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Proof-of-Concept Demonstration for the Proposed Runway 8R End Around Taxiway (EAT) at Hartsfield-Jackson Atlanta International Airport (KATL)

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12. Abstract

The City of Atlanta, Department of Aviation, and Delta Air Lines, Inc., propose the construction and operation of an End-Around Taxiway (EAT) at the approach end of Runway (RWY) 8R at Hartsfield -Jackson Atlanta Airport (KATL). To address this specific request, the FAA performed a proof-of-concept demonstration in a flight simulator to gather Human Factors (HF) and operational information, to potentially assist in the development, application, and approval of EAT procedures for aircraft departing RWY 26L at KATL while simultaneous EAT operations are being conducted at the approach end of RWY 8R. The intention was to evaluate the visual scene from a HF standpoint through elicited subjective responses and comments from aircrews, as well as objective observation of crew performance through closely scripted scenarios. From a human performance and limitation perspective, there is no appreciable increase in mental or physical workload that would compromise current levels of safety. There do not appear to by any HF-specific issues that should hinder progress towards further developing EAT procedures for departure operations at KATL. The results of a concurrent Collision Risk Model (CRM) study indicate that aircraft with tail heights of 55 feet or below presented acceptable levels of risk for unabated taxiing on the EAT and from a Teminal Instrument Procedures (TERPS) standpoint, there are 7 penetrations to the 40:1 and the 121.189 Engine-Out departure surfaces, all of which can be mitigated. Also, operationally, EAT implementation requires the development of airfield and flight procedures to ensure that appropriate levels of safety are maintained.

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EXECUTIVE SUMMARY

The City of Atlanta, Department of Aviation, and Delta Air Lines, Inc., propose the construction and operation of an End-Around Taxiway (EAT) at the approach end of Runway (RWY) 8R at Hartsfield-Jackson Atlanta International Airport (KATL). There are no regulatory criteria or standards that dictate EAT design and/or operation, nor are there any standards that prohibit EAT operations. To address this issue, the FAA is now in the early stages of developing an EAT national standard.

To address this specific EAT request, the FAA performed a proof-of-concept demonstration in a flight simulator to gather Human Factors (HF) and operational information, to potentially assist in the development, application, and approval of EAT procedures for aircraft departing RWY 26L at KATL while simultaneous EAT operations are being conducted at the approach end of RWY 8R. Terminal Instrument Procedures (TERPS) and Collision Risk Model (CRM) analyses of the proposal were also conducted and are included in this report.

This proof-of-concept demonstration was conducted in a flight simulator in accordance with the approved plan. In keeping with the stated purpose of evaluating EAT procedures for aircraft departing KATL, this demonstration was successful in meeting the intended purpose. The intention to evaluate the visual scene from a HF standpoint was accomplished through elicited subjective responses and comments from aircrews, as well as objective observation of crew performance during closely scripted scenarios. Pilot comments were relatively consistent across all crews with no observed or recorded anomalies or extreme deviations from normal crew and aircraft performance.

From a human performance and limitation perspective, there is no appreciable increase in mental or physical workload that would lead to a compromise in current safety levels. Any additional human-in-the-loop requirements, aside from basic crew familiarization, would be required based upon local restrictions, site-specific peculiarities, and company operational rules and procedures.

This was a limited HF evaluation of the proof of concept. It looked for macro issues and found none in the departure case. Performing a more in-depth study, as previously described, is not warranted at this time and would not be expected to yield significantly different results in the departure case because of the cockpit cutoff angle after V_1. The pilot simply cannot see the EAT aircraft at that point in the flight profile.

There do not appear to be any HF specific issues that should hinder progress towards further developing EAT procedures for departure operations at KATL.

From a CRM perspective, the results in every scenario indicated that aircraft with tail heights of 55 feet or below presented acceptable levels of risk for unabated taxiing on the EAT, and aircraft with taller tail heights should be controlled so that no over-flights flights occur.

From an operational perspective, the implementation of EAT requires the development of airfield and flight operational procedures to ensure that the appropriate level of safety is maintained while promoting capacity goals. All operational issues have been identified, and feasible recommendations/mitigations have been provided.

From a TERPS perspective, for RWY 26L, there are 7 penetrations to the 40:1 (TERPS) and the 121.189 Engine-Out departure surfaces. The largest penetrations are 39.54 feet (TERPS) and 3.68 feet (121.189). These can be mitigated by:

Since the 40:1 departure surface is not clear, option (1) or (2) are available.

If option 1 is chosen then:

(1) Aircraft remain clear of the end around taxiway during departure operations;

Or

(2) Permit aircraft to use end around taxiway during departures, and require departure minimums no lower than 300'/1 NM;

If option 2 is chosen then:

(1) Publish runway available for standards all engine take off of 8,418 feet RWY 26L, and 9,770 feet for engine out take-off (121.189).

Or

(2) Publish runway available for standards all engine take off of 7,978 feet RWY 26R, no obstacle problem for engine out take-off (121.189).

There do not appear to be any HF, CRM, Operational, or TERPS-specific issues that cannot be overcome through mitigation strategies. Therefore, there are no issues that should hinder progress towards further developing EAT procedures for departure operations on RWY 26L at KATL. However, if landing operations to RWY 8R are expected, or the EAT is expected to be utilized during low visibility conditions, additional testing will be warranted. Conclusions drawn from this data, analysis, and demonstration cannot be broadly generalized to other runways or other locations. Otherwise, the Flight Technologies and Procedures Division, AFS-400, recommends proceeding towards the completion of the on-going Runway Protection Zone (RPZ) study and final report.

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1.0. INTRODUCTION

1.1. PURPOSE

The purpose of this proof-of-concept demonstration was to gather Human Factors (HF) and operational information, potentially leading to the development, application, and approval of End-Around Taxiway (EAT) procedures for aircraft departing Runway (RWY) 26L at Hartsfield-Jackson Atlanta International Airport (KATL) while simultaneous EAT operations are being conducted at the approach end of RWY 8R. Terminal Instrument Procedures (TERPS) and Collision Risk Model (CRM) analyses of the proposal were also conducted and are included in this report.

1.2. BACKGROUND

The City of Atlanta, Department of Aviation, and Delta Air Lines, Inc., propose the construction and operation of an EAT at the approach end of RWY 8R at KATL. Their key goals/objectives and features of this project are listed in Attachment 1. There are no regulatory criteria or standards that dictate EAT design and/or operation, nor are there any standards that prohibit EAT operations. To address this issue, the FAA is now in the early stages of developing an EAT national standard.

Prior to the development of national EAT criteria, site-specific proposals, such as KATL, must be evaluated on a case-by-case basis. Further discussion and analysis of the KATL case with KATL, Delta Airlines, Airline Pilots Association (ALPA), FAA (Flight Standards, Air Traffic, and Airports), the Center for Advanced Aviation System Development/MITRE, and others reflected that this unique proposal for KATL EAT operations warranted further risk assessment and safety analysis, particularly regarding HF (human performance and limitations) issues. The results of this demonstration are intended to also contribute to the development of a national standard for EAT operations.

2.0. HUMAN FACTORS EVALUATION

2.1. GENERAL

This proof-of-concept demonstration was conducted in accordance with the approved plan. In keeping with the stated purpose of evaluating EAT procedures for aircraft departing KATL, this demonstration was successful in meeting the intended purpose. The intention to evaluate the visual scene from a HF standpoint was accomplished through elicited subjective responses and comments from aircrews, as well as objective observation of crew performance during closely scripted scenarios. Pilot comments were relatively consistent across all crews with no observed or recorded anomalies or extreme deviations from normal crew and aircraft performance.

The demonstration focused on evaluating EAT operations within the constraints of the visual scene as presented to the pilots in the simulator environment. It was not possible to fully evaluate the pilot's perception of a real world operation in a flight simulator visual scene, given that depth and other important visual cues are not a one-for-one relationship between actual and simulated environments. Specifically, time and simulator constraints did not allow the study to depict the full spectrum of varying fuselage geometries; aircraft sizes; aircraft paint schemes; and atmospheric and visibility conditions that affect the visual scene. These items are important and could impact real world operations. Nor did it fully evaluate the effect of the visual scene on visual scan or aircraft system monitoring. To accomplish this would have required the use of an expensive (time and money) and intrusive eye tracking system and comparison of a baseline simulator operation to an EAT operation in actual visual conditions to determine if there were any significant differences. This was a limited human factors evaluation of the proof of concept, seeking to uncover macro issues that may manifest themselves as a result of flying specific and limited scenarios in a simulator.

2.2. SIMULATION SCENARIOS

Each crew conducted seven distinct scenarios per the approved plan (Table 1), alternating between Captain and First Officer for each scenario. After completing the seven-scenario set, each crew conducted the same full set again, alternating in different order.

2.3. SUBJECTIVE QUESTIONNAIRE

After each scenario/run, each crewmember (regardless of pilot-flying (PF) or pilot-not-flying (PNF)) was given a six-question, check-the-block, subjective questionnaire (Figure 1). It was stressed that each questionnaire was designed to capture pilot reaction to that particular stand-alone scenario.

Following the simulator session, both the Captain and First Officer were given a final post-simulation questionnaire (Figure 2) to gather their overall view of the operation and encompassing all fourteen scenarios/runs. Upon completion of the final questionnaire, the crew and evaluators/observers conducted a verbal post-simulation de-brief (Figure 3).

All evaluators and observers briefed crews from a scripted briefing sheet and de-briefed crews in the same manner in order to preserve data/test continuity and integrity.

Flight Simulator Scenarios for proposed KATL RWY 8R EAT Operations

DATE/TIME: **CREW:**

Scenario #	Pilot Flying	Wind (Knots)	Ceiling (Feet AGL)	Visibility (SM/RVR)	Day/ Night	Conditions (Weight/Temp)	Remarks
1 Takeoff	CP	215/15	1000’	3	Day	Normal/90º	
2 Takeoff	FO	305/15	1000’	3	Night	MAXIMUM/90º	
3 Takeoff	CP	215/15	400’	6000	Day	Normal/100º	
4 Takeoff	FO	305/15	400’	6000	Night	MAXIMUM/90º	
5 Takeoff	CP	215/15	400’	6000	Day	MAXIMUM/100º	**Engine Out/Abort ****
6 Landing	FO	305/15	1000’	3	Day	MAXIMUM/100º	
7 Landing	CP	215/15	400’	6000	Night	MAXIMUM/90º	
8 Taxi (Snow)	CP	305/15	-	600	Day	MAXIMUM/30º	
9 Taxi (Rain)	CP	215/15	-	600	Night	MAXIMUM/90º	

** Engine-out or abort not required and only authorized with pilot qualified in-type

TABLE 1

Post-Run Questionnaire

FIGURE 1

1. In general, compared to departure procedures that your company normally performs, characterize the overall procedure flown in the test.

Easy Moderate Difficult

1 2 3 4 5 6 7 8 9

2. Rate your level of comfort while departing when EAT operations are in effect.

Very Comfortable Moderately Comfortable Uncomfortable

1 2 3 4 5 6 7 8 9

3. Rate your level of comfort before V1 when an aircraft is on the End-Around Taxiway but you do not have visual acquisition of it.

