RTCA, Inc.
1150 18th St N.W., Suite 910
Washington D.C. 20036 USA

Aircraft Secondary Barriers and Alternative Flight Deck Security Procedures

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Prepared by: SC-221
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RTCA, Inc.

Telephone: 202-833-9339
Facsimile: 202-833-9434
Internet: www.rtca.org

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Foreword

This document was prepared by Special Committee 221 (SC-221) and approved by the RTCA Program Management Committee (PMC) on September 28, 2011.

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- Coalescing aviation system user and provider technical requirements in a manner that helps government and industry meet their mutual objectives and responsibilities;

- Analyzing and recommending solutions to the system technical issues that aviation faces as it continues to pursue increased safety, system capacity and efficiency;

- Developing consensus on the application of pertinent technology to fulfill user and provider requirements, including development of minimum operational performance standards for electronic systems and equipment that support aviation; and

- Assisting in developing the appropriate technical material upon which positions for the International Civil Aviation Organization and the International Telecommunication Union and other appropriate international organizations can be based.

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1.0 INTRODUCTION

1.1 Purpose and Scope

Since September 11, 2001, the Department of Transportation (DOT), the Federal Aviation Administration (FAA), the U.S. Congress, and the International Civil Aviation Organization (ICAO) have issued a series of new standards to protect flight decks from intrusion and penetration by small-arms fire (14 CFR 25.795). These have resulted in the installation of reinforced flight deck doors by U.S. and international passenger-carrying[1] air carriers flying to/from the United States. These doors provide protection when they remain closed and locked throughout a flight. The operational reality, however, is more complex.

On many flights the flight deck door cannot remain closed for the entire duration of the flight. On longer flights the flight deck door must be opened for crewmembers to access lavatory facilities, to transfer meals to aircrew, and also to switch crew positions on longer flights for crew rest purposes. The flight deck access procedures used by crewmembers are integral in protecting the flight deck, as is the door itself.

During the opening and closing of the flight deck door, or "door transition", the protective anti-intrusion/anti-penetration benefits of the reinforced door are reduced if established procedures and/or equipment are not properly utilized by crewmembers. Regulators have noted this vulnerability and mandated supplemental procedures during door transition. Both the FAA and ICAO have defined these supplemental procedures. For example, according to 14 CFR 121.584(a)(1), no one may unlock the flight deck door unless, "The area outside the flight deck door is secure." ICAO provides for similar guidance during door transition.

The FAA has determined that additional regulatory guidance material, to supplement the existing regulations, would be desirable to provide more specific guidance to the FAA and to industry.

When closed and locked, as required in 14 CFR 121.587 (a), the flight crew compartment door provides increased security against potential threats. However, 14 CFR 121.587 (b) allows the door to be opened under certain circumstances, and it is during these times that the flight deck becomes vulnerable to hostile individuals or groups. FAA regulation 14 CFR 121.587 specifies requirements related to the closing and locking of the flight crew compartment door:

A. Except as provided in paragraph (b) of this section, a pilot in command of an airplane that has a lockable flight crew compartment door in accordance with Sec. 121.313 and that is carrying passengers shall ensure that the door separating the flight crew compartment from the passenger compartment is closed and locked at all times when the aircraft is being operated.

B. The provisions of paragraph (a) of this section do not apply at any time when it is necessary to permit access and egress by persons authorized in accordance with 14 CFR Part 121.547 and provided the 14 CFR Part 119 operator complies with FAA approved procedures regarding the opening, closing and locking of the flight deck doors.

To date, passenger-carrying air carriers have utilized several methods to support security during the periods of flight when the flight deck door is open. One method employs a combination of procedures using crewmembers to monitor the area and/or aircraft equipment, including galley carts to block access to the flight deck.

[1] The FAA mandate for a fortress door only applies to passenger-carrying air carriers.

