International Civil Aviation Organization

Air Traffic Management-Measurement Task Force

First Meeting (ATMM TF/1)
(Cairo, Egypt, 8 –9 September 2013)

Agenda Item 2: Estimation of Environmental benefits accrued from operational improvements

ICAO FUEL SAVINGS ESTIMATION TOOL (IFSET)

(Presented by the Secretariat)

SUMMARY

This paper presents the IFSET tool designed to measure the benefits accrued from operational improvements.

Action by the meeting is at paragraph 3.

REFERENCES

- MIDANPIRG/13 Report

1. INTRODUCTION

1.1 The MIDANPIRG/13 Meeting was held in Abu Dhabi, UAE, from 22 to 26 April 2012.

1.2 For the purpose of estimation and reporting of fuel savings from operational improvements; MIDANPIRG/13 meeting agreed to establish an Air Traffic Management Measurement Task Force (ATMM TF) dedicated to the measurement process.

1.3 Operational improvements are a key strategy that can be applied to deliver tangible reductions in aircraft fuel consumption. The Global Air Navigation Plan (Doc 9750) and the Operational Opportunities to Minimize Fuel Use and Reduce Emissions (Circular 303) are among several documents providing guidance regarding operational improvements being implemented to improve efficiency of the ATM System.

1.4 The term “operations” in the context of aviation can be used to describe a broad range of activities including: the flying of the airplane, the control and/or monitoring of the aircraft by the air traffic management system, and the conduct of various airport activities. Operations begin with planning activities even before the passengers and cargo are loaded, through the entire flight, until after the passengers have disembarked and the cargo has been unloaded. One constant that applies whenever it comes to defining operational procedures, is that safety must always come first.

2. DISCUSSION

2.1 Against a background of increasing concern regarding the impact of aircraft engine emissions on the environment, ICAO has been considering what steps could be taken by the international aviation community to control and measure emissions.

2.2 Implementation of operational improvements will generally have benefits in areas such as improved airport and airspace capacity, shorter cruise, climb and descend times through the use of more optimized routes and an increase of unimpeded taxi times. These improvements have the potential to reduce fuel burn and lower levels of pollutants.

2.3 Calculation of aviation emissions is dependent on several different factors including the number and type of aircraft operations, the type and efficiency of the aircraft engines, the type of fuel used, the length of flight, the power setting, the time spent at each stage of flight, and the location (altitude) at which exhaust gases are emitted.

2.4 Specifically for operational improvements benefit analyses, it is necessary to have data that can reflect the operational changes and depending on the need, there are different levels of analysis possible: order of magnitude, simple consideration of CO2 based on fuel burn, detailed modelling of all emissions parameters, and variations in between.

2.5 The main purpose of this paper is to request the estimation and reporting of fuel savings resulting from national or regional operational improvements through the use of a simple tool (ICAO Fuel Savings Estimation Tool - IFSET) specifically designed for this purpose and that does not require any specific skills from the user.

2.6 The tool is designed to assist States to estimate and report fuel savings consistently with the models approved by ICAO's Committee on Aviation Environmental Protection (CAEP) and aligned with the Global Air Navigation Plan. IFSET can help States measure benefits from:

- shortening/eliminating level segments on departure and arrival route;
- shorter ATS – Routes (either in time or distance)
- cruising at different altitudes/levels
- reduction in taxi times.

2.7 The tool is not intended to replace the use of detailed measurement or modelling of fuel savings, where those capabilities exist. Rather, it is provided to assist those States or ANSPs without such facilities to estimate the benefits from operational improvements. IFSET User Guide is at **Appendix A** to this working paper. The IFSET, as well as instructions on its use, can be accessed at http://www.icao.int/environmental-protection/Pages/Tools.aspx protection. ICAO is committed to updating the tool based on the feedback received from all stakeholders.

2.8 Simplifying assumptions are made regarding, *inter alia*, aircraft weight, aircraft centre of gravity (CG), engine thrust setting, meteorology, airframe/engine combinations, etc. As a result, the tool is not suitable for assessing the effects related to aircraft weight, thrust settings, or differences between aircraft/engine models.

2.9 The tool is intended to report differences in the fuel consumption based on the comparison of two scenarios and it is not appropriate to use the tool to compute the absolute fuel consumption for a specific procedure. It cannot be used for flight planning purposes or any other purpose that may affects safety of operations.

