

METROPOLITAN AIRPORTS COMMISSION

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December 15, 2016

Airports Council International-North America

PO Box 5007

Client ID 500022

Merrifield, VA 22116-5007

To Whom It May Concern,

It is with great enthusiasm that I am submitting the Metropolitan Airports Commission Environment Department for consideration of the 2017 ACI-NA Environmental Achievement Award. This submittal addresses each of the selection standards to demonstrate why the Optimized Profile Descent application built by the MAC is deserving of the award.

Thank you for the opportunity to submit this innovative effort for consideration. For any additional information on this topic, beyond that submitted herein, please feel free to contact me.

Sincerely,

Dana Nelson

Manager of Noise, Environment & Planning

Metropolitan Airports Commission



2017 ACI-NA Environmental Achievement Award Entry Form *One Project per Entry Form*

Entries due Friday, December 16th 2016

Award applications must be submitted **electronically** in PDF or Microsoft Word format. Applications must be double-spaced and may not exceed 30 pages including all text, graphics and photos. The entry form and letters of support do not count toward the 30-page limit. Entry form and accompanying payment information may be e-mailed, faxed or mailed to the address below, but must be received by the deadline.

Please check to ensure your application(s) include the following:

- Completed official ACI-NA Environmental Achievement Award entry form;
- Entry fee for airport project award nominations only (\$85) – there is no fee for nominees of the individual award;
- One-page application summary, signed and dated by the lead applicant representative;
- Narrative fully describing the project, program, or initiative and how it meets the selection criteria described in the instructions document; and
- At least one letter of support from an entity(ies) other than the applicant(s). For the individual award, the letter of support may come from the primary nominator (i.e. person other than the individual being nominated for recognition)

Metropolitan Airports Commission

Airport Name

Dana Nelson

Contact Name

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MAC Optimized Profile Descent Application and Associated Emission Reduction Results

Project Name

We no longer require airports to select their award category! The judging panel will select a winning project for each of the four awards categories from the full list of nominated projects. The four categories are:

- Environmental Management
- Mitigation
- Outreach, Education and Community Involvement
- Innovative/Special Projects

Entry Fee Due: \$85.00

Payment by

- Check (made payable to ACI-NA)
- Credit Card

Please fax your forms with credit card information to 202-478-0889 or if you have an electronic fax service, you can send your information to our secured eFax email address at: 12024780889@efaxsend.com. For security reasons please **do not** email your credit card information to an ACI-NA staff email address.

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Mail Checks to:
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PO Box 5007
Client ID 500022
Merrifield, VA 22116-5007

Fax or EFax credit card information to:

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MAC Optimized Profile Descent Application and Associated Emission Reduction Results

Submittal for 2017 ACI-NA Environmental Achievement Award

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INTRODUCTION

The Metropolitan Airports Commission (MAC) Environment Department works to reduce the negative environmental impacts of operating an international airport within a major metropolitan area. (The MAC, a public corporation of the State of Minnesota, owns and operates Minneapolis-St. Paul International Airport (MSP) and six reliever airports located in the Minneapolis-St. Paul metropolitan area.) Much of the MAC's work involves helping communities and their residents understand the complexities associated with operating an airport as well as celebrating achievements to reduce the environmental impacts to these communities. The MAC Environment Department prides itself in being innovative, resourceful and technically skilled to provide valuable information to the communities, air traffic control and airport users and to pinpoint realistic opportunities to reduce environmental impacts. A critical component to these efforts include shedding light on the results and outcomes of activities that reduce environmental impacts.

In 2016, the MAC Environment Department accomplished a significant and innovative achievement by developing an application to quantify up-to-date fuel savings and emission reduction during the descent phase of flight resulting from the implementation of Optimized Profile Descents (OPDs) at MSP.

BACKGROUND

The first step to collaboratively implementing OPDs originated in 2005 with the MSP Noise Oversight Committee (NOC). In August 2005 a request was submitted by the MAC Board under the recommendation of the NOC that the Federal Aviation Administration (FAA) develop a Continuous Descent Approach to Runway 35 as a test. While this request was not granted, it

began to pave the way for the FAA to consider Performance Based Navigation (PBN) procedures at MSP.

In 2007, the NOC evaluated PBN procedures in an effort to learn how Area Navigation (RNAV) technology might enhance existing noise abatement procedures at MSP. As part of these efforts, the NOC worked with Northwest Airlines (now Delta) to design and flight-test procedures.

Then, in 2011, as part of its NextGen Initiative, the FAA identified MSP as an airport suitable for development and implementation of airspace-wide PBN arrival and departure procedures.

