Technical Report
DOT-FAA-AFS-440-76

EVALUATION TO DETERMINE IF PILOTS CAN DEVELOP A WAKE TURBULENCE AVOIDANCE STRATEGY WHILE CONDUCTING SIMULTANEOUS OFFSET INSTRUMENT APPROACHES (SOIA) AT SAN FRANCISCO INTERNATIONAL AIRPORT (SFO) WITH A CEILING OF 1,600 FEET

September 2011

Flight Operations Simulation Branch, AFS-440
6500 S. MacArthur Blvd, STB Annex (Bldg. #26) Room 212
Oklahoma City, Oklahoma 73169
Phone: (405) 954-7466

DOT-FAA-AFS-440-76

Flight Operations Simulation Branch
Flight Technologies and Procedures Division
Flight Standards Service

EVALUATION TO DETERMINE IF PILOTS CAN DEVELOP A WAKE TURBULENCE AVOIDANCE STRATEGY WHILE CONDUCTING SIMULTANEOUS OFFSET INSTRUMENT APPROACHES (SOIA) AT SAN FRANCISCO INTERNATIONAL AIRPORT (SFO) WITH A CEILING OF 1,600 FEET

Reviewed by:

9/20/2011

Stephen W. Barnes **Date**
Manager, Flight Operations Simulation Branch, AFS-440

Released by:

9/21/2011

Leslie H. Smith **Date**
Manager, Flight Technologies and Procedures Division, AFS-400

September 2011

Technical Report

Technical Report Documentation Page

1. Report No. DOT-FAA-AFS-440-76	**2. Government Accession No.**	**3. Recipient's Catalog No.**
4. Title and Subtitle EVALUATION TO DETERMINE IF PILOTS CAN DEVELOP A WAKE TURBULENCE AVOIDANCE STRATEGY WHILE CONDUCTING SIMULTANEOUS OFFSET INSTRUMENT APPROACHES (SOIA) AT SAN FRANCISCO INTERNATIONAL AIRPORT (SFO) WITH A CEILING OF 1,600 FEET		**5. Report Date** September 2011
6. Author(s) Dean Alexander, AFS-440; Larry Eversmeyer, AFS-440; Mark Reisweber, AFS-440; Larry Newman, ATSI; Nancy Law, ATSI; Joe Lintzenich, ATSI		**7. Performing Organization Code** AFS-440
8. Performing Organization Name and Address Flight Operations Simulation Branch, AFS-440 6500 S. MacArthur Blvd, STB Annex (Bldg. #26), Room 212 Oklahoma City, Oklahoma 73169		**9. Type of Report and Period Covered** Technical Report
10. Sponsoring Agency Name and Address Federal Aviation Administration Flight Operations Simulation Branch, AFS-440 6500 S. MacArthur Blvd, STB Annex (Bldg. #26), Room 212 Oklahoma City, Oklahoma 73169		
11. Supplementary Notes		
12. Abstract The Flight Operations Simulation Branch, AFS-440, was tasked to conduct this operational evaluation to determine if pilots can develop a wake turbulence avoidance strategy while conducting Simultaneous Offset Instrument Approaches (SOIA) at San Francisco International Airport (SFO) with a ceiling of 1,600 feet. Subjective pilot data were taken utilizing the Federal Aviation Administration's (FAA) Boeing 737-800 Level D Full Flight Simulator conducting the Localizer-Type Directional Aid (LDA) Precision Runway Monitor (PRM) RWY 28R approach. The FAA's heavy Airbus 330-200 Level D Full Flight Simulator was utilized as the leading aircraft conducting the Instrument Landing System (ILS) PRM RWY 28L approach. Results of this evaluation indicate that pilots were able to develop a wake turbulence avoidance strategy with a ceiling of 1,600 feet.		
13. Key Words Instrument Landing System (ILS) Simultaneous Offset Instrument Approach (SOIA) San Francisco International Airport (SFO) Wake Turbulence Avoidance Strategy		**14. Distribution Statement** Controlled by AFS-440
15. Security Classification of This Report Unclassified		**16. Security Classification of This Page** Unclassified

