



Source: Unalaska Department of Public Safety

Runway Overrun During Landing PenAir Flight 3296 Saab 2000, N686PA

Unalaska, Alaska
October 17, 2019

Deputy Managing Director's Introduction

- Capt. David Helson – Deputy Director, Office of Aviation Safety
- Dr. Sathya Silva – Investigator-in-Charge
- Steve Magladry – Systems
- Dr. Dajuan Sevillian – System Safety and Human Performance
- Capt. Marvin Frantz – Operations
- Kathleen Silbaugh – General Counsel

Deputy Managing Director's Introduction

- Doline Hatchett – Director, Office of Safety Recommendations and Communications
- Jim Ritter – Director, Office of Research and Engineering
- Charles Cates – Flight Data Recorder and Visuals
- Kevin Renze – Aircraft Performance
- Jason Fedok – Survival Factors
- Karen Stein – Report Writer
- Nathan Hoyt – Safety Recommendations



Accident Overview

Sathya Silva, Ph.D.
Investigator-in-Charge

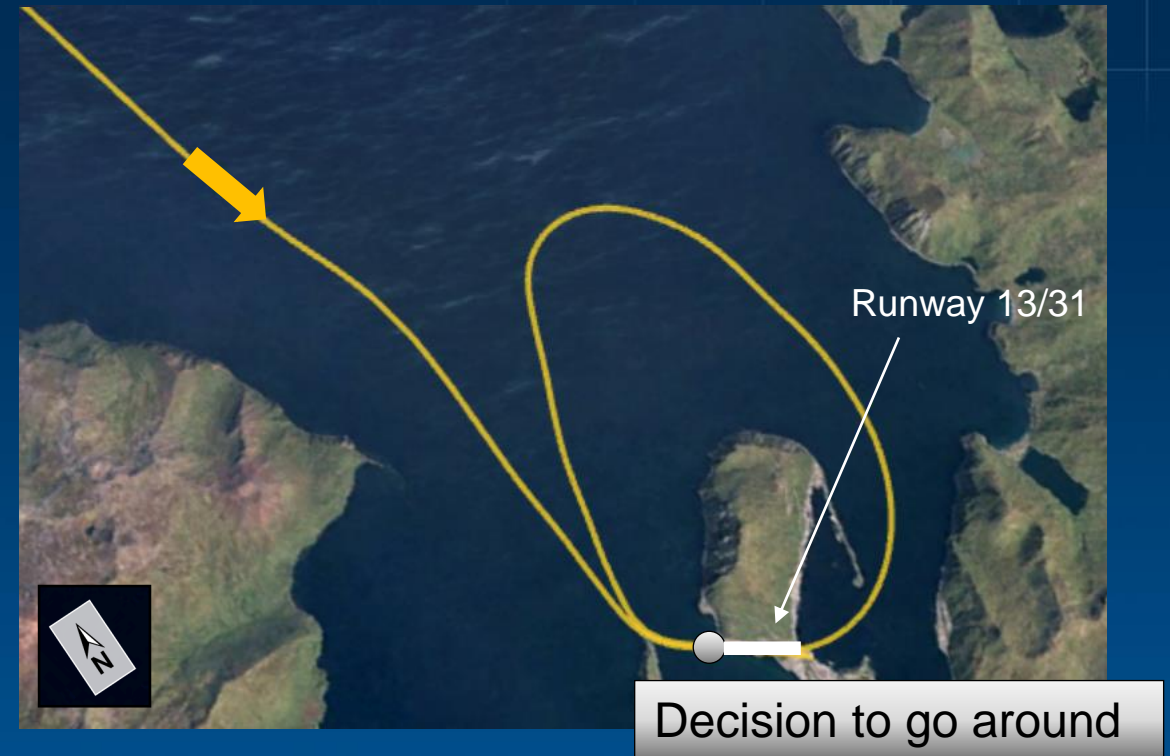
Initial Information

- October 17, 2019
- 5:40 p.m. Alaska daylight time
- PenAir flight 3296
- Saab 2000 substantially damaged during landing overrun at Unalaska Airport (DUT)
- Passenger injuries
 - One fatal
 - One serious
 - Eight minor