2.10 To have all the necessary data to generate an annual report, it is proposed that any operational improvement being planned or implemented by a State/ANSP or the Region should use IFSET or a more advanced model / measurement capability and report, at least, the data proposed using the table at **Appendix B** to this working paper to report environmental benefits of operational improvements.

2.11 The meeting may wish to note that MIDANPIRG/13 was apprised of the outcome of the IFSET workshop held in Cairo, Egypt 29 January 2012 which was supported by CANSO. The outcome of the workshop is at **Appendix C** to this working paper.

3. ACTION BY THE MEETING

3.1 The meeting is invited to use the IFSET tool for the development of the first MID Region Air Navigation Environmental Report.

ATMM TF/1-WP/2
Appendix A

2011

ICAO FUEL SAVINGS ESTIMATION TOOL (IFSET) USER'S GUIDE

12/12/2011

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ICAO FUEL SAVINGS ESTIMATION TOOL (IFSET)

1-Introduction

Against a background of increasing concern regarding the impact of aircraft engine emissions on the environment, the ability to adequately estimate fuel burn and emissions savings accrued from operational improvements being put in place by all members of the ATM community on a system wide scale is of high importance.

Operational improvements are a key strategy that can be applied to deliver tangible reductions in aircraft fuel consumption. The Global Air Navigation Plan (Doc 9750) and the Operational Opportunities to Minimize Fuel Use and Reduce Emissions (Circular 303) are among several documents providing guidance regarding operational improvements being implemented to improve efficiency of the ATM System.

However, to-date, a tool to assist those States without an automated means to estimate, model or report those benefits in a harmonized way, has not been available.

This *User's Guide* will detail the steps that the user of this application follows to generate the estimated fuel savings from the implementation of operational improvements.

2-Objective

This document describes the ICAO Fuel Savings Estimation Tool (IFSET) developed to be applicable globally with the ability to capture the difference in flight trajectory performance in terms of fuel consumption before and after implementation of operational improvements at local, regional or global level.

The tool is to assist the States to estimate and report fuel savings consistently with the models approved by ICAO's Committee on Aviation Environmental Protection (CAEP) and aligned with the Global Air Navigation Plan.

3-Description

The tool is not intended to replace the use of detailed measurement or modelling of fuel savings, where those capabilities exist. Rather, it is provided to assist those States without such facilities to estimate the benefits from operational improvements.

Fuel savings can be enabled through the implementation of operational improvements in the general categories listed in Table 1.

Table 1. Operational improvements to be evaluated by IFSET.

• Reduced cruise distance or time • Availability of optimal (preferred) altitude • Reduced taxi time • More efficient departure and approach/arrival procedures

4-Assumptions

Simplifying assumptions are made regarding, *inter alia*, aircraft weight, aircraft centre of gravity (CG), engine thrust setting, meteorology, airframe/engine combinations, etc. As a result, the tool is not suitable for assessing the effects related to aircraft weight, thrust settings, or differences between aircraft/engine models.

The tool is intended to report differences in fuel consumption based on the comparison of two scenarios and therefore is not appropriate to use the tool to compute the absolute fuel consumption for a specific procedure. It cannot be used for flight planning purposes or any other purpose that may affect safety of operations.

5-Methodology

The tool will estimate the difference in fuel mass consumed by comparing a pre-implementation (i.e. "baseline") case against a post-implementation case (i.e. "after operational improvements"), as illustrated notionally in Figures 1 and 2.

