



CENTER FOR ADVANCED AVIATION SYSTEM DEVELOPMENT (CAASD)

Flight Deck Based Indications and Alerting To Increase Runway Safety

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ICNS Conference 2008

Bethesda, MD

5-7 May 2008

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Briefing Overview

- **Introduction**
- **Discuss the problem and current methods**
- **Basic operational concept**
- **Defining indications and alerts**
- **Surface alerting scenario example**
- **Engineering issues**
- **Human factors issues**
- **Next steps**



Introduction

- **Industry activity through RTCA Special Committee**
 - **SC 186 Automatic Dependent Surveillance – Broadcast, Working Group 1**
 - **ATSA SURF IA subgroup**
 - **Operational Services Environmental Description (OSED) projected for completion mid 2009**
- **Use ADS-B to identify a conflict and provide indications and alerts in cockpit**
- **System is intended to be usable by all classes of aircraft at many different airports**
- **Intended to reduce the risk of runway incursions and collisions**



Defining the Problem & Current Methods

FAA and ICAO Definition

“A runway Incursion is any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and takeoff of aircraft.”

Addressing the problem in the USA

- Surface marking Standards
- Runway Status Lights & Takeoff Hold Lights
- AMASS & ASDE-X Surface Movement Radar
- New airport designs
- End around taxiways
- Runway Incursion Information Evaluation Program (RIIEP)
- Cockpit moving maps on the surface
- Guidance to standardize surface movement
- Industry initiated training about runway safety
- International efforts developing A-SMGCS



Runway Incursions Continue to Occur

FAA Response to NTSB

NTSB Recommendation to FAA

“Require, at all airports with scheduled passenger service, a ground movement safety system that will prevent runway incursions; the system should provide a direct warning capability to flight crews. In addition, demonstrate through computer simulations or other means that the system will, in fact, prevent incursions.”

- **Two different classes of runway safety alerting systems proposed**
 1. **Ground based safety critical surveillance and alerting logic**
 2. **Flight deck based type of solution**

Subject of this briefing





Flight Deck Based Solution Proposed

The FAA has made a decision to deploy ADS-B ground equipment through an NPRM for ADS-B emitter avionics proposed for completion in 2020

- **Receives and processes surveillance info directly on flight deck**
 - **Determines conflicts**
 - **Presents indications and alerts directly in cockpit**
 - **Requires ADS-B that emits and receives broadcast**
 - **Ground based infrastructure* to increase coverage is beneficial but optional to this application**

*ADS-R and TIS-B



Elements of Flight Deck Based Solution

Air Traffic Situation Awareness

- **Airport Surface Situation Awareness (ASSA*)**
 - displays complete airport
- **Final Approach Runway Awareness Application (FAROA*)**
 - displays only the runway
 - Subset of ASSA

Situation Awareness plus Alerting and Indication

- **Highlighting of safety relevant information under normal operational conditions to facilitate safety critical awareness**
- **Alerting about non-normal conditions to facilitate immediate pilot response**

*Surface situation awareness applications in RTCA DO-289



Advantages of Flight Deck Based Solutions

- **Flight crews have immediate access to safety relevant information**
 - **Ground speed, heading, position of conflict**
- **Enhanced by auditory and visual alerts that attract pilots attention to focus on the specific conflict**
- **Provides faster and therefore more effective conflict resolutions**
- **Intended for use at all airports and by all aircraft**
- **Increases awareness of runway incursions**



Terms Alerts and Indications

- **Consistent with FAA AC 25.1322**
- **ATSA SURF Alerts**
 - **Flight deck annunciation meant to attract the attention of flight crews to a non-normal event**
 - **Advisories**
 - **May require subsequent flight crew response (may or may not include auditory signal)**
 - **Cautions**
 - **Require immediate flight crew awareness and subsequent response (includes auditory signal)**
 - **Warnings**
 - **Require immediate flight crew awareness and immediate response (includes auditory signal)**



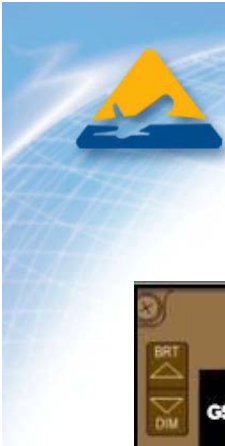
Operational Concept

- **Flight crew uses Cockpit Display of Traffic Information (CDTI) to support general awareness on the airport surface**
- **CDTI information elements are highlighted dependent on ownship position, movement, and current heading**
 - **Current or predicted runway occupancy of a runway that could be relevant for ownship**
 - **Traffic moving toward ownship**
 - **High speed movement on runway in vicinity of ownship**
- **Auditory and visual alerts are provided if conflicts are detected**