Very Comfortable Moderately Comfortable Uncomfortable

1 2 3 4 5 6 7 8 9

4. Rate your level of comfort when over-flying an aircraft on the End-Around Taxiway.

Very Comfortable Moderately Comfortable Uncomfortable

1 2 3 4 5 6 7 8 9

5. Rate your perceived level of **individual workload** for this procedure from the standpoint of mental demand (e.g. thinking, deciding, calculating, remembering, looking, searching, etc.).

Low Moderate High

1 2 3 4 5 6 7 8 9

6. Rate the level of **crew workload** for this procedure from the standpoint of mental demand (e.g. thinking, deciding, calculating, remembering, looking, searching, etc.).

Low Moderate High

1 2 3 4 5 6 7 8 9

Post-Simulation Questionnaire

FIGURE 2

1. In general, compared to other departure procedures that your company performs, characterize the overall procedure flown in the test.

Easy			Moderate			Difficult		
1	2	3	4	5	6	7	8	9

2. Rate your overall level of comfort with this procedure.

Very Comfortable			Moderately Comfortable			Uncomfortable		
1	2	3	4	5	6	7	8	9

3. Rate your perceived level of **individual workload** for this procedure from the standpoint of mental demand (e.g. thinking, deciding, calculating, remembering, looking, searching, etc.).

Low			Moderate			High		
1	2	3	4	5	6	7	8	9

4. Rate the level of **crew workload** for this procedure from the standpoint of mental demand (e.g. thinking, deciding, calculating, remembering, looking, searching, etc.).

Low			Moderate			High		
1	2	3	4	5	6	7	8	9

5. Compared to other departure procedures, rate the overall level of effort required to perform this one.

Lower			No Different			Higher		
1	2	3	4	5	6	7	8	9

6. Rate the realism of the aircraft flight simulator versus the actual aircraft (e.g. control feel, power response, landing characteristics, visual display).

Not Realistic			Realistic			Extremely Realistic		
1	2	3	4	5	6	7	8	9

Post-Simulation De-Brief

FIGURE 3

1. Overall, did you feel comfortable with this procedure (i.e., as the departing aircraft with an aircraft on the End-Around Taxiway or as the EAT aircraft)?

____

Why? Why Not? Which phase(s) was more critical? ________________________

____

2. What additional mental or physical requirements, if any, were imposed on you during this procedure?

____

____

3. Which phase of the procedure was more difficult? ________________________
Why? ____

____

4. Provide comments on the flight simulator fidelity. How closely representative is it of real world flying?

____

____

5. Do you have any suggestions for this procedure in the future?

____

____

6. Have you ever been to Miami or any other location where End-Around Taxiway or similar operations are in effect? ______________________________
Where? ____
What were your impressions? _______________________________________

____

7. Did you have any problems discriminating between aircraft that were on the EAT and aircraft that were holding short at the end of the runway?

____

____

8. Is it your sense that over time you might become complacent when EAT operations are in effect (e.g. you might assume that an aircraft is on the EAT when it might actually be holding short of the active?

____

2.4. SUBJECTIVE QUESTIONNAIRE RESPONSES

As shown in Table 2, 60 separate departure and 24 separate approach scenarios, using 6 different crews, were conducted. The crews were a mix of instructor pilots and line pilots. All crewmembers were current or former (recently retired) captains. After each run, both the PF and PNF were given the 6-question subjective questionnaire (168 total questionnaires). The numbers in Table 2 represent total number of responses by specific question. They are further broken down by responses from both the PF and the PNF.

Question 1 dealt with a comparative analysis between departures while EAT operations are on-going and other departure procedures that the crewmember has flown. Of the total responses, 92% (yellow shaded area) considered this procedure to be comparatively “Easy.” The remaining 8% of responses were given primarily during the first few departure scenarios. As pilots became more experienced and familiar with EAT operations in the simulator, pilot perception of difficulty lessened. Figure 4 graphically depicts the responses for Question 1.

Questions 2 through 4 (pink shaded area) were intended to derive information concerning crewmember comfort level. Of the responses to Question 2, 93% indicated moderate to high levels of comfort with EAT operations (Figure 5). Of the responses to Question 3, 97% indicate that at V_1, with no visual acquisition of an aircraft on an EAT, comfort levels are moderate to high (Figure 6). Of the responses to Question 4, 85% indicate moderate to high levels of comfort when over-flying another aircraft (Figure 7). All other response percentages, either in the moderately comfortable or uncomfortable ranges, resulted from an initial response to not ever having performed departures with EAT operations in effect. As indicated, comfort levels improved as experience and familiarity with EAT operations in the simulator increased.

Questions 5 and 6 (gray shaded area) queried crewmembers about their perceived levels of both individual and crew workload (i.e., any change in level of workload that can specifically be attributed to EAT operations). Of the responses, 85% and 87%, respectively, indicate that both individual and crew workload levels are low. Of the remaining percentages, pilot comments indicate that the side-step approach and landing and/or the engine-inoperative scenarios were the more difficult phases of the simulation. Since these two scenarios were flown during the same period as the departures, pilots commented on them in comparison with the entire scenario set. Figures 8-9 graphically depict the responses for Question 5-6.

Scale	Question / Response	1(92%) Versus Other Approaches PF	1 PNF	2(93%) Comfort During Depart. PF	2 PNF	3(97%) Comfort Before V1 PF	3 PNF	4(85%) Comfort W/Overflight PF	4 PNF	5(85%) Individual Workload PF	5 PNF	6(87%) Crew Workload PF	6 PNF
EASY (Question 1) / VERY COMFORTABLE (Questions 2, 3, 4) / LOW WORKLOAD (Questions 5 & 6)	1 PF PNF		43						46				44
	2 PF PNF		7						12				23
	3 PF PNF		5						14				6
	4 PF PNF	3	2	2	2	0	3	7	7	8	7	6	9
	5 PF PNF	1	1	0	2	0	0	2	2	2	1	5	1
	6 PF PNF	0	1	0	0	0	0	2	1	3	2	0	1
	7 PF PNF	1	0	1	1	0	0	2	2	1	0	1	0
	8 PF PNF	0	0	0	0	0	0	1	1	1	0	0	0
DIFFICULT (Question 1) / UNCOMFORTABLE (Questions 2, 3, 4) / HIGH WORKLOAD (Questions 5 & 6)	9 PF PNF	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 2

Figure 4 - Compare EAT Procedure to Normal Procedure (DAL Sim)

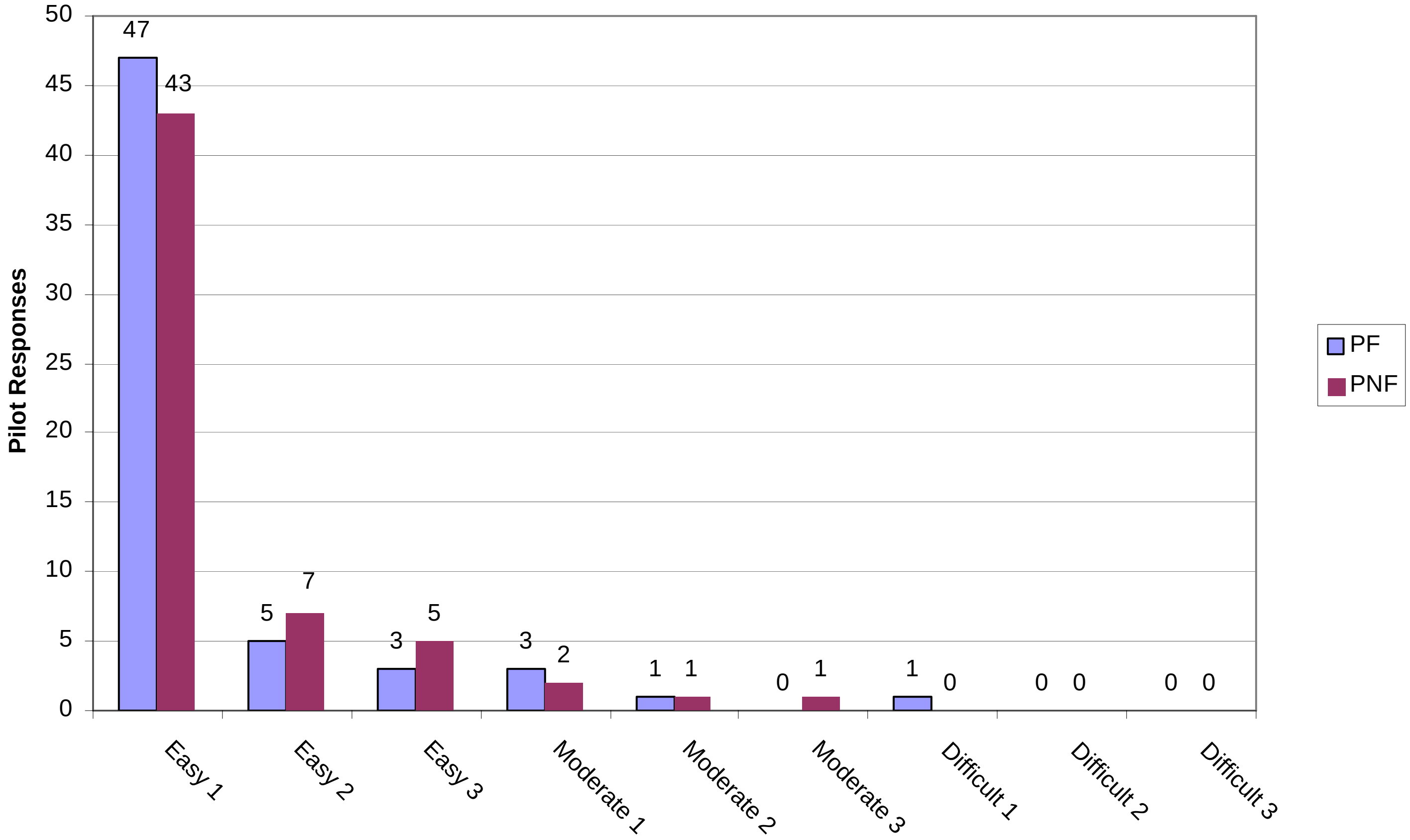


Figure 5 - Level of Comfort During Departure (DAL Sim)

