Why Mitigating Loss of Control In-Flight Matters

Karl Schlimm, Director of Flight Operations
Aviation Performance Solutions
Thank You for the Opportunity

Karl Schlimm
APS Director of Flight Operations

- 6500+ Flight Hours
- Part 141 Chief Instructor
- ATP / CFI/ Master CFI – Aerobatics
- 2500+ Hrs All-Attitude Instruction Given (Extra 300L)
- Part 135 Charter/Management Experience
- 20+ Years US Air Force & Air Force Reserves
- Formal Course F-16 Instructor
- 34 Years of General Aviation Experience
- **APS is the Official In-Flight Upset Recovery Provider for:**

**Training Density**
- 1000+ Pilots per Year
- ~ 80 Flights per Week
- ~ 400 UPRT Sets per Day

**BOMBARDIER LEADINGEDGE 2.0**
Safety Standdown - Delivered
Presentation Overview

- Statistics of Loss of Control In-Flight (LOC-I)
- Why LOC-I Penetrates Licensing Training
- Industry Recognition of the Threat and Actions
- Statistical Results of APS Training Mitigations
- What a Comprehensive Upset Prevention & Recovery Training Program Looks Like
- Questions to Ask Training Providers
1st Key Question
Why are professional pilots continuing to lose control of their airplane?
The Need

Loss of Control – In Flight (LOC-I) fatalities have risen in prominence despite improvements in aircraft design and existing training.

... there is a solution
Loss of control (LOC) was identified far and away as the most prevalent type of fatal GA accident with 1,190 fatal accidents followed by controlled flight into terrain, with 432 …
Why Mitigating the Loss of Control In-Flight Threat Matters

~40% of the Causes of All Commercial Fatalities Addressed by Comprehensive Upset Prevention & Recovery Training
Why Mitigating the Loss of Control In-Flight Threat Matters

Chance of Next Fatality Being LOC-I*

- Runway Excursion (T/O & LDG)
  - 2.0 X more likely to be LOC-I

- Smoke/Fire
  - 350 X more likely to be LOC-I

- Engine Failure / Power Plant
  - 1000 X more likely to be LOC-I

- Runway Incursion
  - 1500+ X more likely to be LOC-I

*Source: Boeing/CAST – July 2012
Why Mitigating the Loss of Control In-Flight Threat Matters
Major Threat: The Aerodynamic Stall Dynamic Instability
All Sizes and Configurations of Fixed Wing Airplanes

C-5 Galaxy **Loss of Control** Diego Garcia: Stall on final approach with successful recovery 800 ft AGL (Night/IMC)
Status of Pilot Population

- Pilots are well trained
- Aircraft have protection systems:
  - stick shakers
  - stick pushers
  - audible / visual warnings
  - push-to-level buttons
  - FBW flight envelope protection
  - airframe parachutes
  - angle-of-attack indications (in some platforms)

- Yet … *despite today’s best training and systems* …
Loss of Control still happens!
Why?
Licensing Assumptions

Why the Classic Track of Licensing Training is Penetrable by LOC-I
Training/Licensing Assumptions

1. Aircraft is within normal operational envelope and in a non-agitated flight condition (Prevention)

2. Situational awareness and information can be accurately correlated by the pilot with respect to observed flight condition.

3. Airplane handling skills and strategies established by regulatory licensing can directly resolve an escalating condition.

4. Human psychophysical response is predictable and reliable.
Why Mitigating the Loss of Control In-Flight Threat Matters

What is an Airplane Upset?

**Attitude**

- Roll (Left)
- Roll (Right)
- Pitch (+up)
- Pitch (-down)

- Pitch attitude greater than 25 deg nose up.
- Pitch attitude greater than 10 deg nose down.
- Bank angle greater than 45 deg.

**Envelope**

- L/D Max
- Stall
- Vmo / Mmo

Or, within those parameters, but flying at airspeeds inappropriate for the conditions.
Why Mitigating the Loss of Control In-Flight Threat Matters

All-Attitude Knowledge Deficiencies

- **Upset Definition (45 AOB, +25 & -10 Pitch)**: 4.9%
- **Max Licensing Limits (60 AOB, +/-30 Pitch)**: 11.1%
- **All-Attitude Training (180 AOB, +/-90 Pitch)**: 100%

**Atypical Skill & Knowledge Required**
- Abnormal Conditions – Time Critical
- Cuing is Unfamiliar / Unexpected
- Skills / IP Techniques Absent
- Pilot Psycho / Physiology Altered
What would you do here?
Is it really that hard?

