Royal Aeronautical Society
Flight Simulation Group

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

Sponsored by:

AgustaWestland · BAE SYSTEMS · BAE Systems · BOEING · CAE · FlightSafety · Mechtronix · OPINICUS · THALES

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

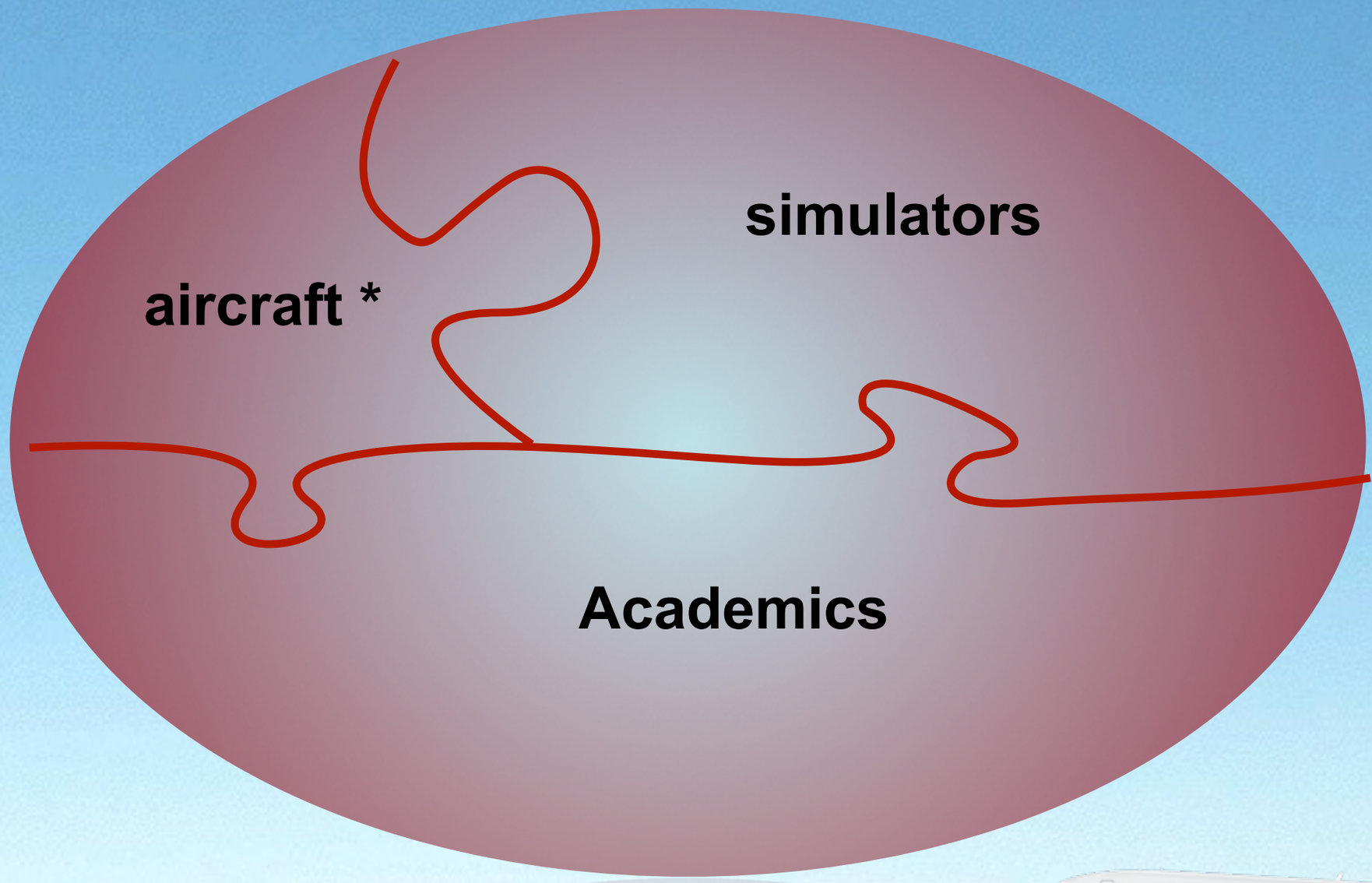
Synopsis

Gap Analysis:

- In UPRT, there is **no <u>single</u> tool** for optimum training - each has limitations and advantages

UPRT Requires Integrated Training Elements

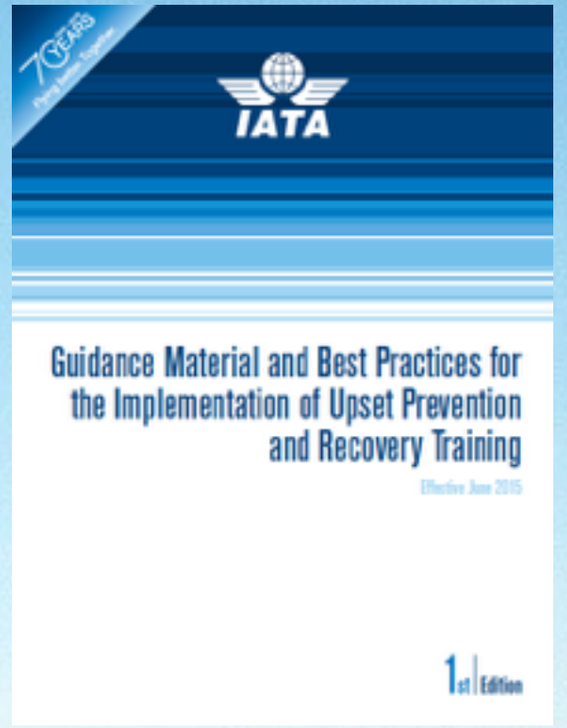
Integrated Elements



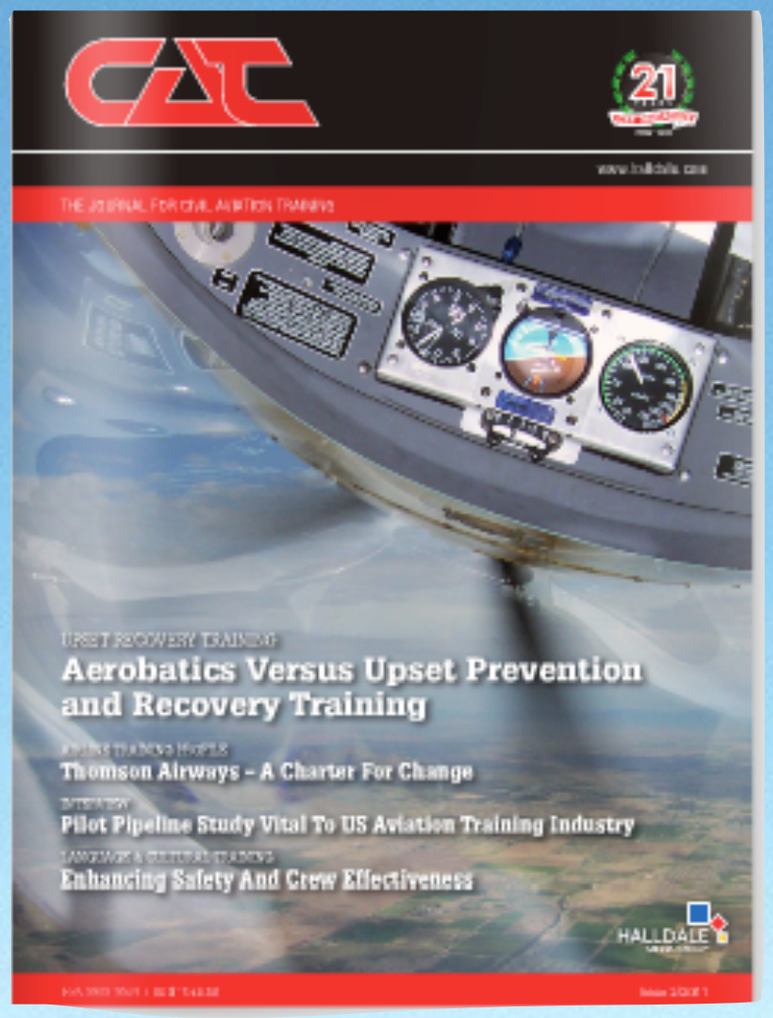
Element 1 - Academics

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

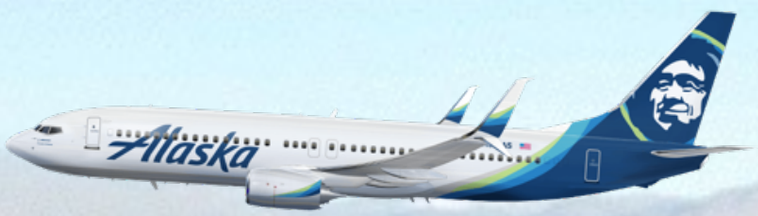
- **ICATEE UPRT Manual (2015):**
  - **Pilot Academic Knowledge & Skill Preparation**
  - **Instructor Guidance in UPRT**
  - **Authorized Training Providers**
  - **Regulatory Guidance**



