and select the Hide command. Then use the File menu and select Exit. EXCEL will ask if the changes to the STD_HIST.XLS file are to be saved. Clicking the Yes button will save the changes and exit EXCEL.

To use a standard fleet in a CEA, a "Standard Fleet" tools button is used. This button opens a dialog box which displays a list of the available standard fleets. The description for each fleet is as specified in the STD_HIST.XLS file. Click on the description that is desired to be loaded and then click the OK button or press enter.

An option to select an alternate file to use as the standard is also available. To specify an alternate file, click the large button at the bottom of the dialog box and then specify the new name. To create a new standard history, copy the STD_HIST.XLS file to another file, then edit it as required using the method described above. In the Open Dialog Box the Cancel button will cancel any changes input into the dialog box. This will close out the dialog box and return the user to the EXCEL spreadsheet.

3. Loading the CEA Input

To load a previously saved set of CEA input, a "Load" tools button may be used. This button displays the typical EXCEL "Open File" dialog box. Select the drive, directory and filename for the input file to be loaded.

4. Saving the CEA Input

To save a set of CEA input, the "Save" tools button may be used. This opens a "Save As" Dialog Box. Double click on the appropriate file name, tab to the appropriate file name and press enter or tab to the appropriate file name and click on the OK button. This saves the appropriate cells to the file name that is specified. In the Open Dialog Box the Cancel button will cancel any changes input into the dialog box. This will close out the dialog box and return the user to the EXCEL spreadsheet. The Help button provides additional information on the "Save As" Dialog Box.

5. Printing the Results

To print the CEA results, a "Print" tools button must be used. This opens a Print Report Dialog Box that provides the option of choosing one of the following reports:

A) Complete CEA

B) Summary Page Only

C) Page 1 Only

D) Page 2 Only

E) Page 3a Only

F) Page 3b Only

G) Page 4a Only

H) Page 4b Only

I) Page 5 Only

J) Interim Calculations Only

After selecting one of reports, click the Print button which opens a Print Dialog Box that requests the number copies desired. After selecting the number of copies, click the OK button or press enter. In the Open Dialog Box the Cancel button will cancel any changes input into the dialog box. This will close out the dialog box and return the user to the EXCEL spreadsheet. The Help button provides additional information on the Print Report command.

The Print Report Dialog Box provides a Close button that cancels the input and closes out the Print Dialog Box.

The Add button opens an Add Report Dialog Box that enables a customized report to be developed. A report consists of multiple sections. Each section can have a different view, or scenario, or both. To create a section, choose View and/or Scenario, customize the report desired and click the Add button.

The Edit button opens the Add Report Dialog Box to edit already customized reports.

The Move Up, Move Down button changes the order of selections in the Current Lists section. The Delete button deletes the current selection that is highlighted.

If there is difficulty with the quality of the printout, Windows Print Manager may need to be disabled. The CEA Deck (as well as EXCEL) contain a significant number of graphical images such as the toolbar, borders on cells, background color, etc. Due to the high demand for graphics resources during the print routine, Windows sometimes ruins the printout when the Print Manager is in use. The Print Manager attempts to return control of the computer back to the user before all of the printing is complete. Normally this is a useful feature that allows the user to continue working while the printing is being accomplished.

To disable the Print Manager, double click on the Windows Control Panel icon found in the Main Program section. Select (double click) the Printers icon in the Control Panel window. Deselect the check box labeled "Use Print Manager".

6. Closing the CEA Deck

To close the CEA Deck, use the File menu and select the Close command. EXCEL will prompt the user to save the spreadsheet. Clicking the Yes button does not alter the original CEADECK.XLT template. It saves the changes made to the spreadsheet before it closes out the spreadsheet. Clicking the No button does not save the changes made to the spreadsheet since the last time the document was saved. It merely closes out the spreadsheet. The Cancel button cancels the Close command while the Help button provides additional information on saving changes in a document.

XI SUMMARY, CONCLUSION, AND RECOMMENDATIONS

A. SUMMARY

The main objective of this thesis was to develop a comprehensive procedures manual and user's guide which will enable both current users and beginners to understand and employ the Cost Effectiveness Analysis Model (CEAMOD), Version 2.0, in their service's aircraft engine Component Improvement Program (CIP). CEAMOD is written in EXCEL spreadsheet software. It was formally approved by the Joint Services Propulsion Council in June 1993 for use in evaluating Engineering Change Proposals (ECPs) from contractors as a part of the aircraft engine Component Improvement Program.

In order to develop this comprehensive procedures manual and user's guide, the author had to study the format and logic of the model and validate, where possible, each cell's formula in the conversion from LOTUS 123 to EXCEL.

The comprehensive manual contained in this thesis includes a review of the model's history, its basic assumptions, and its spreadsheet format. A description of each page is provided along with the formulas used in each column of the spreadsheet. This is accomplished by providing the purpose of each page of the model, by describing each spreadsheet column and by explaining the logic behind each cell formula.

A "getting started" user's guide was also created to provide the user with the basic information necessary to actually use the CEA Deck/EXCEL spreadsheet software. It provides brief instructions on accessing the model, loading a standard history file, loading CEA input, saving the input, printing the results, and closing the CEA Deck.

The appendices provide an example of each page of the CEAMOD spreadsheet model and the Standard History File engine fleet input pages.

B. CONCLUSION

The CEAMOD is a complex model that requires a thorough understanding of its format, logic and assumptions as well as a working knowledge of the Engineering Change Proposal process within the service's Component Improvement Program if it is to be used effectively.

The source of cell formula data is confusing at times due to multiple cell references for the identical input data. This is a consequence of the translation from LOTUS 123 to EXCEL. Also, it was determined through a cell formula equation review that there were instances where the translated formulas contained errors causing some of the calculations to be questionable (these were not highlighted but will be presented to the next meeting of the Users group for discussion). Despite this, the CEAMOD, Version 2.0, seems to provide a fairly reasonable estimate of the projected savings in logistics costs associated with an ECP over the remaining life cycle of an aircraft engine.

C. RECOMMENDATIONS

The user should be familiar with this manual and should read the "getting started" section prior to executing the model. Due to the complexity of the model, it is strongly recommended that the user also have a thorough understanding of the model's format, logic and assumptions as well as a working knowledge of the Engineering Change Proposal process within the service's Component Improvement Program. This manual should provide the former.

Because CEAMOD Version 2.0 is the first version to be translated into EXCEL and needs additional study and effort to identify, update incorrect formulas, and simplify cell references. Any actual changes to the CEAMOD must, of course, be approved by the CEA Model User's Group. This manual should then be officially updated. Since it is designed to also be available in a PC readable format on a 3.5" floppy disk (as is Version 2.0), changes should be rather easily made. Once these problems have been resolved, the manual should be ready for approval by the Joint Services Propulsion Council. Following that, it can be disseminated by the services as the official CEAMOD User's Reference Guide.

This manual has been provided to Professor Alan McMasters of the Naval Postgraduate School on a 3.5" floppy disk in WordPerfect 5.1 and Microsoft Word 2.0 formats. Requests for copies of the disks should be addressed to him. His phone number is 408-656-2678.