First Approach and Go-Around

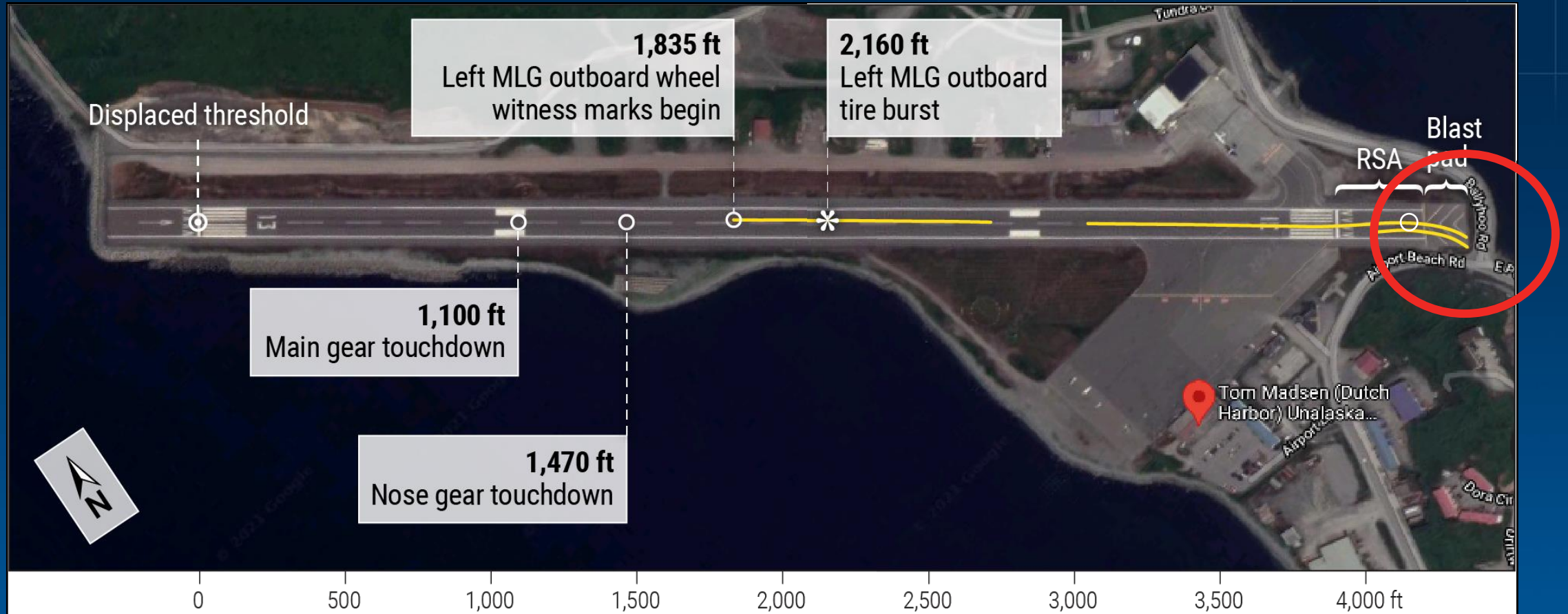
- DUT runway 13/31
- Wind shifting and favored runway 31
 - Flight crew planned for runway 13
 - First approach became unstabilized
 - Flight crew conducted go-around



Second Approach



Touchdown and Landing Rollout



Security Camera Video

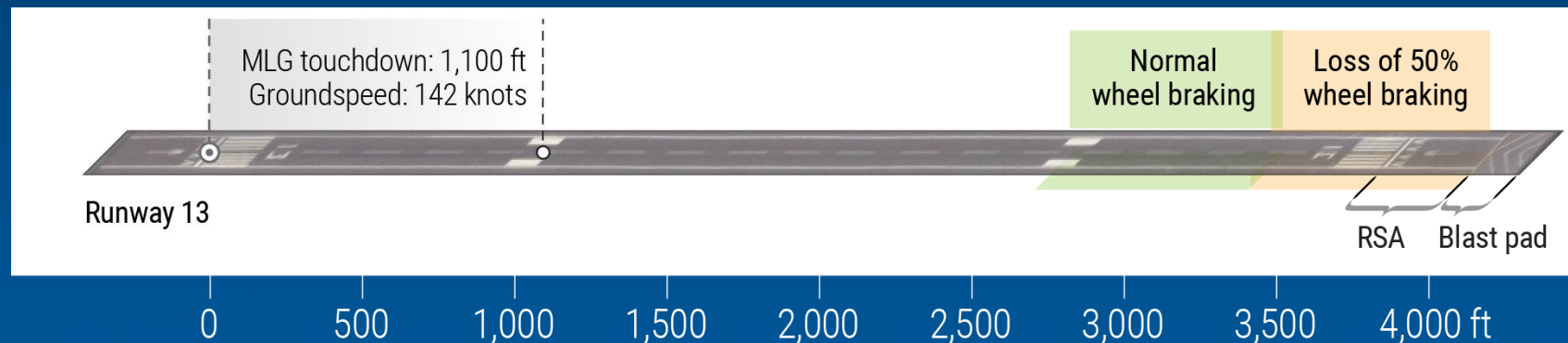
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OPH Fuel Tank