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An additional method, one that two major US airlines implemented on their own initiative, blocks access to the flight deck through the presence of an Installed Physical Secondary Barrier (IPSB)- a device that crewmembers deploy prior to opening the flight deck door. Additionally, Boeing and Airbus have designed variants of the IPSB as options on certain models of their next generation aircraft.

After nearly nine years of experience with reinforced flight deck doors, the FAA and industry stakeholders have agreed in principle to review procedures used during flight deck door transitions.

The work of RTCA SC-221, Secondary Barriers, has focused on four activities:

1) Develop consensus-based recommendations for interpretation of applicable regulatory requirements;
2) Review procedures and aircraft equipment currently in use by U.S. air carriers to secure the flight deck and adjacent area during door transition;
3) Provide recommendations and guidance for IPSB applications; and
4) Provide recommendations for standardization of procedures for use of "Secondary Barrier Systems" (SBS) by crewmembers.

The Committee's specific guidance, or terms of reference (TOR) associated with those tasks are noted below.

A. Invite participation from appropriate regulators, industry representation, and other applicable parties, specifically the Transportation Security Administration (TSA), Federal Air Marshals, aircraft manufacturers, equipment manufacturers, airlines, modification centers, pilots and flight attendants associations, and other trade associations.

B. Review the existing protection procedures employed by crewmembers and aircraft equipment manufacturers relevant to the opening, closing and locking of the flight deck door, including securing the area outside the flight deck door.

C. Recommend methodologies that may be employed to comply with applicable regulatory requirements while developing and recommending guidelines to comply with federal regulations.

D. Review a representative sample of current aircraft cabin interior layouts to determine IPSB performance criteria and any associated difficulties that particular layouts may pose.

E. Develop guidelines for IPSB Applications. The guidelines will contain common design characteristics, minimum performance criteria, installation guidance and approval certification guidance for IPSB. It will also contain recommended procedures for use of the IPSB.

F. Review the standards and procedures used by major airlines that use an IPSB to determine if they can serve as the baseline for the special committee recommendations.

This RTCA document provides guidance for use of various Secondary Barrier Systems (SBS) as acceptable means of compliance with current U.S. regulations, as well as an evaluation of best practices, and other considerations to be taken into account when determining compliance with these regulations. Secondary Barrier Systems provide a solution to this need by providing an extra layer of defense during door transitions.

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The purpose of these systems is to provide an obstacle that will delay an attacker long enough for crewmembers to close and secure the flight deck door. These systems are not intended to stop the initiation of an attack, nor protect the flight deck for an indefinite period of time. It is simply a delaying system.

The concept of a secondary barrier system is built around the idea that protection of the flight deck door requires the crew to provide a secure zone aft of the door, large enough for crewmembers to maneuver in and out of the flight deck efficiently and securely. This secure zone need only exist for the time necessary for the door transition to be safely accomplished. After the door transition is complete and the door is once again locked closed, this secure zone no longer needs to be actively protected.

Development of the secondary barrier system concept evolved over time as each airline sought to comply with the post-9/11 regulations. One airline, United, conducted an internal risk assessment of the threat to the flight deck and elected to develop a more robust system than was required by regulation.

The Installed Physical Secondary Barrier (IPSB) was developed to ensure the distance and time requirement of the secondary barrier system could be accomplished in a predictably reliable manner. For those air carriers not equipped with an IPSB, they have developed various alternate methods to accomplish the same goal.

This document provides general guidelines, which apply to all secondary barrier systems, regardless of the type selected, as well as specific guidelines, which apply only to the type of secondary barrier system that is described. These specific guidelines are categorized by the type of secondary barrier system`:

- Installed Physical Secondary Barriers (IPSB),
- Improvised Non-installed Secondary Barriers (INSB), and
- Human secondary barriers.

Compliance with the guidelines in this document is recommended as one means of ensuring that the equipment will perform its intended function(s) (see section 1.5) satisfactorily under all conditions normally encountered in routine operations. Any regulatory application of these standards is the sole responsibility of the appropriate governmental agencies.