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

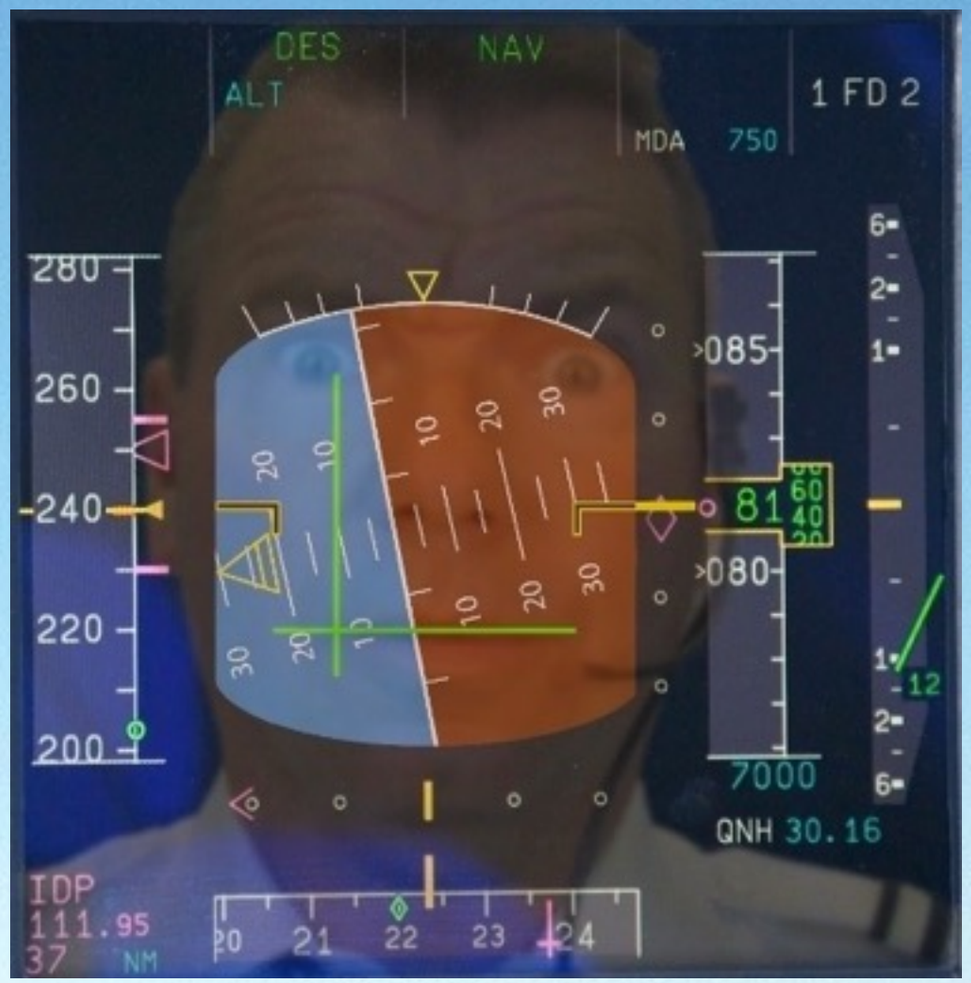
graduated approach

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)

- **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

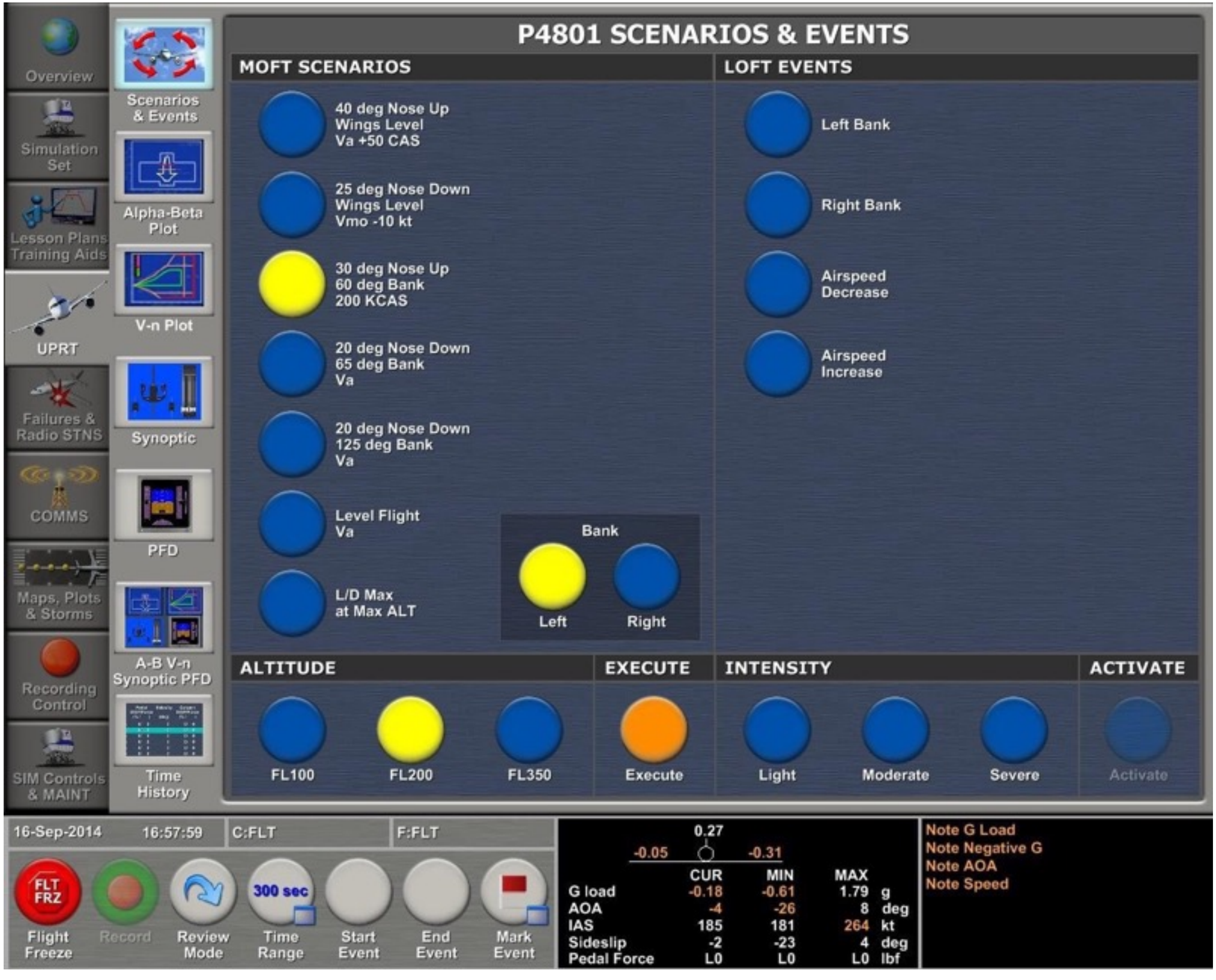
Effect: Simulator instantly pitches nose up 10 degrees AND begins roll past 90 degrees bank

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



American Airlines 587 NTSB Report

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

Then


MACH
KNOTS
PULL TO SET
AVIAFILMS.COM


OFF
PULL
TO
CAGE

Now


Left Outboard display
LNAV
VNAV PTH
.78
LNAV/VNAV
CMD
10000
35200
34980
34800
34600
STD
.677
280
260
240
200
180
MAG