Aircraft Performance Study

- Determined 15-knot tailwind existed at touchdown
- Calculations indicated airplane should have safely stopped with
 - Flaps: 20° or 35°
 - Wheel braking: Normal or up to 50% loss
- Deceleration during accident rollout worse than expected; skid marks and tire burst evidence indicated wheel brake system anomaly



Safety Issues

- Cross-wiring of antiskid system during maintenance
- Lack of consideration of human error during maintenance in manufacturer system safety assessments
- Need for safety management systems (SMS) for organizations that design, manufacture, and maintain aircraft
- Federal Aviation Administration (FAA) oversight of air carriers undergoing periods of significant organizational change
- FAA approval of Saab 2000 operation at DUT without consideration of available runway safety area

Investigation Staff

Charles Cates

Pocholo Cruz

Jesus Cudemus

Jason Fedok

Marvin Frantz

Lauren Friedman

Max Green

Jim Hookey

Nathan Hoyt

Peter Knudson

John Lovell

Steve Magladry

Michael Portman

Noreen Price

Kevin Renze

Mike Richards

Dujuan Sevillian

Sathya Silva

Christy Spangler

Karen Stein

Parties to Investigation

- FAA
- PenAir
- Crane Aerospace and Electronics

Accredited Representatives

- Swedish Accident Investigation Authority (SHK)
 - Saab
 - European Union Aviation Safety Agency (EASA)
- United Kingdom Air Accidents Investigation Branch (AAIB)
 - APPH Limited
 - Rolls-Royce
 - Dowty Propellers