APPENDIX A

The CEA model, as seen in the EXCEL spreadsheet, is comprised of eleven pages (two of which have a part "a" and a part "b"). Nine pages make up the CEA printout package and the remaining two pages are included in the model to aid in the cell formula calculations found throughout the model. These pages and the corresponding EXCEL spreadsheet columns which make up each page are provided below:

Page 1	Input Parameters and Calculated Costs (Columns B through H)
Calculated Subtotals	(Columns I through M)
Page 2	Standard History File (Columns N through W)
Scheduled/Unscheduled Events	(Columns Y through AZ)
Pages 3a and 3b	Current Configuration (Columns BA through CK)
Pages 4a and 4b	Proposed Configuration (Columns CM through DW)
Page 5	Current/Proposed Configuration Comparison (Columns DY through ED)

Page 6	Summary Page (Columns EF through EM)
Page 7	Interim Calculations and Summary Equations (Columns EO through EV)

TITLE | | CEA VERSION 2 0 | 7/15/93
ENGINE MODEL Fwww-xx-yyy | F-zz | | Pg 1
TASK/ECP

Task Incorporation Input

1 0	Incorporation Style (1,2 or 3)	0
	1 = Attrition	
	2 = Retrofit at 1st Opportunity	
	3 = Forced Retrofit — Kits / Month →	0
2 0	Does Kit Cost Replace Normal Maint. Material Cost? 1=Yes 0=No	0
3 0	Delta Production Cost	$0
4 0	Kit Hardware Cost - $ / Engine	$0
5 0	Kit Labor Manhours at O&I	0
6 0	Kit Labor Manhours at Depot	0
7 0	Technical Pubs Cost - Total $	$0
8 0	TCTO Cost - Total $	$0
9 0	Tooling/Support Equipment Cost-Total $	$0
10.0	Spare Parts Factor	0%
11 0	Scheduled % Events being Modified	0%
12 0	Unscheduled % Events being Modified	0%
13.0	Unscheduled Event Rate allowing Modification	0 000
14 0	Production Incorporation Date — Year → 1993	Month → 1
15.0	Field Incorporation Date — Year → 1993	Month → 1

Standard Inputs

Fiscal Year Dollars	0
NPV Rate	0%
Labor Cost / Manhour at O&I	$0 00
Labor Cost / Manhour at Depot	$0 00
Cost to introduce new P/N - $ / PN	$0
Cost to Maintain each P/N / Year	$0
Fuel Cost / Gallon	$0 00
Test Fuel - Gallons / Hour	0
Flight Fuel - Gallons / Hour	0
EFH / Year	200
TAC / EFH Ratio	2 00
TOT / EFH Ratio	1 50
Aircraft Cost	$0

Scheduled Input

		CURRENT	PROPOSED
16.0	Scheduled Maintenance Interval (TAC's)	9999999	9999999
17.0	Calculated Scheduled Maintenance Interval Rate/1000 EFH	0.000	0.000
18.0	Scheduled Manhours to Inspect at O level	0.0	0.0
19.0	Scheduled % Removed at O&I level	0%	0%
20.0	Scheduled Manhours to Remove/Replace at O level	0.0	0.0
21.0	Scheduled Manhours at I level	0.0	0.0
22.0	Scheduled % at O&I requiring Repair	0%	0%
23.0	Scheduled Repair Cost at O&I level	$0	$0
24.0	Scheduled % Returned to Depot	0%	0%
25.0	Scheduled Manhours at Depot	0.0	0.0
26.0	Scheduled % at Depot requiring Repair	0%	0%
27.0	Scheduled Repair Cost at Depot	$0	$0
28.0	Scheduled % Scrapped	0%	0%
29.0	Hardware Cost to Scrap	$0	$0
30.0	Scheduled Engine Test Time	0 00	0 00

Unscheduled Input

		CURRENT	PROPOSED
31.0	Unscheduled Event Rate/1000 EFH	0.000	0.000
32.0	Unscheduled Manhours at O level	0.0	0.0
33.0	Unscheduled % Removed at O&I level	0%	0%
34 0	Unscheduled Manhours to Remove/Replace at O level	0.0	0.0
35.0	Unscheduled Manhours at I level	0.0	0.0
36.0	Unscheduled % at O&I requiring Repair	0%	0%
37.0	Unscheduled Repair cost at O&I level	$0	$0
38.0	Unscheduled % Returned to Depot	0%	0%
39.0	Unscheduled Manhours at Depot	0.0	0.0
40.0	Unscheduled % at Depot requiring Repair	0%	0%
41 0	Unscheduled Repair Cost at Depot	$0	$0
42.0	Unscheduled % Scrapped	0%	0%
43.0	Hardware Cost to Scrap	$0	$0
44.0	Unscheduled Engine Test Time	0.00	0.00
45.0	Unscheduled Secondary Damage Costs	$0	$0
46.0	Unscheduled Incidental Costs	$0	$0
47.0	Number of P/N's	0	0

Optional Input

48 0	% Improvement in Specific Fuel Consumption from Current to Proposed	0%
49.0	Aircraft Loss Rate Improvement / 1,000,000 EFH	0.00

CEA Guru

Calculated Costs / Event

Kit Cost	$0.00
Labor Cost to Install the Kit	$0.00
Total Cost to Install the Kit	$0.00

Scheduled	Current	Proposed
O & I Labor Cost / Scheduled Event	$0.00	$0.00
Depot Labor Cost / Scheduled Event	$0.00	$0.00
Total Labor Cost / Scheduled Event	$0.00	$0.00
O & I Repair Cost / Scheduled Event	$0.00	$0.00
Depot Repair Cost / Scheduled Event	$0.00	$0.00
Scrap Cost / Scheduled Event	$0.00	$0.00
Total Material Cost / Scheduled Event	$0.00	$0.00
Test Labor & Fuel Cost / Scheduled Event	$0.00	$0.00
Total Material Incl Test Cost / Scheduled Event	$0.00	$0.00

Unscheduled	Current	Proposed
O & I Labor Cost / Unscheduled Event	$0.00	$0.00
Depot Labor Cost / Unscheduled Event	$0.00	$0.00
Total Labor Cost / Unscheduled Event	$0.00	$0.00
O & I Repair Cost / Unscheduled Event	$0.00	$0.00
Depot Repair Cost / Unscheduled Event	$0.00	$0.00
Scrap Cost / Unscheduled Event	$0.00	$0.00
Total Material Cost / Unscheduled Event	$0.00	$0.00
Test Labor & Fuel Cost / Unscheduled Event	$0.00	$0.00
Total Material Incl Test Cost / Unscheduled Event	$0.00	$0.00
Second Dam & Inced Cost / Unscheduled Event	$0.00	$0.00
GrandTotal Material Cost / Unscheduled Event	$0.00	$0.00
Cost to Introduce the New Part Numbers	N/A	$0.00

TITLE: **STANDARD HISTORY FILE** CEA VERSION 2.0 7/15/93
ENGINE MODEL: Fwww-xx-yyy F-zz Pg. 2
TASK/ECP:

(N)	(O) No. of Available Mod Months	(P)	(Q) Engine Deliveries	(R)	(S) Annual Engine Flight Hours	(T)	(U)	(V) Attrition	(W)
Calendar Year	Production	Field	Annual	Cumulative	Fleet	Average per Engine	Cumulative Engines	Cumulative Whole Engine	Annual Whole Engines
1993	12	12	0	0	0	200.00	0.00	0	0
1994	12	12	0	0	0	200.00	0.00	0	0
1995	12	12	0	0	0	200.00	0.00	0	0
1996	12	12	0	0	0	200.00	0.00	0	0
1997	12	12	0	0	0	200.00	0.00	0	0
1998	12	12	0	0	0	200.00	0.00	0	0
1999	12	12	0	0	0	200.00	0.00	0	0
2000	12	12	0	0	0	200.00	0.00	0	0
2001	12	12	0	0	0	200.00	0.00	0	0
2002	12	12	0	0	0	200.00	0.00	0	0
2003	12	12	0	0	0	200.00	0.00	0	0
2004	12	12	0	0	0	200.00	0.00	0	0
2005	12	12	0	0	0	200.00	0.00	0	0
2006	12	12	0	0	0	200.00	0.00	0	0
2007	12	12	0	0	0	200.00	0.00	0	0
2008	12	12	0	0	0	200.00	0.00	0	0
2009	12	12	0	0	0	200.00	0.00	0	0
2010	12	12	0	0	0	200.00	0.00	0	0
2011	12	12	0	0	0	200.00	0.00	0	0
2012	12	12	0	0	0	200.00	0.00	0	0
2013	12	12	0	0	0	200.00	0.00	0	0
2014	12	12	0	0	0	200.00	0.00	0	0
2015	12	12	0	0	0	200.00	0.00	0	0
2016	12	12	0	0	0	200.00	0.00	0	0
2017	12	12	0	0	0	200.00	0.00	0	0
2018	12	12	0	0	0	200.00	0.00	0	0
2019	12	12	0	0	0	200.00	0.00	0	0
2020	12	12	0	0	0	200.00	0.00	0	0
2021	12	12	0	0	0	200.00	0.00	0	0
2022	12	12	0	0	0	200.00	0.00	0	0
2023	12	12	0	0	0	200.00	0.00	0	0
2024	12	12	0	0	0	200.00	0.00	0	0
2025	12	12	0	0	0	200.00	0.00	0	0
Totals		Engines Delivered -->	0	EFH -->	0				0

EFH / Year =	200	Test Fuel - Gallons / Hour =	0
TAC / EFH=	2.0	Flight Fuel - Gallons / Hour =	0
TOT / EFH=	1.5	Aircraft Cost	$0

Engine Attrition / EFH 0.00000

(Y) Upgraded Engines: Done by Attrition	(Z) Upgraded Engines: Done by 1st Opp	(AA) Upgraded Engines: Done by Forced	(AB) Done in Prod	(AC) Cumulative Kits Installed	(AD) Cumulative Kit EFH	(AE) No. of Kits Over and Above MAJBOTs	(AF) Unmod Scheduled Available Year	(AG) EFH for Proposed Unmod Sched Inspections	(AH) Mod Scheduled Available Year	(AI) EFH for Proposed Mod Sched Inspections	(AJ) EFH for Current Sched Inspections
0	0	0	0	0	0	0	25741	0	25741	0	0
0	0	0	0	0	0	0	25742	0	25742	0	0
0	0	0	0	0	0	0	25743	0	25743	0	0
0	0	0	0	0	0	0	25744	0	25744	0	0
0	0	0	0	0	0	0	25745	0	25745	0	0
0	0	0	0	0	0	0	25746	0	25746	0	0
0	0	0	0	0	0	0	25747	0	25747	0	0
0	0	0	0	0	0	0	25748	0	25748	0	0
0	0	0	0	0	0	0	25749	0	25749	0	0
0	0	0	0	0	0	0	25750	0	25750	0	0
0	0	0	0	0	0	0	25751	0	25751	0	0
0	0	0	0	0	0	0	25752	0	25752	0	0
0	0	0	0	0	0	0	25753	0	25753	0	0
0	0	0	0	0	0	0	25754	0	25754	0	0
0	0	0	0	0	0	0	25755	0	25755	0	0
0	0	0	0	0	0	0	25756	0	25756	0	0
0	0	0	0	0	0	0	25757	0	25757	0	0
0	0	0	0	0	0	0	25758	0	25758	0	0
0	0	0	0	0	0	0	25759	0	25759	0	0
0	0	0	0	0	0	0	25760	0	25760	0	0
0	0	0	0	0	0	0	25761	0	25761	0	0
0	0	0	0	0	0	0	25762	0	25762	0	0
0	0	0	0	0	0	0	25763	0	25763	0	0
0	0	0	0	0	0	0	25764	0	25764	0	0
0	0	0	0	0	0	0	25765	0	25765	0	0
0	0	0	0	0	0	0	25766	0	25766	0	0
0	0	0	0	0	0	0	25767	0	25767	0	0
0	0	0	0	0	0	0	25768	0	25768	0	0
0	0	0	0	0	0	0	25769	0	25769	0	0
0	0	0	0	0	0	0	25770	0	25770	0	0
0	0	0	0	0	0	0	25771	0	25771	0	0
0	0	0	0	0	0	0	25772	0	25772	0	0
0	0	0	0	0	0	0	25773	0	25773	0	0
0	0	0									

(AF) Unmod Scheduled Available Year	(AK) Current Sale Events: Cumulative Decimal	(AL) Current Sale Events: Cumulative Integer	(AM) Current Sale Events: Annual Integer	(AN) Proposed Sale Unmod Events: Cumulative Decimal	(AO) Proposed Sale Unmod Events: Cumulative Integer	(AP) Proposed Sale Unmod Events: Annual Integer	(AQ) Proposed Sale Mod Events: Cumulative Decimal	(AR) Proposed Sale Mod Events: Cumulative Integer	(AS) Proposed Sale Mod Events: Annual Integer	(AT) Years of Incorporation	(AU) Unsched Incorporation Opportunities: Cumulative Decimal	(AV) Unsched Incorporation Opportunities: Cumulative Integer	(AW) Unsched Incorporation Opportunities: Annual Integer	(AX) Kit Incorporation Events: Unsched	(AY) Kit Incorporation Events: Sched
25741	0.00	0	0	0.00	0	0	0.00	0	0	0	0.00	0	0	0	0
25742	0.00	0	0	0.00	0	0	0.00	0	0	0	0.00	0	0	0	0
25743	0.00	0	0	0.00	0	0	0.00	0	0	0	0.00	0	0	0	0
25744	0.00	0	0	0.00	0	0	0.00	0	0	0	0.00	0	0	0	0
25745	0.00	0	0	0.00	0	0	0.00	0	0	0	0.00	0	0	0	0
25746	0.00	0	0	0.00	0	0	0.00	0	0	0	0.00	0	0	0	0
25747	0.00	0	0	0.00	0	0	0.00	0	0	0	0.00	0	0	0	0
25748	0.00	0	0	0.00	0	0	0.00	0	0	0	0.00	0	0	0	0
25749	0.00	0	0	0.00	0	0	0.00	0	0	0	0.00	0	0	0	0
25750	0.00	0	0	0.00	0	0	0.00	0	0	0	0.00	0	0	0	0
25751	0.00	0	0	0.00	0	0	0.00	0	0	0	0.00	0	0	0	0
25752	0.00	0	0	0.00	0	0	0.00	0	0	0	0.00	0	0	0	0
25753	0.00	0	0	0.00	0	0	0.00	0	0	0	0.00	0	0	0	0
25754	0.00	0	0	0.00	0	0	0.00	0	0	0	0.00	0	0	0	0
25755	0.00	0	0	0.00	0	0	0.00	0	0	0	0.00	0	0	0	0
25756	0.00	0	0	0.00	0	0	0.00	0	0	0	0.00	0	0	0	0
25757	0.00	0	0	0.00	0	0	0.00	0	0	0	0.00	0	0	0	0
25758	0.00	0	0	0.00	0	0	0.00	0	0	0	0.00	0	0	0	0
25759	0.00	0	0	0.00	0	0	0.00	0	0	0	0.00	0	0	0	0
25760	0.00	0	0	0.00	0	0	0.00	0	0	0	0.00	0	0	0	0
25761	0.00	0	0	0.00	0	0	0.00	0	0	0	0.00	0	0	0	0
25762	0.00	0	0	0.00	0	0	0.00	0	0	0	0.00	0	0	0	0
25763	0.00	0	0	0.00	0	0	0.00	0	0	0	0.00	0	0	0	0
25764	0.00	0	0	0.00	0	0	0.00	0	0	0	0.00	0	0	0	0
25765	0.00	0	0	0.00	0	0	0.00	0	0	0	0.00	0	0	0	0
25766	0.00	0	0	0.00	0	0	0.00	0	0	0	0.00	0	0	0	0
25767	0.00	0	0	0.00	0	0	0.00	0	0	0	0.00	0	0	0	0
25768	0.00	0	0	0.00	0	0	0.00	0	0	0	0.00	0	0	0	0
25769	0.00	0	0	0.00	0	0	0.00	0	0	0	0.00	0	0	0	0
25770	0.00	0	0	0.00	0	0	0.00	0	0	0	0.00	0	0	0	0
25771	0.00	0	0	0.00	0	0	0.00	0	0	0	0.00	0	0	0	0
25772	0.00	0	0	0.00	0	0	0.00	0	0	0	0.00	0	0	0	0
25773	0.00	0	0	0.00	0	0	0.00	0	0	0	0.00	0	0	0	0
			0			0			0	0			0	0	0