Realizing the FAA's initiative had the potential to generate new and/or different noise impacts around MSP, the NOC established a list of minimum expectations for the FAA to consider when it began designing PBN procedures for MSP. One of the expectations was that a public information program would be conducted by the FAA to inform the public of the new procedures prior to procedure implementation.

In its response, the FAA acknowledged the group's work, but noted that since MSP was not part of a larger Metroplex project, the budget and timeline would not allow for the public information program.

Disappointed but not dissuaded, the NOC attempted to meet community expectations on its own by requesting MAC staff conduct a PBN noise analysis and present the findings at two public open houses. Through this act of bold transparency, the NOC ensured surrounding communities received the data needed to ultimately bring their concerns about the proposed procedures before the MAC board.

Soon thereafter, the FAA sought the MAC's agreement on implementation of PBN departure and arrival procedures at MSP. However, based on concerns expressed by communities located northwest of the airport, the board told the FAA it could not support PBN departure procedures to the north of the airport and would only support proposed procedures for aircraft departing to the south of the airport. The MAC board and NOC recognized the potential environmental, economic and safety benefits of implementing PBN arrival procedures due to OPDs and the minimal changes that would result from flight tracks close-in to the airport; therefore, PBN arrival procedures received full support. In the end, the agreement was to implement only PBN arrival procedures, incorporating OPDs.

As a result of the collaborative efforts beginning in 2005 between the airport and community stakeholders, in March 2015 the FAA implemented PBN arrival procedures at MSP. The MAC Environment Department, along with several other stakeholders, felt it was crucial to quantify the procedures' environmental benefits. While the FAA monitors and reports some of this information through a dashboard website, local stakeholders found the information inadequate and significantly delayed. To fill the void, MAC Environment Department partnered with the FAA's Airports Planning and Environmental Division, the MSP Air Traffic Management and Delta Air Lines to develop an application to track OPD usage. With actual flight track and fuel burn data, the MAC is able to quantify fuel and carbon emission reductions for real-time, event-based reporting. This is a one-of-a-kind application and a significant advancement in quantifying the benefits of PBN procedures around the U.S.

This document addresses the criteria for the ACI-NA Environmental Achievement Award to demonstrate that the MAC Environment Department's OPD application achieves each of the following: environmental benefit, innovation, effective implementation, widespread applicability and cost effectiveness.

ENVIRONMENTAL BENEFIT

The project should achieve overall environmental benefits. Benefits should be demonstrated through a comparison of the state before implementation to the state after implementation using quantitative performance measures.

MSP is a large hub airport operating within a dense urban environment. As the airport owner, the MAC has voluntarily reported on Greenhouse Gas (GHG) Emissions associated with MSP on a bi-annual basis. The most recent Greenhouse Gas Inventory Report highlighted that more than 95% of all emissions associated with the operation of MSP result from aircraft. Further, 85% of all MSP emissions are the result of aircraft emissions above 3,000 feet AGL. While the MAC remains committed to monitoring and, when possible, reducing GHG emission from all sources associated with MSP, the greatest possible reductions are from the aircraft. From an emissions and noise reduction standpoint, the MAC has continually supported the use of emerging technologies to decrease the impact of the airport on the environment.

As discussed in this paper, the MAC began to work collaboratively to develop airspace wide PBN arrival and departure routes for MSP. This work ultimately led to the implementation of RNAV Standard Terminal Arrival Route (STAR) procedures with OPDs at MSP in March 2015. Prior to these procedures, aircraft arrivals were taking a stair-step approach to the airport at the direction

of Air Traffic Control. After implementation, the MAC Environment Department set out to quantify the environmental benefit and to demonstrate the advantages of implementing these procedures for all stakeholders, including the communities, airlines, the airport and the FAA. The MAC developed an OPD application to accomplish this task.

According to the MAC's OPD application, from April 1, 2015 through November 30, 2016, 86.3% of the arrivals to MSP have flown an OPD. Compared to the fuel burn and emissions from traditional approaches, these arrival procedures have saved MSP carriers 7,880,190 gallons of fuel during the descent phase of flight. The fuel savings prevents 77,552 metric tons of CO₂e emissions from being released into the atmosphere during descent. On an annualized basis, OPD arrivals save 44,659 metric tons of CO₂e from being emitted every year during descent.

INNOVATION

The project should exhibit innovation in working toward an environmental solution at the airport or surrounding community. Examples include new technologies, methods or information, or innovative methods of implementing or utilizing existing technologies, methods of information.