Saab 2000 Brake System

Steve Magladry

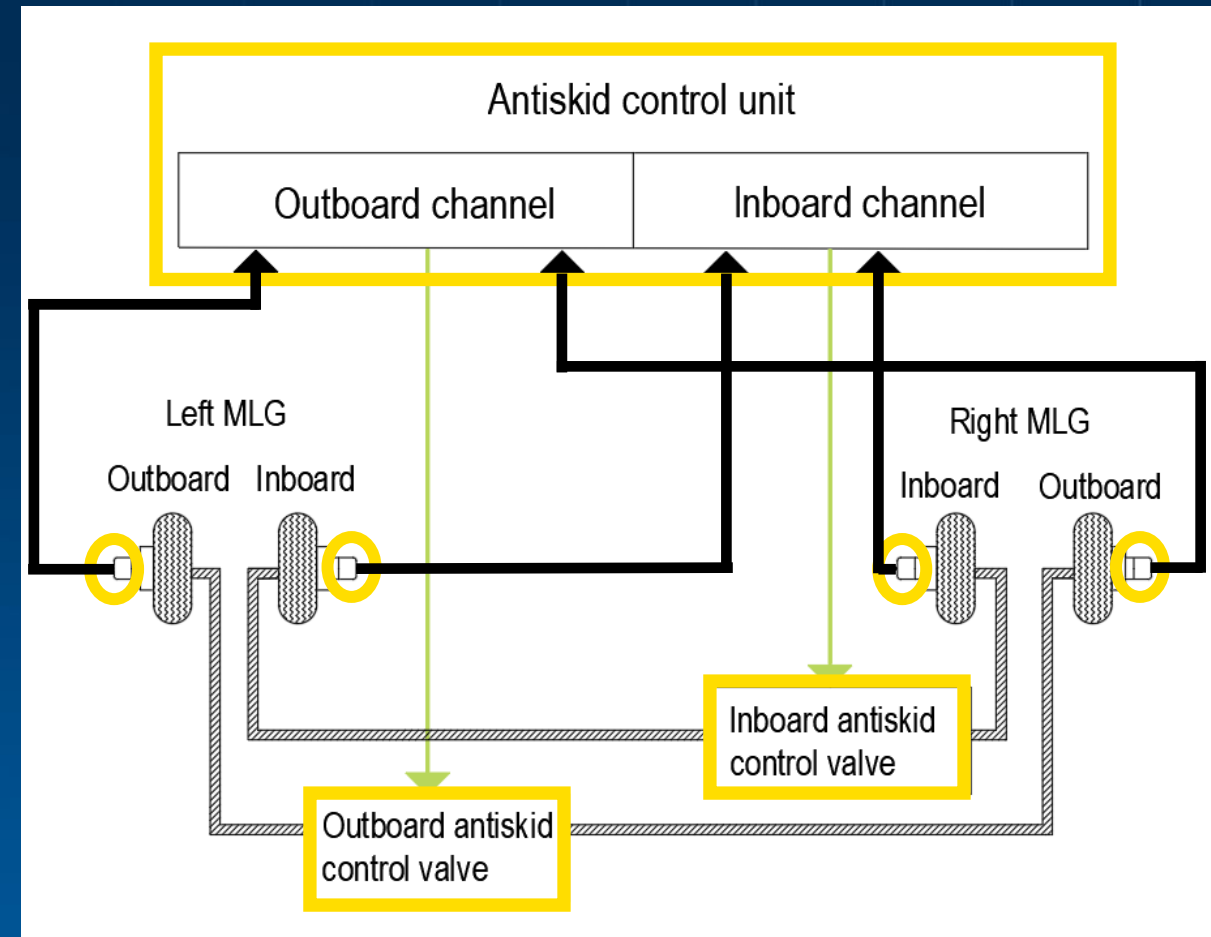
Systems Group Chairman

Overview

- Description of Saab 2000 antiskid system
- Findings related to accident airplane brake system
- Difficulties with routing antiskid system wiring and troubleshooting incorrect routing
- Determination of when incorrect routing occurred on accident airplane
- Actions taken since accident

Antiskid System Description

- Consists of antiskid control unit, wheel speed transducers, and hydraulic control valves
- Manages skids in pairs (inboard and outboard)
- When excessive skid sensed, brake pressure reduced to wheel pair to eliminate skid



Brake System Findings

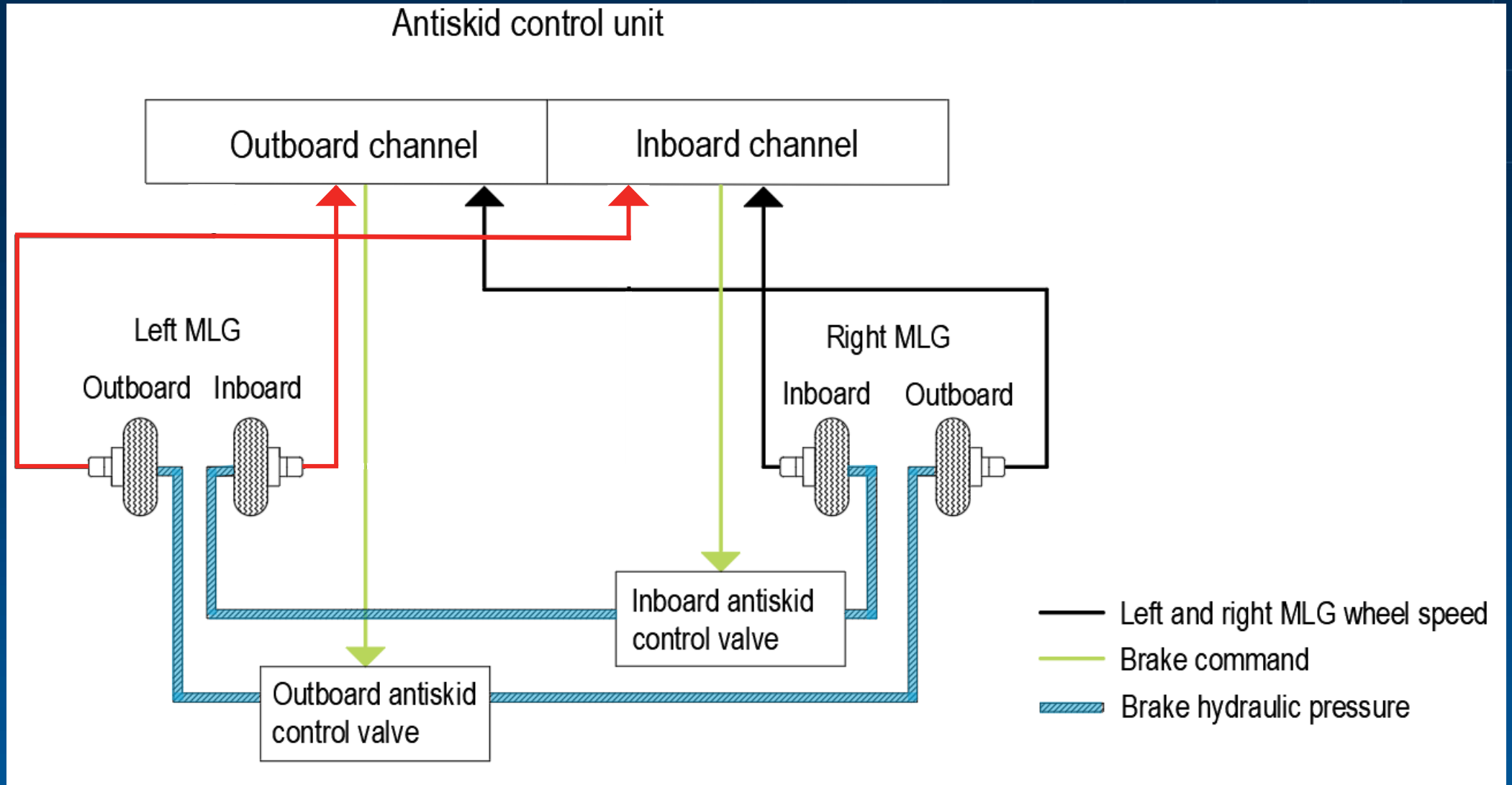
- Examination of antiskid wheel speed transducer wire harnesses on left main landing gear (MLG) revealed incorrect (crossed) routing
- Left MLG outboard tire flat from skid
- Fault messages showed antiskid system commanding full release of brake pressure to inboard pair of wheels for most of landing rollout