Maximum Kits/Yr [illegible]

Unmod Sale Inspection Interval in TACs [illegible]
Unmod Sale Inspection Interval in EFH [illegible]
which is 23740 Years / Inspection Interval
and 0 Inspections / Year

TITLE:
ENGINE MODEL: Fwww-xx-yyy F-zz
TASK/ECP:

CURRENT CONFIGURATION

(BA)	(BC) Avg. No. Engines	(BD)	(BE) Yearly Engine Flight Hours	(BF)	(BG) Unsch. Events	(BH)	(BI) Sched. Events	(BJ)	(BM)	(BN) Engine Kits	(BO)	(BP)	(BQ) Spare Kits	(BR)
Calendar Year	Unmod Engines	Mod Engines	Unmod EFH (1000 EFH)	Mod EFH (1000 EFH)	Unmod	Mod	Unmod	Mod	No Installed	Mat'l Cost $(000)	Labor Cost $(000)	No Installed	Mat'l Cost $(000)	Labor Cost $(000)
1993	0		0.000		0		0							
1994	0		0.000		0		0							
1995	0		0.000		0		0							
1996	0		0.000		0		0							
1997	0		0.000		0		0							
1998	0		0.000		0		0							
1999	0		0.000		0		0							
2000	0		0.000		0		0							
2001	0		0.000		0		0							
2002	0		0.000		0		0							
2003	0		0.000		0		0							
2004	0		0.000		0		0							
2005	0		0.000		0		0							
2006	0		0.000		0		0							
2007	0		0.000		0		0							
2008	0		0.000		0		0							
2009	0		0.000		0		0							
2010	0		0.000		0		0							
2011	0		0.000		0		0							
2012	0		0.000		0		0							
2013	0		0.000		0		0							
2014	0		0.000		0		0							
2015	0		0.000		0		0							
2016	0		0.000		0		0							
2017	0		0.000		0		0							
2018	0		0.000		0		0							
2019	0		0.000		0		0							
2020	0		0.000		0		0							
2021	0		0.000		0		0							
2022	0		0.000		0		0							
2023	0		0.000		0		0							
2024	0		0.000		0		0							
2025	0		0.000		0		0							
Totals			0.000		0		0							

TITLE:
ENGINE MODEL: Fwww-xx-yyy F-zz
TASK/ECP:

CURRENT CONFIGURATION

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(BT)	(BU)	(BW) Part Maint Cost	(BX)	(BY) Unmod Unsch Cost (Minus Kit Instl)	(BZ)	(CA) Unmod Sched Cost (Minus Kit Instl)	(CB)	(CC) Mod Unsched Cost	(CD)	(CE) Mod Sched Cost	(CF)	(CG)	(CH) Operational Fuel	(CI)	(CK)
Calendar Year	One-Time Costs $(000)	Unmod $(000)	Mod $(000)	Labor $(000)	Material $(000)	Labor $(000)	Material $(000)	Labor $(000)	Material $(000)	Labor $(000)	Material $(000)	Current Total Cost $(000)	Gal/Yr (000)	Cost $(000)	Total Cost Curr Config w/ Fuel $(000)
1993		$0.00		$0	$0	$0	$0					$0	N/A	N/A	$0
1994		$0.00		$0	$0	$0	$0					$0	N/A	N/A	$0
1995		$0.00		$0	$0	$0	$0					$0	N/A	N/A	$0
1996		$0.00		$0	$0	$0	$0					$0	N/A	N/A	$0
1997		$0.00		$0	$0	$0	$0					$0	N/A	N/A	$0
1998		$0.00		$0	$0	$0	$0					$0	N/A	N/A	$0
1999		$0.00		$0	$0	$0	$0					$0	N/A	N/A	$0
2000		$0.00		$0	$0	$0	$0					$0	N/A	N/A	$0
2001		$0.00		$0	$0	$0	$0					$0	N/A	N/A	$0
2002		$0.00		$0	$0	$0	$0					$0	N/A	N/A	$0
2003		$0.00		$0	$0	$0	$0					$0	N/A	N/A	$0
2004		$0.00		$0	$0	$0	$0					$0	N/A	N/A	$0
2005		$0.00		$0	$0	$0	$0					$0	N/A	N/A	$0
2006		$0.00		$0	$0	$0	$0					$0	N/A	N/A	$0
2007		$0.00		$0	$0	$0	$0					$0	N/A	N/A	$0
2008		$0.00		$0	$0	$0	$0					$0	N/A	N/A	$0
2009		$0.00		$0	$0	$0	$0					$0	N/A	N/A	$0
2010		$0.00		$0	$0	$0	$0					$0	N/A	N/A	$0
2011		$0.00		$0	$0	$0	$0					$0	N/A	N/A	$0
2012		$0.00		$0	$0	$0	$0					$0	N/A	N/A	$0
2013		$0.00		$0	$0	$0	$0					$0	N/A	N/A	$0
2014		$0.00		$0	$0	$0	$0					$0	N/A	N/A	$0
2015		$0.00		$0	$0	$0	$0					$0	N/A	N/A	$0
2016		$0.00		$0	$0	$0	$0					$0	N/A	N/A	$0
2017		$0.00		$0	$0	$0	$0					$0	N/A	N/A	$0
2018		$0.00		$0	$0	$0	$0					$0	N/A	N/A	$0
2019		$0.00		$0	$0	$0	$0					$0	N/A	N/A	$0
2020		$0.00		$0	$0	$0	$0					$0	N/A	N/A	$0
2021		$0.00		$0	$0	$0	$0					$0	N/A	N/A	$0
2022		$0.00		$0	$0	$0	$0					$0	N/A	N/A	$0
2023		$0.00		$0	$0	$0	$0					$0	N/A	N/A	$0
2024		$0.00		$0	$0	$0	$0					$0	N/A	N/A	$0
2025		$0.00		$0	$0	$0	$0					$0	N/A	N/A	$0
Totals		$0.00		$0	$0	$0	$0					$0	0	$0	$0
$ (000) / Event used in the above columns				$0.000	$0.000	$0.000	$0.000								