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

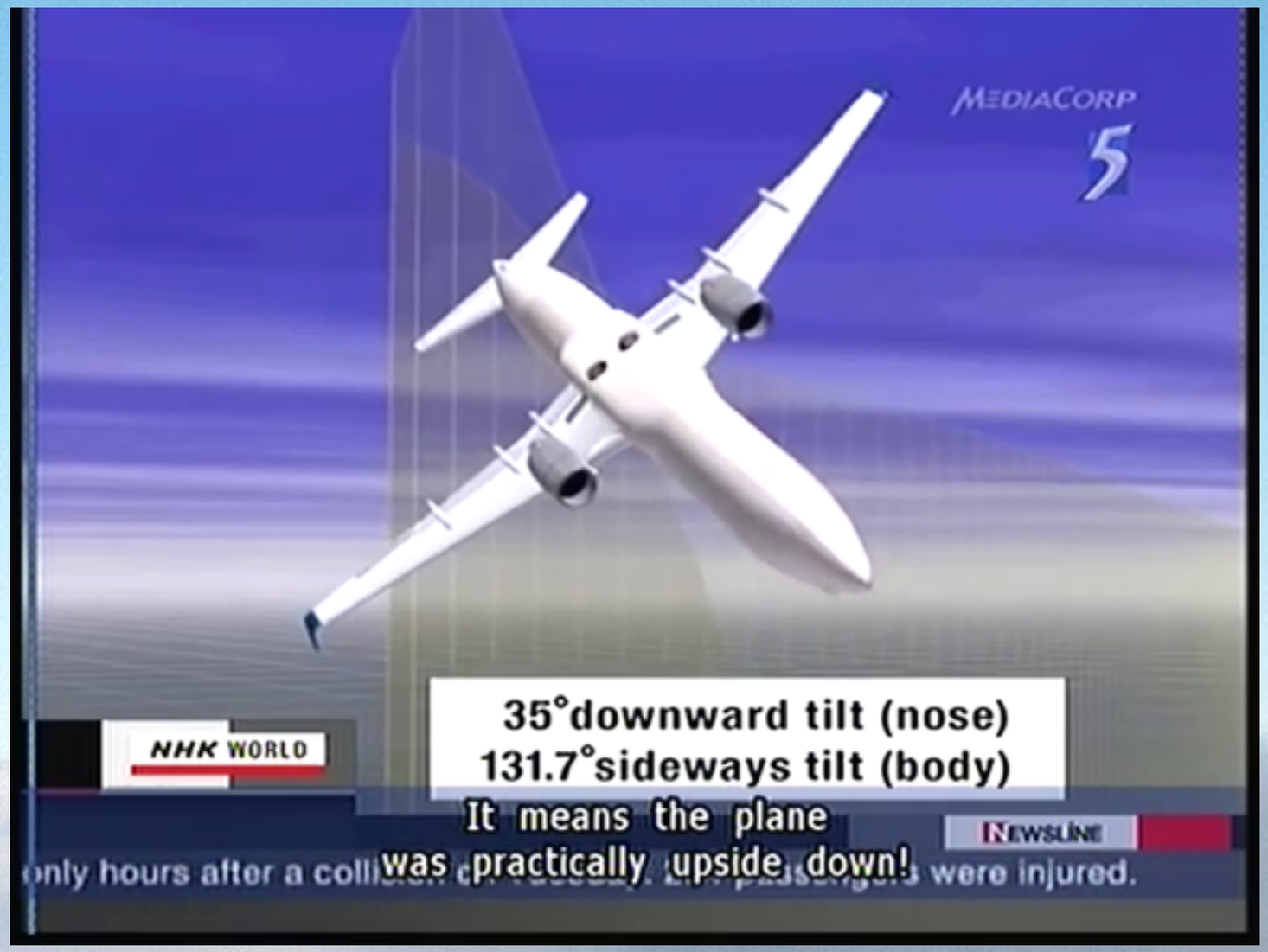
Example of great Stall Recovery

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)

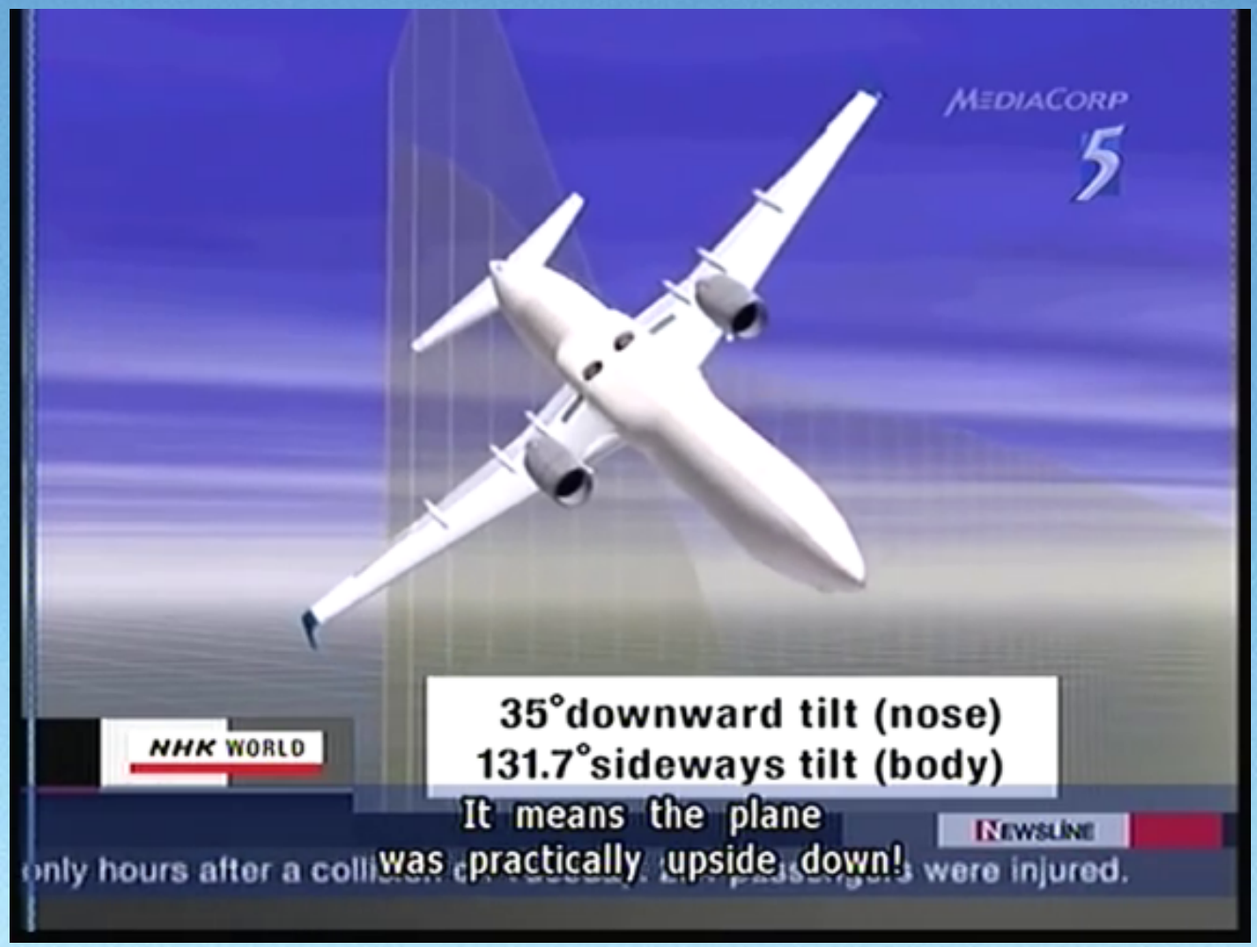
No continuous “g” capability in simulator…
to avoid over-stressing the jet, nose-up recovery should be targeted around normal rotation rate for take-off
…..2 degrees per second….