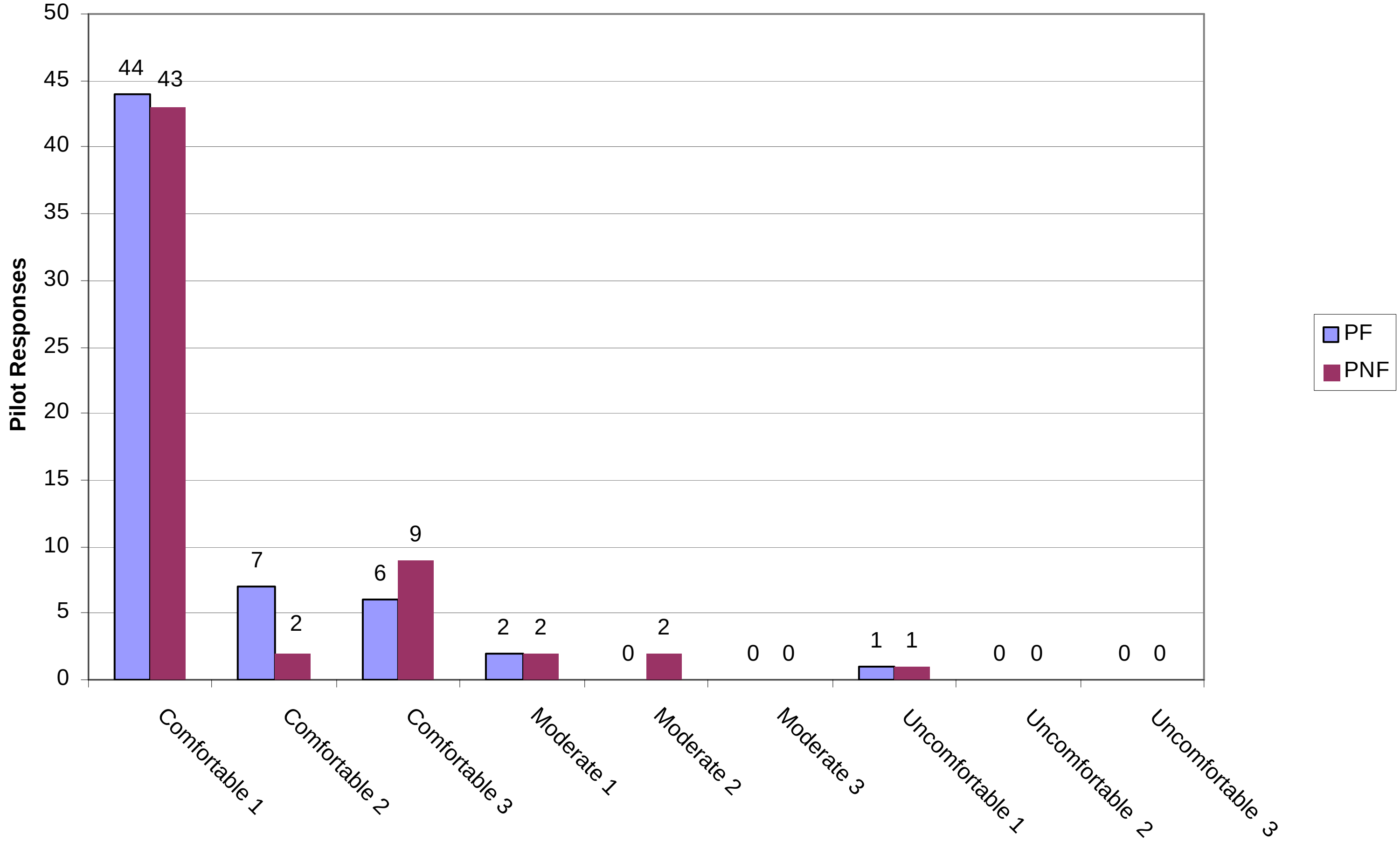


Figure 6 - Level of Comfort Before V1 (DAL Sim)

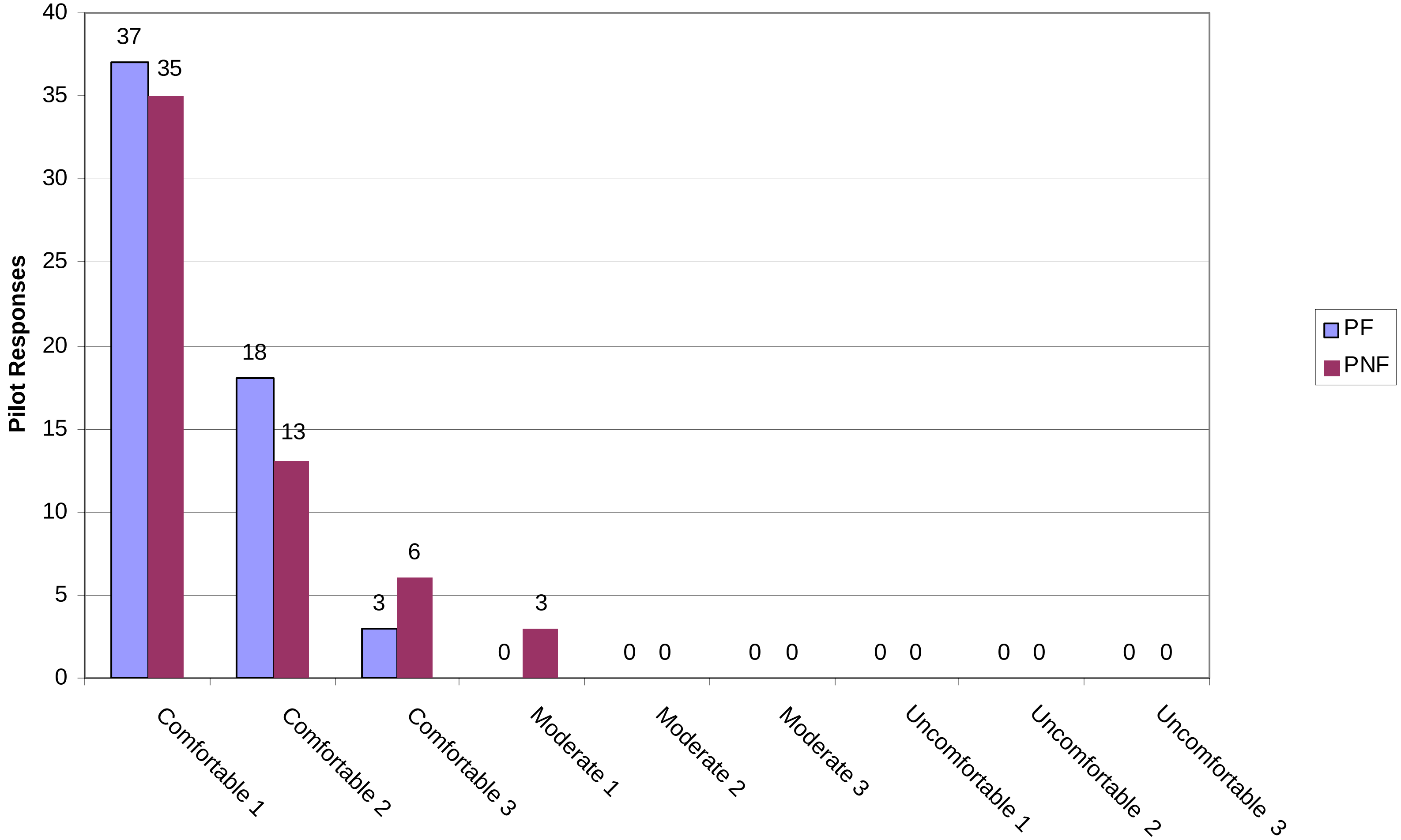


Figure 7 - Level of Comfort With Overflight (DAL Sim)

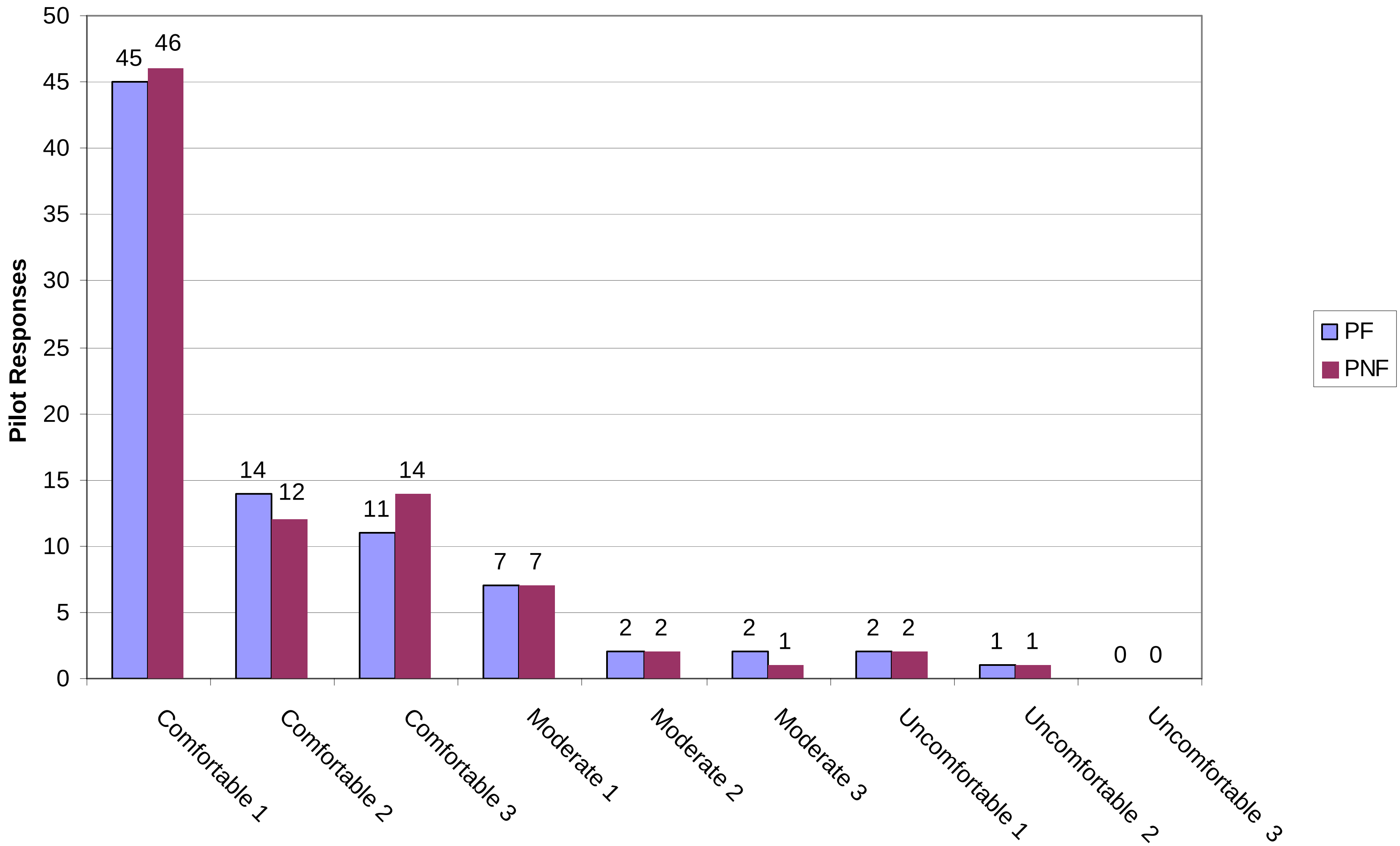


Figure 8 - Perceived Individual Workload (DAL Sim)