This document is laid out in the following sections:

- Section 1 of this document provides information on the purpose and scope of the secondary barrier system initiative and informs the development of related system characteristics and guidelines in follow-on Section 2.
- Section 2 of this document contains general as well as functional guidelines for secondary barrier system equipment. These guidelines describe desired system performance under standard operating and environmental conditions.
- Section 3 of this document provides information on other considerations in designing and implementing a secondary barrier system.
- Section 4 of this document provides information on environmental considerations that may affect equipment performance.

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1.2 System Overview

The Secondary Barrier System (SBS) is a set of procedures and/or equipment onboard the aircraft that allows the crew, during authorized ingress/egress or flight deck door transition, to recognize, react, and respond to a potential threat by closing the flight deck door before the threat can reach the flight deck. In other words, the SBS is defined as a combination of people, procedures and/or equipment onboard the aircraft that provides for the space and time needed behind the flight deck door to secure the flight deck environment during door transition.

Components of SBS include:

- crewmembers (pilots, flight attendants or flight deck/cabin jumpseaters),
- equipment, such as galley carts or other improvised non-installed equipment (INSB); or, an installed physical secondary barriers (IPSB), and
- standard operating procedures (SOPs).

1.3 Discussion of Threat

The most serious credible threat to crewmembers and airborne law enforcement personnel is posed by a team of highly trained, armed, athletic individuals who are intent on using deadly force to defeat all security measures preventing their ability to infiltrate the flight deck.

A review of current commercial aviation security threat mitigations reveal a predisposition towards two major elements of security threats: a focus on interdicting a pre-meditated intent to do harm, and a focus on interdiction of weapons or improvised weapons which can be used to aid an attack. These security layers do not and cannot predict random attacks by mentally unbalanced passengers or others intent on committing acts of violence.

The vulnerability of the flight deck exists regardless of whether the intruder is a part of a pre-meditated, coordinated attack, or if the intruder is a random, criminal, or deranged passenger. The consequences of a breach of the flight deck are equally catastrophic.

1.4 Assumptions and Scope

The design guidelines presented in this document assume that:

- The primary focus is to be U.S. aircraft, current fleet, 14 CFR Part 121 operations equipped with an enhanced flight deck door.
- Aircraft not required to have an enhanced flight deck door, such as cargo aircraft, are not a part of the scope of this committee's guidance.
- The guidelines provided in this document are not meant to be exhaustive or comprehensive. The committee's work focused on an evaluation of current best-practices for secondary barrier systems, and developing performance guidelines for the IPSB.
- SC-221 makes reference to the Airbus privacy door system because, according to our committee's judgment, it meets the definition a secondary barrier system; and it is a best-practice currently employed by a manufacturer that supplies some types of aircraft to U.S. air carriers. (SSI deleted information here). It is the position of SC-221 that the privacy door system designed by Airbus could possibly provide an equivalent level of security to the guidelines we've proposed for the IPSB. That, however, would require additional evaluation. SSI referenced in this section can be requested by contacting the FAA's Flight Standards Office (AFS-007).

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- The guidelines outlined in this document are focused on intended functionality rather than engineering requirements or specifications.
- Any evaluation of an SBS should assume multiple attackers as the most serious credible threat to the flight deck.
- The guidelines recommended by SC-221 are meant to serve as a reference point against which specific designs can be measured.
- The guidelines complement TSA's existing layers[1] of security for the aviation sector while complying with existing Title 14 of the Code of Federal Regulations (CFR). It is assumed that an attacker or attackers have successfully thwarted the existing layers of U.S. aviation security.

These design guidelines do not specifically address the following:

- Other emerging aircraft security technologies not known or addressed by this committee.
- The cost-benefit analysis of secondary barrier system options.
- Cargo carriers without an enhanced flight deck door.
- Specific guidelines for current privacy door systems on the Airbus A380.