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

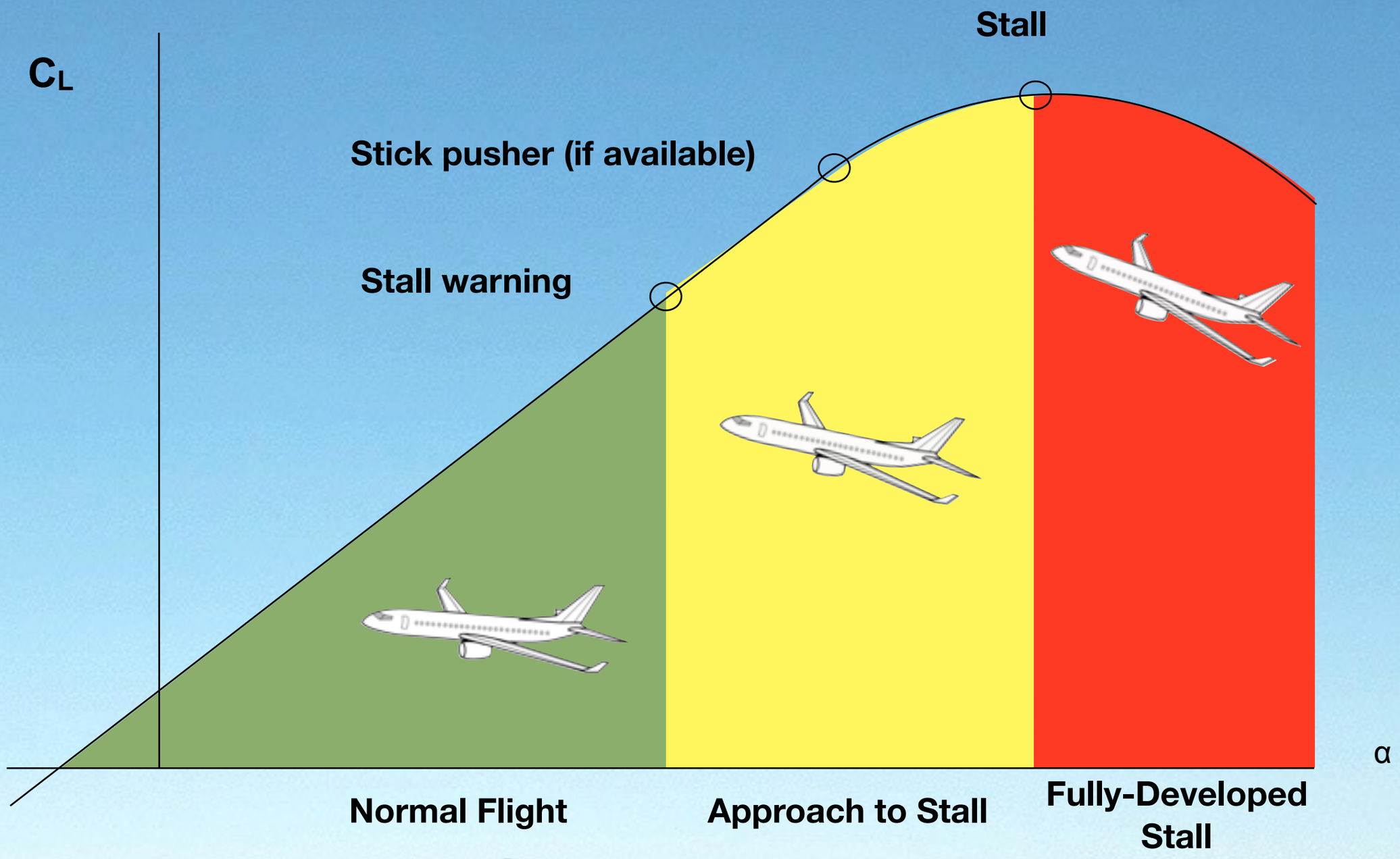
Rationale: Accident Reports indicate pilots have difficulty recognizing stall condition **(NTSB)**

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

Stall procedure is the same: recover at first indication!

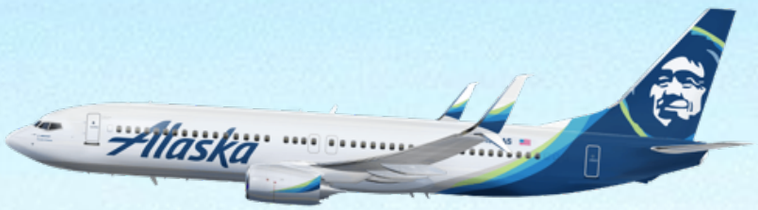
Recovery aspects are expected to improve as pilots become more familiar with stall behavior and cues

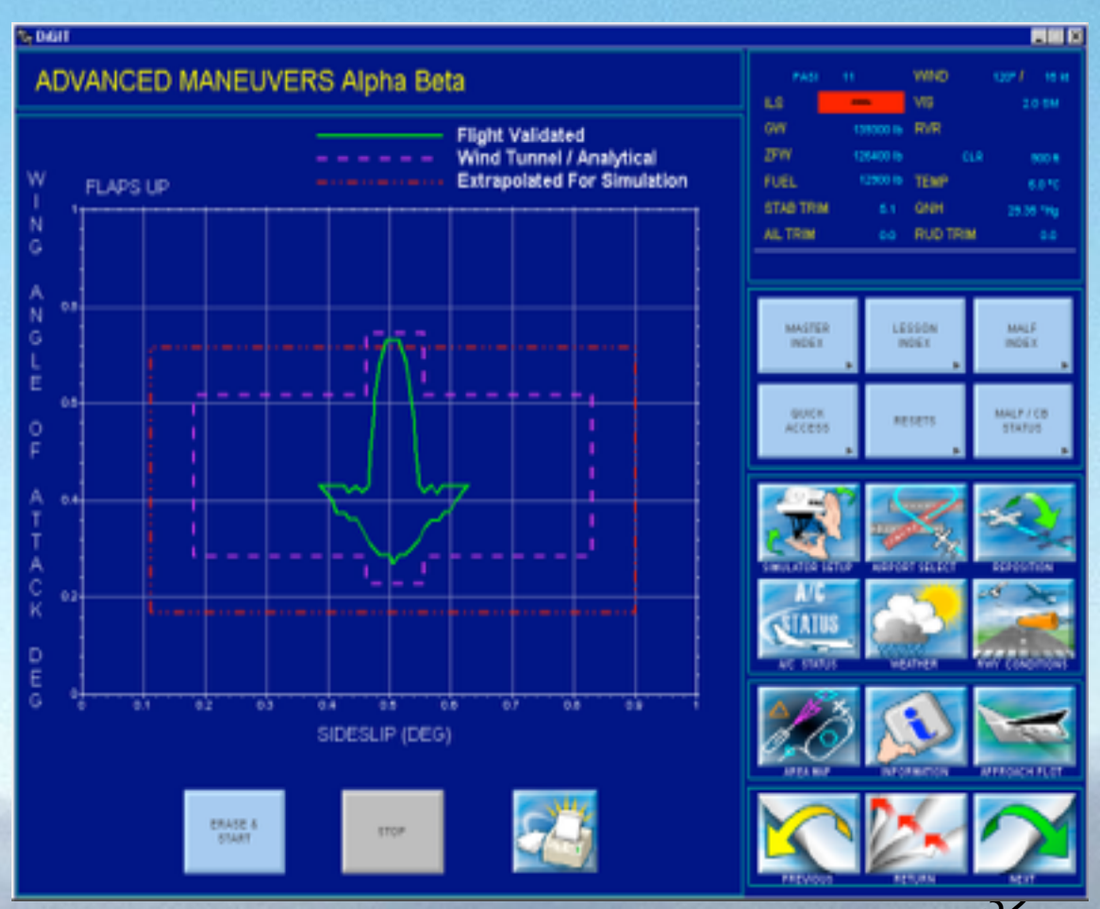
Enhanced Stall Aeromodel



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)**

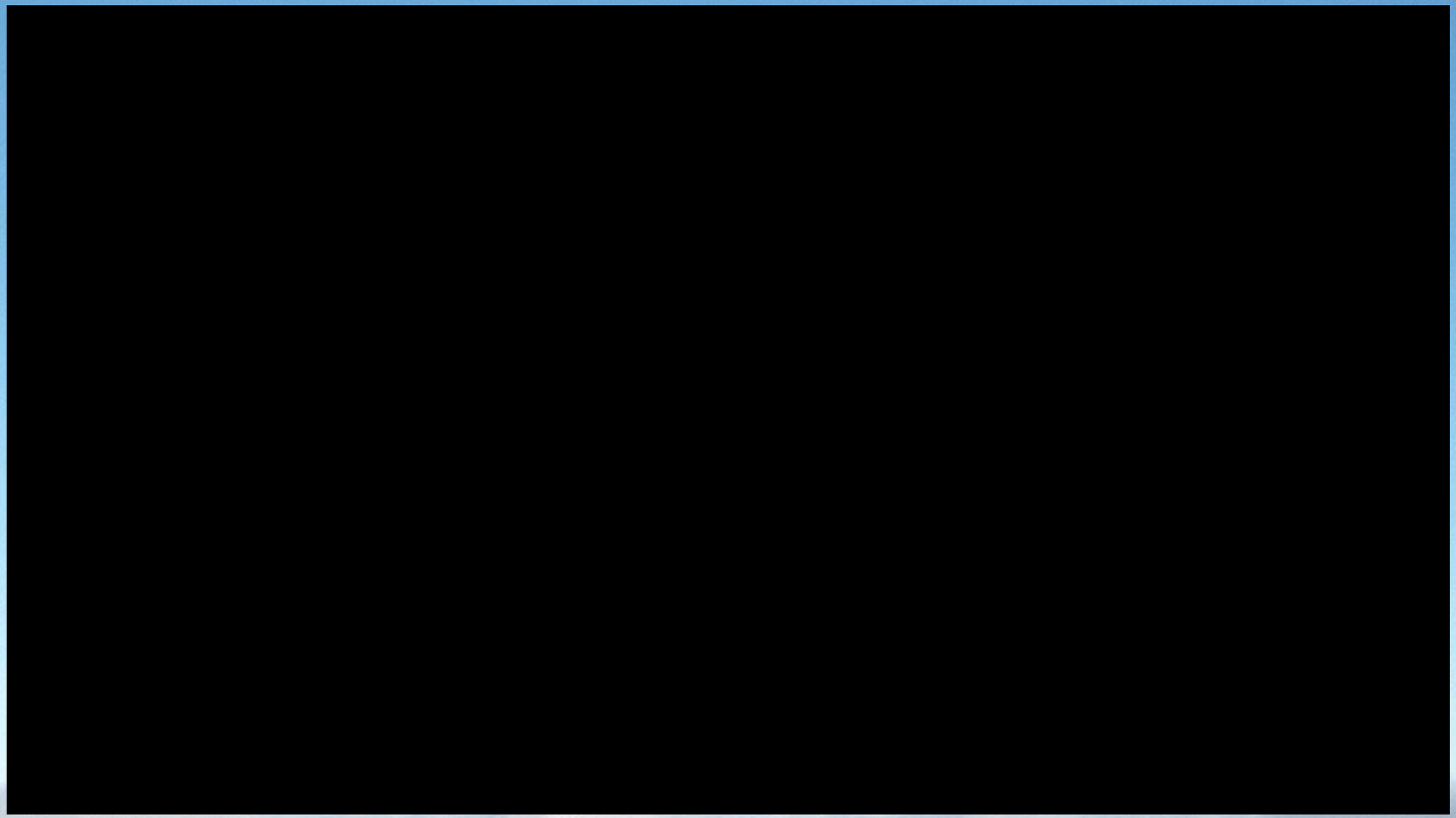
Surprising Results With the New Stall Recovery Technique

