Progression of Human Factors Considerations for the In-Trail Procedure

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The In-Trail Procedure (ITP) is one of the Automatic Dependent Surveillance-Broadcast (ADS-B) applications in the NextGen program. The Federal Aviation Administration, in partnership with United Airlines, is conducting an operational evaluation of the ADS-B ITP on revenue flights between the West Coast of the United States and various Pacific destinations. Part of this evaluation is a human factors assessment of the equipment and procedures from the users' perspective. Here, we provide an update to the human factors issues identified in 2013 and show that pilots' and controllers' acceptance of the ITP maneuver has improved. Pilots see the ADS-B traffic display as a valuable tool for situation awareness and use it to increase flight efficiency/safety. While more interactive ITP training was suggested, pilots are comfortable interacting with the display and provided insights as to why ITP requests are so infrequent. Controllers are no longer confusing ADS-B ITP with the Automatic Dependent Surveillance-Contract Climb/Descend Procedure and are no longer reluctant to approve a valid ITP request. Controllers' concerns have been largely addressed with training and/or will be addressed with changes to the automation platform.

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APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
oz	ounces	28.35	grams	g
		TEMPERATURE (exact degrees)		
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
mL	milliliters	0.034	fluid ounces	fl oz
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
g	grams	0.035	ounces	oz
		TEMPERATURE (exact degrees)		
°C	Celsius	1.8C+32	Fahrenheit	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	Kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380. (Revised March 2003)

Contents

Acronyms and Abbreviations

AC	Advisory Circular
ADS-B	Automatic Dependent Surveillance-Broadcast
ADS-C	Automatic Dependent Surveillance-Contract
ATC	Air Traffic Control
ATOP	Advanced Technologies & Oceanic Procedures
CBT	Computer-Based Training
CDP	ADS-C Climb/Descend Procedure
CPDLC	Controller Pilot Data Link Communication
FAA	Federal Aviation Administration
FMC	Flight Management Computer
ITP	In-Trail Procedure
kts	Knots
LCA	Line Check Airman
NATCA	National Air Traffic Controllers' Association
NM	Nautical Miles
SBS	Surveillance and Broadcast Services
SFO	San Francisco International Airport
TCAS	Traffic Alert and Collision Avoidance System
UAL	United Airlines
ZOA	Oakland Air Route Traffic Control Center

Preface

This report was prepared by the Aviation Human Factors Division of the Safety Management and Human Factors Technical Center at the John A. Volpe National Transportation Systems Center. It was completed with funding from the Federal Aviation Administration (FAA) Human Factors Division (ANG-C1) in support of the FAA Office of Aviation Safety (AVS), including Aircraft Certification Service Systems and Equipment Standards Branch (AIR-130), and Flight Operations Branch (AFS-410). We are thankful for our support from ANG-C1, including Regina Bolinger, Sheryl Chappell, Joey Jaworski, Nick Lento, and Rachel Seeley. We would like to thank our technical sponsors at the FAA Cathy Swider, Don Walker, and Paul Von Hoene; stakeholders Doug Arbuckle, David Gray, and Ken Jones; and Captain Rocky Stone at United Airlines. The team is grateful to Scott Conde and JT Lenhart (National Air Traffic Controllers' Association) and Dustin Byerly (Manager, Oakland Oceanic Airspace and Procedures) for arranging the discussions with controllers.

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Executive Summary

The In-Trail Procedure (ITP) is one of the Automatic Dependent Surveillance-Broadcast (ADS-B) applications in the NextGen program. It increases opportunities for aircraft in oceanic airspace to climb or descend to an optimal flight level through the use of ADS-B technology. The use of ITP is intended to allow aircraft to fly at more fuel-efficient altitudes more often (reducing both fuel use and emissions) and increase passenger comfort and cabin safety by vacating turbulent altitudes.

