International Civil Aviation Organization

WORKING PAPER

FIFTH MEETING OF THE ALLPIRG/ADVISORY GROUP

(Montreal, 23 – 24 March 2006)

Agenda Item 2.7: Environmental benefits of CNS/ATM Systems

ADVANCING THE ENVIRONMENTAL BENEFITS OF CNS/ATM SYSTEMS

(Presented by the United States of America)

SUMMARY

The environmental benefits of new communication, navigation, surveillance/air traffic management (CNS/ATM) systems include decreased fuel consumption, engine exhaust emissions and, in some cases, noise impacts. CNS/ATM addresses growing congestion and delays by offering a more efficient air traffic system worldwide. The expected global and local environmental benefits represent an important justification for early CNS/ATM implementation, and the International Civil Aviation Organization (ICAO) regional planning groups must consider and assess those benefits in their planning for the new CNS/ATM systems. This paper proposes that ICAO urge air navigation authorities to prioritise the implementation of improvements in their air traffic management with emphasis on fuel, emissions and noise benefits to help mitigate the costs to industry and to reduce environmental impact.

Action by ALLPIRG/5 is in paragraph 5.

1. INTRODUCTION

1.1 Communications, navigation, surveillance and air traffic management (CNS/ATM) systems are used by air navigation services to improve flight safety and to optimize the use of available airport capacity and airspace worldwide. Constraints on airport capacity and the related impact on congestion and delays, plus accelerating fuel costs and public pressures regarding aviation emissions, are all accelerating the need to realize the benefits of worldwide implementation of CNS/ATM systems. The optimization of these systems has the potential to reduce delays by providing more direct and efficient

aircraft routing; and, in turn, reduce flight, holding and taxi times, distance flown and associated fuel consumption. The United States, working in conjunction with the ICAO Committee on Aviation Environmental Protection (CAEP), has been advancing methods to assess the environmental benefits of CNS/ATM systems and developing improved procedures that emphasize noise, fuel and emissions benefits. This paper provides information on U.S. research efforts, tool development and other efforts to improve ATM systems while benefiting the environment. States are encouraged to consider this information in their efforts to advance implementation of improvements in their air traffic management systems.

1.2 As recognized at previous ALLPIRG meetings, the implementation of CNS/ATM systems varies from region to region based on regional needs, capabilities and resources. It is thus important for each region to assess the environmental impact of its specific implementation plan, and to promote those benefits to the government policy makers faced with making the necessary commitments to CNS/ATM systems. In this context, the balance of this document provides information that regions can use in the planning, development and implementation of their respective programs to improve CNS/ATM systems with consideration for fuel savings and environmental benefits.

2. INFORMATION RESOURCES

2.1 At ALLPIRG/4 in 2001, CAEP presented the results from a joint U.S./EUROCONTROL parametric analysis that estimated the emissions benefits of implementing CNS/ATM systems. The study looked at many types of CNS/ATM systems enhancements, including: route network optimization through reduced separation standards, airspace management and civil/military coordination, collaborative flight planning and re routing, strategic capacity management, reduced vertical separation minimum (RVSM) and wind optimized direct routes resulting in shorter cruise times. The results of the study demonstrated overall fuel savings, and associated reductions of carbon dioxide (CO2) on the order of 5% in both the United States and European Region.[1]

2.2 In February 2003, CAEP, EUROCONTROL and the U.S. provided additional guidance in the form of ICAO Circular 303 — *Operational Opportunities to Minimize Fuel Use and Reduce Emission.* The circular identifies and reviews various operational opportunities and techniques for minimizing fuel consumption, and therefore emissions, in civil aviation operations. It is based on the premise that the most effective way to minimize aircraft emissions is to minimize the amount of fuel used in operating each flight. It considers opportunities for improvements at airports, in aircraft technology and for in-flight fuel saving, and provides specific examples for each stakeholder group.

