CAST Runway Excursion Team Study & Results

Rob Noges – Boeing
RASG-PA Runway Excursion Prevention Seminar
October 2014
CAST Runway Excursion (RE) Study Overview

- Background
- Review of CAST Runway Excursion Study
- CAST Recommended Safety Enhancements
- Expected Benefits
CAST RE Study
All Accident Categories, 2002-2011

2002-2011 World Wide Hull Loss and Fatal Accidents*

*Western-built airplanes, Part 121 equivalent operations, 288 Accidents
CAST RE Study
All Accident Categories, 2002-2011

2002-2011 World Wide Hull Loss and Fatal Accidents*

*Western built airplanes, Part 121 equivalent operations: 288 Accidents
CAST RE Study
**Worldwide Runway Excursions, 1987-2011**

World Wide RE-Landing + Takeoff Hull Loss and Fatal Accidents*

*Western built airplanes, Part 121 equivalent operations*
CAST RE Study
Part 121 Runway Excursions, 1987-2011

RE-Landing + Takeoff - Operator Domicile: USA

*Western built airplanes, Part 121 operations
CAST RE Study
All Accident Categories, Latin America & Caribbean 2004-2013

2004-2013 Latin America & Caribbean Hull Loss and Fatal Accidents

*Western built airplanes, Part 121 equivalent operations; 49 Accidents
CAST RE Study

Latin America & Caribbean Runway Excursions, 1987-2013

*Western built airplanes, Part 121 equivalent operations
Overruns often are caused by more than one factor!
CAST RE Study
Correlation of Stabilized Approach vs. Touchdown Point

Analysis of 29 Jet Overrun Accidents and Incidents

- Landed Long:
  - Unstable Approach: 62%
  - Stable Approach: 38%

- Landed within Touchdown Zone:
  - Unstable Approach: 6%
  - Stable Approach: 94%
CAST RE Study

Effect of Delayed Reverse Thrust Use

Inadequate Deceleration — Delayed Thrust Reverser Use

Delayed Reverse-Thrust Scenario

- Engine speed N1
- Thrust reverser command
- Maximum reverse

- Flight idle
- Ground idle

Prompt Reverse-Thrust Scenario

- Engine speed N1
- Thrust reverser command
- Maximum reverse

- Flight idle

Time (seconds)

Touchdown

0 4 8 12 16 20 24
CAST RE Study

Overrun Speed vs. Outcome Severity

Overrun Speed vs Outcome

Landed Long

Hull Loss

No damage – substantial damage

Hull Loss

Hull Loss

Hull Loss & Onboard Fatalities

0

20

40

60

80

100

120

Overrun Speed (kts)
CAST identified runway excursion (RE) as an area of ongoing concern in both U.S. and worldwide accident data trends.

Numerous analytical studies have been performed over the past decade on the subject of RE.

CAST chartered the RE Study in spring 2012 to:
- review existing industry reports
- summarize findings and recommendations
- develop cost-beneficial CAST Safety Enhancements that encompass the most effective mitigations
CAST RE Study

Process

Review Industry RE Reports/Studies
- Capture and consolidate recommended actions

Assess the Recommended Actions
- Feasibility
- Risk reduction potential

Present to CAST for Approval

Develop CAST SEs
- Recommended Actions
- Define responsible organizations
- Develop schedule
- Cost Estimates
- Assess risk reduction

Present SEs for CAST approval
- Approved SEs placed on the SkyBrary web site

Develop Report for CAST approval
CAST RE Study
Source Reports Reviewed

TALPA ARC
Airport/Part 139 WG
Part 25 WG

European Action Plan
EAPPRE Condensed & Full Report

NLR (National Aerospace Laboratory Netherlands)
NLR-CR-2010-259

EuroControl
International RE Report

IFALPA (International Federation of Air Line Pilots' Associations)
Runway Safety Report

CAA
Sig 7 Task Force RPT
RE Task Force Update

FSF (Flight Safety Foundation)
Reducing Risk of RE

ATSB (Australian Gov. Safety Bureau)
RE Reports Part 1 & 2

ACRP (Airport Cooperative Research Program)
Reports 3 & 50

FAA – Accident Investigation
RE Report Recommendations

Boeing
RE Accident Summary
CAST RE Study

Recommendations Refinement

Review of 15 Industry Runway Excursion Reports:

→ 273 Recommended Actions

→ 75 Intervention Strategies

→ 16 SE Concepts

→ 7 Final SEs + 1 R&D Plan
CAST Recommended RE Safety Enhancements
Recommended Safety Enhancements

**SE 215 Landing Distance Assessment**

- **Regulatory actions**
  - Guidance material from Flight Standards, Aircraft Certification, and Airports
  - Air Traffic Control Procedure Changes