The Federal Aviation Administration (FAA), in partnership with United Airlines (UAL), is conducting an operational evaluation of the ADS-B ITP on revenue flights between the West Coast of the United States and various Pacific destinations. Part of this evaluation is a human factors assessment of the equipment and procedures from the users' perspective. Quantitative (e.g., request/approval rate) data is continuously collected from Oakland Air Route Traffic Control Center (ZOA). In September 2013, user comments were solicited from both pilots and controllers who have used, or were in a position to use, ITP. This information revealed that pilots were reluctant to request an ITP maneuver (and the reasons for that reluctance) and identified controllers' concerns for approving the ITP requests (Lennertz, Cardosi, & Donohoe, 2013). The discussions helped to identify a number of potential training issues for both pilots and controllers that were inhibiting the full realization of ITP benefits. Pilot opinion was that 'hands-on' experience with the procedure before use on revenue flights could increase pilot confidence in the procedure and thus increase the frequency of ITP requests. Controllers at first tended to confuse ITP with the Automatic Dependent Surveillance-Contract (ADS-C) Climb/Descend Procedure (CDP) and then identified several concerns about ITP specifically regarding training and automation (i.e., the need to override conflict probe to approve the ITP request).

The present report provides an update to the human factors issues identified in 2013 and shows that the attitudes toward ITP have changed, with marked improvements in both pilots' and controllers' acceptance of the ITP maneuver. While pilots are not requesting an ITP maneuver at every opportunity, they accept the ADS-B traffic display (including both "plan view" and "ITP view") as a valuable tool for situation awareness and use it to increase flight efficiency and safety. While they are quick to suggest more interactive training for ITP, they are also comfortable interacting with the display. Pilots provided insights as to why ITP requests are so infrequent and look forward to the equipment being in more aircraft and the procedure being an option in the Atlantic.

Controllers, though somewhat unfamiliar as a function of the infrequency of requests, are no longer confusing ADS-B ITP with the ADS-C CDP, nor are they reluctant to approve a valid ITP request. Controllers' concerns have been largely addressed with additional training and/or will be addressed with planned changes to the automation platform (so controllers do not need to override the conflict probe to approve an ITP request). Both pilots and controllers welcomed the information that the fuel savings as a result of ITP equipage has been measured and averages almost 600 pounds of fuel per flight. A collateral benefit of the discussions was a renewed interest in ITP by both pilots and controllers. Continued performance monitoring will determine if this renewed interest results in more ITP requests.

1. Introduction

The In-Trail Procedure (ITP) is one of the Automatic Dependent Surveillance - Broadcast (ADS-B) applications in the NextGen program (NextGen Implementation Plan, FAA, 2013). It allows an aircraft in non-radar oceanic airspace to climb or descend to a flight level through altitudes that would have been blocked by conventional separation standards. Using ADS-B technology, an aircraft can calculate its speed and distance from ADS-B Out equipped aircraft and make an ITP request. If certain criteria are met, Air Traffic Control (ATC) may approve the aircraft for the ITP climb or descent. The use of ITP can allow aircraft to fly at more fuel-efficient altitudes, reduce fuel consumption, and have a positive impact on both the economy and environment (Chartrand, Bussink, Graff, & Jones, 2009; Martensson & Rekkas, 2009; Murdoch, Bussink, Chamberlain, Chartrand, Palmer, & Palmer, 2008). Aircraft may vacate turbulent altitudes, increasing passenger comfort and cabin safety (Murdoch et al., 2008, RTCA DO-312, 2008; RTCA Supplement, 2012). A full description of the ITP procedure is provided in the appendix and it is now included in the ICAO *Procedures for Air Navigation Services – Air Traffic Management* (PANS-ATM, Doc 4444), section 5.4.2.7.

The Federal Aviation Administration (FAA) Surveillance and Broadcast Services (SBS) Program, in support of the FAA's Aircraft Certification Service and Flight Standards Service (responsible for evaluating and approving systems, equipment, and procedures) and in partnership with United Airlines (UAL), is conducting an operational evaluation of the ADS-B ITP on revenue flights between the West Coast of the United States and several Pacific destinations (see IPACG/38, IP/04 and IP/10, 2013). Quantitative data on the number of ITP requests, approval rate, and effect of the approvals are continuously collected (see FAA, 2015). The fuel savings has already been quantified: FAA has estimated that "for every flight of an ITP-equipped airplane, that airplane saved an average of 573 pounds of fuel over an aircraft that did not have ITP equipment." (FAA, 2015, p. 7). ADS-B ITP operations in the U.S. are only authorized in the Oakland Oceanic Flight Information Region, but use of the ITP display is not restricted to any particular airspace. While it is clear that flight crews are using the ITP equipment to improve their operations, the number of actual ITP requests remains unexpectedly low (approximately five per month in 2015 in Oakland airspace, see also Cardosi & Lennertz, 2015). The fuel savings observed is more a function of the use of the ADS-B traffic display than approved ITP requests. How the pilots are using the display, the reasons for the lack of ITP requests, and reasons for controller denial of valid ITP requests could only be assessed through discussions with pilots and controllers.