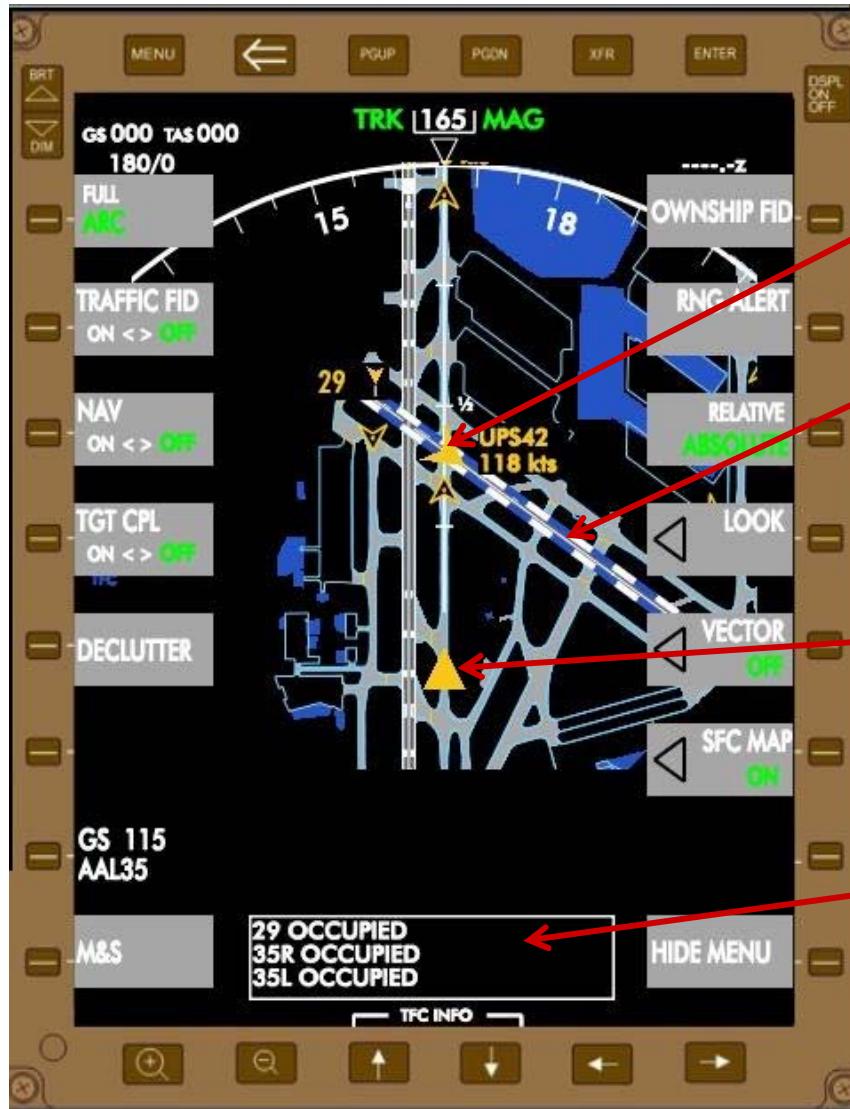


About Indications

- **Identify normal events relevant to runway safety**
- **May be precursor to a non-normal situation or operation**
- **Triggered by ownship entering a predefined area relating to runway safety**
- **Also considers the “energy state” of other aircraft operating within the predefined and relevant area of the runway**
- **Identifies runways with other aircraft, operating above a specified speed, on the relevant runway**



Example Display For Indications



Traffic occupying runway

Indication (occupied runway)

Ownership

Indication Message Text Area



Types of Runway Safety Situations

- **OSED Identified over 107 different scenarios, grouped as follows:**
 - **Ownship Taxies Toward Runway To Enter**
 - **Ownship Departing**
 - **Ownship Approaches Runway**
 - **Ownship Has Landed On Runway**
 - **Ownship Has Stopped or Is Taxiing on Runway**



Types of Runway and Traffic Indications

- **Ownship runway occupied during low energy operations**
 - Aircraft stopped, taxiing, or crossing
- **Ownship runway in use during high energy operations**
 - Departures or landings
- **Crossing runway occupied or in use**
- **Closely spaced parallel runway occupied or in use**
- **Ownship runway or crossing / closely spaced runway predicted in use**
- **Ownship runway or crossing / closely spaced runway predicted to be occupied**