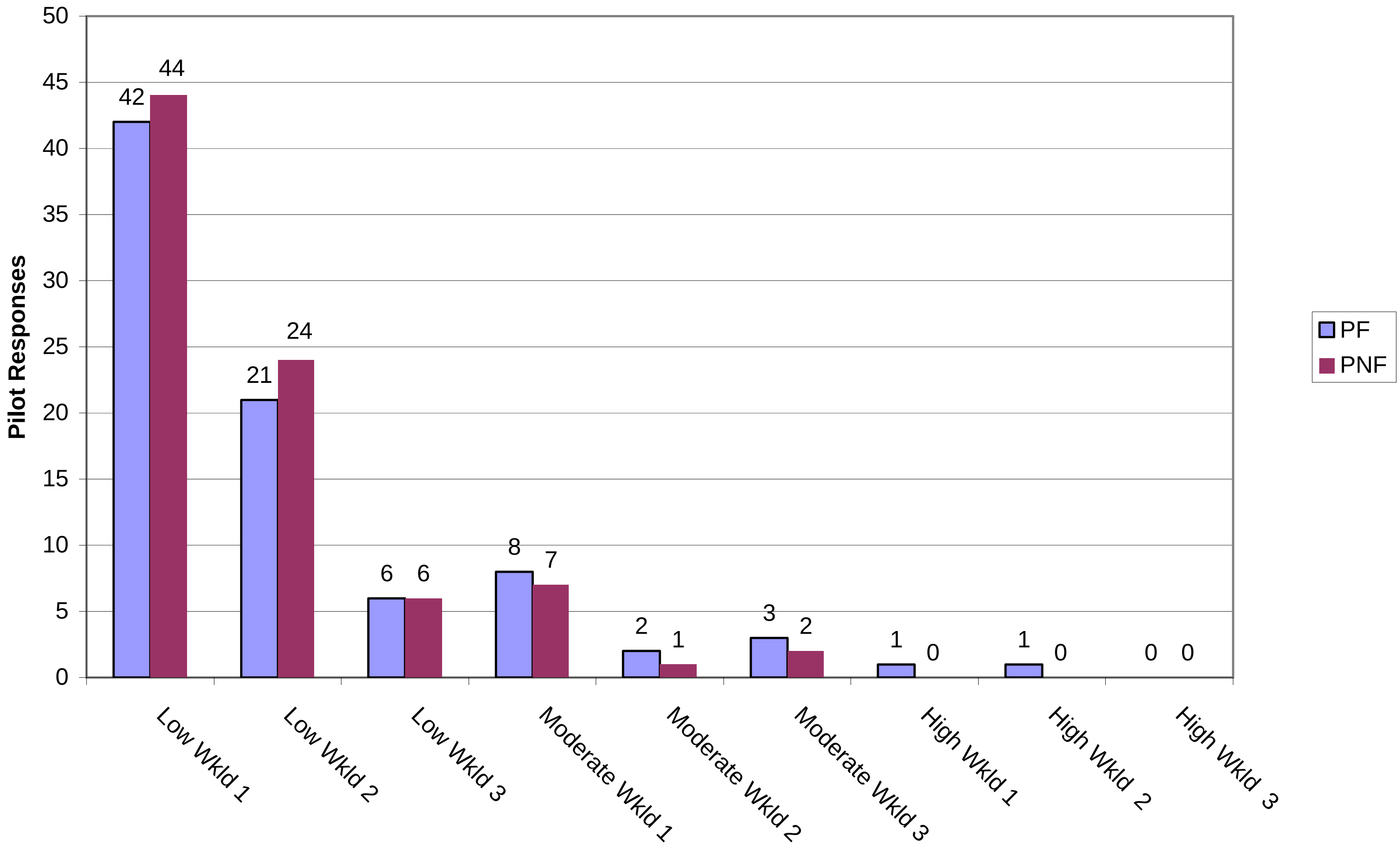
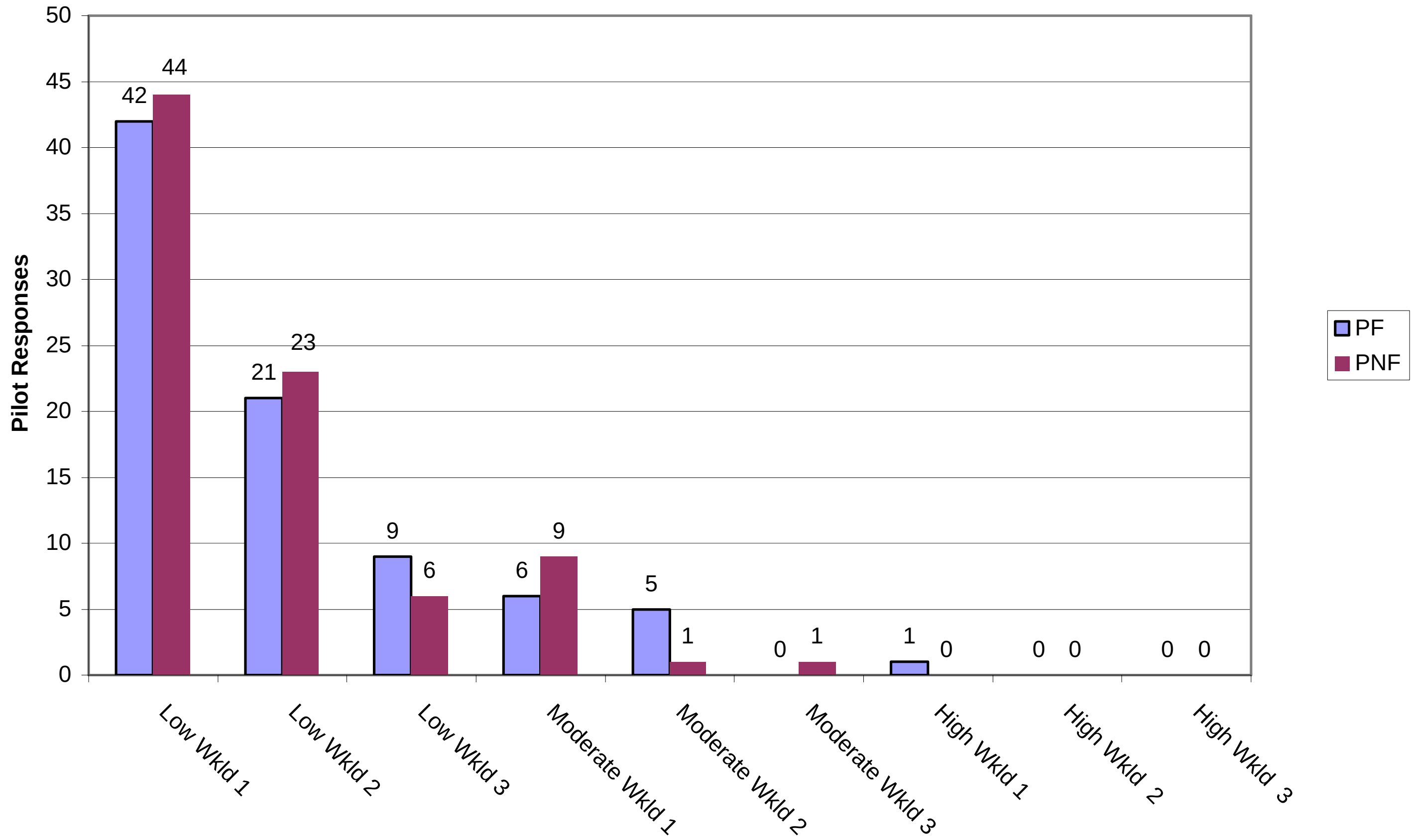


Figure 9 - Perceived Crew Workload (DAL Sim)



2.5. OBJECTIVE (IN-THE-COCKPIT) OBSERVATIONS

Objective crew performance measures were accomplished through simple observation of pilot/crew performance. Observers, which included pilots who were familiar with commercial aircraft pilot procedures and techniques, were unobtrusively positioned directly behind the pilot stations in the simulator. All flight scenarios were carefully scripted. During those periods in a given flight sequence when a pilot/crew would perform a task out of the norm, both primary and secondary task completion were monitored. That is to say, during those times pilots might have been required to do more or different actions within the scope of their duties to safely maneuver the aircraft. As such, mental or physical workload might have increased; tasks may have been perceived as more difficult; reaction times might have changed; or task shedding may have taken place. Visual scan patterns and instrument/systems monitoring might also have changed. Such changes were observed and recorded. NOTE: Reaction times, visual scan patterns, and instrument/system monitoring were not measured.

Generally, pilots had no difficulty with physically performing departure procedures with simultaneous EAT operations in effect. There did not appear to be any appreciable increase in either mental or physical demands based upon the EAT scenario. That is to say, during those times when other large aircraft were operating on the EAT, pilots might have been required to accomplish more or different actions within the scope of their duties to safely maneuver the aircraft (e.g., additional/modified radio calls, visual acquisition strategies, scanning techniques, crew cockpit coordination); however, no primary or secondary task shedding was observed, nor were there any appreciable changes observed in visual scan patterns or instrument/system monitoring.

During departure operations, pilots did not appear to be distracted by aircraft on any part of the EAT. Both the PF and PNF remained on task during departures. Typically, both PF and PNF indicated they could not see the aircraft on the EAT. This is probably attributed to: (1) aircraft attitude and pitch configuration preclude visual acquisition at the position on the runway when the aircraft is beyond rotation and climbing; or (2) the EAT at KATL is depressed as much as 29 feet below the surface of the runway and, therefore, the most visible feature of any aircraft on the EAT is the tail. Occasionally, the PNF was observed leaning forward to gain visual acquisition of EAT aircraft (due to the cockpit cutoff angle). Those crewmembers indicated this was done more out of curiosity than out of operational necessity, and this behavior would likely subside as they gained operational exposure and experience with these procedures.

Although not a primary goal in this demonstration, the 24 approach scenarios flown by the six flight crews to runway 8L, with a side-step maneuver to 8R, did indicate the need for further testing if the airport operator requests such an operation. This should also include an evaluation of the EAT during low visibility conditions for taxiing aircraft to determine if any specific operational procedure, lighting, marking, signage, etc., will be needed.

2.6. PILOT COMMENTS/DE-BRIEFING REMARKS

After each crew completed all 14 scenarios, we conducted a de-briefing to gather crew comments, concerns, and recommendations. Predominant and frequent crew comments are listed below:

-There was no appreciable increase in mental or physical workload during departures when EAT operations were in effect, whether they had visual acquisition of an EAT aircraft or not.

-Any aircraft holding short of the runway were more of a potential distraction than an EAT aircraft.

-Comfort levels increased significantly with more flights flown.

-There is no difference between night and day operations.

-Although crewmembers felt that the simulation fidelity was very representative, they were not specifically asked for a breakdown between aircraft performance fidelity and visual scene fidelity. FAA evaluators and Delta Airlines' Program Manager for Threat and Error Management agree that aircraft performance fidelity is extremely high, while visual scene fidelity does not approach a one-to-one relationship and is not equivalent to performance fidelity.

3.0. COLLISION RISK MODEL ANALYSES

Earlier CRM analyses indicated that taxiing aircraft could safely be moved on an EAT while an aircraft was on an Instrument Landing System (ILS) approach, if the taxiway was of sufficient distance beyond the runway threshold. The distance required is dependent on the tail heights of the taxiing aircraft. These analyses suggest that with a threshold crossing height of 50 feet or more, aircraft with tail heights of 46 feet or less could safely taxi on an EAT at 2,240 feet or more from runway threshold; aircraft with tail heights of 55 feet or less could taxi safely at 2,600 feet or more from threshold; aircraft with tail heights of 65 feet or less could taxi safely at 3,000 feet or more from threshold; and aircraft with tail heights of 80 feet or less could taxi safely at 3,600 feet or more from the threshold.