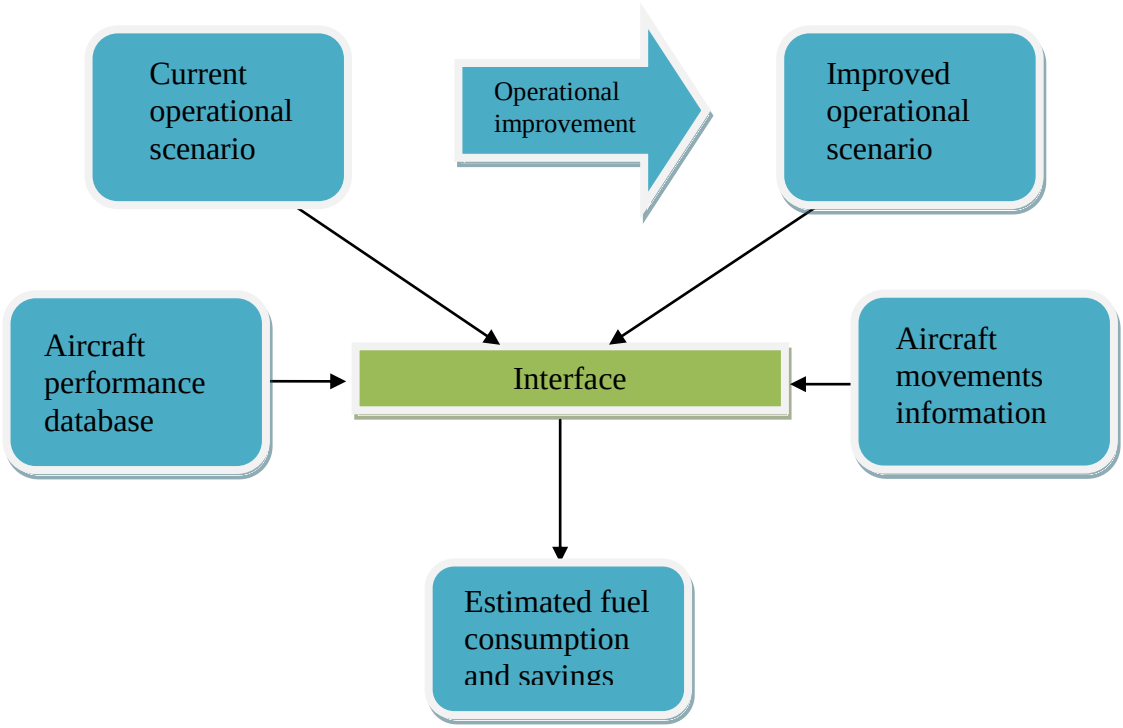


Figure 1. Notional fluxogram.

The selection of the baseline case is an important step of the process. It will be defined by the user and could correspond to:

- the published or planned procedure (AIP, flight plan) scenarios;
- the daily practices;
- a combination of the two;
- other criteria as appropriate.