Discussions were originally conducted with five oceanic controllers at Oakland Air Route Traffic Control Center (ZOA) and 21 UAL 747-400 pilots at San Francisco International Airport (SFO) in September 2013. This paper describes the results of follow-up discussions conducted with five controllers at ZOA and 16 pilots at SFO in January 2016. The goal of these discussions was to learn about pilot and controller experience with ITP, including perceived benefits, drawbacks, and suggested improvements. In each case, participants were asked, "What do you think about ITP?" Additional questions were formulated based on the participants' responses. Controllers were selected on the basis of availability and discussions were held in a conference room at the facility. Similarly, any available 747-400 pilot was invited to share their thoughts on ITP in a conference room at the crew briefing facilities at SFO; most of these pilots were about to depart on an equipped aircraft. Pilots were either interviewed individually or with additional pilots (usually the crew that they were about to fly with).

This paper provides a summary of the January 2016 discussions, comparisons with the 2013 discussions, and insights into ways to further increase the success of ITP and realize projected and collateral benefits.

2. Pilot Discussions

Informal discussions with pilots were organized and hosted by UAL at United's Flight Operations Office at SFO on January 18 and 20, 2016. A total of 16 Boeing 747-400 pilots (eight Captains and eight First Officers) provided feedback over the two-day period. All but one of the pilots, even those who had never requested an ITP, regarded the ADS-B traffic display (both "plan view" and "ITP view") as a valuable tool for situation awareness and used it routinely to increase the safety and efficiency of the flight. In fact, a few of the pilots who stopped in to give their feedback were solely interested in helping to ensure that the display was not removed from the aircraft. The pilot who did not use the ADS-B traffic display mentioned that he "relies on TCAS" (Traffic Alert and Collision Avoidance System) for situation awareness. Another pilot said that he "didn't find it that useful … on the other hand, it's good to see who's around us".

By far, the general consensus was that the ADS-B display (both "plan view" and "ITP view") is "a very useful tool". When pilots were told that measured fuel savings, resulting from the use of ITP equipage, averages almost 600 pounds of fuel per flight (FAA, 2015), they welcomed the information.

2.1 Uses of the ADS-B Traffic Display (both "plan view" and "ITP view")

2.1.1 ITP Requests

The vast majority of pilots (14 of 16) had made at least one ITP request, either in the South Pacific or Oakland airspace; on average about half of the ITP requests were approved[1]. Several pilots mentioned that they look forward to being able to use ITP in the North Atlantic. Only two pilots (one who said he did not know what ITP was until reminded of what the acronym stands for) said they had never made an ITP request, but even they cited the usefulness of the ADS-B traffic display for situation awareness saying "it's nice to know who's around us". Only one of the 16 pilots, a captain, said he did not use the ADS-B traffic display for situation awareness, saying, "I rely on my TCAS". This captain said ITP was a "good idea, but

[1] Some requests had been denied because the target aircraft was not UAL – this was an error on the part of ATC that has since been corrected in training.

I'm not a fan", despite the fact that he had a first officer request an ITP climb and it was approved. Further discussion revealed that this negativity was based on the false assumption that pilots were accepting separation responsibility during the ITP maneuver. He also noted the effects of fatigue and a vulnerability to error during a long flight and noted, "I'm not a fan of Tailored Arrivals either." After being informed the Advisory Circular (AC 90-114A) states that ATC retains responsibility for separation assurance during the ITP maneuver, he changed his view of ITP and suggested that the ITP checklist be put on a quick-reference card.