Brake System Findings

Incorrectly routed wire harnesses on left MLG significantly affected braking performance during skid

- Left outboard tire skid not relieved, so tire burst
- Left and right inboard tire pair commanded to near-zero brake pressure
- Result was loss of braking capability on three of four wheels after tire burst

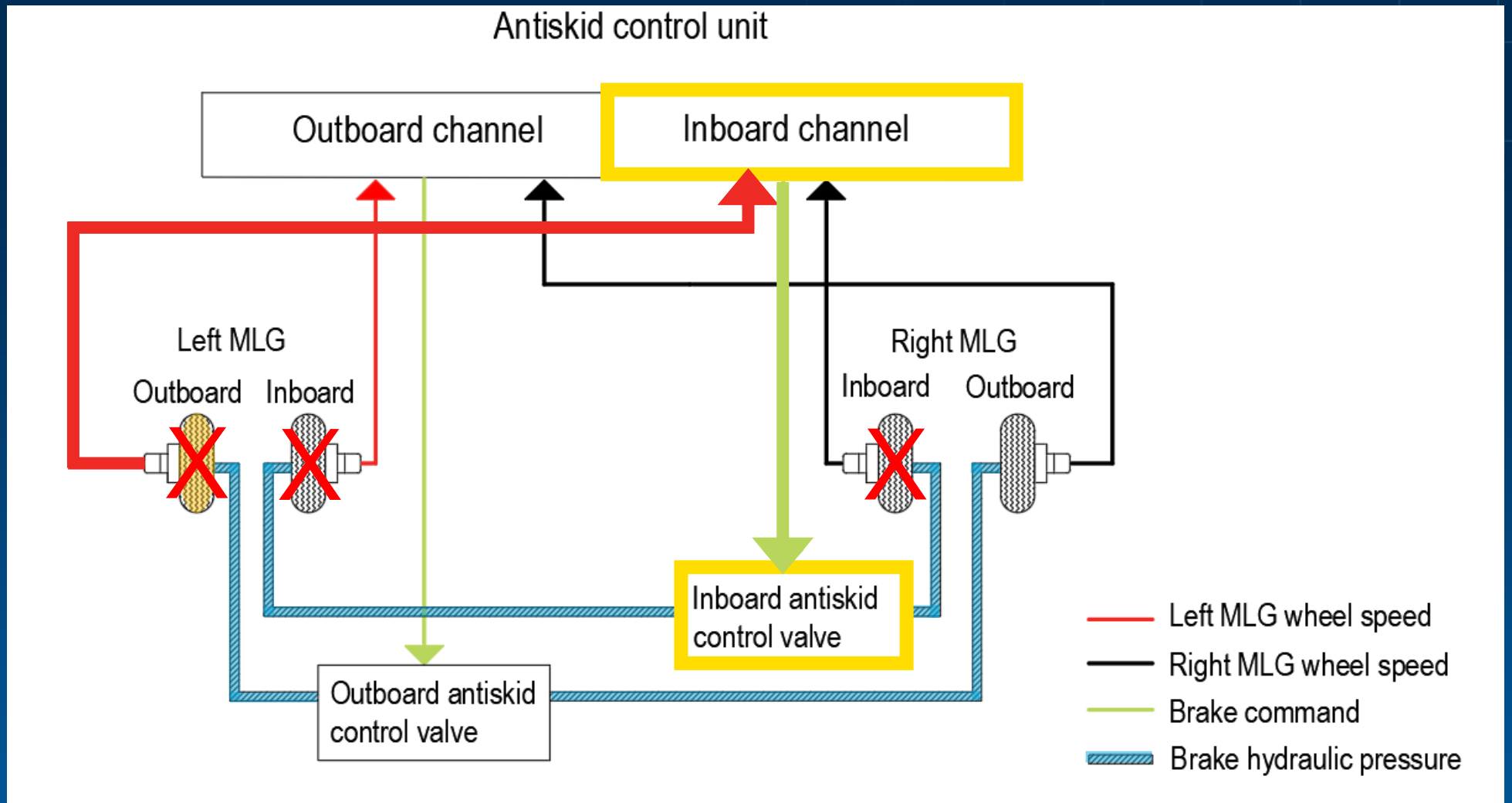
Accident Airplane Cross-Wiring Condition