TITLE:
ENGINE MODEL: Fwww-xx-yyy F-zz
TASK/ECP:

PROPOSED CONFIGURATION

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(CM)	(CN)	(CO) Avg. No. Engines	(CP)	(CQ) Yearly Engine Flight Hours	(CR)	(CS) Unsch. Events	(CT)	(CU) Sched. Events	(CV)	(CW) A/C Loss Events	(CX)	(CY)	(CZ) Engine Kits	(DA)	(DB)	(DC) Spare Kits	(DD)
Calendar Year	Engines Mod in Prod	Unmod Engines	Mod Engines	Unmod EFH EFH / 1000	Mod EFH EFH / 1000	Unmod	Mod	Unmod	Mod	Cum	Annual	No Installed	Mat'l Cost $(000)	Labor Cost $(000)	No Installed	Mat'l Cost $(000)	Labor Cost $(000)
1993	0	0	0	0.000	0.000	0	0	0	0	0.0	0	0	$0	$0	0	$0	$0
1994	0	0	0	0.000	0.000	0	0	0	0	0.0	0	0	$0	$0	0	$0	$0
1995	0	0	0	0.000	0.000	0	0	0	0	0.0	0	0	$0	$0	0	$0	$0
1996	0	0	0	0.000	0.000	0	0	0	0	0.0	0	0	$0	$0	0	$0	$0
1997	0	0	0	0.000	0.000	0	0	0	0	0.0	0	0	$0	$0	0	$0	$0
1998	0	0	0	0.000	0.000	0	0	0	0	0.0	0	0	$0	$0	0	$0	$0
1999	0	0	0	0.000	0.000	0	0	0	0	0.0	0	0	$0	$0	0	$0	$0
2000	0	0	0	0.000	0.000	0	0	0	0	0.0	0	0	$0	$0	0	$0	$0
2001	0	0	0	0.000	0.000	0	0	0	0	0.0	0	0	$0	$0	0	$0	$0
2002	0	0	0	0.000	0.000	0	0	0	0	0.0	0	0	$0	$0	0	$0	$0
2003	0	0	0	0.000	0.000	0	0	0	0	0.0	0	0	$0	$0	0	$0	$0
2004	0	0	0	0.000	0.000	0	0	0	0	0.0	0	0	$0	$0	0	$0	$0
2005	0	0	0	0.000	0.000	0	0	0	0	0.0	0	0	$0	$0	0	$0	$0
2006	0	0	0	0.000	0.000	0	0	0	0	0.0	0	0	$0	$0	0	$0	$0
2007	0	0	0	0.000	0.000	0	0	0	0	0.0	0	0	$0	$0	0	$0	$0
2008	0	0	0	0.000	0.000	0	0	0	0	0.0	0	0	$0	$0	0	$0	$0
2009	0	0	0	0.000	0.000	0	0	0	0	0.0	0	0	$0	$0	0	$0	$0
2010	0	0	0	0.000	0.000	0	0	0	0	0.0	0	0	$0	$0	0	$0	$0
2011	0	0	0	0.000	0.000	0	0	0	0	0.0	0	0	$0	$0	0	$0	$0
2012	0	0	0	0.000	0.000	0	0	0	0	0.0	0	0	$0	$0	0	$0	$0
2013	0	0	0	0.000	0.000	0	0	0	0	0.0	0	0	$0	$0	0	$0	$0
2014	0	0	0	0.000	0.000	0	0	0	0	0.0	0	0	$0	$0	0	$0	$0
2015	0	0	0	0.000	0.000	0	0	0	0	0.0	0	0	$0	$0	0	$0	$0
2016	0	0	0	0.000	0.000	0	0	0	0	0.0	0	0	$0	$0	0	$0	$0
2017	0	0	0	0.000	0.000	0	0	0	0	0.0	0	0	$0	$0	0	$0	$0
2018	0	0	0	0.000	0.000	0	0	0	0	0.0	0	0	$0	$0	0	$0	$0
2019	0	0	0	0.000	0.000	0	0	0	0	0.0	0	0	$0	$0	0	$0	$0
2020	0	0	0	0.000	0.000	0	0	0	0	0.0	0	0	$0	$0	0	$0	$0
2021	0	0	0	0.000	0.000	0	0	0	0	0.0	0	0	$0	$0	0	$0	$0
2022	0	0	0	0.000	0.000	0	0	0	0	0.0	0	0	$0	$0	0	$0	$0
2023	0	0	0	0.000	0.000	0	0	0	0	0.0	0	0	$0	$0	0	$0	$0
2024	0	0	0	0.000	0.000	0	0	0	0	0.0	0	0	$0	$0	0	$0	$0
2025	0	0	0	0.000	0.000	0	0	0	0	0.0	0	0	$0	$0	0	$0	$0
Sub Totals	0			0.000	0.000	0	0	0	0		0	0	$0	$0	0	$0	$0
Combined Unmodified & Modified Totals				0		0		0									

	Total	$(000) / Kit
Kits Installed	0	"N/A"
Kit Material Cost	$0	$0.000
Kit Labor Cost	$0	$0.000

TITLE
ENGINE MODEL: Fwww-xx-yyy F-zz
TASK/ECP:

PROPOSED CONFIGURATION

CEA VERSION 2.0 7/15/93
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(DF) Calendar Year	(DG) One-Time Costs $(000)	(DH) Delta Prod. Cost $(000)	(DI) Part Maint Cost Unmod $(000)	(DJ) Part Maint Cost Mod $(000)	(DK) Unmod Unsch Cost (Minus Kit Instl) Labor $(000)	(DL) Unmod Unsch Cost (Minus Kit Instl) Material $(000)	(DM) Unmod Sched Cost (Minus Kit Instl) Labor $(000)	(DN) Unmod Sched Cost (Minus Kit Instl) Material $(000)	(DO) Mod Unsched Cost Labor $(000)	(DP) Mod Unsched Cost Material $(000)	(DQ) Mod Sched Cost Labor $(000)	(DR) Mod Sched Cost Material $(000)	(DS) Proposed Total Cost $(000)	(DT) Operational Fuel Gal/Yr (000)	(DU) Operational Fuel Cost $(000)	(DV) A/C Loss Delta $(000)	(DW) Total Cost Prop Config w/ Fuel A/C $(000)
1993	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	N/A	N/A	$0	$0
1994	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	N/A	N/A	$0	$0
1995	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	N/A	N/A	$0	$0
1996	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	N/A	N/A	$0	$0
1997	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	N/A	N/A	$0	$0
1998	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	N/A	N/A	$0	$0
1999	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	N/A	N/A	$0	$0
2000	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	N/A	N/A	$0	$0
2001	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	N/A	N/A	$0	$0
2002	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	N/A	N/A	$0	$0
2003	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	N/A	N/A	$0	$0
2004	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	N/A	N/A	$0	$0
2005	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	N/A	N/A	$0	$0
2006	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	N/A	N/A	$0	$0
2007	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	N/A	N/A	$0	$0
2008	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	N/A	N/A	$0	$0
2009	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	N/A	N/A	$0	$0
2010	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	N/A	N/A	$0	$0
2011	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	N/A	N/A	$0	$0
2012	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	N/A	N/A	$0	$0
2013	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	N/A	N/A	$0	$0
2014	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	N/A	N/A	$0	$0
2015	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	N/A	N/A	$0	$0
2016	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	N/A	N/A	$0	$0
2017	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	N/A	N/A	$0	$0
2018	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	N/A	N/A	$0	$0
2019	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	N/A	N/A	$0	$0
2020	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	N/A	N/A	$0	$0
2021	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	N/A	N/A	$0	$0
2022	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	N/A	N/A	$0	$0
2023	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	N/A	N/A	$0	$0
2024	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	N/A	N/A	$0	$0
2025	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	N/A	N/A	$0	$0
Sub Totals	$0	$0	$0.00	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	$0	$0	$0
Combined Unmodified & Modified Totals			$0.00		$0		$0			$0		$0					
$ (000) / Event used in the above columns					$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000					