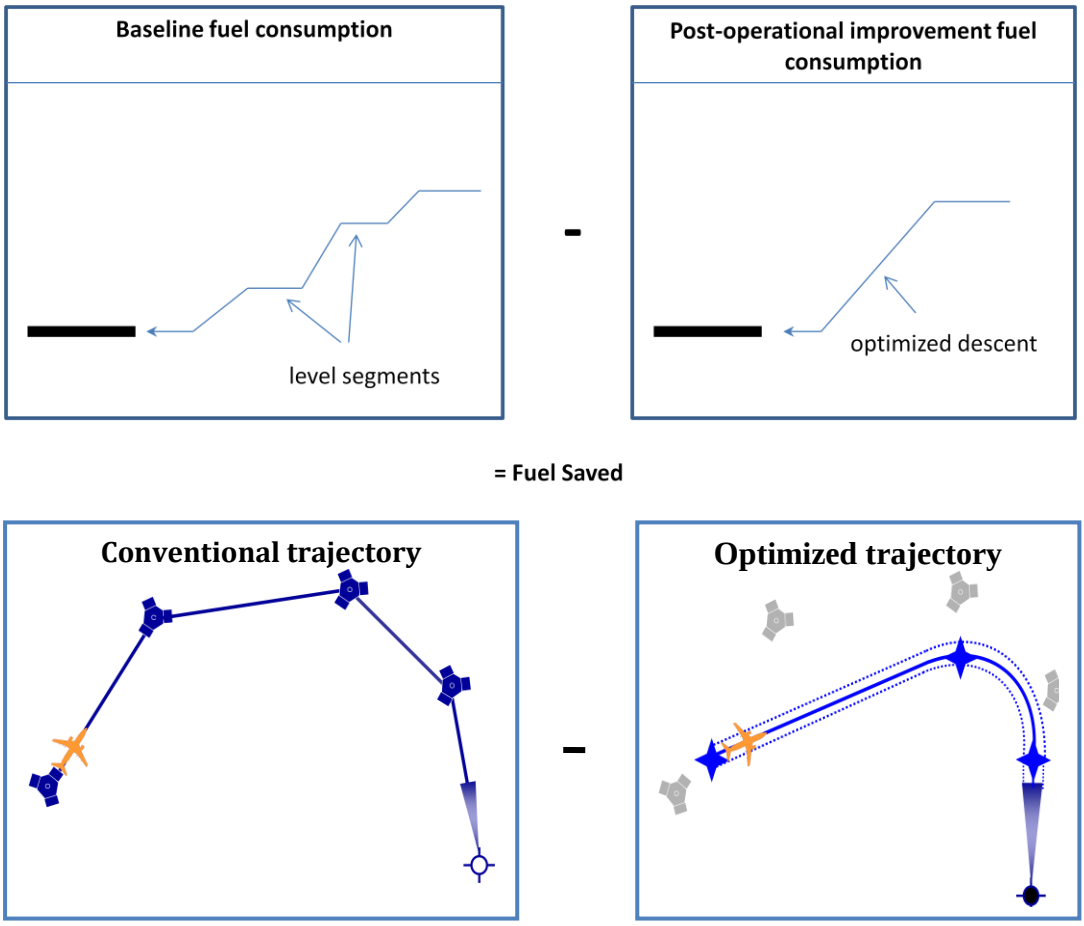


Figure 2. Notional illustration of fuel savings.

In order to compute the fuel consumed in two different scenarios, the following information listed in Table 2 will be required for both scenarios.

Table 2. Data required to compute fuel consumption changes.

- Number of operations by aircraft category

Plus, a combination of the following elements that describes both scenarios

- Average taxi time
- Time spent or distance flown at a specific altitude
- Top of descent altitude and bottom of descent altitude
- Base of climb altitude and top of climb altitude
- Distance flown in a climb or descent procedure

6-Requirements

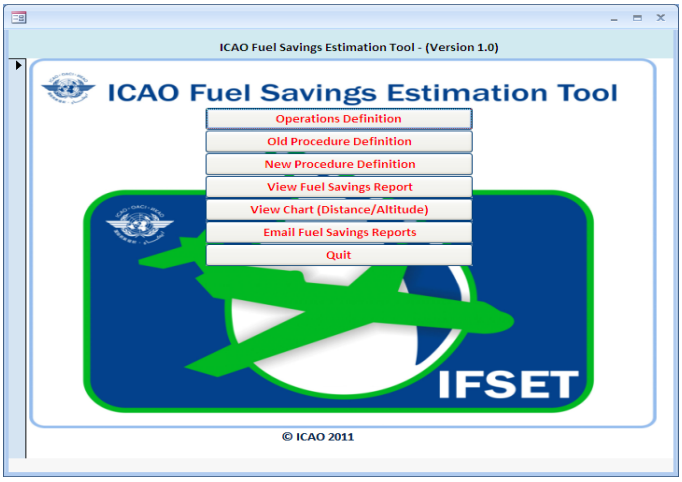
The tool will be a Microsoft Windows application that requires running an operating system of Windows XP or newer. The user interface is intended to be easy-to-use, requiring minimal input from the user.

All analyses begin with describing the baseline and post-implementation cases. As defined in Table 2, the user begins by specifying the number of operations in both scenarios.

This is accomplished by selecting the aircraft types from a dropdown list of available types and then entering the number of operations. The list also contains basic aircraft categories that can be selected. Those aircraft categories include: single engine piston, multi engine piston, turboprop, short range single aisle jet, medium range single aisle jet, twin aisle jet (2 engine), and twin aisle jet (3+ engines). The number of operations entered can be hourly, daily, annually, etc. The resultant fuel savings will be reported on the same basis. The reason that the operations need to be defined in both cases is to permit the consideration of procedures that will only be available to properly equipped aircraft.