Executive Summary

The Flight Operations Simulation Branch, AFS-440, was tasked to conduct this operational evaluation to determine if pilots can develop a wake turbulence avoidance strategy while conducting Simultaneous Offset Instrument Approaches (SOIA) at San Francisco International Airport (SFO) with a ceiling of 1,600 feet. Subjective pilot data were taken utilizing the Federal Aviation Administration's (FAA) Boeing 737-800 Level D Full Flight Simulator conducting the Localizer-Type Directional Aid (LDA) Precision Runway Monitor (PRM) Runway (RWY) 28R approach. The FAA's heavy Airbus 330-200 Level D Full Flight Simulator was utilized as the leading aircraft conducting the Instrument Landing System (ILS) PRM RWY 28L approach. Results of this evaluation indicate that pilots were able to develop a wake turbulence avoidance strategy with a ceiling of 1,600 feet.

TABLE OF CONTENTS

1.0 Introduction

The Simultaneous Offset Instrument Approach (SOIA) operation at San Francisco International Airport (SFO) requires aircraft to approach in pairs, with the aircraft on the Instrument Landing System (ILS) 28L approach leading the aircraft conducting the Localizer-Type Directional Aid (LDA) 28R approach (See Appendix A). Currently, SOIA at SFO is only conducted when the weather is at or above 2,100 feet ceiling and four miles visibility. When the LDA aircraft exits the cloud ceiling, the pilot makes visual contact with the leading ILS aircraft. Inside the LDA Precision Runway Monitor (PRM) Runway (RWY) 28R Decision Altitude (DA), the LDA aircraft maintains visual separation from the adjacent ILS aircraft and is responsible for wake avoidance while maneuvering to land on RWY 28R.

The Flight Operations Simulation Branch, AFS-440, was tasked to conduct an operational evaluation to determine if pilots can develop a wake turbulence avoidance strategy while conducting SOIA operations at SFO with a ceiling of 1,600 feet. Subjective pilot data were taken utilizing the FAA's Boeing 737-800 Level D Full Flight Simulator (B737) conducting the LDA PRM RWY 28R approach. The FAA's heavy Airbus 330-200 Level D Full Flight Simulator (A330) was utilized as the leading aircraft conducting the ILS PRM RWY 28L approach.

2.0 Purpose

The purpose of this operational evaluation was to collect subjective pilot response data and observational data to determine the operational capabilities of pilots to formulate a wake turbulence avoidance strategy while conducting the SOIA LDA PRM RWY 28R approach at SFO with a cloud ceiling of 1,600 feet.

3.0 Evaluation Execution and Methodology

A set of 12 SOIA operations (6 LDA approaches each for both the Captain (CA) and First Officer (FO) was developed (See Appendix A). Each crew completed all 12 LDA approaches, 6 of which were during daytime lighting conditions; 6 of which were flown during nighttime lighting conditions. Independent variables that may have directly impacted the performance were day, night, and/or initial longitudinal separation between the ILS and LDA aircraft. Consistent with typical RWYs 28L/R arrival pairings at SFO, scenarios were randomized to have in-trail initial separations of 0.5 Nautical Miles (NM), 1.0 NM or 1.5 NM. The subject pilot aircraft (B737) flying the LDA was paired with an A330, flying the parallel ILS 28L approach at SFO. A 10-knot left crosswind component (from the wake generating aircraft toward the subject pilot aircraft) was utilized on each approach. This is the maximum crosswind component authorized for SFO SOIA operations.

This operational assessment was limited in scope. Scenarios were not designed to task-saturate crews. Wake turbulence was not modeled into the scenarios.

3.1 Duties and Responsibilities

3.1.1 Test Director (TD): operated the B737 Instructor Operating Station (IOS) and assured that each run set-up corresponded with the intended scenario; prepared and delivered the pre-briefing and conducted the de-briefing to capture the flight crew's feedback concerning the operation.

3.1.2 Human Factors (HF) Observer (FAA): helped administer the post-run and post-simulation questionnaires; maintained written data logs that captured information directly pertaining to pilot performance.

3.1.3 Pilot Observer (PO) (FAA/Contractor): maintained written data logs that captured pilot performance data, pertaining directly to specific pilot tasks and functions; assisted the TD/IOS Operator and HF Observer as needed.