Pretraining Evaluation showing improper recovery execution without inflight training

Eval Scenario - TP Stall
All-Envelope Knowledge Deficiencies

Why Mitigating the Loss of Control In-Flight Threat Matters
Why Mitigating the Loss of Control In-Flight Threat Matters
AIAA Modeling and Simulations Technology Conference – Aug 2012

*Unexpected Pilot Performance Contributing to Loss of Control in Flight (LOC-I)*

All Twenty (20) CAST July 2011 Accidents Analyzed by Three Independent Evaluators

From 62% to 100% Correlation

tinyurl.com/aiaa-loci-performance
Learning Objective – Stall Awareness

- **Prevention & Recovery technique:**
  - PL 111 – 216 (Effective Aug 2013)
    - Reduce AOA as First Priority
    - Stall and Approach to Stall Evaluation Criteria MUST NOT mandate a predetermined minimum altitude loss
  - Realistic Stall Scenarios in Operational Conditions
  - Pilot Training: Stall and Approach to Stall Treated the Same
  - Stick Pusher Training (if aircraft is equipped)

- **Recognizing Symptoms**
  - Buffet
  - Reduced Lateral Control / Reduced Stability
  - Lack of Pitch Authority / Inability to Arrest Descent
  - Associated Stall Warnings (usually present)

[tinyurl.com/AC120-109]
2nd Key Question
What Does a Comprehensive Loss of Control In-Flight Mitigation Program Look Like?
Why APS Works …

- Proven & Current Over a Decade
  - Airplane Upset Recovery Training Aid Compliant
- Pertinent Academic Training
- Simple, Transferrable and Effective UPRT Strategies
- Instructor & Program Credibility
- Address the Psychology of UPRT
  - Recall Technology in a Crisis
  - Dramatic Events
  - CRM Integration
- Train to Deal with Reality while Integrating Multi-Engine Jet FFS Limitations & Capabilities:
  - G / AOA / Sideslip / Motion Cuing
  - Performance Response / Glass Cockpit
- Repetition to Proficiency (Practice!)
- On-going Evidence-Based Research & Development

APS Formal Research
115 Pilots since 2007-2008
Varying Experience
- Nose Low Over-bank
- Wake Turbulence
- Cross-Control Stall
- Nose High UA

Control Failure: Rudder

Successful Recovery Statistics:

Before Training (1st Flight)
28.1%(All) / 40.4%(Pro)

After Training (5th Flight)
96.3%

Retention after 18 months
76.4%

Expanded Info: apstraining.com/study
UPRT Footprint

- Academic Preparation
- **Awareness** Training
- **Prevention**: Recognition & Avoidance
  - Aeronautical Decision Making
  - Proportional Counter-Response
- **Recovery**: Recognition & Recovery
  - Primary Control Strategies
  - Alternate Control Strategies
  - Type / Class Specific Considerations
- Startle / Surprise Factor
- CRM Integration (if applicable)
Key Conclusions & Findings

- Paramount Components of UPRT
  - The Reality Factor: Psychophysiology of Fear
    - Experience gained through in-flight experience, exposure to a diversity of upset situations, and associated practice
  - Immersion in the All-Attitude All-Envelope environment
    - Application of counter-intuitive techniques within the all-attitude environment is critical to knowledge, skill, retention and mitigation effectiveness
- Tools and Methodologies to Assist Practical Application
- Transfer of Skill (Transferability. Must avoid negative training)
- Repetition to Proficiency
Sample Academic Concepts

- Flight Envelope Awareness
  - Dynamic Margin of Safety
  - Implications of Varying Load Conditions
  - A Study of the V-G Diagram

- Critical Importance of Angle of Attack Management in an Airplane Upset
  - Stall / Spin Awareness: An Escalating Threat
  - Nose-Low and Nose-Low High-Bank Events
  - Nose-High Events
Upset Strategies

• Primary Control Strategies
  • Angle of Attack
  • Yaw
  • Lift Vector
  • Energy and/or Pitching Moments
  • Manage Settings, Performance and Configurations

• Alternate Control Strategies
  • Pitch Upset
  • Roll Upset
  • Yaw Upset

Push
Rudder
Roll
Power
Stabilize
- Flight Path
- Configuration
- Build SA
Investigating UPRT Providers

- Questions to Ask a Prospective UPRT Provider
  
  **Company**
  - Get Industry-relevant References and Call Them
  - Safety Record (Investigate any Accidents)

  **Program**
  - Written Syllabus (preferably Part 141 in US)
  - Building Block
  - AURTA – Revision 2 Compliant
  - Delivered in Relation to the LOC-I Threat Distribution
  - Vetted by Industry. If so, how?
  - **NOT** Aerobatics: Ask for an explanation why

  **Instructors**
  - Standardized to What and How?
  - Corporate and/or Commercial Operational Experience
  - Instructional Experience

  **Training Platforms:**
  - On-Aircraft: Aerobatic-certified or Equivalent (Investigate Level of Maintenance)
  - Simulators: Operated within Fidelity Envelope

[tinyurl.com/uprt-questions]
Manual Handling Skills Degradation

- Systems Knowledge
- An additional potential benefit of UPRT
- Manual Handling

Why Mitigating the Loss of Control In-Flight Threat Matters
Proper UPRT Benefits

Type 1
Unrecognized
Upset Event

Type 2
Recognized & Correcting
Upset Event

Type 3
Incapacitating
Upset Event

Student Pilot

Rated Pilot

Competent UPRT Grad

Why Mitigating the Loss of Control In-Flight Threat Matters
### Fatalities by CAST/ICAO Common Taxonomy Team (CICTT) Aviation Occurrence Categories