- **Airplane Manufacturers**
  - Airplane performance data to support standardized landing distance assessment

- **Airport Operators**
  - Changes to runway friction measurement and reporting terminology

- **Air Carriers**
  - Implementation in SOPs
Recommended Safety Enhancements
SE 216 and SE 217 Flight Crew Procedures and Training

• Landing Training
  – Focus on stable approach, flare, and touchdown
  – Tailwind, crosswind, and contaminate runway scenarios

• Takeoff Performance
  • Ensuring correct data communication from dispatch to flight crew
  • Special precautions when using EFBs

• Training for the RTO Decision
  • Scenario-Based
  • When and when NOT to RTO
Recommended Safety Enhancements
SE 218 and SE 222 Airplane Design

• Runway Overrun Awareness and Alerting Systems
  • Manufacturer development on new and existing designs
  • Air carrier implementation as feasible and cost-beneficial

• Airplane-based Runway Friction Measurement and Reporting
  • Complete research underway in FAA on prototype systems
Recommended Safety Enhancements

**SE 219 Air Traffic and Airport Operations Procedures**

- Changes to ATC Procedures
  - Runway selection and arrival/departure configuration based on tailwind levels
  - Reporting of most adverse wind on arrival or departure runway

- Training for controllers on factors that contribute to RE
Recommended Safety Enhancements

**SE 220 and SE 221 Airport Operator Actions**

- **Airports**
  - Increase implementation of distance-remaining signs

- EMAS installation at critical airports
- Improve Runway Safety Areas (where needed)
- Use of grid maps for reporting events
- Dedicated airport radio frequency for communication after an RE event
Landing Excursion Mitigation – Part 121 Fleet

Overall Awareness of RE Landing RISK in Policies and Procedures (Regulators, Air Traffic Control, Airports, Operators, Manufacturers)

Landing Distance Assessment

- Timely and accurate field condition reports (winds and runway surface conditions) & ATC tailwind limits
  - SE 215 & 219
- Enhance approach and landing stability, flare and touchdown:
  - ATC and Crew Training
  - SE 216 & 219

Enhance Crews Situational Awareness of Airplane Position and Stopping Performance on Runway
- Distance to go signs
  - SE 198
- SE 216 & 219

Crews knowledge and use of airplane stopping devices
- SE 216
- SE 220

Field Conditions and Reporting, RSA
- SE 215
- SE 221

Airplane systems that enhance the flight crews ability to land and stop the airplane: (e.g., unstabilized approach alerts, flare guidance, deceleration guidance, and features that enhance the crews situational awareness of the airplanes position on the runway;
- SE 215, 216 & 219
Systems that quantify braking performance on slippery runways.
Takeoff Excursion Mitigation – Part 121 Fleet

Overall Awareness of RE Takeoff RISK in Policies and Procedures
(Air Traffic Control, Operators)

- Timely and accurate wind and runway information (takeoff decision)
  - SE 215 & 219

- Takeoff Performance Planning and Thrust Setting
  - SE 217

- RTO decision making – training and operator SOPs
  - SE 217

- Field Conditions and Reporting, RSA
  - SE 217 & 219

- SE 215 & 219

- SE 221
Recommended Safety Enhancements
Estimated RE Risk Reduction

Estimated Part 121 Runway Excursion Accident Risk Mitigated by Proposed RE-JSAIT Safety Enhancements*
(2025 & 100% Implementation Levels)

- Estimated Implementation as of 2025
- 100% Implementation

Portion of RE Accident Risk Eliminated

- (SE 215) RE - Airline Operations and Training - Landing Distance Assessment
- (SE 216) RE - Airline Ops and Crew Landing Training
- (SE 217) RE - Airline Ops and Trng - Flight Takeoff Procedures and Training
- (SE 218) RE - Design - Overrun Awareness and Alerting Systems
- (SE 219) RE - ATO Policies Procedures and Training to Address RE
- (SE 220) RE - Runway Distance Remaining Signs
- (SE 221) RE - Mitigation of RE Accident Severity (Part 139 airports)
- (SE 222) RE - Research - Airplane-based Runway Friction Measurement

Portion of events with mitigate severity
Potential
Recommended Safety Enhancements
Cost vs. Expected Risk Reduction

- 1-to-1 Benefit to Cost
- 5-to-1 Benefit to Cost
- 10-to-1 Benefit to Cost

SE Event Risk Reduction %

SE Cost ($M)
CAST RE Study
Acknowledgements

- Airbus
- Airlines for America
- Air Line Pilots Association
- Austin Digital, Inc.
- Boeing
- FAA
  - Aircraft Certification
  - Airports
  - Air Traffic Organization
  - Flight Standards
- Honeywell
- Mitre
- PAI Consulting
- Rockwell-Collins
CAST RE Study
Thank You