2.1.2 Other Uses

In 2013, pilots reported several uses for the ADS-B traffic display outside of the ITP procedure. In 2016 pilots reported these same uses:

- Call aircraft ahead, above, or below them to inquire about turbulence; the traffic display is particularly helpful in this regard because it shows the aircraft flight identification (ID).
- Support route changes and altitude requests that have a greater chance of being approved (since it is easier to see conflicting traffic). In 2016, a pilot said, "We no longer have to wonder 'Why didn't I get this altitude?' – you can figure it out." Most pilots, however, do not know what the separation standards are. Even those who are familiar with separation standards in general have no way to know which standard the controller is applying for a given pair of aircraft.
- Help route them around convective weather (and all of the other aircraft trying to do the same).
- See who might be ahead of them and competing with them for Customs and Immigration resources upon arrival. While this might appear to be trivial, it actually has practical and operational implications. The larger the aircraft ahead of them, the larger the lines will be in customs. Large lines result in disgruntled passengers, increased chances of missed connections, and the need for airline rescheduling.
- In addition, several pilots in 2016 reported using the display to examine the traffic situation and strategically manage their airspeed to avoid holding as they approached a busy airport. As one pilot stated, "I can see aircraft vectored for holding or path vectoring before holding is announced and slowdown 200 miles away" (i.e., to avoid it and potentially save fuel).
- An additional use identified in 2016 was to call aircraft ahead, above, or below them to inquire about winds or to call blocking traffic and ask when they would be able to climb. Each of these uses can increase fuel efficiency.

2.2 Training

In the 2013 discussions with pilots, the most common negative comment was that pilots were apprehensive about requesting an ITP due to the lack of hands-on training for the procedure. Pilots who preferred having the equipment and procedure available to them also had the benefit of hands-on, interactive training; these were either Line Check Airmen (LCAs) or pilots who had trained with a LCA. Most of the line pilots, however, had received only the computer-based training (CBT) module (i.e., essentially a PowerPoint briefing with narration). This training covered the intent and mechanics of the ITP, explained the conditions under which an ITP could be requested, and how to use the equipment to see if a climb or descent could be requested. If the ITP conditions were met, the "ITP view" on the ADS-B traffic display would show the pilot the words to use to communicate the ITP request via Controller Pilot Data Link Communication (CPDLC). This tutorial was a presentation only and did not include any opportunity to interact with a mock-up of the system. Several pilots stated that they did not feel that the CBT alone was sufficient training for a reduced-separation maneuver. Not surprisingly, this sentiment was echoed in the 2016 discussion: none of these pilots had experienced the revised training, since it is only available to pilots in initial training for the B747-400 aircraft. However, the pilots' general consensus was that they would feel comfortable requesting an ITP if they needed it (i.e., were stuck at an undesirable altitude).

The discussions in 2013 revealed that some pilots were reluctant to use the ADS-B traffic display because they thought that it was connected to the Flight Management Computer (FMC). These pilots said they were more likely to use the display after understanding that it is not connected to the FMC. In 2016 it was clear that pilots were comfortable using the display options and most pilots used it on a routine basis to increase flight safety and efficiency.

2.3 Display Considerations

In 2013, only one pilot had said that he never turned the display on (due to the training issue). The rest thought that the display was very helpful (even if they had never requested an ITP) for traffic situation awareness. However, none of the pilots liked the location of the ADS-B traffic display in the B747-400.

In 2016, only a few negative comments were received on the placement of the display. One captain noted a serious concern – interference with the tiller (steering) – but said that this seemed to have been resolved. None of the other complaints were safety-related (e.g., "Now I have no place for my crew meal."). However, several pilots mentioned that they wished the information on the ADS-B traffic display was integrated into other displays[2].

2.4 Equipage

Several pilots lobbied for increased equipage. At the time of the 2016 discussions, 11 of the 23 aircraft in the fleet were equipped with two of the 11 displays deactivated until they could be repaired. Three pilots said that they had heard that the displays were being removed – one of these pilots said that he has been asked by co-pilots if they're "supposed to" (as in allowed to) turn it on. This type of uncertainty

[2] In other aircraft, United desires to integrate this information on the Navigation Display, as this is the implementation on most recent Airbus and the Boeing 787.

hinders usage. When ITP was first installed on the aircraft in 2011, pilots were not authorized to turn on the display until after they completed the training. As of April 2013, all United pilots are trained on ITP. It is included in the transition training curriculum so any new B747-400 pilots at United will be trained prior to flying the aircraft.

