Implementing Enhanced UPRT

Lessons learned at Alaska Airlines:

High Level Seminar and Course on Loss of Control in-Flight (LOC-I) and Upset Prevention and Recovery Training
(Lima, Peru 29, November 2017)

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In the Beginning......

Royal Aeronautical Society, London, June 2009

Spring 2009 Flight Simulation Conference
Flight Simulation: Towards the Edge of the Envelope
Wednesday 3 – Thursday 4 June 2009
No.4 Hamilton Place, London W1J 7BQ, UK

Synopsis
Gap Analysis:

- In UPRT, there is no single tool for optimum training - each has limitations and advantages.

UPRT Requires Integrated Training Elements
Integrated Elements

- aircraft *
- simulators
- Academics
Element 1 - Academics

- Airplane Upset Recovery Training Aid (1998, new 2017 edition 3) is the industry reference

  - Pilot Academic Knowledge & Skill Preparation
  - Instructor Guidance in UPRT
  - Authorized Training Providers
  - Regulatory Guidance
Element 2 - Airplane

- Exposure to
  - Psychological component
  - Physiological component
  - Accurate recovery environment
    - (Real “G” awareness)
- Requires:
  - qualified aircraft
  - qualified instructors
Element 3: Appropriate Use of FSTD’s

- **Better** use of today’s devices
- **Improved** simulation fidelity in extended envelope
  - aero model
  - pilot cueing (buffet, motion)
- **Enhanced** feedback in today’s sim’s
What will airline UPRT look like?

- **What is enhanced, integrated UPRT?**
  - Academics
  - On-aircraft training at licensing level
  - Appropriate use of enhanced FSTD’s

- **What is it based on?**
  - Training Needs Analysis/Gap Analysis (Training Matrix)

- **How will it be Implemented?**
  - A Graduated Strategy
    - Maximize use of existing infrastructure
    - Building Block approach, graduated implementation
    - Examples of Future Airline UPRT
Lessons Learned from UPRT Implementation

- This is Difficult!
- Take Small, Accurate Steps
- Simulator Time is limited
- Instructor Training is Key
Upset Prevention and Recovery Training
Lessons Learned: Alaska Airlines (2011)

AVOID NEGATIVE TRAINING

- Bring In Simulator Experts
- Use FFS only within their capability
- Realistic Training Scenarios
- “Wash-out” or “Aerodynamic Slew”
Examples of Negative Training: Alaska

Aerodynamic Slew “Washout” in Simulator

Training Objective High Altitude Upset
- wake turbulence, FL 370…pitch up and roll event

Selected on Menu of Simulator Instructor station

Effect: Simulator instantly pitches nose up 10 degrees
AND begins roll past 90 degrees bank

Result: Pilots input full and aggressive nose down elevator,
aileron and spoiler and even rudder……..
For High Altitude Upsets, pilots need to use smooth,
proportional flight control inputs

Air Canada 190, 2008

China Airlines 006, 1985
Example of New UPRT Instructor Pages: CAE B-737-900
The AAMP excessive bank angle simulator exercise was unrealistic because the airplane quickly achieved a 90 degree bank angle that pilots were led to believe resulted from the effects of a wake turbulence encounter. The roll upset recovery techniques taught during this exercise may have resulted in inappropriate (negative) training regarding the effects of wake turbulence and the proper response to it.

Further, the inhibition of the flight controls during the initial part of the exercise misrepresented the true airplane response to large rudder inputs and could have led pilots to believe that large wheel and rudder pedal inputs would initially have little effect on the airplane. This misrepresentation could have imparted inappropriate training to over-control the airplane during a wake encounter and could contribute to surprise and confusion if large wheel and rudder pedal inputs were attempted in an actual wake turbulence encounter.
Alaska Airlines

Upset Prevention and Recovery Training (UPRT) for 2012

Training Objective:

Aerodynamics and Manual Handling
Flight Displays

Aerodynamics and Approach to Stall, Medium & High Altitude
UPRT Training Objectives:

Approach to Stall Medium Altitude and High Altitude
- emphasize new Approach to Stall Training Procedure

Manual Handling Characteristics Medium and High Altitude
- Aerodynamic Differences
- Thrust Limits
- Transition to Manual Flight
  (Automation preferred but capable of safe transition to manual flight. Incident record, Airbus Study)

Emphasis on Flight Displays (PFD)
AOA, Speed Tape, FPV, Acceleration carat, PLI’s,
Hand-Flown Maneuvering: 10,000

- PFD cues:
  - FPV, Dynamic Speed Tape, Acceleration Carat
  
  Combined with valid flight model...See and Feel for learning

- Manual Handling Qualities
- Excess Thrust
- Huge Operational Envelope
- Contrast Aileron/ Spoiler vs. Rudder for Roll Control

Flight Display cues combined with Flight Model (control feel)
Hand Flown Maneuvering 35,000

**FL 350**

Maneuvering, Aerodynamics, Flight Displays

Limited Performance Envelope

Thrust Limits

Lack of Aerodynamic Damping (pitch and roll rates)

Handling Differences
10,000’
Approach to Stall Demonstration

Procedure: Immediately reduce AOA, Elevator is primary!