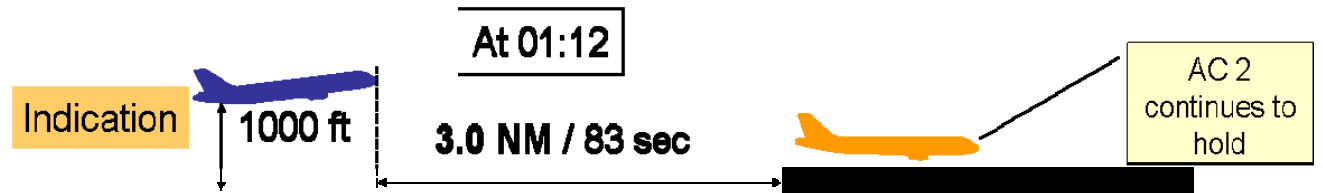


About Alerting

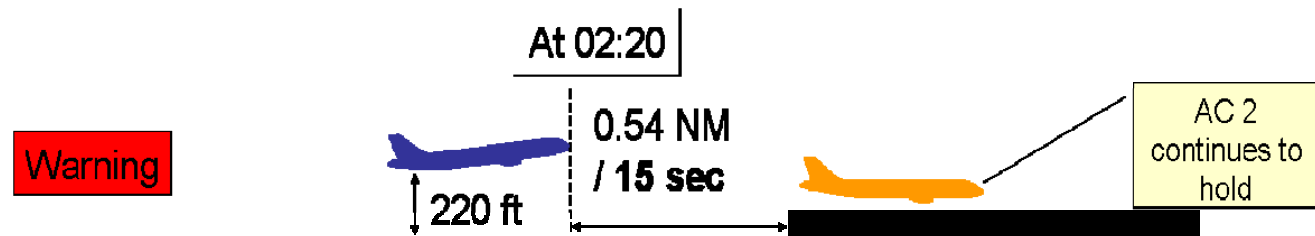
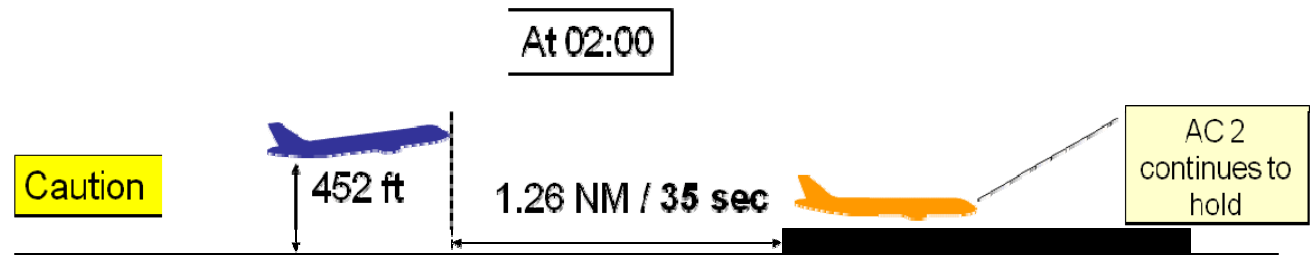
- **Intended to help prevent potential collisions**
- **Proposed as a two level system for ATSA-SURF IA**
 1. **Cautions: Precautionary and are intended to prepare flight crew for possible warning**
 2. **Warnings: Involve immediate risk of imminent collision**
- **Alerts are triggered dependent on scenario of the encounter and sensitive to the following factors:**
 - **Time to conflict, ownship operation, movement and position of conflict, flight crew responses, the acceptable degree of uncertainty**
- **Alerts are presented sequentially and follow indications given prior to the alert**



Sample Scenario



Ownship, a Boeing 757, is lined up for a landing on runway 17R. Visibility conditions are 0.5 statute mile (SM) (2400 feet). Approach speed is 130 knots.





Some Engineering Issues

- **Currently there is no industry definition of the systems on the aircraft to host the ATSA SURF IA functions**
 - Industry definition will assist in promoting a consistent implementation
 - Some manufacturers have demonstrated surface movement systems with the capability of alerting
- **Can Class II EFBs satisfy certification issues? (possibly solved through engineering design)**
 - Allowing a Class II EFB to provide alerting on the surface
 - Current precedence for Class II EFB to display ownship on surface moving map
 - Can restrictions be mitigated through the use of an engineering solution?



Some Human Factors Issues

- **May ATSA SURF IA warnings contain commands or be limited only to information?**
- **What are the acceptable rates for false, nuisance and missed alerts?**
- **To what extent should auditory information be used for ATSA SURF indications?**
 - **Are they distracting for indications?**
 - **Do they provide value in some instances?**
- **Should ATSA SURF alerts be provided to ATC?**
 - **How will ATC react to pilots taking actions without ATC concurrence?**



Next Steps

- **ATSA SURF IA continues to be defined within RTCA SC-186**
- **Human in the loop (HITL) simulations are being conducted**
 - **First HITL simulation investigated indications (March 2008)**
 - **A second HITL simulation will examine alerting**
 - **Additional HITL simulations will be conducted**
- **Analyses on surveillance accuracy requirements and algorithm development continue**
- **Safety analysis in progress**



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Questions

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