Notwithstanding the above-mentioned exceptions, this document is intended to represent a set of recommendations and guidelines that air carriers, aircraft manufacturers, and equipment vendors can use as a baseline for current and future secondary barrier system design, evaluation and implementation.

1.5 Intended Function(s)

A Secondary Barrier System (SBS) is intended to increase the overall security of the aircraft environment by securing and protecting the fight deck from intrusion using a combination of people, procedures, and/or equipment onboard the aircraft. The SBS is intended to provide for the space and time needed behind the flight deck door to secure the flight deck environment during door transition.

The SBS is intended to supplement, not replace, the enhanced flight deck door required by 14 CFR 121.313.(j). It is not intended to be a second "enhanced" fortress-type door, although the guidelines from this document do not preclude the option of an air carrier installing a second enhanced flight deck door in place of an IPSB.

Key elements in meeting the intended functions of the SBS include:

A. Communication and coordination of ingress/egress intentions to relevant crewmembers.

B. Enhancement of the situational awareness of crewmembers and other official personnel on the aircraft during door transition.

C. Early warning of potential threats during the time the flight deck door is open.

D. Provisions for an adequately protected area behind the flight deck door for a period of time necessary to secure the door should an attempt be made to breach the flight deck.

E. Provisions for procedural guidelines for crewmembers to ensure an adequate area immediately outside of the flight deck door is clear while the flight deck door is in transition.

[1] http://www.tsa.gov/what-we-do/layers/index.shtm

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F. An "adequate area" behind flight deck door is defined as enough space for a crewmember to deploy an IPSB or INSB, to open and close the flight deck door, and to monitor the area behind the flight deck door during door transition. This area should normally be able to accommodate a cabin crewmember as well as the individual exiting the flight deck. An "adequate area" should prevent an attacker from reaching through and holding the flight deck door open.

1.6 Operational Goals

The Secondary Barrier System (SBS) is defined as a combination of people, procedures and/or equipment onboard the aircraft that provide for the space and time needed behind the flight deck door to secure the flight deck environment during door transition. The system is designed to delay the ingress of unauthorized personnel until the flight deck door can be both closed and secured in the face of a threat. In order to be effective, the SBS should include the following operational, workload and usability factors associated with the transport category aircraft environment

- Crewmember situational awareness during door transition.
- Flight deck protection during door transitions.
- Passenger awareness and compliance with air carrier procedures associated with door transition (Note: passengers are not a part of the SBS).
- Aural warning by crewmember of an attempt to breach the flight deck.
- Deterrence of intentional hijacking attempts or other violent behavior from passengers.
- Crew-based training programs that maximize situational awareness and minimize the potential for crewmember injury.

1.7 Review of Existing Procedures

In order to determine the scenarios and evaluation protocols that would be used to assist with the creation and testing of any SBS design guidelines, it was imperative that the committee first understand the current procedures, methods and equipment being used by various U.S. Airlines to help protect the flight deck door during transition.

Understanding staffing requirements for flight attendants relevant to commercial operations was also important. Flight attendant staffing is determined, in part, by the number of passenger seats onboard an aircraft (14 CFR Part 121.391). Flight attendant staffing levels vary from single flight attendant operations to multiple flight attendant operations. Therefore for any door transition the committee used the minimum staffing level as one of the baseline tests. This meant that some scenarios would be tested with a single flight attendant protecting the flight deck door during transition. In situations where more than one flight attendant was part of the minimum crew, the information gathered below reflected that the highest number of flight attendants present for door transition was usually two; even if the flight attendant minimum crew was more than two.

To determine the methods to be evaluated, the committee, through the Association of Flight Attendants-Communication Workers of America (AFA), sent out an email questionnaire to the AFA member airlines' safety committee representatives. The various methods documented would then be used to help determine the baseline methods to evaluate the protection methods currently in use by U.S. air carriers.