2.3 At CAEP/6 in 2005, the United States introduced a new tool, the System for assessing Aviation's Global Emissions (SAGE). This tool was developed by the U.S. Federal Aviation Administration (FAA) with support from the Volpe National Transportation Systems Center (Volpe), the Massachusetts Institute of Technology (MIT) and the Logistics Management Institute (LMI). SAGE is a high fidelity computer model that dynamically models aircraft performance, fuel burn and emissions, capacity and delay at airports, and forecasts of future scenarios. Thus, SAGE can calculate aircraft emissions for any year that input data is available and can generate forecast variations that take into account air traffic changes, aircraft equipment changes, or any input-variable scenario. Analyses and results can specify aircraft, engine, airport, region, and global totals, with output generated in terms of

[1] Additional information regarding this study and its results can be found in the Global Air Navigation Plan for CNS/ATM Systems and on the internet at: http://www.faa.gov/opsresearch/Emissions/Emissions_121800_Main.pdf.

latitude, longitude, altitude and time for fuel burn and emissions of carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NOx), carbon dioxide (CO2), water (H2O), and sulfur oxides (SOx modeled as SO2). This new type of model provide significant advancement over the 2001 parametric analysis in its ability to estimate fuel burn and emissions benefits of implementing CNS/ATM systems. Currently at Version 1.5, SAGE is not for use on a stand-alone personal computer; it is an FAA government research tool, not for release to the public. However, results from the model have been made available to the international aviation community at a variety of forums and FAA is committed to the continued development, support and reporting of SAGE. Additional information regarding the tool and results can be found on the FAA website at http://www.faa.gov/about/office_org/headquarters_offices/aep/models/sage/.

2.4 The benefits of aviation, as well as its effects on the environment, result from a complex system of interdependent technologies, operations, policies and market conditions. Policy and research investment options related to aviation and the environment are currently considered within narrowly-focused contexts (e.g., only noise, only local air quality, only climate change), and the full economic effects, and health and welfare impacts of these options are not considered. Actions in one domain can produce unintended negative consequences in another. There is no single technological or operational solution to resolve the conflict between goals for aviation and the environment. To more effectively analyze the full costs and benefits of proposed actions the FAA has initiate the development of a comprehensive framework of aviation environmental analytical tools and methodologies to assess interdependencies between noise, emissions, and economic performance. These tools will be key to informing development investments for operational opportunities and other efforts to improve ATM systems while mitigating the costs to industry and reducing environmental impact.

3. IMPROVED PROCEDURES TO REDUCE EMISSIONS AND SAVE FUEL

3.1 A number of enhanced procedures are being put in place in the United States that will both mitigate aviation’s emissions impacts as well as reduce the operating costs to industry through fuel savings. The major initiatives in the last couple of years include:

3.1.1 Reduced Vertical Separation Minimum (RVSM). RVSM reduces the minimum vertical separation from 2000 feet to 1000 feet between the altitudes of 29,000 and 41,000 feet for approved aircraft. As such, it will double the air traffic capacity options for controllers and pilots, and allow more aircraft to operate at their most fuel efficient altitude. Instituted in January 2005 in U.S. airspace, we originally estimated that RVSM would save operators approximately $5.3 billion through 2016, an estimate that now appears to be very conservative in light of the dramatic increase in fuel prices since 2003.

3.1.2 Area Navigation (RNAV). RNAV procedures have a variety of benefits in the areas of safety, capacity, access and efficiency. These procedures promote reduced fuel usage through smoother climb gradients; shorter, more predictable, and more repeatable ground tracks; and reduced delays. RNAV procedures are performing successfully at Las Vegas, Philadelphia, and Dulles airports. Last year, 13 RNAV departure procedures and four RNAV arrival procedures went into full operation at Atlanta Hartsfield-Jackson International Airport – the world’s busiest airport. The procedures can result in significant fuel efficiencies and reduced emissions, which translates into cost savings for air carriers and reduced environmental impact. For example, the annual operational benefits from RNAV procedures at Atlanta are estimated to be $15 million.