7-The Tool Step by Step

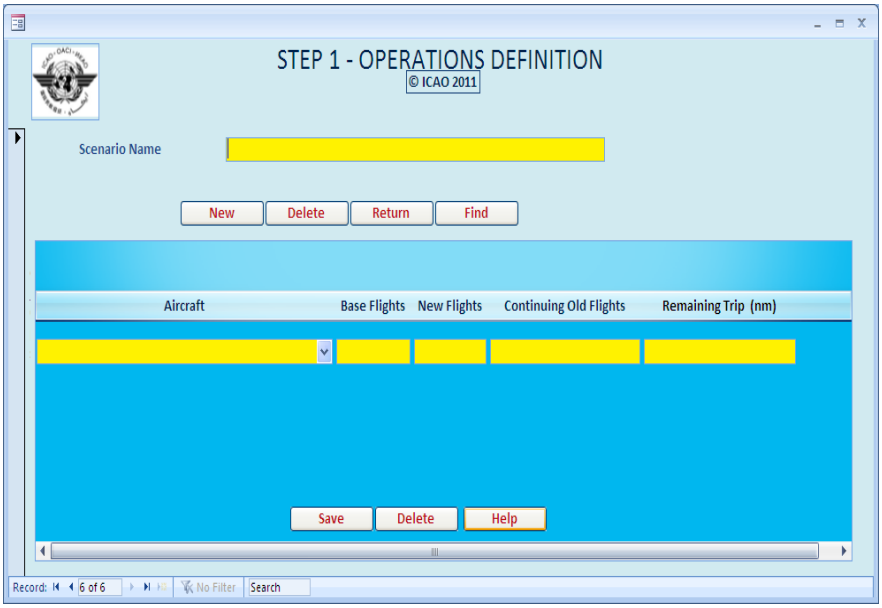
7.1 Main Screen



INPUT

Start by selecting **Operations definition** tab, the following screen opens

7.2 Operations definition



Command Buttons on this screen (Top)

New - will open a blank screen allowing users to input new scenarios.

Delete - will delete the scenario, the aircraft mix and all associated operational definitions.

Return - will bring the user to the main screen.

Find - will enable the users to select an appropriate scenario among multiple scenarios saved in the database. After selection the scenario can be deleted or the aircraft mix on the second half of the screen can be edited.

Command Buttons on this screen (Bottom)

Save - will save this scenario and the related aircraft mix.

Delete - the user can select a row associated with an aircraft, the number of operations and remaining trip distance and delete that row.

Help – The User can see the various aircraft types and the associated aircraft categories so that he can make an appropriate input of the required aircraft type.

Clicking on **Return** will bring you to the Main Screen where the user will select **Old Procedure Definition.**

INPUT

Scenario Name - Give a descriptive name for the operational scenario.

Aircraft - Input the aircraft mix relating to the scenario under the aircraft category column from a drop down list. If required make use of the Help Button indicated earlier to help in the selection of the appropriate aircraft category.

Base flights - indicate the number of flights under the old operational scenario.

New flights - indicate the number of flights under the new operational scenario. It means the number of operations benefiting from the operational improvement.

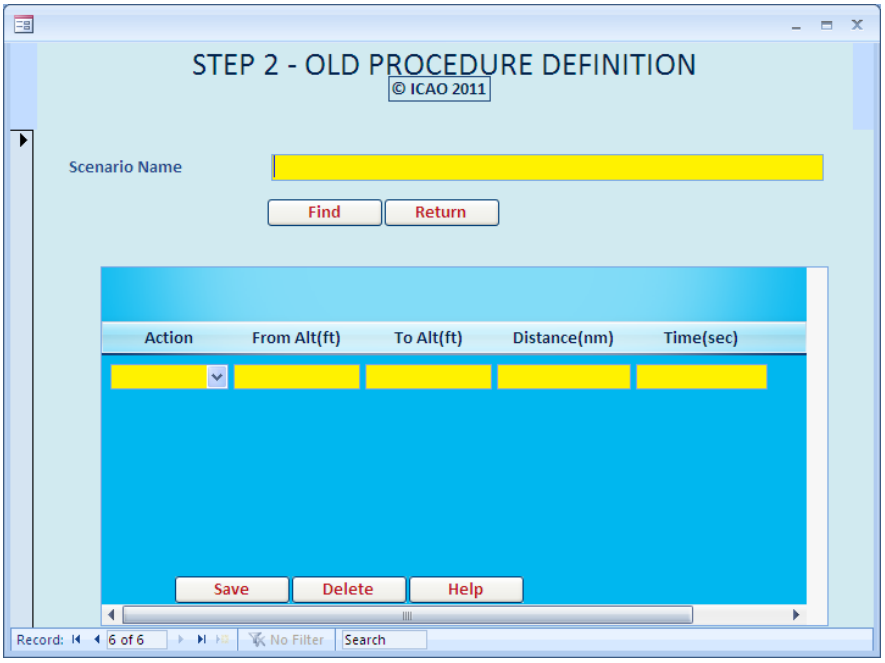
Continuing Old flights - indicates those flights though being part of the new operational scenario continues to follow the old operational definitions. It means number of operations not benefiting from the operational improvement.