Some additional advantage can be gained if the EAT is sloped down away from the threshold, so that the taxiway elevation is lower than the runway threshold elevation. It should be noted that these distances are consistent with a plane whose origin is 400 feet beyond threshold with a slope of 40:1. This is more restrictive than the 34:1 ILS W Obstacle Clearance Surface, because a collision of an approaching aircraft with a taxiing aircraft would be a catastrophic event and, therefore, requires a reduced likelihood of occurrence.

KATL is proposing to build an EAT beyond the arrival end of RWY 8. This taxiway is designed to be only 1,520 feet beyond the RWY 8 threshold, well inside of the distances indicated in the preceding paragraph.

However, the elevation of the EAT is designed to be 29 feet below the runway at the point where it crosses the runway centerline extended. The intended use is for aircraft with tail heights of 55 feet or less to taxi unabated on this EAT, regardless of over-flights flights of approaching or departing aircraft. Also, it is intended that the movement of taxiing aircraft with tail heights greater than 55 feet be controlled so that over-flights flights of approaching or departing aircraft do not occur.

Specifically, the KATL proposed EAT was examined using CRM analyses (Appendix A). The runway involved presented acceptable levels of risk for EAT operations as proposed during ILS CAT I or CAT II operations. The end-around scenarios were modeled by placing 55 feet tail height aircraft upon both the parallel taxiways leading out to the EAT and the end around taxiway itself. The results in every scenario indicated that aircraft with tail heights of 55 feet or below presented acceptable levels of risk for unabated taxiing on the EAT, and aircraft with taller tail heights should be controlled so that no over-flights flights occur.

Appendix A contains the obstacle database and CRM summary results for this runway. Please note that the databases only include tails of taxiing aircraft distributed along the EAT path and do not include any other obstacles. If there are other existing or proposed significant obstacles, then the validity of these CRM analyses may be in question. Additionally, the CRM does not examine the visual segment of approaching aircraft, nor does it examine departures. The impacts of these issues are not considered in these CRM analyses.

4.0. OPERATIONAL ISSUES

The implementation of EAT requires the development of airfield and flight operational procedures to ensure that the appropriate level of safety is maintained while promoting capacity goals.

The following issues have been identified, and recommendations are provided:

4.1. AIRFIELD PROCEDURES AND EQUIPMENT CONSIDERATIONS

Signage, Marking: EATs need to be evaluated and a national policy established to standardize naming conventions, holding lines (for metering purposes), runway safety area/obstacle free zone boundary signs, etc.

Contaminated taxiway operations: Policy needs to be established on the use of EATs when contaminated by snow, ice, or other potentially hazardous conditions. Specifically, evaluation needs to be made of the requirement for lighting, marking, and/or signage to ensure safe operations away from other airfield reference points (other taxiways, terminals and runways).

Foreign Objects and Debris (FOD): The airport should evaluate and develop policy for inspecting and clearing EATs of FOD, especially as related to the affect of takeoff operations' jet blast movement of debris onto EAT surfaces.

Evaluation of the effect of the presence of aircraft beyond the localizer antenna during CAT I/II/III operations: FAA should flight check ILS procedures with representative aircraft on the EAT to ensure required signal attributes remain intact during EAT operations.

Crash/Fire Rescue (CFR): Existing CFR plans should be evaluated for response procedures for the additional taxiway surfaces and management of the movement of CFR assets during EAT operations.

Visual aid development: Consideration should be given to avoiding mis-interpretation of EAT taxiway traffic with runway crossing traffic by pilots of departing aircraft, in order to avoid un-necessary takeoff aborts. Such risk may be mitigated by an EAT taxiway design which precludes unobstructed view of EAT taxiing aircraft by pilots of departing aircraft (such as significantly lower EAT taxiway elevation below the runway surface elevation). If the view is unobstructed, a standard obscuring, frangible barrier design should be considered to allow the takeoff aircraft crew's easy determination of a taxiing aircraft's position on the EAT or conventional runway crossing taxiway. This concept is similar to the approach light obscuring panels developed at certain airports to reduce misidentification of the light structure as an aircraft by pilots of opposite direction departing aircraft.

4.2. TRAFFIC PROCEDURE CONSIDERATIONS

Radio Phraseology: Standard radio phraseology should be developed for EAT operations and incorporated into the Aeronautical Information Manual (AIM) and Aeronautical Information Publication (AIP).

Radio Frequency to be used: Policy needs to be established on the standard radio frequency to be used in EAT operations (ground or tower).

Use of surveillance aids during low visibility EAT operations: Policy should be developed on the use of Airport Surveillance Detection Equipment (ASDE), multi-lateration, remote cameras, and other technologies to support safe control of traffic on EATs during low visibility operations.

Automatic Terminal Information Service (ATIS): Policy and standardized phraseology should be developed on the use of ATIS to indicate EAT operations in effect. This information should be published in the AIM and AIP.

Mixing of aircraft on the EAT: A policy should be developed as to mixing EAT and other runway crossing taxiway usage, including policies on the use of EATs by uni- or bi-directional traffic flows.

4.3. OPERATIONAL PROCEDURE CONSIDERATIONS

Operators intending to use EATs should ensure that flight crews are familiar with EAT operations, procedures, lighting/marking/signage, phraseology, and the affect of EAT operations on aircraft systems (brake usage, including heat monitoring and control; power required for uphill operations; speed control in downhill operations; limitations on thrust reverser usage).

Specifically, operators should ensure that flight crews are aware of the need to scan the EAT (as much as possible, given visibility and geometry limitations) to avoid nose-to-nose encounters on the EAT, and to scan the departure path to avoid unnecessary taxi directly beneath over-flying aircraft, if possible. Operators of smaller aircraft need to consider EAT operations from the standpoint of jet blast issues.

Standard policy should be developed on the use of aircraft and vehicle lights using EATs and conventional taxiways to ensure easy determination of route and intent of operation by other aircraft, vehicles and air traffic control (ATC).

Standard policy should be developed on the use of EATs during Surface Movement and Guidance Control System (SMGCS) operations, especially any metering requirements for larger group aircraft.

Obviously, these considerations have great inter-operability between airfield procedures and equipment, ATC procedures, and operational procedures. Solutions for each issue must be integrated between the airfield, air traffic, and operational community to ensure successful resolution.

4.4. TAKEOFF PERFORMANCE CONSIDERATIONS

An additional issue remains concerning the affect of aircraft taxiing on EATs to the allowable takeoff weight for departing aircraft.

At issue is the affect of a taxiing aircraft on the EAT against regulatory requirements, specifically, the aircraft certification requirements of 14 CFR 25.111, 25.121, and 121.189. These regulations are attached in Appendix B.

FAR 25 generally requires that turbojet transport airplanes achieve a height of 35 feet at the end of the runway, followed by a climb of at least 2.4% net climb gradient to at least 400 feet, followed by a reduced climb gradient of 1.2% to 1,500 feet above the departure end of runway (DER). The 2.4% requirement applies to two-engine airplanes, while higher gradients are required for three and four-engine airplanes. These climb requirements are based on an engine failure at V_1, a speed which is achieved while the aircraft is still on the runway, just prior to or coincident with rotation. FAR 25 Subpart B contains these standards.

The pertinent operational performance requirements for this discussion are specified in 14 CFR 121 Subpart I. This subpart requires that an operator meet any airplane flight manual (AFM) limitations, as well as specific performance requirements based on phase of flight. In addition to meeting the AFM takeoff weight requirements (which are limited by the performance required by 14 CFR 25), 121.189 generally requires a 35-foot clearance of obstacles after takeoff, using the net climb gradient as described in FAR 25.

Of interest, is that for nearly all transport category turbojets (SR 422A and subsequent), no additive factor is required (no additional buffer provided based on distance traveled from the DER). Hence, with no obstacles present, such a departure from a theoretical airport in the Bonneville Salt Flats, once the aircraft has reached 35 feet at the end of the runway, 121.189 would require no net climb gradient other than the AFM requirement, which is tied to FAR 25.121 (yielding 2.4% for two-engine airplanes). Essentially, to determine the required climb gradient, one would evaluate the FAR 25.111 and .121 second segment climb, and the 121.189 35-foot obstacle clearance requirement and select the most restrictive.

For an obstruction 45 feet above the DER elevation, the “break point” is 1,875 feet from the DER. For distances below 1,875 feet, the 121.189 (d)(2) requirement is more restrictive. For distances of 1,875 feet or greater, the FAR 25.111 and .121 requirements control.

The slides provided in Appendix C describe this interrelationship.

Note also that under wet runway circumstances, 14 CFR 25.113 allows performance planners to use a 15 foot screen height in lieu of the 35 foot DER height described to permit a wider range of options to continue the takeoff in the event of an engine failure rather than conduct an abort on a wet runway.

The effect of this reduction in screen height is to anchor the climb path at the DER at 15 rather than 35 feet. Such a reduction will impact the required climb gradient to meet the 121.189 (d) (2) 35-foot clearance by moving the “break point” to 2,708 feet from the DER.

From an operational point of view, the current declared distance standard marking, and particularly the distance remaining markers, does not indicate to the pilot their position along the takeoff run available (TORA) or the takeoff distance available (TODA). It indicates the end of useable pavement, which may include the safety area. This may be acceptable when an operator with established airport-specific performance data regularly uses a particular runway, but there may be a negative impact on critical decision making by crews of supplemental or non-scheduled operators who rarely use the airport in question. Crews determining performance based on the using the observed distance-to-go markings on a declared distance runway will not come up with an accurate assessment.

5.0. TERPS ANALYSIS

This analysis was from a Flight Standards perspective with particular attention given to the provisions of FAA Order 8260.3B (TERPS) and 14 CFR 121.189.

5.1. RUNWAY 26L DEPARTURE

There are seven penetrations to the 40:1 TERPS and the 121.189 Engine-Out departure surfaces. The largest penetrations are 39.54 feet (TERPS) and 3.68 feet (121.189).

Mitigations:

-The aircraft would: (1) remain clear of the taxiway departures; (2) publish minimums of 300/1; or (3) publish a TODA of 8,418 feet (TERPS) and 9,770 feet (121.189).

-Operators will adjust their performance given the particular circumstance per operational specifications (Ops Specs).

5.2. RUNWAY 26R DEPARTURE

-There are two penetrations to the 40:1 TERPS and 121.189 Engine-Out departure surfaces. The largest penetration due to the new taxiway is 25.54 feet (TERPS), and the taxiway does not have penetrations to the 121.189 surface.

Mitigations:

-The aircraft would: (1) remain clear of the taxiway during departures; (2) publish minimums of 300/1; or (3) publish TODA of 7,978 feet (TERPS). This assumes the use of the 200 feet (on airport) and the 300 feet (off airport) engine-out evaluation widths. (NOTE: No penetrations occur due to the new taxiway).

-Operators will adjust their performance given the particular circumstance per Ops Specs

5.3. RUNWAY 8R ARRIVAL

-There are five penetrations to the final approach surfaces. The largest penetration of 35.51 feet due to the new taxiway is in the “W” area. This will cause a minimum height above touch down (HAT) of 250 feet.