Presented to: InfoShare

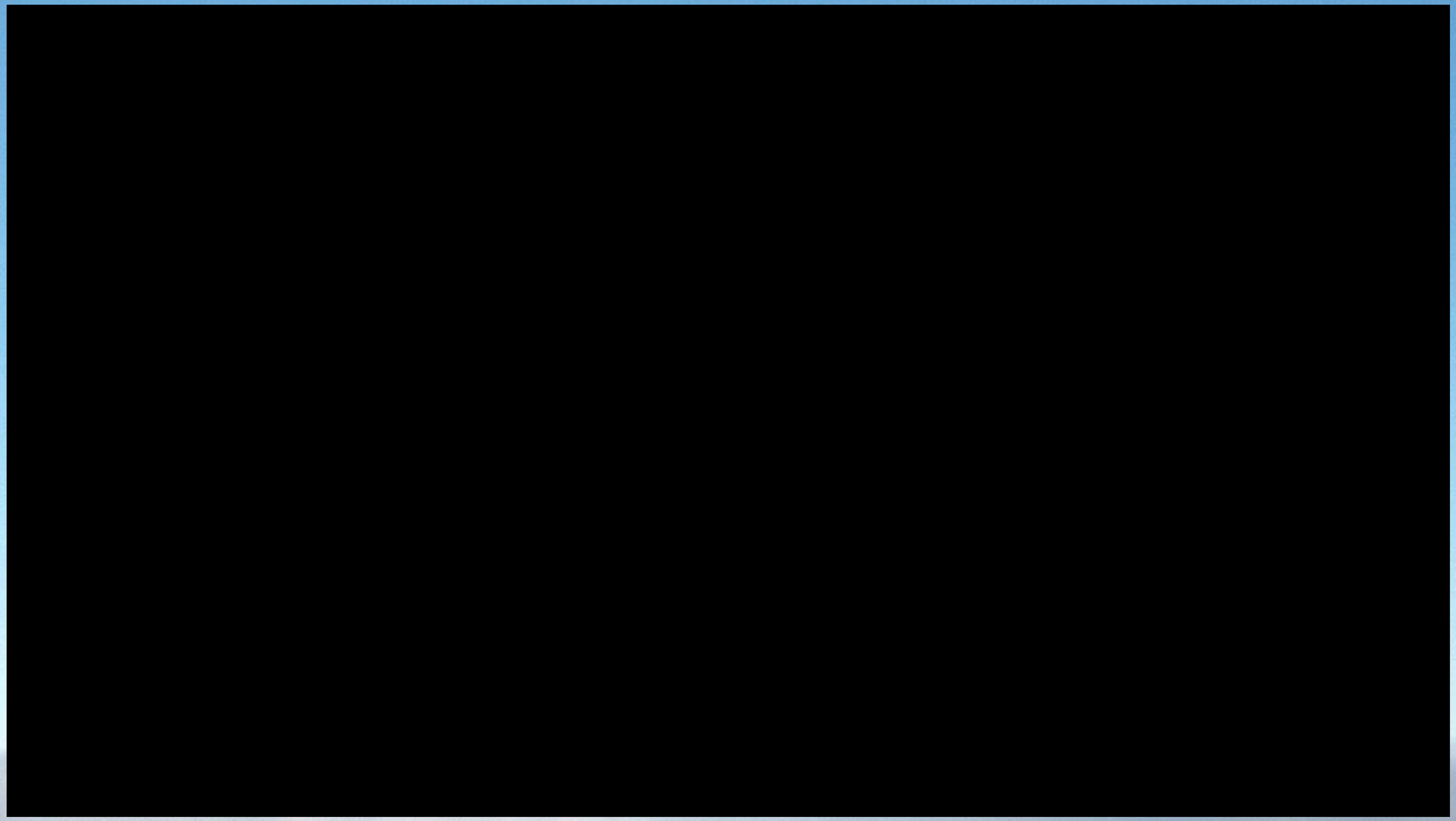
By: Jeff Schroeder
Chief Scientific and Technical Advisor
Flight Simulation Systems