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Representatives from nine airlines responded. They represent carriers that conduct single flight attendant domestic operations to multi flight attendant international operations. Therefore equipment available also varied.

AFA asked the flight attendant safety representatives to answer the following questions:

- *Do you use a service cart or any other type of physical device to block the aisle during cockpit door transitions?*
- *If you use a service cart to block the aisle, are you required to remain with the cart or can you step away from the cart? (as long as you maintain the FAA's expectation of attendance).*
- *Do you stand in front of the cart or behind it?*
- *If you do not use a cart or physical device to block the aisle, do you post a monitoring Flight Attendant in the secure area to scan for suspicious behavior while the door is in transition?*
- *If a potential threat is detected while the cockpit door is in transition, are Flight Attendants at your carrier instructed to verbalize any type of specific command or code word to signal that the open cockpit door should be closed immediately?*
- *Finally, and of prime importance, how many Flight Attendants are required to accomplish your carrier's access procedures?*

Responses to the questions above are considered sensitive information (SSI), which can be requested by contacting the FAA's Flight Standards Office (AFS-007).

With this information several scenarios were selected that would use one or two flight attendants to protect the flight deck during door transition. Relevant to the number of attackers, the committee determined that the various attack scenarios would include one or two attackers. In addition, testing scenarios would vary between utilizing only a human barrier or a barrier that included a human and equipment found on an aircraft.

Using the scenarios, Federal Air Marshals (FAMS) acting as pilots, flight attendants and attackers a demonstration was conducted for the committee at the FAMS Washington DC Field Office in an aircraft cabin mock up. The purpose of this March 2009 demonstration was to familiarize the committee members with the dynamics and speed of the attack and thus allow for the development of effective evaluation protocols.

The first evaluation was conducted at the FAMS training facility in Atlantic City, New Jersey on May 13, 2009. They were conducted on the L1011 and B727 aircraft at that facility. The working group evaluated the speed a person could move through the cabin towards the flight deck door. In addition, the group evaluated scenarios with a simulated video surveillance system and simulated opaque barrier.

The next evaluation was of bi-fold doors in use on some aircraft conducted at Dulles International Airport (IAD) on September 1, 2009.

These evaluations provided the committee with a reasonable estimate of the time required to close the flight deck door in response to a threat of an attack and the velocity an attacker could move through the cabin toward the flight deck door.

The next step was to determine an additional time factor to compensate for the predictability of the testing environment, where test subjects knew they would be attacked as opposed to the "average crew on an average day". Throughout 2010 a "First Look" test was conducted with crews asked to demonstrate door transitions with an unexpected emergency command. The time demonstrated to close the fight deck door was recorded.

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On October 14, 2010 an evaluation of the video surveillance system and installed opaque barrier installed on a B777 aircraft was conducted. Speed at which an attacker could move through the cabin toward the flight deck door was also re-evaluated.

On March 24, 2011 the committee evaluated flight deck protection methods with and without galley carts or similar obstacles. These evaluations utilized physically fit individuals with extensive training in defensive tactics or close quarter combat skills. It was conducted in Dallas Texas onboard a committee participant airline's selected aircraft**.**

1.8 Definitions of Terms

This section contains a definition of terms used that may have multiple, special, or unique meanings in this document. Additional definitions for terms that are well established and do not have a special or unique meaning in this document are in Appendix A.

Door Transition: Whenever the flight deck door is not closed and locked.

Equivalent Level of Security: An "equivalent level of security" is an "approximately equal level of security" that may be determined by qualitative or quantitative means. As such, it may involve a change to the level of expected risk that is not statistically or mathematically significant as determined by qualitative or quantitative risk analysis. An "equivalent level of security", for example, may be claimed by an IPSB design that does not call for the "positive control" of the flight deck door during its transition by virtue of the mitigation of related risk by more robust design criteria that combines greater structural integrity, in accordance with AC 25.795-1A, with advanced surveillance and control systems.