3.1.4 IOS Operator: assured proper simulator set up, functionality, and completion of all scenarios.

3.1.5 Subject Pilots (Alternating CA or FO): flew each approach and provided subjective data.
Subject pilots were to be qualified and current in a Boeing 737-NG and needed to have flown as air carrier line pilots within the past 6 months. Each crew was to be comprised of pilots from the same company. In the case of unplanned subject pilot absences, the TD determined that a replacement for that particular data collection session could be used. Of the 12 required crews, 4 crews had only one contracted crewmember available, which had to be rounded-out by a current and qualified FAA contractor pilot (substitute pilot). The substitute pilot was qualified in the Boeing 737-800 but was currently serving as a B767 line Captain. When used, the substitute pilot was instructed to fly as objectively as possible commensurate with his training, experience and company Standard Operating Procedures (SOPs). In those scenarios when the substitute pilot was used, a decision was made not to include the substitute pilot's data in the final analysis. Subject pilots were to have had prior experience with SOIA or to have reviewed the approved SOIA/PRM Training Video prior to arrival at the data collection site.

3.1.6 Air Traffic Controllers: performed as individuals serving as the Foster Arrival Controller and a separate Tower Controller, familiar with SFO SOIA Operational Procedures.

3.2 Configuration of Flight Simulators

3.2.1 Boeing 737-800: The B737 was released from simulator-freeze and configured prior to each run as follows:

- 11.9 NM from the threshold at 3,800 feet Mean Sea Level (MSL); the Flight Management System (FMS) appropriately loaded for the approach procedure
- Speed – 170 Knots Indicated Airspeed (KIAS)
- Flaps – 10
- Gear – DOWN
- Aircraft Approach (APP) mode selected for the LDA PRM RWY 28R approach
- Number one Very High Frequency (VHF) radio 120.35 (NORCAL APP), Standby frequency 120.5 (SFO Tower)
- Number two VHF radio 127.675 (Monitor)
- Aircraft Gross Weight (GW) = 130,000 pounds (aircraft approach speed of 141 knots)
- Aircraft cleared for the approach

3.2.2 Airbus 330-200: The A330 was simultaneously released from simulator-freeze and configured prior to each run as follows*:*

- 10.4 NM, 10.9 NM, 11.4 NM from runway threshold; the FMS appropriately loaded for the approach procedure
- Established on glidepath and localizer
- Speed – 170 KIAS
- Flaps – 2
- Gear – UP
- Aircraft engaged in APP mode for ILS
- Number one VHF radio 135.65 (NORCAL APP), standby frequency 120.5 (SFO Tower)
- Aircraft GW = 353,000 pounds (approach speed of 141 knots)
- Aircraft cleared for approach
- Contact SFO Tower on frequency 120.5 when passing NEPIC

4.0 Post-Data Collection Analysis

Over the course of 4 days, the 12 crews each flew a total of 12 approaches, for a total of 144 approaches. All scenarios were flown In Accordance With (IAW) the established data collection matrix in Appendix B; each pilot performing as the Pilot Flying (PF) for 6 scenarios and as the Pilot Monitoring (PM) for 6 scenarios.

4.1 Subject Pilot Demography

Company Representation: 4 major commercial air carriers

Boeing 737-NG Flight Experience: 280 up to 17,000 flight hours
SOIA/SFO Experience: 12 of 20 pilots

4.2 Subjective Pilot Response Data

A single-question post-run questionnaire was used. It was designed to capture pilot response to the single purpose of this evaluation: "On this approach, were you able to formulate a wake turbulence avoidance strategy?" Yes or No

Of the 240 responses (120 PF/120 PM), 119 out of 120 PFs responded with "Yes" and 118 out of 120 PMs responded with "Yes". NOTE 1: During one run erroneously generated Traffic Alert Collision Avoidance System (TCAS) traffic resulted in the subject crew executing a go-around and both answering "No" to this question (making these 2 "No's" invalid). One PM (the third "No") initially stated "No" due to the lack of a corresponding TCAS target while Instrument Meteorological Conditions (IMC). Once the traffic was visually acquired that PM stated he then could formulate a wake turbulence avoidance strategy. NOTE 2: When the FAA Contractor pilot flew, he did not fill out post-run questionnaires, attributing to 48 non-responses of the potential 288.