Remaining Trip distance - is the average stage length in nautical miles (NM) appropriate for the aircraft category selected. If not known, the tool assumes a default value based on data already tested.

Click **Save** – it will save this scenario and the related aircraft category mix.

Click **Return –** it will bring the user back to the main screen.

7.3 Old procedure definition



Find the **scenario name** which you have entered earlier under Operations definition by clicking the **Find** Button. Select the Scenario Name and either add or edit appropriate actions associated to the operational procedures for the selected scenario. The scenario name on this screen is locked and no entry is allowed.

Navigate to the second half of the screen and enter the **Action** followed under the old operational procedures. The allowable actions are Level, Descend, Climb and Taxi selected from a drop down list.

For "Level" Action either the distance in nautical miles or time in seconds can be entered.

For "Taxi" Action only Time in seconds can be entered.

For all actions except "Taxi" enter the "From" and "To" altitudes in feet. For the level action the "To" altitude will be automatically entered after entering the "From" altitude and clicking the "Tab" button.

For "Climb" or "Descend" actions, if there are variations in distance or time, the distances or time flown during climbing or descending shall be also entered.

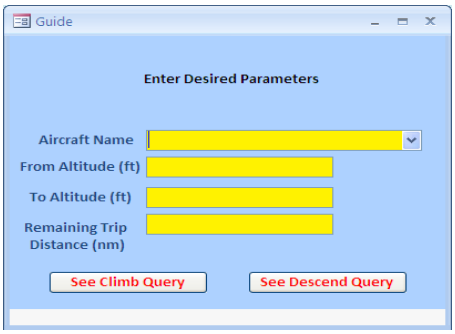
Command Buttons on this screen (Top)
Find – as explained above, this allows the user to select the scenario name entered earlier under operations definition and either add or edit appropriate old operational procedures for the selected scenario.

Return will bring the user to the main screen.

Command Buttons on this screen (Bottom)
Save will save the action associated to the procedure definitions for the selected scenario.

Delete will enable the user to select a row of **Action** and delete it.

Help – The user can select an aircraft category and enter the altitudes associated with a climb or a descend phase and the remaining trip distance as shown –



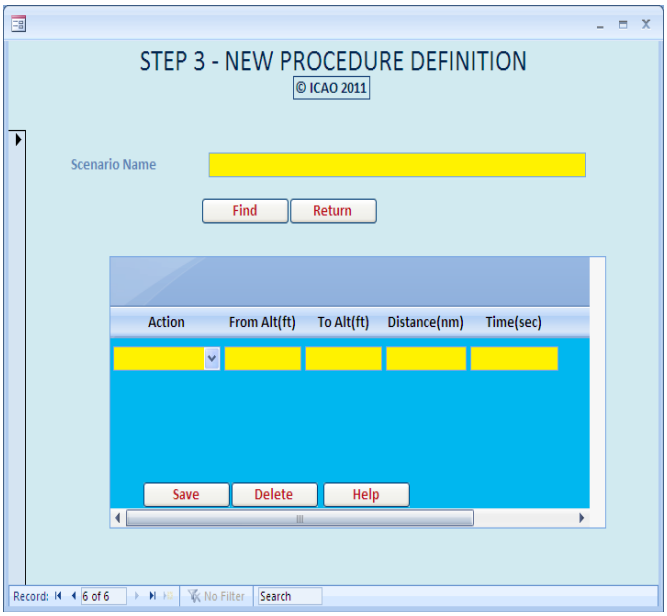
On generating the query the user can view the distance in nautical miles, time in seconds and speed (nm/hour) for his selection criteria which is static in the database and inherent to the model.

The distance and time will act as a guide to the user to input meaningful distances or time especially when the savings in distance or time associated with a new procedure is known but where the overall distances or time involved under an old procedure are not known.

Clicking on **Return** will bring the user back to the Main Screen where the user selects "**New procedure definition**".