2.5 Recommendations

Pilots noted an uncomfortable level of lack of familiarity with how to make ITP requests. They attributed this to too few opportunities to make ITP requests due to the limited equipage, limited airspace in which it can be used, and not being needed very often when on random routes. As one pilot suggested, the 747 monthly newsletter could be used to publish an “ITP update” to raise awareness amongst crews of the uses of the display and inform them of the measured benefits of ITP equipage on fuel savings. In addition to a brief description of the procedure and the checklist to be used for ITP, it would be helpful to notify crews of the company’s plans for equipage and changes to ATC that will help to approve ITP requests more readily. Timing of the publication would be most effective in conjunction with these changes to the ground automation.

In order to contact the aircraft directly or to refer to the aircraft to ATC, pilots need to translate the displayed aircraft flight ID to the call sign used over voice. Some of these translations are likely to be familiar to pilots (such as UAL for United and AAL for American). Others, such as AZA for Alitalia, DLH for Lufthansa, AAR for Asiana, and QFA for Qantas are less likely to be familiar. It would be helpful for pilots to have a way to match the three letter identifier in the aircraft flight ID to the call sign prefix used over voice. This could as simple as a list of carriers that they are likely to encounter during their flight in the newsletter article, or this information could be placed on their iPads in a ready reference location.

3. Controller Discussions

ZOA management and the National Air Traffic Controllers’ Association (NATCA) jointly arranged the discussions with controllers on September 3, 2013 and then again on January 19, 2016. Discussions were held with five controllers in 2013. For the more recent discussions, five controllers were available from the oceanic areas in which ITP opportunities are most likely to occur.

During the discussions in 2013, it was clear that controllers were confusing ADS-B ITP with ADS-C based CDP and regarded both as labor intensive. In 2013, controllers were unaware of the information and equipment that the pilots use to make the ITP request, and of the planned changes to the controllers’ automation platform to improve the ITP procedure. Since then, the controller training has been revised and in 2016, only one of the five controllers interviewed was not sure about the differences between ITP and CDP until reminded. Note that confusing the nomenclature does not equate to confusing the procedures: the two procedures are operationally very different, involving different equipage and different checklists. Also as a result of the 2013 discussions, changes were made to the checklist used to approve ITP maneuvers. Controllers were informed that the checklist would only be required until ITP could be incorporated into the automation platform. At that point, controllers would also no longer need to override conflict probe to approve an ITP request.

Although one of the five controllers in the more recent discussion momentarily confused ITP with ADS-C maneuvers, it was clear that these controllers were not only aware of ITP, but also seemed supportive of the procedure and look forward to the Advanced Technologies & Oceanic Procedures (ATOP) automation incorporating it. Controllers noted the infrequency of the requests, which resulted in a lack of proficiency with the checklist of steps need to approve the request. One controller had just received and granted a request that morning. Because of the lack of practice, he said that he "ran through the checklist twice just to be sure I didn't miss anything". The only other request he could recall occurred when ITP first came out but, in that case, a standard climb instruction worked. Another controller was even less familiar, saying that he had "approved a request years ago, but haven't had any since – I wouldn't know where to find the checklist". At the other extreme, another controller recalled about 12 requests: a few were granted as ITP climbs, the rest as standard climbs. He stated, "I don't mind doing it [the checklist], but look forward to the automation being implemented."

The June 2016 update to the ATOP automation system is scheduled to incorporate ITP. This will have several advantages that should help make ITP maneuvers more frequent. First, controllers will no longer need to locate and run through the checklist. As it is now, the busier the airspace, the more likely pilots are to make ITP requests; but the busier the airspace, the more likely it is for controllers to be too busy to approve it. Second, controllers will not need to override the conflict probe in order to approve an ITP maneuver; overriding the conflict probe is, in general, ill-advised. Third, the flight deck automation is programmed to support ITP requests with an ITP distance of 15 nautical miles (NM) or more (per AC 90-114A). Controllers were trained to approve valid requests with a minimum ITP distance of 18 NM. This discrepancy caused some confusion between pilots and controllers, since they had different definitions of what was acceptable. The modification to the automation will remove this discrepancy, although it will be important for controllers to be informed of this change. Another miscommunication was that until recently, controllers thought that in order to be a valid request, both the requesting aircraft and the reference aircraft had to be UAL. A recent bulletin informed controllers that any aircraft making a valid ITP request can be given an ITP clearance.