In terms of human capital and technical systems, the MAC Environment Department has assembled a highly-technical operation for solving complex spatial inquiries using nimble, lean methodologies. This led to the Environment Department to embark upon answering a simple question: How much jet fuel is saved because of OPD? The process required to get accurate results is anything but simple.

In its simplest form, the OPD application determines whether an aircraft flew an optimal descent profile or not. For those that did, fuel reduction values provided by the airlines are applied to the flight.

The OPD application uses a number of innovative technologies for data processing and analysis. The most critical of these technologies is the PostgreSQL database and PostGIS spatial database extension used for storing and calculating data related to OPD. PostgreSQL and PostGIS are both industry-leading open source technologies that allow staff to quickly and easily create multiple database environments to run comparative analyses when developing and testing techniques. Staff took advantage of new functionality available in PostgreSQL version 9.5 to improve the efficiency and performance of the application.

Since complex spatial analysis on large datasets requires significant administrative overhead (i.e. calculation time, data storage, etc.), the application uses the Docker containerization platform. By using new features such as Docker Swarm, the processing within the application is able to be horizontally scaled to improve calculation time. Finally, the use of containerization and open source technologies was critical in developing a process that can be easily shared and implemented at other airports. Without these emerging open source technologies, none of the benefits demonstrated by the OPD application would be possible within the current organizational framework of the MAC.

Currently, the application uses three sources of data: actual flight data supplied from the FAA Airports Planning and Environmental Division and actual fuel burn data from Delta Air Lines and Endeavor Air.

Four-dimensional (latitude, longitude, altitude and time) flight track data for every flight arriving to MSP is being supplied by the FAA Air Traffic Organization Performance Analysis Office each hour. Using this data, the MAC Environment Department's technical experts constructed a flight performance profile for each arrival from top of descent down to the ground. The OPD application then calculates the top of descent location, flight track descent distance, descent duration, level flight segments during descent, percent of descent in level flight, and average rate of descent.

Using statistics about each flight, MAC staff conducted interviews with local FAA air traffic control personnel, completed field observations at Minneapolis Center and TRACON facilities and confirmed application assumptions by listening to ATC/pilot radio transmissions. By building associated criteria from these sources into the data processing, the application can positively identify which aircraft flew a descent profile representative of a pure OPD and which aircraft flew a descent that had characteristics of a conventional stair-step approach.

Having the knowledge of which aircraft flew an efficient, environmentally-friendly descent is merely a novelty. To truly know the environmental benefits during descent, a final set of data had to be obtained. The MAC Environment Department leveraged existing professional relationships to acquire actual fuel burn data from Delta Airlines and Endeavor Air. These airlines provided average fuel burn values during descent and approach for each aircraft in their fleet, by MSP runway before OPD procedures were implemented at MSP and after. This accounts for 71.2 percent of the total fleet mix at MSP. The application applies the appropriate fuel savings for each OPD arrival according to the aircraft type and arrival runway.

There was still approximately 28.8 percent of the MSP fleet mix not accounted for in the actual fuel burn data. For continued enhancement in the OPD application, the MAC is currently working with its environmental consulting partners, Wenck Associates to fill in this portion of the dataset using the fuel burn modeled in the Aviation Environmental Design Tool.

EFFECTIVE IMPLEMENTATION

The project should be effectively implemented in a manner that achieves maximum environmental benefit while cooperating with necessary stakeholders and partners and minimizing time, effort and cost.

After 19 months of collaboration and effort, the MAC's OPD application was first presented in November 2016 to the MSP Noise Oversight Committee. At this time, preliminary results accounting for a third of the arrival operations at MSP were presented. By December, the application completed the calculation of the remaining historical operations. Additionally, the process to calculate each day going forward was built into the application for ongoing, timely reporting.

Policy makers in the local communities and on the MAC Commission provided support for implementing the arrival procedures, realizing the environmental, economic and safety benefits. At that time, they also communicated their expectation to quantify the environmental benefit after the routes were being flown and to report back to the airport's neighbors. Specifically to MSP's OPD procedures, the FAA is currently reporting statistics using two metrics: Average Number of Level-offs per Flight and Distance in Level Flight from Top of Descent to Runway Threshold. In general for the National Airspace System, the FAA currently reports Average Fuel

Burn and CO₂ emissions for the entire airspace system. The local policy makers who supported these procedures wanted MAC to further expand on these statistics for more specific and timely reporting for MSP. The MAC Environment Department worked diligently on developing a solid method to build the OPD application.