Mitigations:

-Restrict taxiway use during arrival operations, or raise the HAT.

5.4. RUNWAY 8L ARRIVAL

-There are NO penetrations to the final approach surfaces due to the new taxiway.

6.0. CONCLUSIONS

6.1. HUMAN FACTORS

From a human performance and limitation perspective, there is no appreciable increase in mental or physical workload that would lead to a compromise in current safety levels. Any additional human-in-the-loop requirements, aside from basic crew familiarization, would be required based upon local restrictions, site-specific peculiarities, and company operational rules and procedures.

This was a limited HF evaluation of the proof of concept. It looked for macro issues and found none in the departure case. Performing a more in-depth study, as previously described, is not warranted at this time and would not be expected to yield significantly different results in the departure case because of the cockpit cutoff angle after V_1. The pilot simply cannot see anything at that point in the flight profile.

There do not appear to be any HF specific issues that should hinder progress towards further developing EAT procedures for departure operations at KATL.

6.2. CRM

The results in every scenario indicated that aircraft with tail heights of 55 feet or below presented acceptable levels of risk for unabated taxiing on the EAT, and aircraft with taller tail heights should be controlled so that no over-flights occur.

6.3. OPERATIONS

The implementation of EAT requires the development of airfield and flight operational procedures to ensure that the appropriate level of safety is maintained while promoting capacity goals. All operational issues have been identified, and feasible recommendations/mitigations have been provided.

6.4. TERPS

Since the 40:1 departure surface is not clear, option (1) or (2) are available.

If option 1 is chosen then:

(1) Aircraft remain clear of the end around taxiway during departure operations;

Or

(2) Permit aircraft to use end around taxiway during departures, and require departure minimums no lower than 300'/1 NM;

If option 2 is chosen then:

(1) Publish runway available for standards all engine take off of 8,418 feet RWY 26L, and 9,770 feet for engine out take-off (121.189);

Or

(2) Publish runway available for standards all engine take off of 7,978 feet RWY 26R, no obstacle problem for engine out take-off (121.189).

6.5. SUMMARY

There do not appear to be any HF, CRM, Operational, or TERPS-specific issues that cannot be overcome through mitigation strategies. Therefore, there are no issues that should hinder progress towards further developing EAT procedures for departure operations on RWY 26L at KATL. However, if landing operations to RWY 8R are expected, or the EAT is expected to be utilized during low visibility conditions, additional testing will be warranted. Conclusions drawn from this data, analysis, and demonstration cannot be broadly generalized to other runways or other locations. Otherwise, the Flight Technologies and Procedures Division, AFS-400, recommends proceeding towards the completion of the on-going Runway Protection Zone (RPZ) study and final report.

APPENDIX A. ATL END AROUND TAXIWAY COLLISION RISK MODEL ANALYSES

Runway 08 R

Obstacle Data Base

OBS No.	x dist	y dist	z dist
01	400	-370	1051
02	1470	-170	1051
03	1480	160	1051
04	390	-370	1065
05	1520	0	1049
06	875	460	1063
07	187	-470	1068
08	858	720	1067
09	905	-370	1058
10	952	390	1061

CAT I, 55 ft tail heights

SPEED CAT.	TYPE OF REPORT	OCA/H FEET	TOTAL RISK	HIGHEST RISK IDENT	OBSTACLE DESCRIPTION	RISK
A	SPECIFIED OCH	200	3.1E-11	04	04	9.6E-12
B	SPECIFIED OCH	200	1.7E-10	05	05	5.1E-11
C	SPECIFIED OCH	200	9.1E-10	05	05	3.0E-10
D	SPECIFIED OCH	200	5.0E-09	05	05	1.8E-09

CAT II, 55 ft tail heights

SPEED CAT.	TYPE OF REPORT	OCA/H FEET	TOTAL RISK	HIGHEST RISK OBSTACLE IDENT	DESCRIPTION	RISK
A	SPECIFIED OCH	100	8.2E-12		GROUND PLANE	4.0E-12
B	SPECIFIED OCH	100	1.2E-10		GROUND PLANE	5.7E-11
C	SPECIFIED OCH	100	1.8E-09		GROUND PLANE	7.7E-10
D	SPECIFIED OCH	100	2.5E-08		GROUND PLANE	1.0E-08

APPENDIX B. 14 CFR 25.111, .121, AND 121.189

§ 25.111 TAKEOFF PATH.

(a) The takeoff path extends from a standing start to a point in the takeoff, at which the airplane is 1,500 feet above the takeoff surface, or at which the transition from the takeoff to the en route configuration is completed and V_{FTO} is reached, whichever point is higher. In addition—

(1) The takeoff path must be based on the procedures prescribed in §25.101(f);

(2) The airplane must be accelerated on the ground to *V*EF, at which point the critical engine must be made inoperative and remain inoperative for the rest of the takeoff; and

(3) After reaching *V*EF, the airplane must be accelerated to V_2.

(b) During the acceleration to speed V_2, the nose gear may be raised off the ground at a speed not less than *V*R. However, landing gear retraction may not be begun until the airplane is airborne.

(c) During the takeoff path determination in accordance with paragraphs (a) and (b) of this section—

(1) The slope of the airborne part of the takeoff path must be positive at each point;

(2) The airplane must reach *V*2 before it is 35 feet above the takeoff surface and must continue at a speed as close as practical to, but not less than *V*2, until it is 400 feet above the takeoff surface;

(3) At each point along the takeoff path, starting at the point at which the airplane reaches 400 feet above the takeoff surface, the available gradient of climb may not be less than—

(i) 1.2 percent for two-engine airplanes;

(ii) 1.5 percent for three-engine airplanes; and

(iii) 1.7 percent for four-engine airplanes; and

(4) Except for gear retraction and automatic propeller feathering, the airplane configuration may not be changed, and no change in power or thrust that requires action by the pilot may be made, until the airplane is 400 feet above the takeoff surface.

(d) The takeoff path must be determined by a continuous demonstrated takeoff or by synthesis from segments. If the takeoff path is determined by the segmental method—

(1) The segments must be clearly defined and must be related to the distinct changes in the configuration, power or thrust, and speed;

(2) The weight of the airplane, the configuration, and the power or thrust must be constant throughout each segment and must correspond to the most critical condition prevailing in the segment;

(3) The flight path must be based on the airplane's performance without ground effect; and

(4) The takeoff path data must be checked by continuous demonstrated takeoffs up to the point at which the airplane is out of ground effect and its speed is stabilized, to ensure that the path is conservative relative to the continuous path.

The airplane is considered to be out of the ground effect when it reaches a height equal to its wingspan.

(e) For airplanes equipped with standby power rocket engines, the takeoff path may be determined in accordance with section II of appendix E.

§ 25.121 Climb: One-engine-inoperative.

(a) *Takeoff; landing gear extended.* In the critical takeoff configuration existing along the flight path (between the points at which the airplane reaches VLOF and at which the landing gear is fully retracted) and in the configuration used in §25.111 but without ground effect, the steady gradient of climb must be positive for two-engine airplanes, and not less than 0.3 percent for three-engine airplanes or 0.5 percent for four-engine airplanes, at VLOF and with—

(1) The critical engine inoperative and the remaining engines at the power or thrust available when retraction of the landing gear is begun in accordance with §25.111 unless there is a more critical power operating condition existing later along the flight path but before the point at which the landing gear is fully retracted; and

(2) The weight equal to the weight existing when retraction of the landing gear is begun, determined under §25.111.

(b) *Takeoff; landing gear retracted.* In the takeoff configuration existing at the point of the flight path at which the landing gear is fully retracted, and in the configuration used in §25.111 but without ground effect, the steady gradient of climb may not be less than 2.4 percent for two-engine airplanes, 2.7 percent for three-engine airplanes, and 3.0 percent for four-engine airplanes, at V_2 and with—

(1) The critical engine inoperative, the remaining engines at the takeoff power or thrust available at the time the landing gear is fully retracted, determined under §25.111, unless there is a more critical power operating condition existing later along the flight path but before the point where the airplane reaches a height of 400 feet above the takeoff surface; and

(2) The weight equal to the weight existing when the airplane's landing gear is fully retracted, determined under §25.111.

(c) *Final takeoff.* In the en route configuration at the end of the takeoff path determined in accordance with §25.111, the steady gradient of climb may not be less than 1.2 percent for two-engine airplanes, 1.5 percent for three-engine airplanes and 1.7 percent for four-engine airplanes, at *V*FTO and with

(1) The critical engine inoperative and the remaining engines at the available maximum continuous power or thrust; and

(2) The weight equal to the weight existing at the end of the takeoff path, determined under §25.111.

(d) *Approach.* In a configuration corresponding to the normal all-engines-operating procedure in which *V*SR for this configuration does not exceed 110 percent of the *V*SR for the related all-engines-operating landing configuration, the steady gradient of climb may not be less than 2.1 percent for two-engine airplanes, 2.4 percent for three-engine airplanes, and 2.7 percent for four engine airplanes, with

(1) The critical engine inoperative, the remaining engines at the go-around power or thrust setting;

(2) The maximum landing weight;

(3) A climb speed established in connection with normal landing procedures, but not more than 1.4 *V*SR; and

(4) Landing gear retracted.

§ 121.189 Airplanes: Turbine engine powered: Takeoff limitations.

(a) No person operating a turbine engine powered airplane may take off that airplane at a weight greater than that listed in the Airplane Flight Manual for the elevation of the airport and for the ambient temperature existing at takeoff.

(b) No person operating a turbine engine powered airplane certificated after August 26, 1957, but before August 30, 1959 (SR422, 422A), may take off that airplane at a weight greater than that listed in the Airplane Flight Manual for the minimum distances required for takeoff. In the case of an airplane certificated after September 30, 1958 (SR422A, 422B), the takeoff distance may include a clearway distance but the clearway distance included may not be greater than 1/2 of the takeoff run.

(c) No person operating a turbine engine powered airplane certificated after August 29, 1959 (SR422B), may take off that airplane at a weight greater than that listed in the Airplane Flight Manual at which compliance with the following may be shown:

(1) The accelerate-stop distance must not exceed the length of the runway plus the length of any stopway.

(2) The takeoff distance must not exceed the length of the runway plus the length of any clearway except that the length of any clearway included must not be greater than one-half the length of the runway.

(3) The takeoff run must not be greater than the length of the runway.

(d) No person operating a turbine engine powered airplane may take off that airplane at a weight greater than that listed in the Airplane Flight Manual—

(1) In the case of an airplane certificated after August 26, 1957, but before October 1, 1958 (SR422), that allows a takeoff path that clears all obstacles either by at least (35+0.01D) feet vertically (D is the distance along the intended flight path from the end of the runway in feet), or by at least 200 feet horizontally within the airport boundaries and by at least 300 feet horizontally after passing the boundaries; or

(2) In the case of an airplane certificated after September 30, 1958 (SR 422A, 422B), that allows a net takeoff flight path that clears all obstacles either by a height of at least 35 feet vertically, or by at least 200 feet horizontally within the airport boundaries and by at least 300 feet horizontally after passing the boundaries.