7.4 New procedure definition

A screen identical to the **Old Procedure Definition** will open;

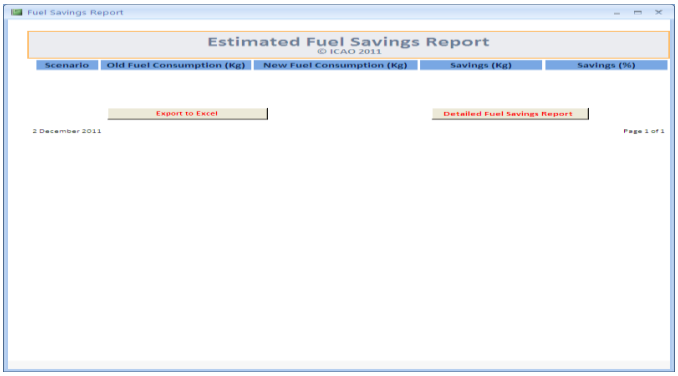


Enter the new operational procedures associated with the selected scenario as described under the "**Old Procedure Definition**". All the command buttons in this screen are identical to the ones explained under the Old Procedure Definition **(7.3)**

Clicking on Return will bring you to the Main Screen where the user can select "**View Full Burn Report**".

7.5 Report generation

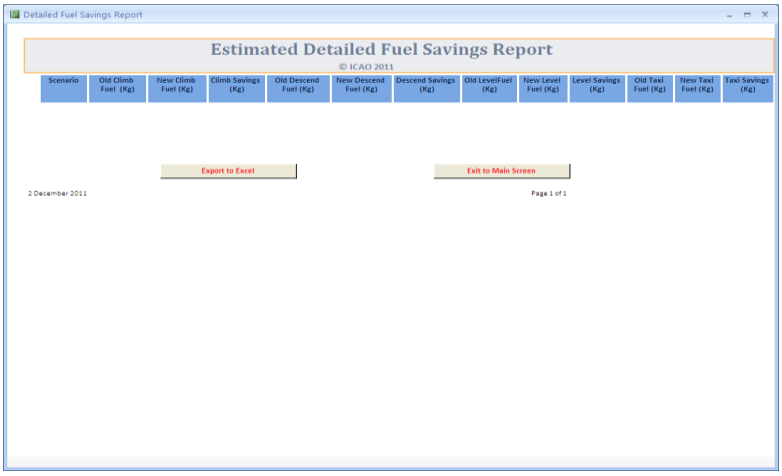
On clicking the View Fuel Savings Report Tab, the consolidated report will be displayed as in the screen below.



The fuel consumption in Kg under old and new operational definitions for each scenario will be displayed along with the estimated savings.

RMK: The savings displayed in the report represents the benefits of reduced fuel consumption due to the adoption of new operational procedures and is restricted only to the phase of flight defined under each scenario.

The user also has the option to generate the detailed report by action or phase of flight by just clicking the "Detailed Fuel Savings Report" key.



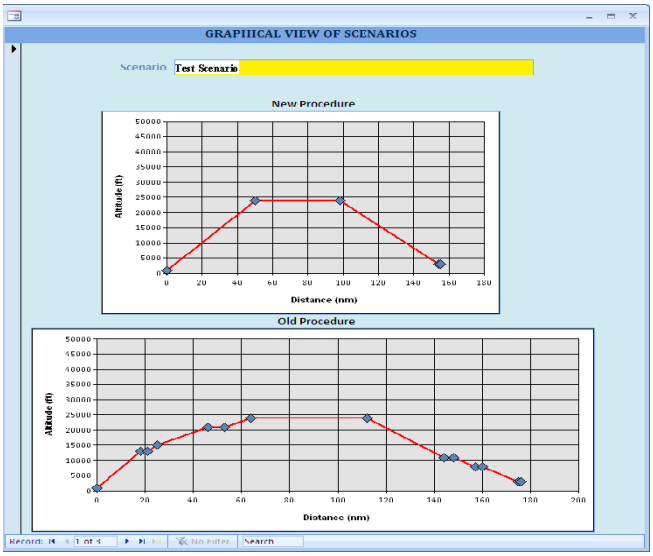
7.5.1 Report generation in Excel

To facilitate the exchange of messages or summation of results, the user can also export the results to an Excel file. For this, just click the "Export to Excel" tab in the appropriate

reports as indicated in section 7.5 Report Generation. An Excel file of the consolidated and the detailed fuel savings reports will be generated for the user's information and can be stored by the user in a desired directory on his computer.