The controllers in the 2016 study were more aware than those in the 2013 study that the value of ADS-B ITP extends beyond the procedure itself. For example, the ADS-B traffic display could be used to call other aircraft and ask them for ride reports. This negates the need for 1) the crew to ask the controller for similar information and 2) the controller to solicit the information from other aircraft. Controllers were pleased that flight crews use the display to make more informed requests of ATC, but noted that the increased awareness also made crews more critical of declined requests.

4. Conclusions

In 2016, the beneficial effects of increased pilot familiarity with the ADS-B traffic display and the revised training of controllers were readily observed. Unlike what was observed in 2013, controllers in the 2016 study were familiar with the procedure and would not hesitate to approve a valid ITP request. Also unlike what was observed in 2013, pilots in the 2016 study were comfortable using the display and cited several ways in which they use the display to increase efficiency and avoid turbulence. Both pilots and controllers would benefit from strategic updates. Notably, once the ATOP automation system is updated to include ITP, controllers will need to be informed through training that the required ITP distance is 15 NM instead of 18 NM. Pilots would benefit from hearing about: the measured benefits of ITP equipage, a reminder of the checklist steps for requesting an ITP, UAL's plans for increased equipage and implementation, and the changes to ATC automation that will increase the chances of having an ITP request approved. Continued performance monitoring will determine the incidence of ITP requests, approval, and fuel savings of equipped aircraft.

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6. Appendix: Description of the ITP

The In-Trail Procedure (ITP) uses Automatic Dependent Surveillance-Broadcast (ADS-B) technology to enable flightcrews to request a higher or lower altitude, typically blocked by procedural separation standards. To request an ITP, the flightcrew must use their on-board ITP display: 1) determine if an aircraft is blocking a climb or descent to their desired altitude (i.e., the reference aircraft), and 2) whether the criteria for an ITP maneuver are met. ADS-B provides the necessary information about the reference aircraft—including its call sign, flight level, direction of travel, ITP distance, and differential ground speed.

Several constraints must be met to qualify for an ITP maneuver:

- The reference aircraft must be on the same track (i.e., traveling within forty-five degrees of the same direction) as the aircraft requesting the maneuver (i.e., the ITP aircraft).
- The requesting aircraft cannot be a reference aircraft for another ITP clearance.
- The reference aircraft must have the ability to transmit ADS-B data out and cannot be in the process of maneuvering or be expected to maneuver.
- The reference and requesting aircraft cannot have an altitude difference greater than 2,000 feet (AC 90-114A).

Additionally, one of the two following speed and distance criteria must also be met:

- the difference between the two aircraft (i.e., both Reference and ITP) from a common point, termed ITP distance, must be equal to or greater than 15 nautical miles (NM), and the difference in ground speed between the two aircraft must be equal to or less than 20 knots (kts), or

- the ITP distance must be equal to or greater than 20 NM and the ground speed differential must be equal to or less than 30 kts.

Flightcrews can request either a climb or descent. Once the flightcrew determines that the ITP criteria are met, they send a request to ATC via CPDLC. Once the controller receives the ITP request, he/she will first examine whether a standard flight level clearance is possible. Assuming a standard clearance is not available, the controller will verify that the reference aircraft has not been issued a clearance (e.g., speed or flight level change), confirm that the speed criterion is met (closing Mach speed differential is less than or equal to 0.06; AC 90-114A), confirm that there is no other intervening traffic and that standard separation will be regained when the aircraft reaches its requested altitude. If these requirements are satisfied, the controller may issue an ITP clearance. Upon receiving the clearance, the flightcrew must re-confirm that the ITP speed and distance criteria are still met. Assuming this is the case, the flightcrew must execute the maneuver as soon as possible—maintaining their Mach cruise speed, and a vertical speed of at least 300 feet per minute (AC 90-114A). The controller maintains separation responsibility. Given that the speed and distance criteria are met at the time the clearance is accepted, the crew does not need to continue to monitor their distance to the reference aircraft. When the crew reports reaching the new altitude, the procedure is complete and standard separation is maintained.

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