(e) In determining maximum weights, minimum distances, and flight paths under paragraphs (a) through (d) of this section, correction must be made for the runway to be used, the elevation of the airport, the effective runway gradient, the ambient temperature and wind component at the time of takeoff, and, if operating limitations exist for the minimum distances required for takeoff from wet runways, the runway surface condition (dry or wet). Wet runway distances associated with grooved or porous friction course runways, if provided in the Airplane Flight Manual, may be used only for runways that are grooved or treated with a porous friction course (PFC) overlay, and that the operator determines are designed, constructed, and maintained in a manner acceptable to the Administrator.

(f) For the purposes of this section, it is assumed that the airplane is not banked before reaching a height of 50 feet, as shown by the takeoff path or net takeoff flight path data (as appropriate) in the Airplane Flight Manual, and thereafter that the maximum bank is not more than 15 degrees.

(g) For the purposes of this section the terms, *takeoff distance, takeoff run, net takeoff flight path* and *takeoff path* have the same meanings as set forth in the rules under which the airplane was certificated.

APPENDIX C. COMPARISON OF 14 CFR 25 SUBPART B AND 14 CFR 121 SUBPART I CLIMB REQUIREMENTS

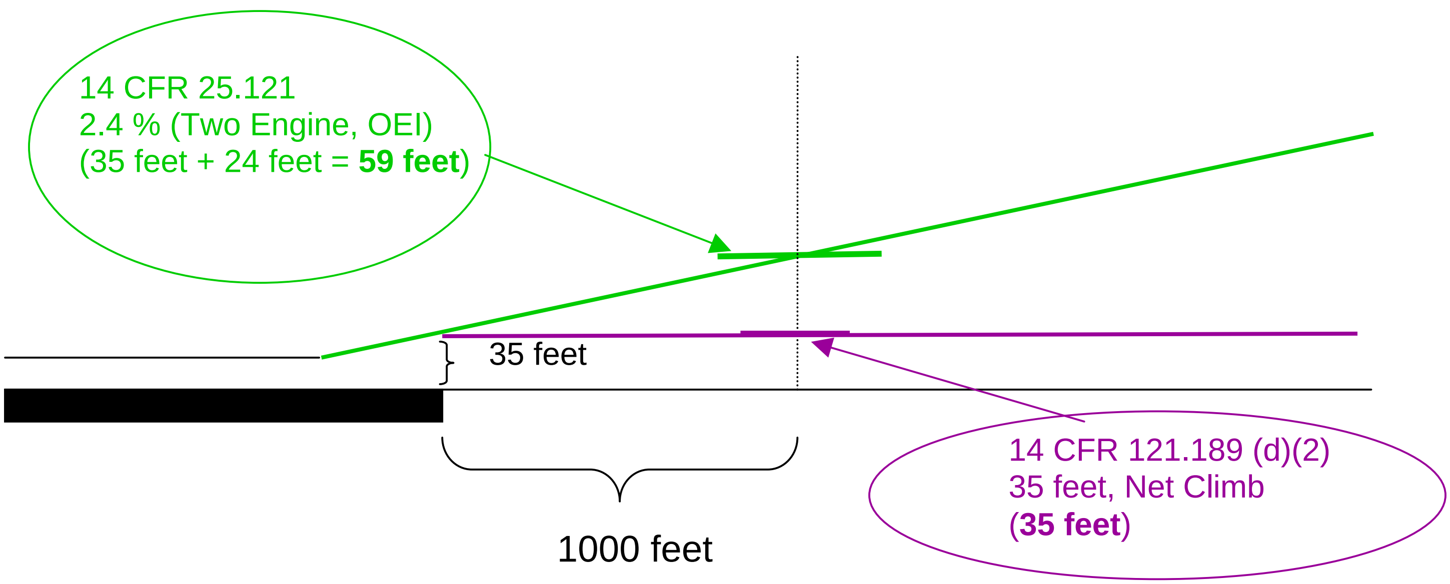
Un-metered End Around Taxiway (EAT) aircraft are considered obstacles for the purpose of performance planning.