#### Fatal Accidents – Worldwide Commercial Jet Fleet

**Note:** Principal categories as assigned by CAST.

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOC-I</td>
<td>Abnormal Runway Contact</td>
</tr>
<tr>
<td>CFIT</td>
<td>Controlled Flight Into or Toward Terrain</td>
</tr>
<tr>
<td>F-NI</td>
<td>Fire/Smoke (Non-Impact)</td>
</tr>
<tr>
<td>FUEL</td>
<td>Fuel Related</td>
</tr>
<tr>
<td>LOC-I</td>
<td>Loss of Control – In flight</td>
</tr>
<tr>
<td>MAC</td>
<td>Midair/Near Midair Collision</td>
</tr>
<tr>
<td>OTHR</td>
<td>Other</td>
</tr>
<tr>
<td>RAMP</td>
<td>Ground Handling</td>
</tr>
<tr>
<td>RE</td>
<td>Runway Excursion (Takeoff or Landing)</td>
</tr>
<tr>
<td>SCF-NP</td>
<td>System/Component Failure or Malfunction (Non-Powerplant)</td>
</tr>
<tr>
<td>SCF-PP</td>
<td>System/Component Failure or Malfunction (Powerplant)</td>
</tr>
<tr>
<td>UNK</td>
<td>Unknown or Undetermined</td>
</tr>
<tr>
<td>USOS</td>
<td>Undershoot/Overshoot</td>
</tr>
<tr>
<td>WSTRW</td>
<td>Windshear or Thunderstorm</td>
</tr>
</tbody>
</table>

No accidents were noted in the following principal categories:
- ADRM: Aerodrome
- AMAN: Abrupt Maneuver
- ATM: Air Traffic Management/Communications, Navigation, Surveillance
- BIRD: Bird
- CABIN: Cabin Safety Events
- EVAC: Evacuation
- F-POST: Fire/Smoke (Post-Impact)
- GCOL: Ground Collision
- ICE: Icing
- LALT: Low Altitude Operations
- LOC-G: Loss of Control – Ground
- RI-A: Runway Incursion – Animal
- RI-VAP: Runway Incursion – Vehicle, Aircraft or Person
- SEC: Security Related
- TURB: Turbulence Encounter

For a complete description go to: [http://www.intlaviationstandards.org/](http://www.intlaviationstandards.org/)

**Diagram:**
- **Fatalities:**
  - External fatalities [Total 214]
  - Onboard fatalities [Total 4547]

**Number of fatal accidents (79 total):**
- LOC-I: 18
- CFIT: 18
- RE (Landing): 15
- UNK: 4
- MAC: 2
- SCF-NP: 1
- SCF-PP: 5
- RE (Takeoff): 2
- OTHR: 2
- WSTRW: 1
- FUEL: 8
- RAMP: 2
- F-NI: 2
- SCF-PP: 2

**Copyright © 2012 Boeing. All rights reserved.**
Thank You for the Opportunity

Paul ‘BJ’ Ransbury
APS Emergency Maneuver Training – President
- 17-Years Full-Time Development & Delivery of **Upset Prevention & Recovery Training (UPRT)**
  More than 5500 Professional Pilots Trained
- Airbus A320 Airline Pilot
- B.Sc. Honors Mathematics & Physics, Royal Military College
- Master CFI – Aerobatics / ATP / CFI / CFII / MEI /AGI
- F/A-18 Hornet Fighter Pilot / Fighter Weapons Instructor
- 4,500+ Upset Recovery Flights Hours (Piston & Jet Aircraft)
Thank You for the Opportunity

Clarke ‘Otter’ McNeace
VP of Flight Training & Standards

- 14,000+ Flight Hours
- 2 x Master CFI – Aerobatics
- ATP / CFI / CFII / MEI / AGI
- 4500+ Hrs All-Attitude Instruction Given
- Boeing 737 Airline Captain
- 10 Years Airline Experience
- 12 Years US Navy: F/A-18 Hornet Fighter Pilot
  - 36 Combat Missions / 300 Carrier Landings
- 34 Years of General Aviation Experience
- FAA Stall/Stick Pusher Group Member
"The curriculum, structure, presentation, and application of the upset training course is nothing short of amazing. The course is not simply about how to correct an aircraft upset, but understanding of forces, aerodynamics, and situations that can lead to an upset. The knowledge and confidence gained was the most productive three days of my career thus far … tremendous value all around ".

Chris Vedo, Jet Aviation: ATP, CFI, Dassault Falcon 900s, 7000 Flt Hours
QUESTIONS?
Thank you for having me!

Upset Prevention & Recovery Training
*Why Mitigating Loss of Control In-Flight Matters*