Date: March 4, 2014

2015: Approach to Stall Landing Configuration



Old School Stall Recovery

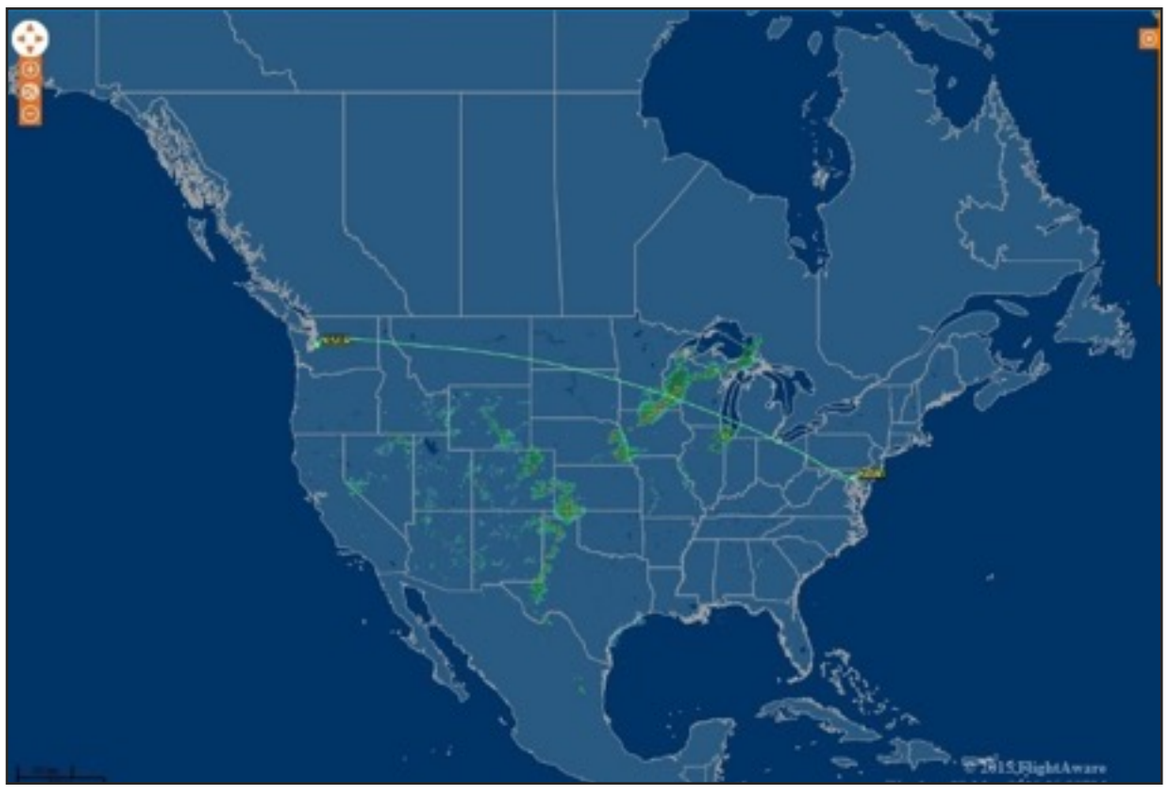


ACADEMICS AT ALASKA AIRLINES

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

Alaska

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

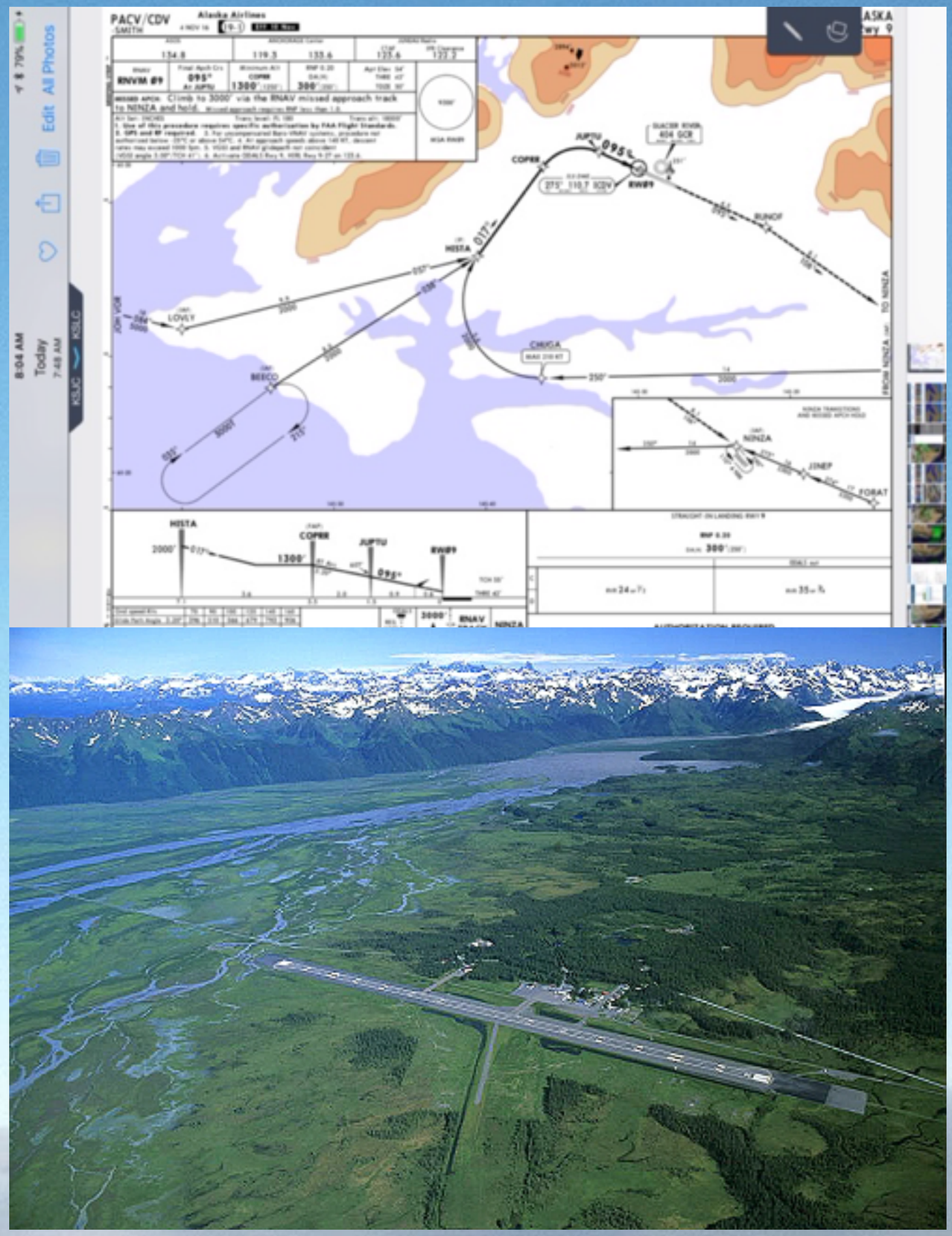
Requires timely recognition….

- 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

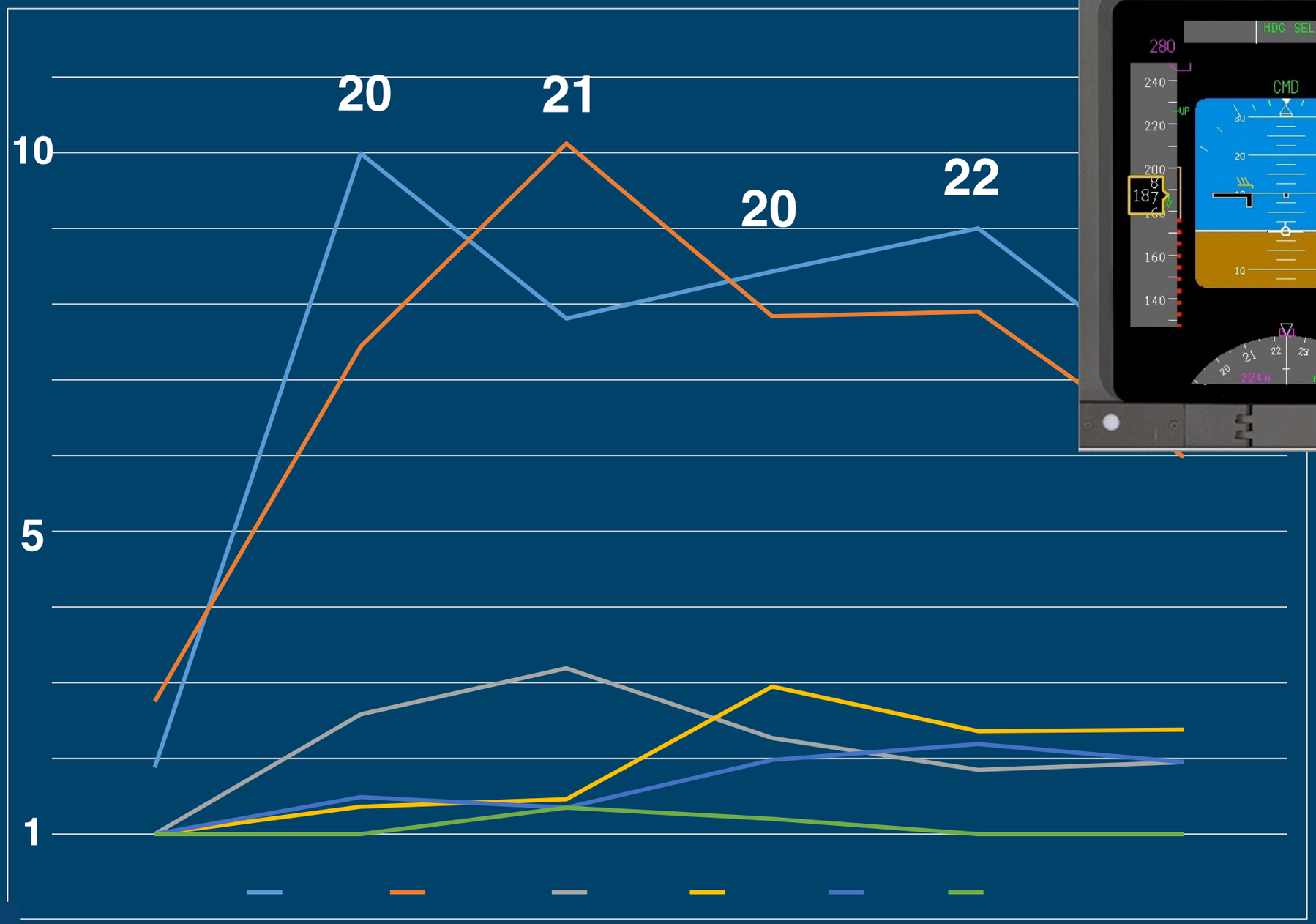
Captains EADI airspeed shows a rapid decrease, leading to a stall indication with stick shaker, FOs airspeed appeared to be accurate. FO disengaged autopilot and auto-throttles, added power and executed a missed approach. We notified ATC of missed approach and requested and were granted climb to 10,000 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.