Pertinent rules are

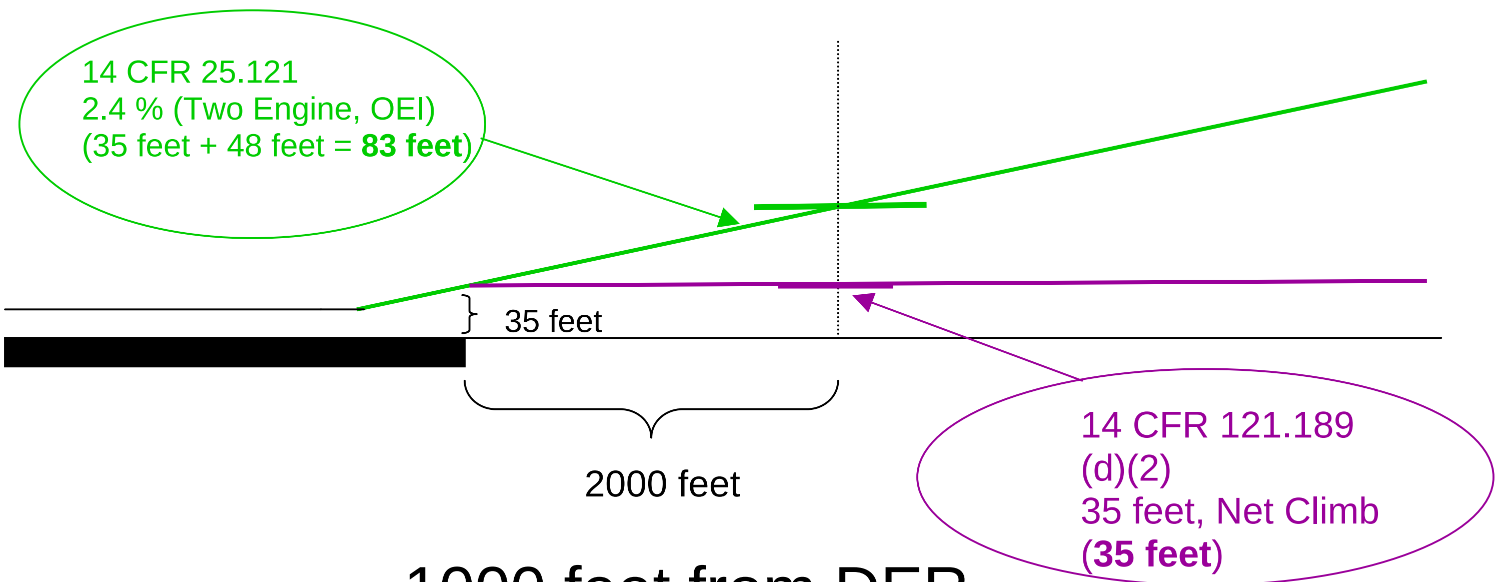
–14 CFR 25.111, and .121, and,

–14 CFR 121.189

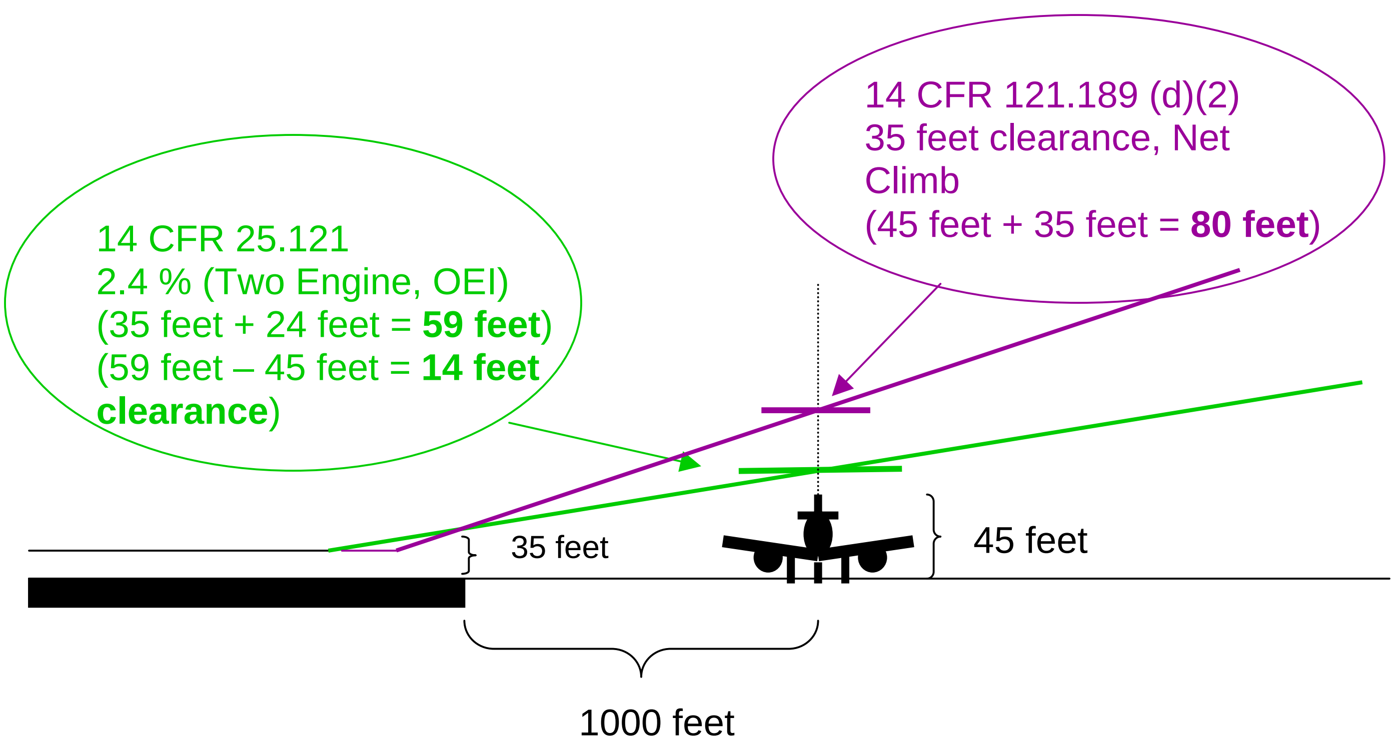
1000 feet from DER, no Obstacle



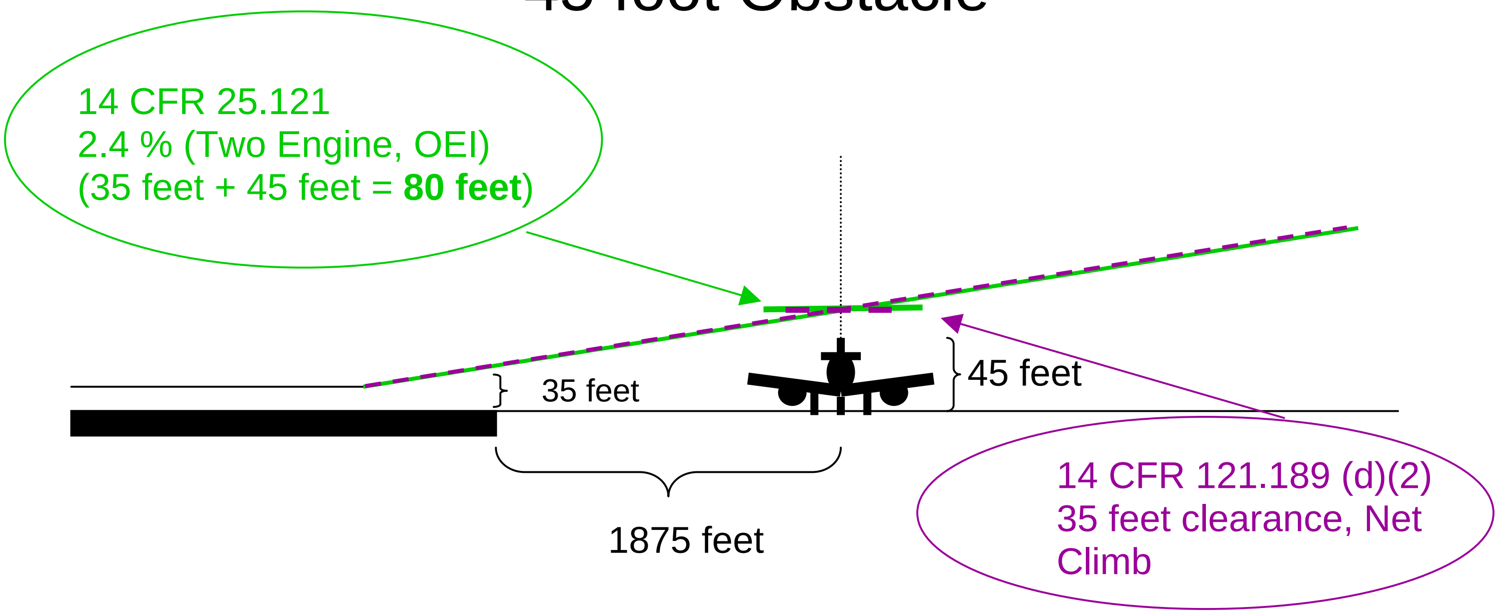
2000 feet from DER, no Obstacles



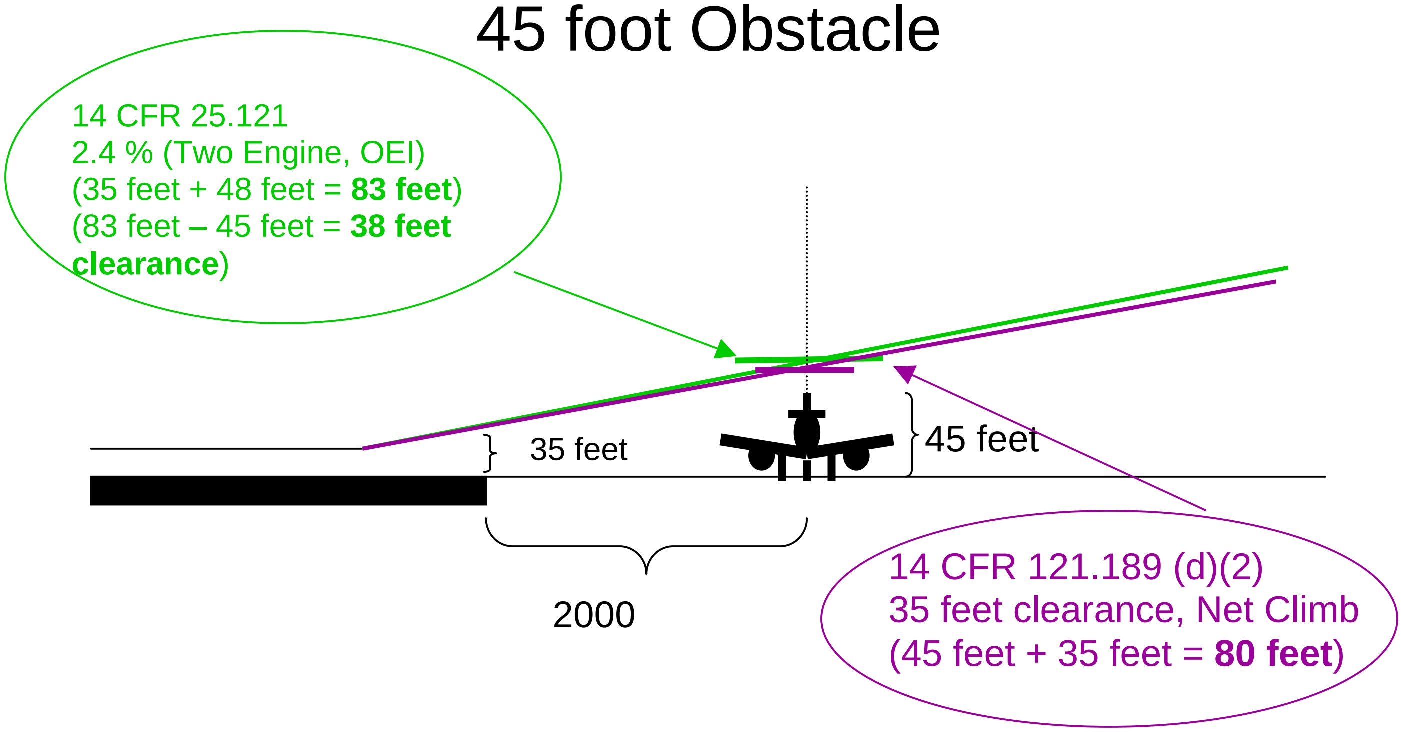
1000 feet from DER, 45 foot Obstacle



1875 feet from DER,
45 foot Obstacle



2000 feet from DER,
45 foot Obstacle



SUMMARY

Takeoff weight must be reduced or limited to that weight which allows

–14 CFR 25 Subpart B (certification rule) climb requirements, or,
–14 CFR 121 Subpart I (operational rule) climb requirements to be met, whichever results in a lower weight.

In operations without an obstacle present, the certification limit will control.

In example operations with an obstacle present at 1,000 feet from DER, the operational limit will control. At 2,000 feet, the certification limit controls. The "break point" is 1,875 feet from the Departure End of the Runway (DER).

Note: Use of airplanes with 3 and 4-engine configurations will skew requirements more toward the certification limit (net climb requirements are higher).

CONCLUSION

The use of End Around Taxiways in the example configurations will result in an increased climb gradient requirement and associated reduction in takeoff weight for climb-limited aircraft when the EAT is within 1,875 from the DER (assuming a maximum EAT aircraft height of 45 feet).

Under these conditions, this reduction in takeoff weight would typically result in lost passenger and/or cargo throughput capacity for the airport.

Project Overview

Key Goals:

- Designed as part of the ATL Master Plan to reduce Runway 26L departure delay.
- Reduce congestion on Taxiways E & F at the entrance to Ramp 1during East Flow operations.
- Facilitate the reduction in the number of runway crossings on Runway 8R/26L over the projected growth of the airport.

Project Overview - (Continued)

Key Features:

- Connects Taxiway E on the south to Taxiway B on the north.
- Taxiway is 1,520' from the end of Runway 8R and is no closer than 380 feet where the taxiway parallels the extended runway centerline.
- Taxiway has a maximum 1.5% downward slope to maximize airspace clearances. Results in a maximum elevation difference of 29.6' between the lowest point on the taxiway (994.2' MSL) and the runway end elevation (1023.8' MSL).
- Taxiway limited to Design Group IV aircraft (includes B767, B757, MD-11) and smaller, to meet airspace and taxiway object free area requirements.
- Existing ALSF-II system replaced with a new MALSF for Runway 8R.
- Runway safety area graded to meet standards and validated to provide line-of-sight from both the existing and proposed airport control tower.
- Environmental – Categorically Excluded
- Provides a blast wall between the taxiway and the relocated roadways.
- Estimated construction cost of $42 million dollars (including soft costs).

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Design Characteristics

- Airport Obstruction Criteria:
  - Runway 8L approaches were evaluated using the proposed TIL 03-040 to ensure that the Category III ILS was protected.
  - As part of the construction of the new Airport Traffic Control Tower, the ILS approach minimums for Runway 8R will increase to 240' AGL and 4000' RVR (3/4 Mile). The following obstacle criteria was used to evaluate impacts to Runway 8R arrivals:
    - TERPS Precision Approach Obstacle Clearance surfaces (POFA, W, X, and Y).
    - AC 150/5300-13, Airport Design Guidelines, Appendix 2, threshold siting surfaces for runway ends expected to serve large aircraft.
  - Runway 26L departure impacts were evaluated using the TERPS 40:1 departure surface.
- Airline Obstruction Criteria:
  - The airlines consulted used a variety of criteria for evaluating their potential engine out weight restrictions as required by FAR Part 121. This included criteria specified in FAR Part 25, ICAO Annex 6, and FAA AC 120-OBS-11.
  - The critical taxiway obstacle considered included any Design Group IV aircraft, which may be present in the engine-out splay while on the end around taxiway.
  - All Delta Air Lines (DAL) aircraft in current fleet cleared all obstacles as required by FAR Part 25 without any performance degradation associated with the end around taxi way.
  - Other airlines (NWA, US Airways, United, FedEx, Aero Mexico, and AirTran Airways) indicated that they either had no weight reduction requirements or had minor weight reduction requirements that would not impact their operations at ATL.

Proposed Taxiway Usage/Limitations

Runway and Operation Affected	West Flow Operation
26R Arrivals	Runway 26R arrivals land, taxi westbound on "B" and continue onto End-Around, taxiing to Taxiway E, Taxiway F, or entrance to Ramp 1 North.
26L Departures	Runway 26L departures continue to depart over aircraft taxiing on End-Around in conditions above 300-foot ceiling and one-mile visibility (300-1).

- **West Flow Summary:**
  - All passenger airline arrivals (with the exception of Design Group V aircraft) landing on Runway 26R use end around taxiway to access the Central Passenger Terminal Complex during Visual Meteorological Conditions.
  - Use of the taxiway during Instrument Meteorological Conditions would be limited to ceiling and visibilities greater than 300' AGL and 1 mile visibility, due to aircraft tail penetrations of the RW 26L TERPS 40:1 Departure Surface.

Runway and Operation Affected	East Operation
8L Arrivals	Runway 8L arrivals continue to land on 8L in all weather conditions, even with aircraft on 8R End-Around queued to depart 8R.
8L Arrivals Sidestepping to 8R	8L arrivals electing to sidestep in visual, daytime conditions are protected by 20:1. Instrument sidestep procedure to 8R would not be protected with aircraft on 8R End-Around. 8R approach light plane would not be protected from aircraft on End-Around.
8R Departures	Aircraft would be able to queue on the Taxiway, providing an opportunity to queue 8R departures on the End-Around and "E" and "F".
8R Arrivals	No aircraft permitted on End-Around when ILS or localizer approaches are conducted to 8R.

- **East Flow Summary:**
  - Runway 8L arrival operations are not impacted.
  - Instrument approaches to Runway 8R not permitted when taxiway is in use.
  - Visual approaches to Runway 8R are permitted.
  - Runway 8R departures may be queued on taxiway as long as there are no instrument approaches being conducted to Runway 8R.