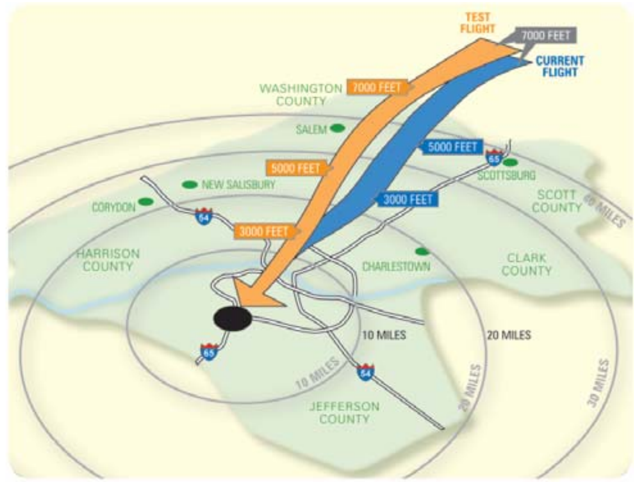
3.1.3 Required Navigation Performance (RNP) is based on RNAV, but adds to RNAV on-board technology that allows pilots to fly more direct point-to-point routes reliably and accurately. RNP is extremely accurate, and gives pilots not only lateral guidance, but vertical precision as well. RNP is expected to provide safety, capacity, efficiency and access benefits to all phases of flight. At present, the focus of RNP implementation is in the approach segment and can result in more direct (shorter) approach paths, and approaches that can be used to lower minimum ceiling and visibility conditions. For example, in January 2005, in partnership with Alaska Airlines, we implemented new RNP approach procedures with Special Aircraft and Aircrew Authorization Required (SAAAR) at Palm Springs International Airport, which is located in very mountainous terrain. Under the previous conventional navigation procedures, planes could not land unless the ceiling was at least 1,900 feet. With the new RNP SAAAR approach procedures, approved air carriers can now operate to a ceiling of 300 feet, which allows much better access during inclement weather. Additionally, RNP SAAAR has enabled aircraft to cut mileage out of their flight path into Palm Springs – nearly 30 miles – which translates into fuel savings for operators.

3.1.4 Advanced Technologies and Oceanic Procedures (ATOP), or Ocean 21. Ocean 21/ATOP adds automatic dependent surveillance, satellite communications, and conflict probe capabilities for oceanic airspace, so that air traffic control can provide more efficient air traffic services. These new capabilities are the tools necessary for ATC to reconfigure airspace in conjunction with the introduction of new separation standards which together will allow aircraft to operate on better time tracks with less fuel reserves, consequently allowing them to carry extra payload. Ocean 21 went operational at the New York ARTCC in June 2005 and the Oakland ARTCC in October 2005.

3.1.5 User Request Evaluation Tool or URET. URET permits the controller to predict potential aircraft to aircraft, and aircraft to airspace conflicts earlier, allowing them to construct alternative flight paths. URET allows these conflicts to be addressed in a strategic sense rather than a tactical sense, with fewer deviations to the route or altitude. Fewer deviations can result in less fuel burn. The system makes it easier for controllers to respond to pilot requests for more efficient routings, more fuel efficient altitudes, and wind-optimal routes, all of which can lead to fuel savings. Estimated savings from URET in FY 2005 are 25 million miles, and $175 million saved.

3.1.6 Airspace Redesign. Throughout 2005, a collaborative team of industry and FAA representatives worked to redesign the airspace in Florida to improve air traffic management efficiency and to reduce airspace complexity. This project is known as the Florida Airspace Optimization. The expected benefits of the airspace redesign for customers include: reduced flight distances on standard arrival and preferential routes into south Florida airports; reduced re-routes into adjoining foreign airspace which cause additional foreign over-flight fees; and reduced departure delays from Boston, New York and Washington, DC metropolitan airports to south Florida destinations. The projected annual cost savings related to the Florida airspace optimization is $18.2 million.