4.3 Post-Data Collection De-Briefing Discussions

When queried specifically about their level of comfort and workload while flying these approaches (SOIA at SFO with 1,600 feet ceilings and 4 miles visibility), 11 crews expressed no significant increase in workload. One CA pointed out that there were definite workload changes. His FO acknowledged that the workload was different than what he was accustomed to but not necessarily heavier.

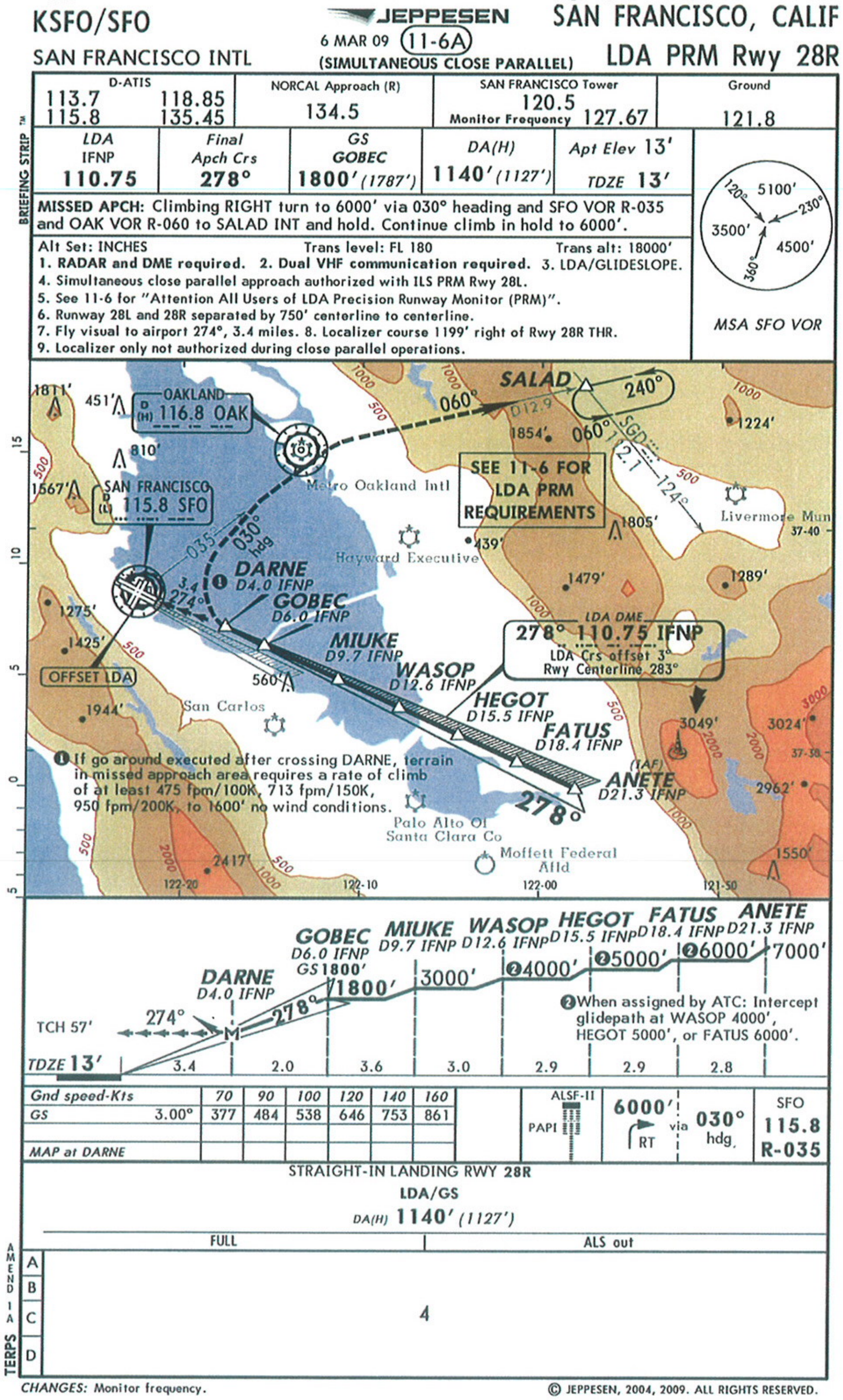
Two pilots commented that lowering the ceiling "compressed" the total time they had to accomplish all the required tasks, but asserted that the task load was quite manageable and that the 1,600 feet ceiling, as tested in the simulator, did not present any problems.