No emphasis on loss of Altitude
FL 350 Approach to Stall Demonstration

Display Info: FPV, speedtape, trend vector, Aerodynamic Buffet, PLI
Instructor Training and Standardization

One Hour of Instructor Training devoted to our UPRT
  - Rationale: (LOC-I accident record)
  - Understand Simulator Limitations
  - Develop IP Briefing Guide
  - AURTA reference

Results: Not enough

Created Demo Video of entire Maneuver Set
  - for all instructors
  - then “pushed” to all pilots
2013: Maneuvers Based Training

Example of Academics and Simulator:
Pilot Error, Roll vs. AOA

Accident Reports indicate pilots often prioritize *Roll over Pitch* when approaching Stall.
Czar 52: 1994
Fairchild AFB, Spokane, WA

C-17: 2010
Elmendorf AFB, Anchorage, AK
Example of Academics and Simulator
Pilot Error: Roll vs. AOA
Example of great Stall Recovery
Sample of UPRT Maneuvers

Nose High
Nose Low
Un-Reliable Airspeed
Manually Flown Departure
Full Aero Stall

- Validated by:
  - FAA
  - Boeing
  - NTSB
  - ICAO
Nose-High Upset Recovery

Progressive Strategies in priority order

- Nose Down Elevator
- Nose Down Elevator and Stabilizer Trim
- Nose Down Elevator, Stabilizer Trim and Thrust Reduction
- Roll to nearest horizon* (30-60 degrees)

Pilot Action:

- recognize and confirm the situation
- A/P, A/T off
- recover, (push, roll, power, stabilize)
  using speed-tape margin and
trend as targets
Nose Low Upset Recovery

For a satisfactory nose-low recovery, the pilot-in-training must avoid ground impact and accelerated stall and respect g-force and airspeed limitations.

Pilot Action:

- recognize and confirm the situation
- A/P, A/T off
- recover (push, roll, power, stabilize)

No continuous “g” capability in simulator…

to avoid over-stressing the jet, nose-up recovery should be targeted around normal rotation rate for take-off

…..2 degrees per second....
Nose-Low Inverted Flight

Graduate Level Maneuver
- Nose Low
- Overbank
- Stall?
- Ground Impact?
- Possible High Energy State?

Prioritize and put it all together

Startle!
Full Aerodynamic Stall

Rationale: Accident Reports indicate pilots have difficulty recognizing stall condition (NTSB)

With accurate data, representative full stall behavior can now be demonstrated.

Stall procedure is the same: recover at first indication!

Recovery aspects are expected to improve as pilots become more familiar with stall behavior and cues
Enhanced Stall Aeromodel

- Stick pusher (if available)
- Stall warning
- Normal Flight
- Approach to Stall
- Fully-Developed Stall
Enhanced Stall Training

- Utilize the Enhanced Boeing Aero-Model for:
  - Approach to Stall Training
  - Aerodynamic Stall Training
- Develop IOS Feedback Tools
- Continue efforts to Standardize
- and Harmonize IP’s
Scenario-Based Training maneuvers

Presented in the context of Line Oriented Training (not evaluation)

- Maneuver Based Training to develop knowledge, skills and attitudes (KSA)
- Scenario Based Training to ensure pilots demonstrate the required (KSA)
- introduce Startle and Surprise into pilot training
- requires shared crew responsibility (role of Monitoring Pilot)
Surprising Results With the New Stall Recovery Technique

Presented to: InfoShare
By: Jeff Schroeder
   Chief Scientific and Technical Advisor
   Flight Simulation Systems
Date: March 4, 2014
2015: Approach to Stall Landing Configuration
Lack of **Aerodynamic Academics** in AS Training Program: *Use AURTA*

Leverage new Distance Learning Platform: *I-Pad*
High Altitude Swept Wing – Enroute Stall
BWI – SEA Weather and Turbulence
Un-reliable Airspeed: New Recall Items