Human Secondary Barrier: A secondary barrier system where the impeding device is one or more crewmembers. Passengers to not meet the criteria for a human secondary barrier.

Improvised Non-installed Secondary Barrier (INSB): A physical device or object on an aircraft that is temporarily used to provide supplemental security for the flight deck during door transition. An example is a galley cart.

Ingress/Egress: Entry into the flight deck/Exit from the flight deck.

Installed Physical Secondary Barrier (IPSB): A secondary barrier that is installed as a permanent physical feature of an aircraft.

May: The term "may" in this document is used for items that are optional. They may be done or not.

MOPS: Minimum Operational Performance Standards.

Must: The term "must" in this document is used for items which are requirements, but required either by a "shall" in this document or by some other document (e.g., a regulation).

Positive Control: The idea that the crewmember has immediate control of the door or other equipment that he is controlling, in contrast with someone who is not in immediate and tactile control of the item in question.

Privacy Door System: The intention of the Privacy Door is to screen the area between the RHS monument (e.g. Flight Crew Rest Compartment, FCRC) and LHS monument (e.g. Lavatory) and to limit the access to crewmembers only. The door is usually closed during the entire flight and secured open during taxi, take-off and landing to avoid a third obstacle in the escape path in the event of an emergency evacuation.

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Note: The Airbus Privacy Door System is an opaque door aft of the cockpit stairs between LHS and RHS monuments. A locking system restricts access to the area aft of the cockpit door in case the privacy door is closed. It can be unlocked by authorized personnel using an access code. The locking system unlocks automatically if the correct code is entered, and there is no feedback from the flight crew required, which is a different philosophy than for the secure cockpit door. The Airbus Privacy Door ensures Safety by providing unrestricted venting in case of cockpit and cabin decompression and by providing means for emergency access.

Reaction Time: The time required, once recognized, to make a decision to respond.

Recognition Time: The time required to perceive the threat as a threat.

Response Time: The time required to verbalize and/or act in accordance with SOP, so as to close and lock the flight deck door.

Risk Mitigation: Actions taken to reduce either the probability or consequences of a threat to the level at which the risk is acceptable. Implied in this definition is the need to track the risk mitigation plan in order to determine if the mitigation has been effective over time.

Secondary Barrier System (SBS): A combination of people, procedures and/or equipment onboard the aircraft that provide for the space and time needed behind the flight deck door to secure the flight deck environment during door transition.

Secure: Protected against a threat or vulnerability.

Shall: The term "shall" in this document is used to indicate requirements, for items, which are requirements, as opposed to "should" items, which are recommendations. Compliance with all "shall" statements is necessary in order to use this document as a means of compliance with a TSO or Advisory Circular which invokes this document.

Should: The term "should" in this document is used to denote recommendations or guidelines that do not constitute a requirement. Compliance with all "should" statements is not necessary in order to use this document as a means of compliance with a TSO or Advisory Circular which invokes this document. However, deviations from the recommendations (should statements) must be justified.

Threat Mitigation Time (TMT): The total time required to recognize, react and respond to a threat by closing and locking the flight deck door. This may be accomplished by any combination of people, procedures and/or equipment onboard the aircraft that provide for the space and time needed behind the flight deck door to secure the flight deck environment during door transition. In other words, TMT is accomplished by proper use of the secondary barrier system (SBS). TMT is measured from the initiation of an attack until the attacker(s) reaches the flight deck door. For the SBS to be successful, TMT must be at least equal to or greater than the time it takes to recognize an attack is in progress, react to that attack by making a decision to act, and then respond to the attack by employing appropriate procedures.

Vigilance: Also known as vigilance task[1]. A type of task where a user must maintain attention on the task while waiting for an uncommon, unpredictable event, such as monitoring security cameras or radar display.

[1] http://www.interaction-design.org/encyclopedia/vigilance.html

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