During the post-data collection debrief, 20 out of 20 subject pilots voiced no objections or issues with the proposal to lower the ceiling on the SFO SOIA approach from 2,100 feet to 1,600 feet based on their experience in the simulator during the SOIA scenarios. None of the 20 pilots appeared to experience any difficulty with visually acquiring the traffic prior to reaching DARNE.

5.0 Evaluation Results

Results of this evaluation indicate that pilots were able to develop a wake turbulence avoidance strategy with a ceiling of 1,600 feet.

Appendix A: Approach Plate and Attention All Users Page (AAUP)



KSFO/SFO JEPPESEN SAN FRANCISCO, CALIF
6 MAR 09 (11-6) SAN FRANCISCO INTL

ATTENTION ALL USERS OF LDA PRECISION RUNWAY MONITOR (PRM)
LDA PRM RWY 28R

Special pilot training required. Pilots who are unable to participate, or dispatchers on their behalf, must contact the FAA Command Center prior to departure (1-800-333-4286 or 703-904-4452) to obtain an arrival reservation. Non-participating pilots enroute to SFO as an alternate, or trained pilots that are unexpectedly unable to participate due to in-flight circumstances will be afforded appropriate arrival services as operational conditions permit. Non-participating pilots shall notify the Oakland ARTCC as soon as practical, but at least 100 miles from San Francisco International Airport.

Condensed Briefing Points:

- **Listen to the PRM monitor frequency when communicating with the NORCAL approach control (120.35), no later than LOC intercept.**
- **Report the ILS traffic in sight as soon as practical and prior to DARNE. DO NOT PASS.**
- **Expect to be switched to SFO tower (120.5) at DARNE (I-FNP 4.0 DME).**
- **Remain on the LDA until passing DARNE (LDA MAP) so as not to penetrate the NTZ.**
- **PRM monitor frequency may be de-selected after determining that the aircraft is on tower frequency.**

1. **ATIS.** When the ATIS broadcast advises that simultaneous ILS/PRM and LDA/PRM approaches are in progress, pilots should brief to fly the LDA/PRM 28R approach. If later advised to expect an LDA DME 28R approach, the LDA/PRM 28R chart may be used after completing the following briefing items:
   (a) Minimums and missed approach procedures are unchanged.
   (b) Monitor frequency no longer required.
   (c) A different glideslope intercept altitude may be assigned when advised to expect LDA/DME 28R approach.

   Simultaneous parallel approaches will only be offered/conducted when the weather is at least 2100 feet (ceiling) and 4 miles (visibility).
2. **Dual VHF Communication required.** To avoid blocked transmissions, each runway will have two frequencies, a primary and a monitor frequency. The NORCAL approach controller will transmit on both frequencies. The PRM Monitor controller's transmissions, if needed, will override both frequencies. Pilots will ONLY transmit on the approach controller's frequency (120.35), but will listen to both frequencies. Select the PRM monitor frequency audio only when in contact with NORCAL approach control (120.35). The volume levels should be set about the same on both radios so that the pilots will be able to hear transmissions on at least one frequency if the other is blocked. If executing a missed approach at DARNE,begin the right turn as soon as practical.
3. **All "Breakouts" are to be hand flown** to assure that the maneuver is accomplished in the shortest amount of time. Pilots, when directed by ATC to break off an approach, must assume that an aircraft is blundering toward their course and a breakout must be initiated immediately.
   (a) **ATC Directed "Breakouts".** ATC directed breakouts will consist of a turn and a climb or descent. Pilots must always initiate the breakout in response to an air traffic controller instruction. Controllers will give a descending breakout only when there are no other reasonable options available, but in no case will the descent be below minimum vectoring altitude (MVA) which provides at least 1,000 feet required obstruction clearance. The applicable MVA is 1600 feet at San Francisco International Airport.
   (b) **Phraseology - "TRAFFIC ALERT":** If an aircraft enters the "NO TRANSGRESSION ZONE (NTZ)", the controller will breakout the threatened aircraft on the adjacent approach. The phraseology for the breakout will be: "TRAFFIC ALERT, (aircraft call sign) TURN (left/right) IMMEDIATELY, HEADING (degrees), CLIMB/DESCEND AND MAINTAIN (altitude)".
4. **Glide Slope Navigation:** Descending on the glide slope ensures compliance with any charted crossing restrictions.
5. **SFO LDA Visual Segment.** If ATC advises that there is traffic on the 28L ILS, pilots are authorized to continue past the LDA 28R MAP to align with runway 28R centerline when:
   a) the ILS traffic is in sight and is expected to remain in sight,
   b) ATC has been advised that "traffic is in sight." (ATC is not required to acknowledge this transmission)
   c) the runway environment is in sight.