(DY) CAL. YEAR	(DZ) Expenditures Current $(000)	(EA) Proposed $(000)	(EB) Delta Cashflow Yearly Savings $(000)	(EC) Cumulative Savings $(000)	(ED) Cumulative NPV at 0% $(000)
1993	$0	$0	$0	$0	$0
1994	$0	$0	$0	$0	$0
1995	$0	$0	$0	$0	$0
1996	$0	$0	$0	$0	$0
1997	$0	$0	$0	$0	$0
1998	$0	$0	$0	$0	$0
1999	$0	$0	$0	$0	$0
2000	$0	$0	$0	$0	$0
2001	$0	$0	$0	$0	$0
2002	$0	$0	$0	$0	$0
2003	$0	$0	$0	$0	$0
2004	$0	$0	$0	$0	$0
2005	$0	$0	$0	$0	$0
2006	$0	$0	$0	$0	$0
2007	$0	$0	$0	$0	$0
2008	$0	$0	$0	$0	$0
2009	$0	$0	$0	$0	$0
2010	$0	$0	$0	$0	$0
2011	$0	$0	$0	$0	$0
2012	$0	$0	$0	$0	$0
2013	$0	$0	$0	$0	$0
2014	$0	$0	$0	$0	$0
2015	$0	$0	$0	$0	$0
2016	$0	$0	$0	$0	$0
2017	$0	$0	$0	$0	$0
2018	$0	$0	$0	$0	$0
2019	$0	$0	$0	$0	$0
2020	$0	$0	$0	$0	$0
2021	$0	$0	$0	$0	$0
2022	$0	$0	$0	$0	$0
2023	$0	$0	$0	$0	$0
2024	$0	$0	$0	$0	$0
2025	$0	$0	$0	$0	$0
Totals	$0	$0	$0		
NPV	$0	$0	$0		

Base Year is 0
NPV Rate 0%

TITLE
ENGINE MODEL Fwww-xx-yyy F-zz
TASK/ECP

CEA VERSION 2.0 7/15/93
CEA Guru

SUMMARY - Delta between current and proposed configurations
All values shown are THOUSANDS of fiscal year 0 dollars

		Cost	Savings
1)	Production Engine Cost		
2)	Operational Engine Modification Cost		
3)	Follow-on Maintenance Material Cost		
4)	Follow-on Maintenance Labor Cost		
5)	Publications Cost	$0 K	
6)	Support Equipment Cost	$0 K	
7)	Part Number Cost	$0 K	
8)	Operational Fuel Cost		
9)	Aircraft Loss Cost		
	Totals	$0 K	$0 K

Net Delta Dollar Impact

Net Present Value at 0% $0 K

ASSUMPTIONS

a)	Incorporation in Production engines will begin in			#N/A
b)	Number of engines produced with this change is			0
c)	Number of spare units incorporating this change is			0
d)	No retrofit.			
e)	Incorporation of this change in operational engines will not occur.			
f)	Total kits installed out of total engines not modified in production is	0	of	0
g)	Total engines lost to attrition is			0
h)	Total engines retired unmodified is			0
i)	Estimated yearly flying hours	200		EFH / Year

TITLE:
ENGINE MODEL Fwww-iot-yyy F-zz
TASK/ECP:

Interim Calculations

CEA VERSION 2.3 7/15/93

(A)	Delta Production Cost	$0.00	(D)	Publications Cost	$0.00
(B)	Kit Cost	$0.00	(E)	Support Equipment	$0.00
(C)	Labor Cost to Install the Kit	$0.00	(F)	Aircraft Cost	$0.00

	Modification Events	Unscheduled	Scheduled	Spares	Total
(G)	Engines Modified in Production				0
(H)	Retrofit Events	0	0	0	0

			Proposed	
	Operational Events & EFH	Current	Unmod	Mod
(J)	Scheduled Events	0	0	0
(K)	Unscheduled Events	0	0	0
(L)	Engine Flight Hours (In Thousands)	0.000	0.000	0.000
(M)	Aircraft Losses Delta	N/A	N/A	0

			Proposed		Equations to Calculate Cost/Evt
	Scheduled Costs / Event	Current	Unmod	Mod	Numbers (xx.0) Reference Input Page
	O & I Labor	$0.00	$0.00	$0.00	(18.0 + 19.0 * (20.0 + 21.0)) * BLR
	Depot Labor	$0.00	$0.00	$0.00	(24.0 * 25.0) * DLR
(N)	Total Labor	$0.00	$0.00	$0.00	
	O & I Repair	$0.00	$0.00	$0.00	(22.0 * 23.0)
	Depot Repair	$0.00	$0.00	$0.00	(26.0 * 27.0)
	Scrap Cost	$0.00	$0.00	$0.00	(28.0 * 29.0)
(P)	Total Material	$0.00	$0.00	$0.00	
	Test Labor & Fuel	$0.00	$0.00	$0.00	(30.0 * G17 * G19) + (30.0 * 2 * BLR)
(Q)	Total Material Incl Test	$0.00	$0.00	$0.00	

			Proposed		Equations to Calculate Cost/Evt
	Unscheduled Costs / Event	Current	Unmod	Mod	Numbers (xx.0) Reference Input Page
	O & I Labor	$0.00	$0.00	$0.00	(32.0 + 33.0 * (34.0 + 35.0)) * BLR
	Depot Labor	$0.00	$0.00	$0.00	(38.0 * 39.0) * DLR
(R)	Total Labor	$0.00	$0.00	$0.00	
	O & I Repair	$0.00	$0.00	$0.00	(36.0 * 37.0)
	Depot Repair	$0.00	$0.00	$0.00	(40.0 * 41.0)
	Scrap	$0.00	$0.00	$0.00	(42.0 * 43.0)
(S)	Total Material	$0.00	$0.00	$0.00	
	Test Labor & Fuel	$0.00	$0.00	$0.00	(44.0 * G17 * G19) + (44.0 * 2 * BLR)
(T)	Total Material Incl Test	$0.00	$0.00	$0.00	
	Second Damage & Incidental	$0.00	$0.00	$0.00	(45.0 + 46.0)
(U)	GrandTotal Material	$0.00	$0.00	$0.00	

Summary Page Equations

1)	Production Engine Cost	(A + G)
2)	Operational Engine Modification Cost	(H_Total * (B + C))
3)	Follow-on Maintenance Material Cost	((K_Cur * U_Cur + J_Cur *Q_Cur) - (K_ProUnmod * U_ProUnmod + J_ProUnmod * Q_ProUnmod + K_ProMod * U_ProMod + J_ ProMod * Q_ProMod)
4)	Follow-on Maintenance Labor Cost	((K_Cur * R_Cur + J_Cur * N_Cur) - (K_ProUnmod * R_ProUnmod + J_ProUnmod * N_ProUnmod + K_ProMod * R_ProMod + J_ProMod * N_ProMod))
5)	Publications Cost	(D)
6)	Support Equipment Cost	(E)
7)	Part Number Cost	(DI48 + DJ48 + L64/1000) - (BW48)
8)	Operational Fuel Cost	(L_Cur * G17 * G20) - (L_ProUnmod + L_ProMod * (1 - 48)) * G17 * G20
9)	Aircraft Loss Cost	(F * M)