Accident Airplane Cross-Wiring Condition

Inboard channel senses low wheel speed

Commands antiskid control valve to reduce brake hydraulic pressure to inboard wheels





Wheel well difficult to access

Sensor connects here



Antiskid System Wiring Issues

- Before accident, no maintenance manual procedures to determine if wheel speed transducer wire harnesses were correctly installed
- Antiskid system not capable of detecting cross-wiring
- Fault might be recorded if excessive skid occurs, but fault not clearly related to cross-wiring condition
- No troubleshooting procedure for fault message

Accident Airplane Cross-Wiring Condition

- PenAir records showed no maintenance that would have required removal of harnesses
- Incorrect routing most likely occurred during landing gear manufacturer's overhaul of MLG in January 2017
- Since accident, actions taken to mitigate incorrect wire harness routing
 - Saab – fleet inspection using new testing
 - EASA and FAA – airworthiness directives
 - APPH – enhanced overhaul procedures

What We Found: *Incorrect Harness Routing*

- Inadequate labeling and difficult access could still lead to incorrect harness routing
- If incorrect routing occurs, no troubleshooting procedure to resolve fault message recorded by antiskid system
- What we propose: **One recommendation to Saab**



System Safety Issues

Dr. Dajuan Sevillian

Human Performance Group Chairman

Overview

- Hazard assessment related to cross-wiring of wheel speed transducers
- SMS for organizations that design, manufacture, and maintain aircraft
- Pilot decision-making and leadership
- SMS for air carriers

Human Error During Maintenance

- Identifying and mitigating human error during maintenance reduces possibility of hazards to airplane and its occupants
- Manufacturers can reduce possibility of such hazards by performing system safety assessments

Engineering System Safety Assessment

Saab performed system safety assessment that

- Analyzed multiple hazard conditions, including failure modes that could occur with landing gear antiskid system
- Was conducted in accordance with section 25.1309, Equipment, Systems, and Installations

Engineering System Safety Assessment

- Saab's system safety assessment did not evaluate
 - Human error in maintenance that could lead to cross-wiring of wheel speed transducers
 - Effect of that hazard on airplane and flight crew
- Saab did not analyze any antiskid cross-wiring failure modes or assess related probability and severity
- Lack of analysis of these failure modes underestimated extent of cross-wiring hazard

Engineering System Safety Assessment

Effects on flight crew

- Saab did not consider annunciation on flight deck to alert flight crews of antiskid anomaly before takeoff and landing
- No procedure or training on how to mitigate antiskid wheel speed transducer malfunction with reduced braking capability