   Otherwise, a missed approach must be executed at the LDA MAP. Between DARNE and the runway threshold, pilots of the LDA aircraft are responsible for separating themselves visually from traffic on the ILS approach, which means maneuvering the aircraft as necessary to avoid the ILS traffic until landing (do not pass), and providing wake turbulence avoidance, if applicable. If visual contact with ILS traffic is subsequently lost, advise ATC as soon as practical and execute the published missed approach unless otherwise instructed by ATC.

CHANGES: None.

Appendix B: Data Collection Matrix

Run	Scenario	PF	In-Trail Separation	Day/Night	DATE ________ CREW ____________ OBSERVER: __________________ REMARKS:
1	1	CA	.5	DAY	
2	4	FO	.5	DAY	
3	6	FO	1.5	DAY	
4	3	CA	1.5	DAY	
5	2	CA	1.0	DAY	
6	5	FO	1.0	DAY	
7	7	CA	.5	NIGHT	
8	10	FO	.5	NIGHT	
9	9	CA	1.5	NIGHT	
10	12	FO	1.5	NIGHT	
11	8	CA	1.0	NIGHT	
12	11	FO	1.0	NIGHT	

Appendix C: Additional Operational Observations

Although not specifically evaluated in this effort nor uniquely applicable to lowering the cloud ceiling to 1,600 feet, post-evaluation debriefings did yield comments and discussions that focused on other, potential issues that may warrant further consideration. They are included below.

C.1 Substitute Pilot

The substitute pilot was not necessarily familiar with the particular procedures used by each representative airline. One subject pilot stated that flying with the substitute pilot rather than a FO from his own airline was somewhat of a distraction during the first few test runs, but became less so as the simulator session progressed. The other three subject pilots paired with the substitute pilot expressed no reservations with him as part of the crew. (NOTE: One of the subject pilots was employed by the same airline as the substitute pilot.) In accordance with generally accepted operating practices, when in the role of PF, the substitute pilot verbalized his wake avoidance plan, including his perception of the wake threat presented by the parallel traffic. The possibility exists that in sharing that information, the substitute pilot may have subsequently influenced the attitude and behavior of the subject pilots with whom he was flying.

C.2 Comfort Level and Workload

Sixteen pilots reported no significant decrement in their comfort level while four pilots said that their comfort decreased at night because of the difficulty in visually acquiring the parallel traffic. Note that when further queried about this, they responded that it was not specific to either the 2,100 feet or 1,600 feet DA.

Two pilots did say that workload was a bit higher when performing monitoring versus flying duties because they felt there were more tasks to perform in the cockpit. (NOTE: One PM stated during the initial runs the increased workload may have been due to having a substitute pilot.)

C.3 SFO Communication

Several pilots missed the required call to Air Traffic Control (ATC) to report visually acquiring the other traffic. One CA did not make the “traffic in sight” call to ATC until passing the LDA Missed Approach Point (MAP) DARNE, and then not until tuned to the tower frequency, believing that was appropriate. Two pilots commented that ATC should be required to acknowledge the “traffic in sight” report, as pilots were accustomed to receiving an ATC response to their required reports. The pilots were also “subconsciously” distracted waiting for that acknowledgment. (NOTE: The AAUP states that controllers are not required to acknowledge this specific pilot report.)