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Fleet 1		Fleet 2		Fleet 3	
ENGINE MODEL Fwww-xx-yyy		ENGINE MODEL Fwww-xx-yyy		ENGINE MODEL Fwww-xx-yyy	
F-zz		F-zz		F-zz	
Dialog Box Option Label		Dialog Box Option Label		Dialog Box Option Label	
Fleet 1 Label Text		Fleet 2 Label Text		Fleet 3 Label Text	
Fiscal Year Dollars	1993	Fiscal Year Dollars	1993	Fiscal Year Dollars	1993
NPV Rate	0 1	NPV Rate	0 1	NPV Rate	0 1
Labor Cost / Manhour at O&I	37 12	Labor Cost / Manhour at O&I	37 12	Labor Cost / Manhour at O&I	37 12
Labor Cost / Manhour at Depot	49 74	Labor Cost / Manhour at Depot	49 74	Labor Cost / Manhour at Depot	49 74
Cost to introduce new P/N - $ / PN	818 83	Cost to introduce new P/N - $ / PN	818 83	Cost to introduce new P/N - $ / PN	618 83
Cost to Maintain each P/N / Year	134 5	Cost to Maintain each P/N / Year	134 5	Cost to Maintain eacn P/N / Year	134 5
Fuel Cost / Gallon	0 75	Fuel Cost / Gallon	0 75	Fuel Cost / Gallon	0 75
Test Fuel/Hr =	150 0	Test Fuel/Hr =	150 0	Test Fuel/Hr =	150 0
Flt Fuel-Gal/Hr =	1000 0	Flt Fuel-Gal/Hr =	1000 0	Flt Fuel-Gal/Hr =	1000 0
EFH/Year	300	EFH/Year	300	EFH/Month	300
TAC/EFH=	3 0	TAC/EFH=	3 0	TAC/EFH=	3 0
TOT/EFH=	1 5	TOT/EFH=	1 5	TOT/EFH=	1 5
Aircraft Cost	$20 000 000	Aircraft Cost	$0	Aircraft Cost	$0
Attrition. Losses / EFH	0 000000	Attrition Losses / EFH	0 000000	Attrition Losses / EFH	0 000000

Year	Deliveries	Historical EFH	Year	Deliveries	Historical EFH	Year	Deliveries	Historical EF
1988	0		1988	0		1988	0	
1989	0		1989	0		1989	0	
1990	0		1990	0		1990	0	
1991	0		1991	0		1991	0	
1992	0		1992	0		1992	0	
1993	0		1993	0		1993	0	
1994	0		1994	0		1994	0	
1995	0		1995	0		1995	0	
1996	0		1996	0		1996	0	
1997	0		1997	0		1997	0	
1998	0		1998	0		1998	0	
1999	0		1999	0		1999	0	
2000	0		2000	0		2000	0	
2001	0		2001	0		2001	0	
2002	0		2002	0		2002	0	
2003	0		2003	0		2003	0	
2004	0		2004	0		2004	0	
2005	0		2005	0		2005	0	
2006	0		2006	0		2006	0	
2007	0		2007	0		2007	0	
2008	0		2008	0		2008	0	
2009	0		2009	0		2009	0	
2010	0		2010	0		2010	0	
2011	0		2011	0		2011	0	
2012	0		2012	0		2012	0	
2013	0		2013	0		2013	0	
2014	0		2014	0		2014	0	
2015	0		2015	0		2015	0	
2016	0		2016	0		2016	0	
2017	0		2017	0		2017	0	
2018	0		2018	0		2018	0	
2019	0		2019	0		2019	0	
2020	0		2020	0		2020	0	

Fleet 4

ENGINE MODEL Fwww-xx-yyy	
F-zz	
Dialog Box Option Label	
Fleet 4 Label Text	
Fiscal Year Dollars	1993
NPV Rate	0 1
Labor Cost / Manhour at O&I	37 12
Labor Cost / Manhour at Depot	49 74
Cost to introduce new P/N - $ / PN	818 83
Cost to Maintain each P/N / Year	134 5
Fuel Cost / Gallon	0 75
Test Fuel/Hr =	150 0
Flt Fuel-Gal/Hr =	1000 0
EFH/Year	300
TAC/EFH=	3 0
TOT/EFH=	1 5
Aircraft Cost	$0
Attrition Losses / EFH	0 000000

Year	Deliveries	Historical EFH
1988	0	
1989	0	
1990	0	
1991	0	
1992	0	
1993	0	
1994	0	
1995	0	
1996	0	
1997	0	
1998	0	
1999	0	
2000	0	
2001	0	
2002	0	
2003	0	
2004	0	
2005	0	
2006	0	
2007	0	
2008	0	
2009	0	
2010	0	
2011	0	
2012	0	
2013	0	
2014	0	
2015	0	
2016	0	
2017	0	
2018	0	
2019	0	
2020	0	

Fleet 5

ENGINE MODEL Fwww-xx-yyy	
F-zz	
Dialog Box Option Label	
Fleet 5 Label Text	
Fiscal Year Dollars	1993
NPV Rate	0 1
Labor Cost / Manhour at O&I	37 12
Labor Cost / Manhour at Depot	49 74
Cost to introduce new P/N - $ / PN	818 83
Cost to Maintain each P/N / Year	134 5
Fuel Cost / Gallon	0 75
Test Fuel/Hr =	150 0
Flt Fuel-Gal/Hr =	1000 0
EFH/Year	300
TAC/EFH=	3 0
TOT/EFH=	1 5
Aircraft Cost	$0
Attrition Losses / EFH	0 000000

Year	Deliveries	Historical EFH
1988	0	
1989	0	
1990	0	
1991	0	
1992	0	
1993	0	
1994	0	
1995	0	
1996	0	
1997	0	
1998	0	
1999	0	
2000	0	
2001	0	
2002	0	
2003	0	
2004	0	
2005	0	
2006	0	
2007	0	
2008	0	
2009	0	
2010	0	
2011	0	
2012	0	
2013	0	
2014	0	
2015	0	
2016	0	
2017	0	
2018	0	
2019	0	
2020	0	

Fleet 6

ENGINE MODEL Fwww-xx-yyy	
F-zz	
Dialog Box Option Label	
Fleet 6 Label Text	
Fiscal Year Dollars	1993
NPV Rate	0 1
Labor Cost / Manhour at O&I	37 12
Labor Cost / Manhour at Depot	49 74
Cost to introduce new P/N - $ / PN	818 83
Cost to Maintain each P/N / Year	134 5
Fuel Cost / Gallon	0 75
Test Fuel/Hr =	150 0
Flt Fuel-Gal/Hr =	1000 0
EFH/Year	300
TAC/EFH=	3 0
TOT/EFH=	1 5
Aircraft Cost	$0
Attrition Losses / EFH	0 000000

Year	Deliveries	Historical EFH
1988	0	
1989	0	
1990	0	
1991	0	
1992	0	
1993	0	
1994	0	
1995	0	
1996	0	
1997	0	
1998	0	
1999	0	
2000	0	
2001	0	
2002	0	
2003	0	
2004	0	
2005	0	
2006	0	
2007	0	
2008	0	
2009	0	
2010	0	
2011	0	
2012	0	
2013	0	
2014	0	
2015	0	
2016	0	
2017	0	
2018	0	
2019	0	
2020	0	