3.1.7 Terminal Area - Continuous Descent Arrivals (TA-CDA). TA-CDA operations keep arriving aircraft at their cruise altitude for longer than conventional approaches followed by a continuous descent to the runway at idle or near idle thrust, with no level flight segments. As depicted in Figure 1, this allows for optimization of a flight's vertical profile and reduces noise and emissions on approaches to airports. The procedure also minimizes the use of engine thrust during the descent, resulting in lower fuel burn. The actual fuel saving depends on the aircraft type and the nature of the descent; however, reductions of between 200 kg and 400 kg per flight, depending on aircraft size, are possible.



Standard flight paths, such as the one at Louisville (shown in blue) involve a series of stepped descents. New continuous descent approach procedures, collaboratively developed by an FAA/NASA/industry/academia team, have been shown reduce noise impacts by keeping aircraft higher, longer. They have also been shown to reduce fuel burn and emissions of local air quality pollutants. (Adapted from a Mike Covington illustration for The [Louisville] Courier Journal.)

Figure 1

Widespread implementation of TA-CDA, however, has been limited by the capabilities of both air traffic controllers and air traffic control automation. In an effort to further the development and implementation, the U.S. FAA has engaged in research efforts to quantify the benefits of and design procedures for TA-CDA implementation. Flight demonstration test at the Louisville International Airport were designed to evaluate the issues associated with embedding TA-CDA within the nominal traffic flow at the airport, analyze the capacity implications of these issues, and propose and certify an initial operational concept for a low-noise procedure that can be adopted in the near term. The research found reductions in flight time, fuel burn, NOx emissions, and noise levels. Details of this research is available on line at http://web.mit.edu/aeroastro/www/partner/reports/cda_rpt.pdf. The intent is that the outcome of this research will serve as models for the rest of the nation, and perhaps, the world.

4. CONCLUSIONS

4.1 Voluntary Operational Measures

4.1.1 Due to the growth of air traffic, one can expect some increasing public pressure for the limitation or reduction of aviation related CO2 emissions in the upcoming years. ICAO has a leading role in promoting the implementation of measures to minimize or reduce the impact of aviation emissions in climate change, and needs to ensure that all measures taken to improve the efficiency of air transport are monitored and reported in terms of environmental savings. In addition to operational measures, ICAO is currently researching the development of guidance for a number of market-based measures for possible use to limit or reduce GHG emissions in a cost-effective manner.

4.1.2 As is evident from the large number of cooperative, operational endeavors already underway on a voluntary basis within the aviation sector, there exist significant scope for airlines, airports, and air navigation service providers to work together to reduce aviation's emission intensity. The United States believes there remain significant opportunities to broaden and expand the level of cooperation among these actors in the aviation sector to reduce the GHG emission intensity of future air traffic growth.

4.1.3 Voluntary measures based on cooperation and mutual gain can be adopted today. Unlike either emissions charges or emissions trading options, voluntary measures pose no significant legal, cost, or administrative issues, and would not impose significant additional costs on an industry which has lost $42 billion since 2001. We believe that by working together on a voluntary basis among airlines, airports, and air traffic service providers, we can make substantial gains in reducing aviation's greenhouse gas intensity while achieving other objectives of advancing economic progress, alleviating poverty, improving human health, and reducing harmful air pollution.

4.1.4 ICAO is currently taking the necessary steps to facilitate the reporting of voluntary measures to reduce aviation emissions. We believe ICAO should take note of the many voluntary, operationally focused initiatives and encourage an active dialogue among airlines, airports, and air traffic service providers to adopt voluntary, operationally driven measures to reduce the GHG emission intensity of aviation growth.

5. **ACTION BY ALLPIRG**

5.1 The ALLPIRG/5 Meeting is invited to:

a) note the information provided in this paper;

b) urge air navigation authorities to prioritize the implementation of voluntary, operationally based improvements in their air traffic management with emphasis on fuel, emissions and noise benefits to help mitigate the costs to industry and to reduce environmental impact;

c) urge airlines and airports to work with air navigation authorities to implement measures in item b) above; and

d) urge countries to work together on a bilateral or regional basis to foster measures in item b) above.

— END —