C.4 Wake Avoidance Strategy

The predominant wake avoidance strategy utilized by the subject pilots was to fly a bit higher on their own glideslope (approximately ½-dot), thus allowing any potential wake to trail beneath them. Of the 18 pilots who established this as their strategy, opinions were mixed concerning their perception of a higher or lower wake encounter potential based upon the longitudinal displacement of the parallel aircraft.

Pilot observers documented two pilots who said that they would use spacing as their primary wake avoidance strategy, including one who said that he would begin to slow down before the LDA FAF GOBEC, regardless of ATC instructions. The other said he would use a combination of slower speed and other methods, such as making a sharper turn toward final and/or “S” turning, if he deemed it necessary to increase the spacing between the aircraft.

Most crews felt that landing long was not an option, due to the requirement to land within the touchdown zone. Several crews attempted to land beyond the touchdown point of the heavy, but stated this was challenging in the simulator, and it ran counter to their habit patterns.

Most pilots stated that once they reached approximately 500 feet Above Ground Level (AGL), they had to focus on landing and not on what the heavy aircraft was doing. Seven pilots felt that a 0.5 NM displacement was safer than a 1.0 or 1.5 NM displacement. Eleven others conversely felt more comfortable with the greater displacement. It was noted that the pilots who said that they would use spacing as their primary wake avoidance strategy were concerned with the 0.5 NM displacement and not with the greater displacements.

Observers also documented 11 individual subject pilots who felt that the threat of encountering wake turbulence from the parallel heavy was less during the testing runs with the 1.0/1.5 NM displacement. Five individual subject pilots perceived that the threat of encountering a wake from the parallel heavy was less during the testing runs with the 0.5 NM displacement.

During the debriefings, several comments were received that reflected differing views and understanding surrounding wake (e.g. wake vortex generation and flow, effect of winds, wake transport, etc.). Some pilots felt that the greatest risk of an encounter occurs at approximately 1.5 NM behind the heavy aircraft (in or near ground effect); others felt the greatest risk was in the 0.5 NM scenarios. Still others felt that the risk was roughly equal at all distances.

This data collection effort identified a potential discrepancy within the subject pilot group in their level of knowledge about the characteristics of wake vortices.

C.5 Perceived Collision Risk versus Wake Avoidance

Seven pilots identified the potential for a collision with the parallel traffic equal to or of greater concern than wake avoidance and potential collision was a greater factor in their decision to fly the strategy they did. Observers documented 12 individual subject pilots who stated that their primary concern with the 0.5 NM displacement was with collision. At least half of those pilots stated that being that close to another aircraft, especially a heavy, made them uncomfortable and presented a distraction. They also indicated that with the 0.5 NM displacement, they were equally concerned with wake turbulence and collision risk.

C.6 Night versus Day Conditions

Pilot/crew opinions on night conditions versus day conditions were mixed equally across crews. Close to half the pilots felt that day conditions [Visual Meteorological Conditions (VMC)] offered them a greater capability to visually acquire and maintain contact with the parallel traffic to their front, while night conditions gave optimum ability to visually acquire the landing environment. Other pilots felt exactly the opposite. Post-evaluation debriefing comments document nine individual subject pilots who perceived the approach to be more challenging at night due to the limited visual cues and the inability to quickly determine the relative track of the parallel traffic. One crew stated that it was easier to acquire the runway at night, but easier to monitor the traffic during the day. Another crew said that while the night visibility in the simulator made the traffic easier to see, the traffic would be more difficult to see and monitor in “real life,” due to lighting ground clutter at SFO at night (this was a crew that said they routinely flew into SFO).

C.7 Pilot Flying versus Pilot Monitoring (Workload, Comfort, Visual Scanning Techniques, Head-in/Head-out Frequency and Duration)

Debriefing documentation indicates that the pilots were about evenly split among those that felt the PM had the greater workload and those that felt that the PF had the greater workload.

A number of crews felt that it was easier to be the PM when in the left seat, as the traffic was on the left side. One CA said that he would assign flying duties to the FO on this approach, so that he could monitor the approach and traffic, as he felt that would be easier and more efficient from the left seat.

The HF observer noted that as aircraft spacing increased, the frequency of head-in versus head-out and dwell time of the outside scan was reduced. An assumption may be made that greater displacement between aircraft reduces workload and increases comfort.