Previous Cross-Wiring Incidents

- Runway overruns
 - 1995, Boeing 737
 - 2007, Airbus A320
 - 2008, Airbus A320
- For all three events, wiring for left inboard and outboard wheel speed transducers was crossed
- Adversely affected flight crews' ability to safely land airplanes

What We Found: *Need for System Safety Assessments*

- Potential for cross-wiring of wheel speed transducer harnesses during installation and maintenance exists for other airplane types
- What we propose: *Two recommendations to FAA and two recommendations to EASA*

What We Found: *Need for SMS for Organizations*

- FAA and EASA developing requirements for SMS for organizations that design, manufacture, and maintain aircraft
 - EASA issued notice of proposed amendment in May 2019
 - FAA plans to issue notice of proposed rulemaking in December 2021
- SMS could help manage and mitigate safety risks
- What we propose: **One recommendation to FAA and one recommendation to EASA**



Source: Unalaska Department of Public Safety

Human Performance Issues

Dr. Dajuan Sevillian

Human Performance Group Chairman

Second Landing Attempt

- Flight crew discussion about wind at DUT
 - Expressed surprise about reported 24-knot tailwind
- Aware of airplane's 15-knot tailwind limitation
- Captain continued to land on runway 13, consistent with plan continuation bias

Captain's Decision-Making and Leadership

Captain demonstrated

- Inadequate aeronautical decision-making skills regarding which runway to use for landing
- Lack of flight deck leadership by continuing landing on runway with significant tailwind

Air Carrier Safety Management Systems

- PenAir's SMS ineffective to detect issues associated with
 - Pilot-in-command (PIC) airport qualification policy
 - Company's punitive safety culture, which did not foster open communication with pilots
- PenAir no longer operating, but lessons learned from this investigation can apply to all air carriers

NTSB

National
Transportation
Safety Board



Federal Aviation Administration Oversight

Captain Marvin Frantz

Operations Group Chairman

Overview

- FAA identification of emerging risks
- FAA approval of airports for air carrier use

FAA Oversight of PenAir

PenAir had undergone significant changes during 2 years before accident

- Reduction of route structure
- Loss of experienced pilots
- Bankruptcy
- Acquisition and merger with another air carrier

FAA Oversight of PenAir

- Two key members of FAA oversight team transitioned into their positions a few months before accident
- Neither had experience with air carrier mergers
- Neither identified any significant safety concerns or need for increased surveillance

FAA Oversight of PenAir

- Previous principal operations inspector (POI) initiated some increased surveillance during time of PenAir's bankruptcy and acquisition
- Surveillance did not identify key safety risk that resulted from loss of senior pilots: Improper application of company procedure to qualify pilots for select airports such as DUT

Company PIC Airport Qualification Procedure

Step 1

- ✘ 300 hours as PIC in airplane
- or
- ✘ Waiver: 100 hours as PIC in airplane with
 - Letter of recommendation
 - Letter of approval



Step 2

- ✔ Evaluation flight with check airman

- Company qualified captain using waiver, but captain did not meet waiver requirements
- Waiver not intended for pilots such as captain with limited experience in airplane type and at airport

What We Found: *Insufficient FAA Oversight*

- Company allowed accident captain to operate at one of the most demanding airports in PenAir's system without experience that qualification policy intended
- FAA oversight of PenAir insufficient to identify this safety risk
- What we propose: **One recommendation to FAA**

FAA Oversight of PenAir

- In informal conversations during transition between POIs, previous POI mentioned no specific areas of concern
- No formalized changeover procedure to highlight previous POI's knowledge of safety risks

What We Found: *Insufficient Transition Procedure*

- Formalized changeover procedure necessary for incoming POI's full awareness of safety risks for operators undergoing significant organizational change
- What we propose: **One recommendation to FAA**

Runway Safety Areas

- Runway safety areas (RSA) designed to reduce damage during overrun
- Length of RSA beyond runway end based on landing speed and size of most demanding aircraft that regularly uses airport

Runway Safety Areas at DUT



Runway Safety Areas at DUT

- RSA length at DUT did not match 1,000-ft length specified for Saab 2000
- Reduced safety margin in case of overrun
- No evidence that PenAir or FAA was aware of this inconsistency
- Accident airplane would have stopped within RSA appropriate for Saab 2000

What We Found: *Runway Safety Area Consideration*

- No guidance exist for FAA oversight personnel to consider RSA when approving airplanes to operate at airports
- What we propose: **One recommendation to FAA**



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