7.6 View Chart (Distance/Altitude)

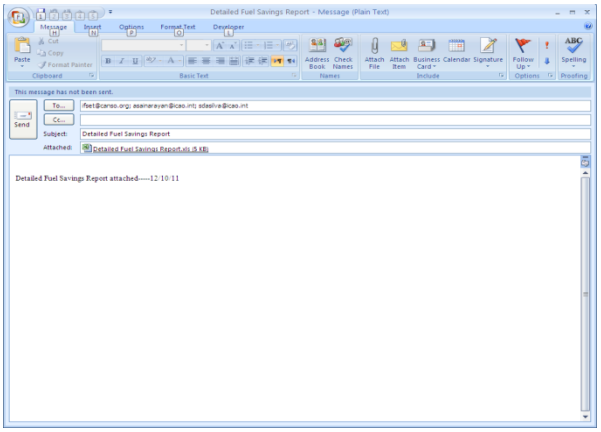
On clicking the View Chart (Distance/Altitude), the user can see in a graphical form the distance and altitude associated with the old and new procedures for each scenario defined by the user. The distance is indicated in the X axis and the altitude in the Y axis.



The user can navigate to different inputted scenarios using the navigation button on the bottom left corner of the Graphical View of Scenarios screen. The chart will facilitate the work of the user to identifying the incremental benefits or otherwise of adopting new procedures for each inputted scenario.

7.7 Sending the report via Email

The report can be sent automatically to the people in charge of generation of the global report by just clicking the "Email Fuel Savings Report" key. A message will be automatically generated to the group in charge of the generation of the global report through Microsoft Outlook with the attachment of the Detailed Fuel Savings Report.



7.8 Summary

IFSET provides a robust platform for estimating the incremental fuel burns from adopting procedures different from the baseline. IFSET has demonstrated that it is capable of providing a reasonable estimate of changes in fuel consumption in a manner that is consistent with more sophisticated approaches. In IFSET, scenarios are defined by climb/descent phases (by specifying height differences), level phases (by specifying time or distance) and taxi phases (by time). Climb and descent rates are not specified, IFSET default values are used. The estimates generated by IFSET can be improved if savings in distance or time inputted into IFSET comes from empirical radar tracks and or using the domain expertise of the air navigation service provider. The release of the first version of IFSET to the Contracting States, the feedback received from them and other users will serve ICAO in making necessary updates to the tool in its future versions.

APPENDIX B

TABLE TO REPORT ENVIRONMENTAL BENEFITS OF OPERATIONAL IMPROVEMENTS

Region	State	Current fuel burn (Kg)	Current CO2 emissions (Kg)	Op. Improvement	Savings-Fuel (Kg)	Savings-CO2 (Kg)	Savings-Fuel-%	Savings CO2-%	Tool
EURNAT	France	1	3.16	RNAV in FIR and TMA	7182902	22697970.32	7182902	7182902	IFSET
EURNAT			3.16			3.16	#DIV/0!	1	IFSET
			3.16			3.16	#DIV/0!	1	
			3.16			3.16	#DIV/0!	1	
			3.16			3.16	#DIV/0!	1	
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APPENDIX C

OUTCOME OF THE IFSET WORKSHOP

- The workshop increased awareness on the environmental issues and the need for states to develop states action plans to reduce CO2 emissions.
- Understating the ICAO requirements and the importance of reporting environmental benefits of operational improvements.
- The participants learned how to install the IFSET and were trained on the use of the IFSET
- Exercise on different scenarios were conducted and reports were generated

Highlights for CNS/ATM/IC SG

- Identify and Develop programs with airspace users that will minimize fuel consumption, reduce operational costs and environmental impact
- Support ATS Planning/Procedure offices in the design and implementation of fuel efficient routes and terminal area procedures
- Work with ATS training institutions to ensure awareness of fuel conservation techniques are incorporated into basic ATS training
- Liaise with the fuel managers of locally based airlines or other aviation organizations to understand fuel and environmental issues of local importance
- Liaise with local air operators and other users to support the development of efficient ATC procedures and training programs for controllers and ATC managers including the environmental impact of inefficient ATC practices
- Continuously sensitize ATS staff and management about the cost of fuel – both in dollar terms, and environmental impact - and its impact on the operating efficiency of airspace users
- Encourage the establishment of familiarization flight for ATC controllers and visits to ATC centers by pilots
- Encourage the establishment of a program to visit operator dispatch and flight planning offices, to better understand the factors affecting scheduling and flight mission management

(Operational Improvement and associated environmental benefits for inclusion in PFF)

- END -