C.8 The Effect of Traffic Alert Collision Avoidance System (TCAS) (Both Traffic Alerts (TAs) and Resolution Advisories (RAs))

In all instances, crews felt that TCAS gave them a great deal of situational awareness concerning other traffic, both on the parallel approach and on their own track (in-front or behind). The opinions offered by crews on the need for TCAS varied from beneficial, as an augmentation to situational awareness, to advocating its mandatory use. When asked about whether TCAS should be a required capability to fly these approaches, six crews indicated they would feel uncomfortable and would be very reluctant to fly without it. Pilot observers documented five subject pilots who stated that they would refuse to fly a SOIA approach if TCAS were not available.

In the simulator, based upon the TCAS display, crews frequently identified and verbalized the position of the parallel traffic they were to follow, before it was identified by ATC. All the subject crews seemed to rely heavily on TCAS to "verify" what they were told by ATC and to increase their comfort level with having parallel traffic. Most crews maintained that the primary information they wanted from ATC was to identify the type of the paired aircraft; they would verify the spacing from the TCAS. Still, two other pilots said they used the difference between the indicated altitude from the TCAS and their own to verify if the lead heavy aircraft was on the glideslope for ILS PRM RWY 28L. Given the limitations of TCAS, the use of this altitude delta is not prescribed, but it, nonetheless, was a strategy used.

Any discussion on the value or benefit of TCAS would have to be tempered since any such benefit is not consistent across aircraft types. For example, the lowest TCAS scale available in some aircraft is ten miles, making it less beneficial for traffic situational awareness in a close terminal environment than it would be on other aircraft, where a 5-mile range can be selected.

C.9 "DO NOT PASS" Restriction

During the debriefing, pilots were asked whether the "DO NOT PASS" restriction would affect their wake avoidance strategy. The restriction was in effect during the evaluation and this question was asked without providing the subject pilots the opportunity or time to carefully consider the issue. Pilot comments were generally all the same. They would be uncomfortable passing another aircraft, especially if that aircraft was categorized as "Heavy." Ten individual subject pilots unequivocally felt the "DO NOT PASS" restriction should remain in place and one crew felt the restriction should be lifted.

Three crews (six individual subject pilots) thought that permitting the traffic on 28R to pass the traffic on 28L might be beneficial in select circumstances, but only with strict criteria in place (i.e. only below 1,000 feet AGL and only with both aircraft aligned with the extended centerline of their respective runways). Their rationale was that a low altitude go-around at SFO, to prevent passing the traffic on 28L, presented more of a risk than allowing the 28R traffic to pass when on short final. They concluded that the control inputs and maneuvers required for a faster aircraft on 28R to stay behind the slower traffic on the left "presented more of a risk for a non-stabilized approach" than the risk presented by allowing the 28R traffic to pass on final. They perceived the collision risk would as small once both aircraft were lined up with their respective runways.

C.10 Other Observations

C.10.1 One pilot expressed the opinion that the DA and turn-to-final should be placed a little higher and further back from the runway. He felt that waiting until DARNE to disconnect the Autopilot (AP), start the turn toward final and contact tower "rushed things too much" and encouraged an unstable approach.

C.10.2 Stabilized approach criteria appeared to vary between air carriers. While the approaches were well controlled, in several instances, pilots established runway alignment below 500 feet AGL. Additionally, observers did see a number of approaches that had vertical speeds that exceeded 1,000 feet per minute (fpm) below 1,000 feet, although only one should have resulted in a mandated go-around IAW that airline's non-stabilized approach criteria.

C.10.3 Two crews considered this a non-precision approach and intentionally used Lateral Navigation (LNAV)/ Vertical Navigation (VNAV) mode, rather than APP mode, prior to DARNE. They stated this was in accordance with their company SOP as a recommended procedure for conducting non-precision approaches. This is not in accordance with the SOIA procedure.

C.10. 4 Several crews were reminded of the need to remain on the LDA until reaching DARNE. NOTE: The AAUP states the aircraft is to remain on the LDA until DARNE.

C.10.5 With the exception of one airline, all the crews noted that PRM training and overall PRM procedural awareness is not a priority with their companies. Some of the crews felt that focus on PRM training might need to be a special interest training item, due to the close proximity of the heavy, parallel traffic.