The cooperation between the MAC, the airlines, the FAA and the surrounding communities was absolutely critical to building and validating the OPD application and communicating the resultant benefits. All stakeholders were active early on during the PBN procedure design phase, there was ownership in the project from all stakeholders. When the time came to build the OPD application, the same parties were asked to provide resources in terms of expertise, consultation and data. As a result of the input of all the stakeholders, the OPD application has been built with a strong foundation of accurate data and solid methodology and is able to demonstrate substantial emissions reductions for aircraft arriving to MSP. This benefit is used to tell the story of successful NextGen implementation at MSP and explain real world benefits to the non-aviation community.

WIDESPREAD APPLICABILITY

The project should contribute information, technology or techniques that provide an environmental benefit while demonstrating the potential for applicability at other airports.

From its infancy, the OPD application was designed with the intent to apply its benefit across the country. This paper discusses the technology and the methods that were utilized for building the application. Using open source database technologies and containerization will allow this tool to

be applied at other airports. Further, the ability of other facilities to reap the benefits of this tool are enabled because the source data was directly supplied from the FAA.

The story of PBN and OPD implementation at MSP is one of partnership, innovation and substantive environmental benefit. Absent the OPD application, this story could not be told. It also represents a stark difference from the current narratives that can engulf an airport and a community when discussing implementation of PBN procedures. In the Minneapolis-St. Paul Metropolitan area, we are as cognizant of aircraft noise as any facility in the country. Even in this engaged community with high expectations, the environmental, economic and safety benefits of PBN were a driving consideration for local decision-makers. Providing concrete evidence of their worth to the non-aeronautical community was crucial to share the complete story.

COST EFFECTIVENESS

The project should be cost effective as demonstrated through a cost-benefit analysis or other cost comparison technique.

For many years, the MAC has maintained a conservative economic stance in the industry. Using cost per enplaned passenger as a crucial metric, the MAC strives to keep MSP in the lower ⅓ of large hub airports to remain financially viable, provide an economic benefit to our tenant airlines, and help control the price of air travel for the public. This stance, while prudent, does not allow grandiose resource spending on superfluous projects. The MAC operates with fiscal conservatism, which deepens a staff culture of innovation and efficiency. The OPD application is the result of the staff technical abilities and innovation and little financial investment.

The staff of the MAC Environment Department relied both on their shared expertise and the technical systems already in place. There was no budget allocated specifically to the OPD application. The only cost to the MAC for project development was staff time. When the programming code was completed, the MAC invested a minimal budget for fuel data augmentation and verification with its environmental consultant, Wenck.

Of course, the PBN procedures themselves have significant cost-savings benefits by saving nearly 8,000,000 gallons of fuel during descent into MSP since implementation. Those 8,000,000 gallons have reduced the airline's impact on the environment by eliminating more than 77,000 metric tons of CO₂e emissions from reaching the atmosphere. While cost-benefit analysis of PBN procedures is happening at a congressional level, the OPD application is a tool that more aptly allows it to occur real-time with single-airport specificity. Moreover, the OPD application provides a realistic approach to quantifying substantial environmental reductions from airport operations that would otherwise go unreported.

CONCLUSION

To get toward carbon neutrality, consideration must be paid to aircraft operational efficiencies in flight—the source that contributes 95% of the carbon footprint at MSP. The airport and the communities around MSP saw that opportunity in 2012 and affirmed their environmental stewardship commitment by supporting the implementation of PBN arrival procedures. Now that the procedures are in place, the MAC Environment Department has leveraged its expertise, technical systems and its history of successfully tackling complex questions to present the industry with a successful PBN implementation with demonstrated environmental benefits.

This submittal is a true example that the MAC Environment Department continues to pioneer airport environmental solutions and is deserving of the 2017 ACI-NA Environmental Achievement Award.



Delta Air Lines, Inc.
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December 15, 2016

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To Whom It May Concern,

I hereby give my unqualified support to the Metropolitan Airports Commission's nomination for the 2017 ACI-NA Environmental Achievement Award.

Having served as the Noise Oversight Committee (NOC) Co-Chair for over four years and being in the airline industry for over 37 years, I can testify that the MAC Environment Department is one of the most professional groups I have ever worked with. This group continually demonstrates innovation and collaboration and fosters data-driven discussions.

When the FAA implemented new arrivals at the Minneapolis-St. Paul International Airport, the MAC team embarked on an endeavor to build a tool for the sake of quantifying environmental and economic benefits from these procedures. In November 2016, MAC staff shared this tool and the effort that went into building and validating it as well as some of the preliminary results. The NOC was in agreement that this was certainly an admirable achievement.

For these reasons, the MAC Environment Department should be a clear winner of this prestigious award.

Sincerely

A handwritten signature in black ink that reads 'Jeffrey Hart'.

Jeffrey Hart
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