Fleet 7

ENGINE MODEL Fwww-xx-yyy	
F-zz	
Dialog Box Option Label	
Fleet 7 Label Text	
Fiscal Year Dollars	1993
NPV Rate	0 1
Labor Cost / Manhour at O&I	37 12
Labor Cost / Manhour at Depot	49 74
Cost to introduce new P/N - $ / PN	818 83
Cost to Maintain each P/N / Year	134 5
Fuel Cost / Gallon	0 75
Test Fuel/Hr =	150.0
Flt Fuel-Gal/Hr =	1000 0
EFH/Year	300
TAC/EFH=	3 0
TOT/EFH=	1 5
Aircraft Cost	$0
Attrition Losses / EFH	0 000000

Year	Deliveries	Historical EFH
1988	0	
1989	0	
1990	0	
1991	0	
1992	0	
1993	0	
1994	0	
1995	0	
1996	0	
1997	0	
1998	0	
1999	0	
2000	0	
2001	0	
2002	0	
2003	0	
2004	0	
2005	0	
2006	0	
2007	0	
2008	0	
2009	0	
2010	0	
2011	0	
2012	0	
2013	0	
2014	0	
2015	0	
2016	0	
2017	0	
2018	0	
2019	0	
2020	0	

Fleet 8

ENGINE MODEL Fwww-xx-yyy	
F-zz	
Dialog Box Option Label	
Fleet 8 Label Text	
Fiscal Year Dollars	1993
NPV Rate	0 1
Labor Cost / Manhour at O&I	37 12
Labor Cost / Manhour at Depot	49 74
Cost to introduce new P/N - $ / PN	818 83
Cost to Maintain each P/N / Year	134 5
Fuel Cost / Gallon	0 75
Test Fuel/Hr =	150 0
Flt Fuel-Gal/Hr =	1000 0
EFH/Year	300
TAC/EFH=	3 0
TOT/EFH=	1 5
Aircraft Cost	$0
Attrition Losses / EFH	0 000000

Year	Deliveries	Historical EFH
1988	0	
1989	0	
1990	0	
1991	0	
1992	0	
1993	0	
1994	0	
1995	0	
1996	0	
1997	0	
1998	0	
1999	0	
2000	0	
2001	0	
2002	0	
2003	0	
2004	0	
2005	0	
2006	0	
2007	0	
2008	0	
2009	0	
2010	0	
2011	0	
2012	0	
2013	0	
2014	0	
2015	0	
2016	0	
2017	0	
2018	0	
2019	0	
2020	0	

Fleet 9

ENGINE MODEL Fwww-xx-yyy	
F-zz	
Dialog Box Option Label	
Fleet 9 Label Text	
Fiscal Year Dollars	1993
NPV Rate	0 1
Labor Cost / Manhour at O&I	37 12
Labor Cost / Manhour at Depot	49 74
Cost to introduce new P/N - $ / PN	818 83
Cost to Maintain each P/N / Year	134 5
Fuel Cost / Gallon	0 75
Test Fuel/Hr =	150 0
Flt Fuel-Gal/Hr =	1000 0
EFH/Year	300
TAC/EFH=	3 0
TOT/EFH=	1 5
Aircraft Cost	$0
Attrition Losses / EFH	0 000000

Year	Deliveries	Historical EFH
1988	0	
1989	0	
1990	0	
1991	0	
1992	0	
1993	0	
1994	0	
1995	0	
1996	0	
1997	0	
1998	0	
1999	0	
2000	0	
2001	0	
2002	0	
2003	0	
2004	0	
2005	0	
2006	0	
2007	0	
2008	0	
2009	0	
2010	0	
2011	0	
2012	0	
2013	0	
2014	0	
2015	0	
2016	0	
2017	0	
2018	0	
2019	0	
2020	0	

Fleet 10

ENGINE MODEL Fwww-xx-yyy	
F-zz	
Dialog Box Option Label	
Fleet 10 Label Text	
Fiscal Year Dollars	1993
NPV Rate	0 1
Labor Cost / Manhour at O&I	37 12
Labor Cost / Manhour at Depot	49 74
Cost to introduce new P/N - $ / PN	818 83
Cost to Maintain each P/N / Year	134 5
Fuel Cost / Gallon	0 75
Test Fuel/Hr =	150 0
Flt Fuel-Gal/Hr =	1000 0
EFH/Year	300
TAC/EFH=	3 0
TOT/EFH=	1 5
Aircraft Cost	$0
Attrition Losses / EFH	0 000000

Year	Deliveries	Historical EFH
1988	0	
1989	0	
1990	0	
1991	0	
1992	0	
1993	0	
1994	0	
1995	0	
1996	0	
1997	0	
1998	0	
1999	0	
2000	0	
2001	0	
2002	0	
2003	0	
2004	0	
2005	0	
2006	0	
2007	0	
2008	0	
2009	0	
2010	0	
2011	0	
2012	0	
2013	0	
2014	0	
2015	0	
2016	0	
2017	0	
2018	0	
2019	0	
2020	0	

Fleet 11

ENGINE MODEL Fwww-xx-yyy	
F-zz	
Dialog Box Option Label	
Fleet 11 Label Text	
Fiscal Year Dollars	1993
NPV Rate	0 1
Labor Cost / Manhour at O&I	37 12
Labor Cost / Manhour at Depot	49 74
Cost to introduce new P/N - $ / PN	818 83
Cost to Maintain each P/N / Year	134 5
Fuel Cost / Gallon	0 75
Test Fuel/Hr =	150 0
Flt Fuel-Gal/Hr =	1000 0
EFH/Year	300
TAC/EFH=	3 0
TOT/EFH=	1 5
Aircraft Cost	$0
Attrition Losses / EFH	0 000000

Year	Deliveries	Historical EFH
1988	0	
1989	0	
1990	0	
1991	0	
1992	0	
1993	0	
1994	0	
1995	0	
1996	0	
1997	0	
1998	0	
1999	0	
2000	0	
2001	0	
2002	0	
2003	0	
2004	0	
2005	0	
2006	0	
2007	0	
2008	0	
2009	0	
2010	0	
2011	0	
2012	0	
2013	0	
2014	0	
2015	0	
2016	0	
2017	0	
2018	0	
2019	0	
2020	0	

Fleet 12

ENGINE MODEL Fwww-xx-yyy	
F-zz	
Dialog Box Option Label	
CEA Sample Test Fleet	
Fiscal Year Dollars	1993
NPV Rate	0 1
Labor Cost / Manhour at O&I	37 12
Labor Cost / Manhour at Depot	49 74
Cost to introduce new P/N - $ / PN	818 83
Cost to Maintain each P/N / Year	134 5
Fuel Cost / Gallon	0 75
Test Fuel/Hr =	150 0
Flt Fuel-Gal/Hr =	1000 0
EFH/Year	300
TAC/EFH=	3 0
TOT/EFH=	1 5
Aircraft Cost	$0
Attrition Losses / EFH	0 000000

Year	Deliveries	Historical EFH
1988	0	0
1989	0	0
1990	50	400
1991	100	1,500
1992	100	26,000
1993	50	
1994	0	
1995	0	
1996	0	
1997	0	
1998	0	
1999	0	
2000	0	
2001	0	
2002	0	
2003	0	
2004	0	
2005	0	
2006	0	
2007	0	
2008	0	
2009	0	
2010	(50)	
2011	(100)	
2012	(100)	
2013	(50)	
2014	0	
2015	0	
2016	0	
2017	0	
2018	0	
2019	0	
2020	0	

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