Crosscheck and Confirm:

1. Autopilot/Autothrottle (if engaged) .................................. Disengage
2. F/D Switches (both) ......................................................... OFF
3. Set the following gear up pitch attitude and thrust:

   Flaps Extended ............................................................. 10° and 80% N1
   Flaps Up ................................................................. 4° and 75% N1

Requires timely recognition….
   - place the aircraft in a safe position
   - buys time to diagnose the problem
   - the A/P will exacerbate the situation
6 Un-Reliable Airspeed Events this year

On approach into CDV, 6 miles out, IMC, RNAV M RWY 9, FO is PF

Captains EADI airspeed shows a rapid decrease, leading to a stall indication with stick shaker, FOs airspeed appeared to be accurate. FO disengaged autopilot and auto-throttles, added power and executed a missed approach. We notified ATC of missed approach and requested and were granted climb to 10,000 msl. We then ran the Unreliable Airspeed checklist, confirming CA airspeed was bad. The yellow SPD flag on the CA EADI then appeared and the CA analog airspeed indicator showed 0 knots. HGS showed same.
Low-Speed Precursor Rate

Low Speed Event VS 1.1 (Avg. = 21)
Example Minimum safe speed equals 120 knots, low speed precursor triggers at 132 knots
Stick Shaker activation rate
(9 events / 247,914 flights 2014-2016)

Recovery Results:

- 2 Good
- 3 OK
- 3 N.C.
- 1 Bad
Wireless Instructor Tablet

- Color-coded time history data
- Dynamic, configuration-dependent thresholds
Instructor Tools: Flight Controls
Stall maneuver with improper recovery technique
Manual Flying Skills… a layer of protection

- When Automation fails, is too complex or is confusing:
- Step it down and have confidence in Manual Flying
- Monitoring Skills also improve…..

- Solid Instrument Scan
- Basic Pitch and Power
Alaska Airlines: Advantages for Manual Flying

- Short-Haul route
- Single Fleet 737
- Small Airports
- Non-Radar/Non-Tower Airports
- Culture of Manual Flying
- Ops Manuals support M.F.
- Pilot Flying chooses auto. level
Developing Manual Flying Skills:
Manual flying on the Line and Validate in Simulator

Pitch, Power, Trim (PPT) Exercise

- Raw data/ no flight directors
- Monitoring opportunities
- Pitch and power settings
The “Nickerator”

Exercise Profile: Flight Directors Off
DCA Takeoff Rwy 19 – Fly runway heading, climb 3000’, accel. and clean up.
@3000’, turn left heading 130, intercept the DCA 160 radial outbound
Accelerate to 235, climb to 4000’
At 16 DME, turn right heading 280 (base leg)
Descend and maintain 2500 feet.
Crossing the DCA 175 radial, turn right heading 330
Interceptor DCA LOC Rwy 01
Maintain 2500 until established,
cleared ILS Rwy 01
Ceiling 500’ and 1 mile visibility

Positive Pilot Feedback
### Possible weaknesses of current approaches

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**Monitoring Enhancements: VSD and Non-F.D.**

*Figure 5*

The *Enroute Swath* indicates the area mapped by the VSD. The display is inhibited both on takeoff and approach when the aircraft is within 6 nm of the runway and less than 3000 ft AFE. The swath width is dependent upon RNP value selected (swath is equal to 1x RNP value) and will adjust proportionally with range selection.

**NOTE:** The correct RNP value should be verified/entered for the respective departure/approach. This minimizes cluttering the VSD with unnecessary terrain data that is not significant to the approach design.

During turns, the swath edge leading the turn opens in the direction of the turn. This provides a larger area mapped on the inside of the turn for the presentation of obstacles on the VSD.
Initial Training: First Maneuver Set
Instrument Departure
- Hand Flown, No Flight Director

Training Objective: Managing AOA

- Constant Thrust
- Maintain Safety and Performance Margins via AOA
Goals for UPRT: Will this work for you?

- Start with your current training infrastructure
- Take small but accurate steps
- Identify and remove negative training
- Plan a **short term and long term** goal
- Good academics with practical demonstrations in FFS
- All simulators are a bit different, so device must be checked for each training objective/maneuver
- **Instructor Training is Key!**
UPRT Goals: Long Term (5 years) regulator/insurance compliance

- develop UPRT lead content development team
- Instructors gain more knowledge and confidence
- Implement New Stall Models
- Implement new Feedback Tools
- Begin Scenario-Based UPRT
- Use airline specific and industry data to improve UPRT
Let's Go Fly some UPRT!

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