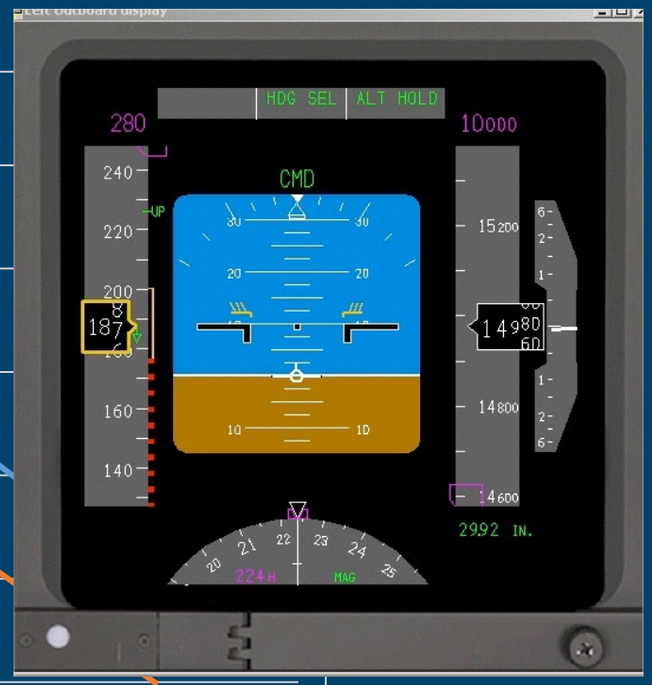


Low-Speed Precursor Rate

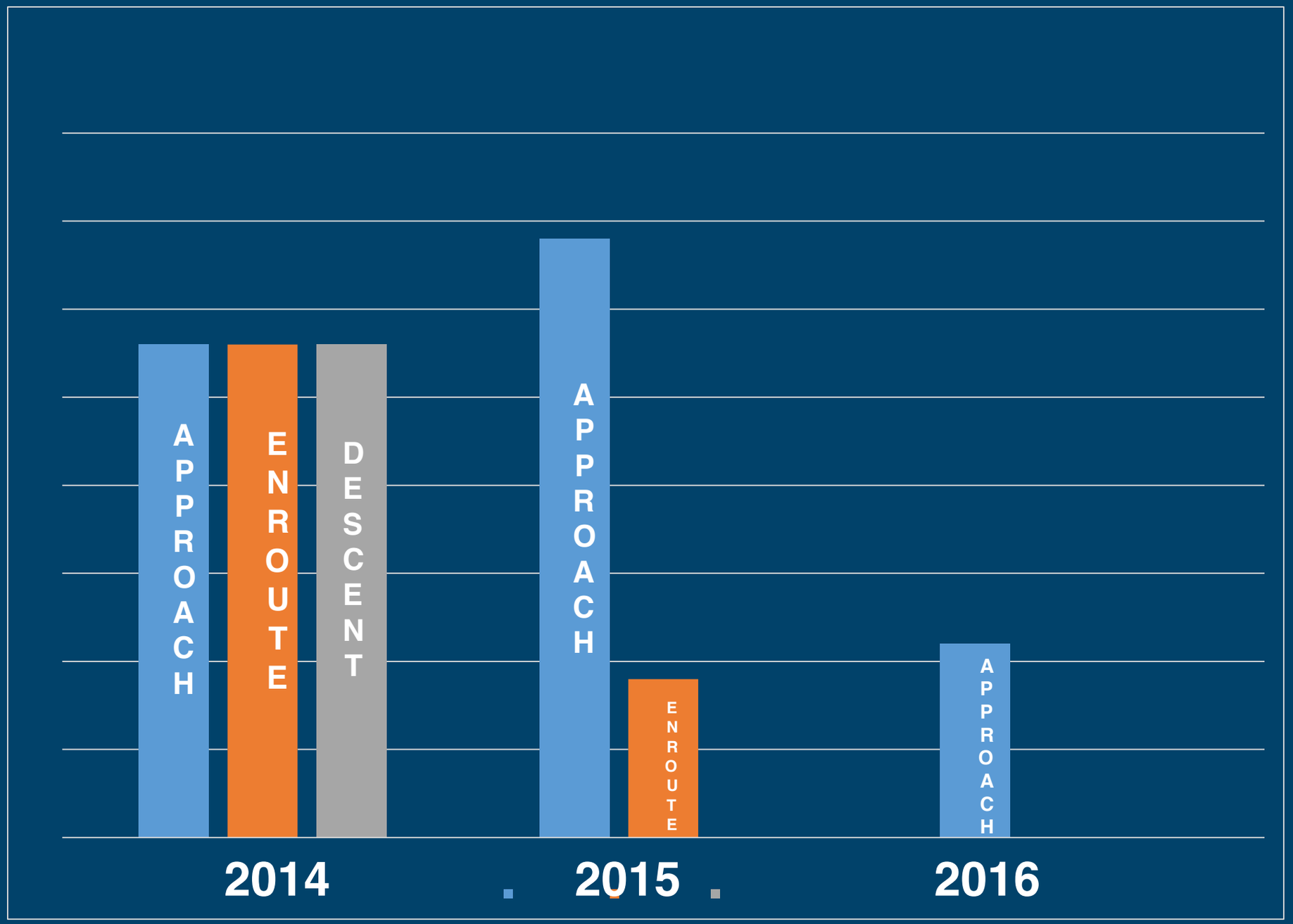
Low Speed Event VS 1.1 (Avg. = 21)

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:

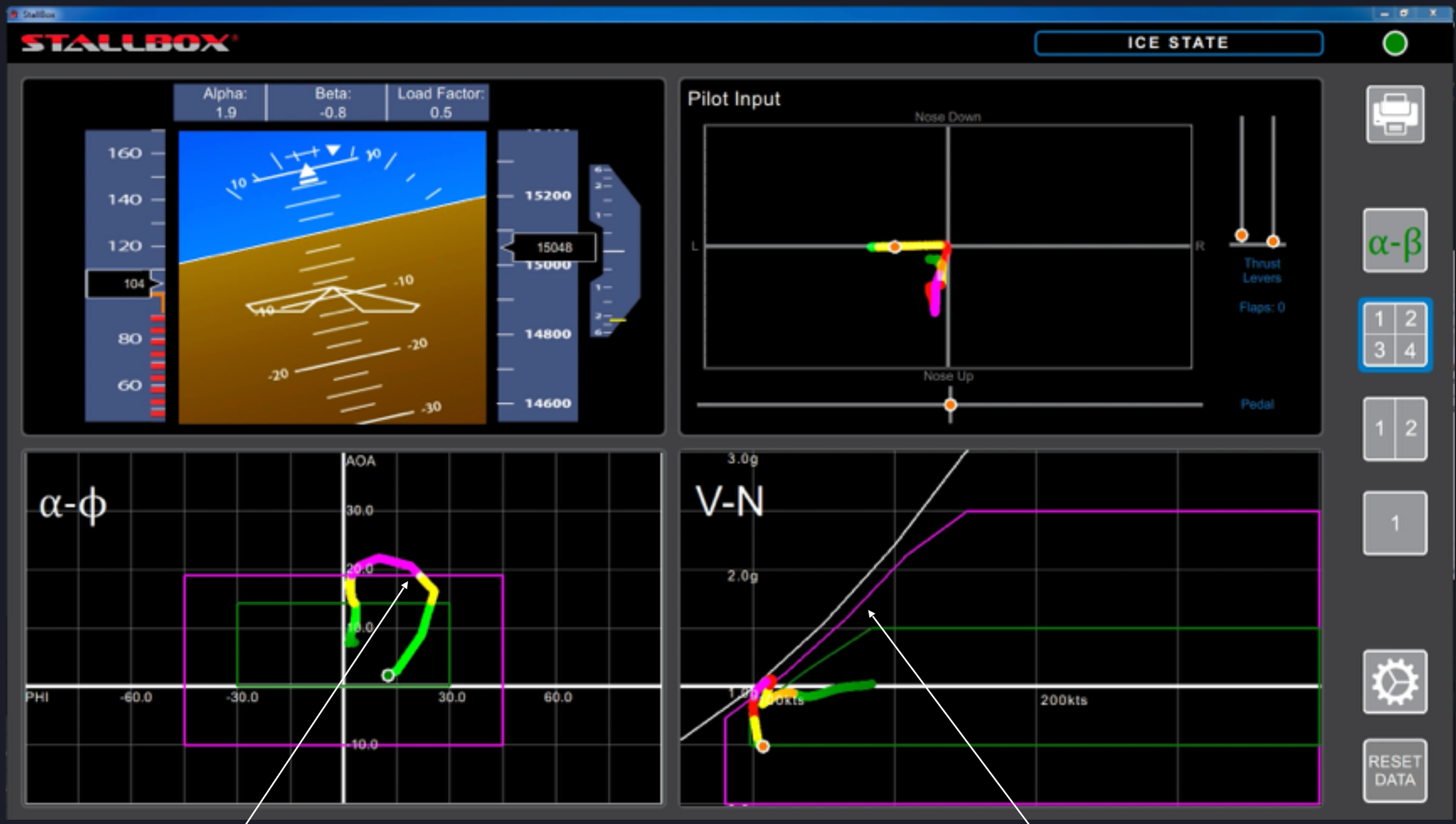
2 Good

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

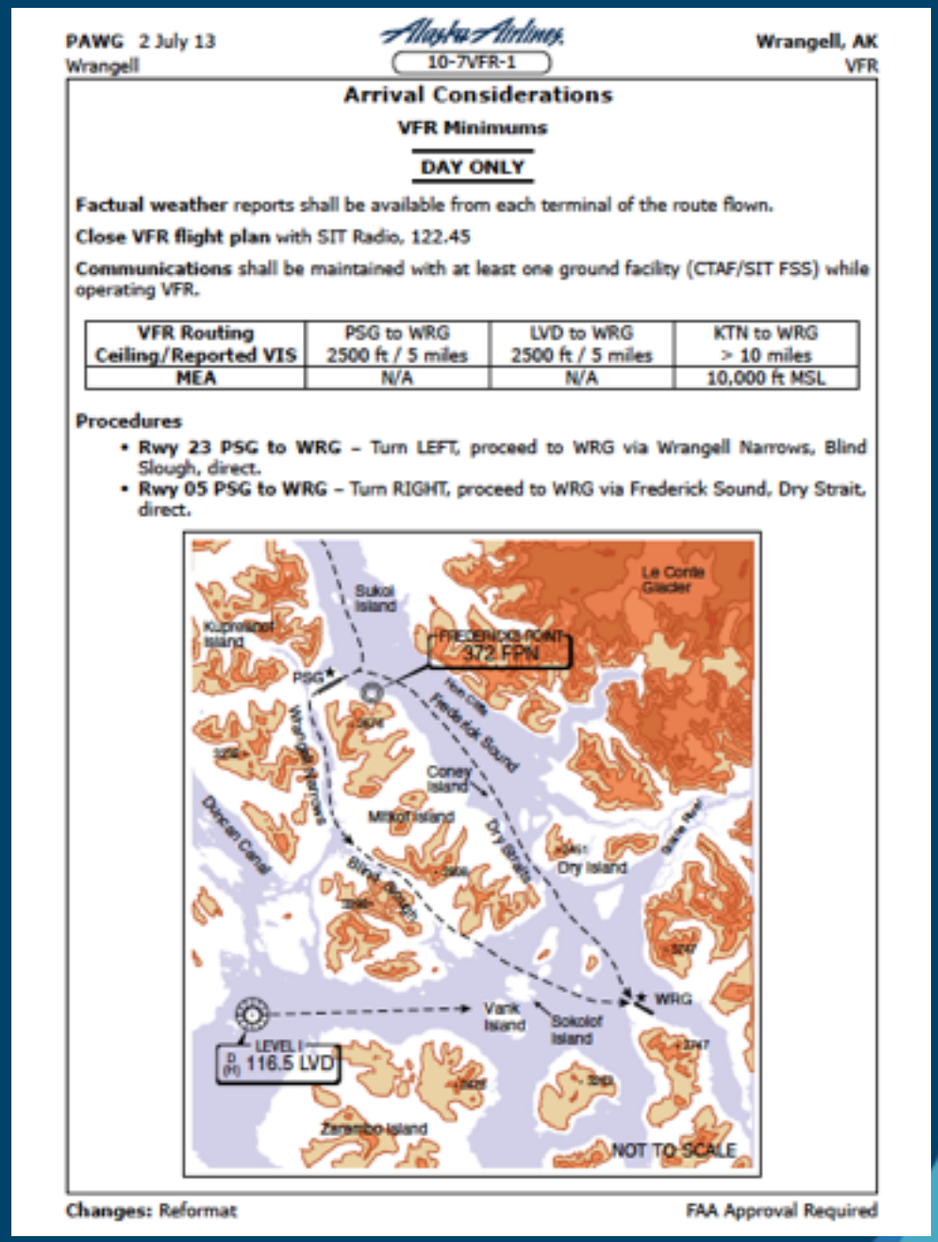
Manual Flying Skills… a layer of protection

- 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



PAWG 2 July 13 — Alaska Airlines — Wrangell, AK
Wrangell — 10-7VFR-1 — VFR

Arrival Considerations

VFR Minimums

DAY ONLY

Factual weather reports shall be available from each terminal of the route flown.

Close VFR flight plan with SIT Radio, 122.45

Communications shall be maintained with at least one ground facility (CTAF/SIT FSS) while operating VFR.

VFR Routing Ceiling/Reported VIS	PSG to WRG 2500 ft / 5 miles	LVD to WRG 2500 ft / 5 miles	KTN to WRG > 10 miles
MEA	N/A	N/A	10,000 ft MSL

Procedures

- **Rwy 23 PSG to WRG** – Turn LEFT, proceed to WRG via Wrangell Narrows, Blind Slough, direct.
- **Rwy 05 PSG to WRG** – Turn RIGHT, proceed to WRG via Frederick Sound, Dry Strait, direct.

Changes: Reformat — FAA Approval Required

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

Intercept 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

	Lack of External Visual References	Flight Crew Impairment	Training	Airplane Maintenance	Safety Culture	Invalid Source Data	Distraction	Systems Knowledge	Crew Resource Management	Automation Confusion / Awareness	Ineffective Alerting	Inappropriate Control Actions	Total
Formosa Airlines Saab 340	x	x			x		x	x	x		x		7
Korean Air 747-200F	x			x		x	x		x		x		6
Flash Airlines 737-300	x		x		x		x		x	x	x	x	8
Adam Air 737-400	x		x	x			x	x	x	x	x	x	9
Kenya Airways 737-800	x		x				x		x	x	x	x	7
Aeroflot-Nord 737-500	x	x	x	x	x		x	x	x	x	x	x	11
Gulf Air A320	x		x				x		x		x	x	6
Icelandair 757-200 (Oslo)	x						x		x	x	x	x	6
Armavia A320	x	x			x		x		x	x	x	x	8
Icelandiar 757-200 (Baltimore)	x				x	x	x	x	x	x	x	x	9
Midwest Express 717	x				x	x	x		x		x	x	7
Colgan Air DHC-8-Q400	x	x	x		x		x	x	x	x	x	x	10
Provincial Airlines DHC-8	x		x				x			x	x	x	6
Thomsonfly 737-800	x		x	x	x		x			x	x		7
West Caribbean MD-82	x	x			x		x	x	x	x	x	x	9
XL Airways A320		x	x	x	x	x	x	x	x	x	x		10
Turkish Airlines 737-800	x			x	x	x	x		x	x	x		8
Empire Air ATR-42	x	x			x		x		x	x	x		7
Overall	17	7	9	6	12	5	18	7	16	14	18	12	

Monitoring Enhancements: VSD and Non-F.D.

Vertical Situation Display – Center MAP Mode

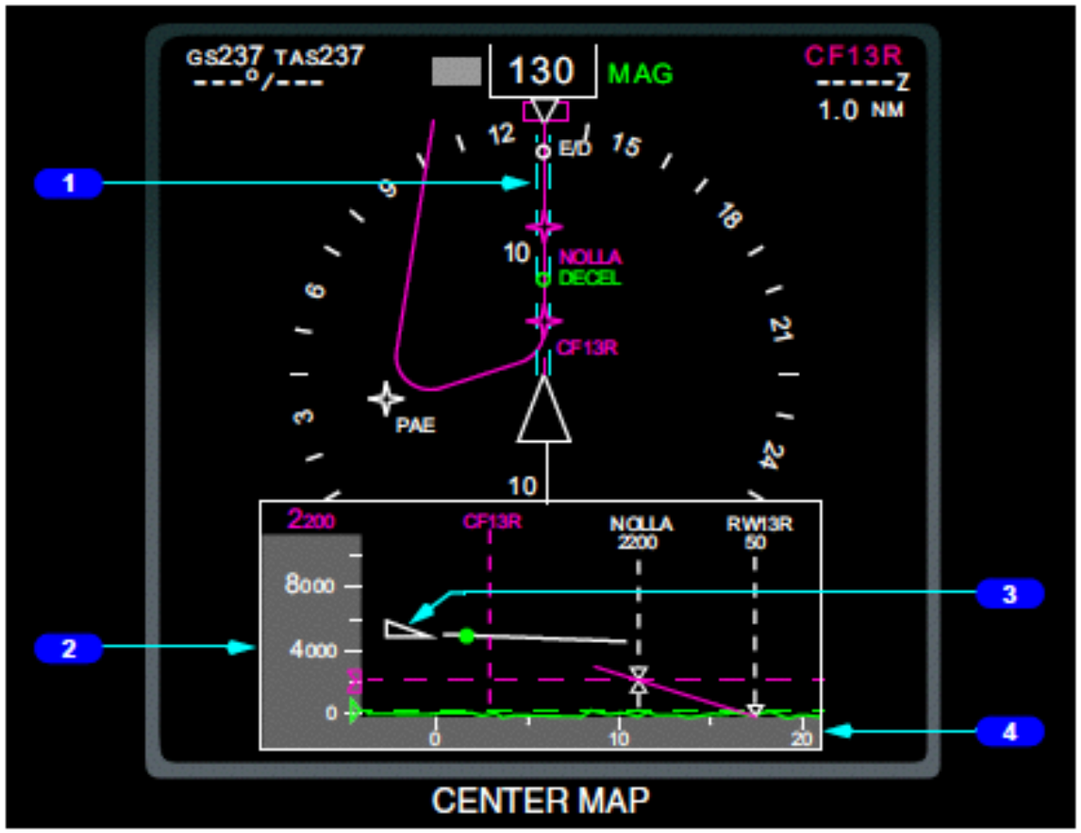


Figure 5

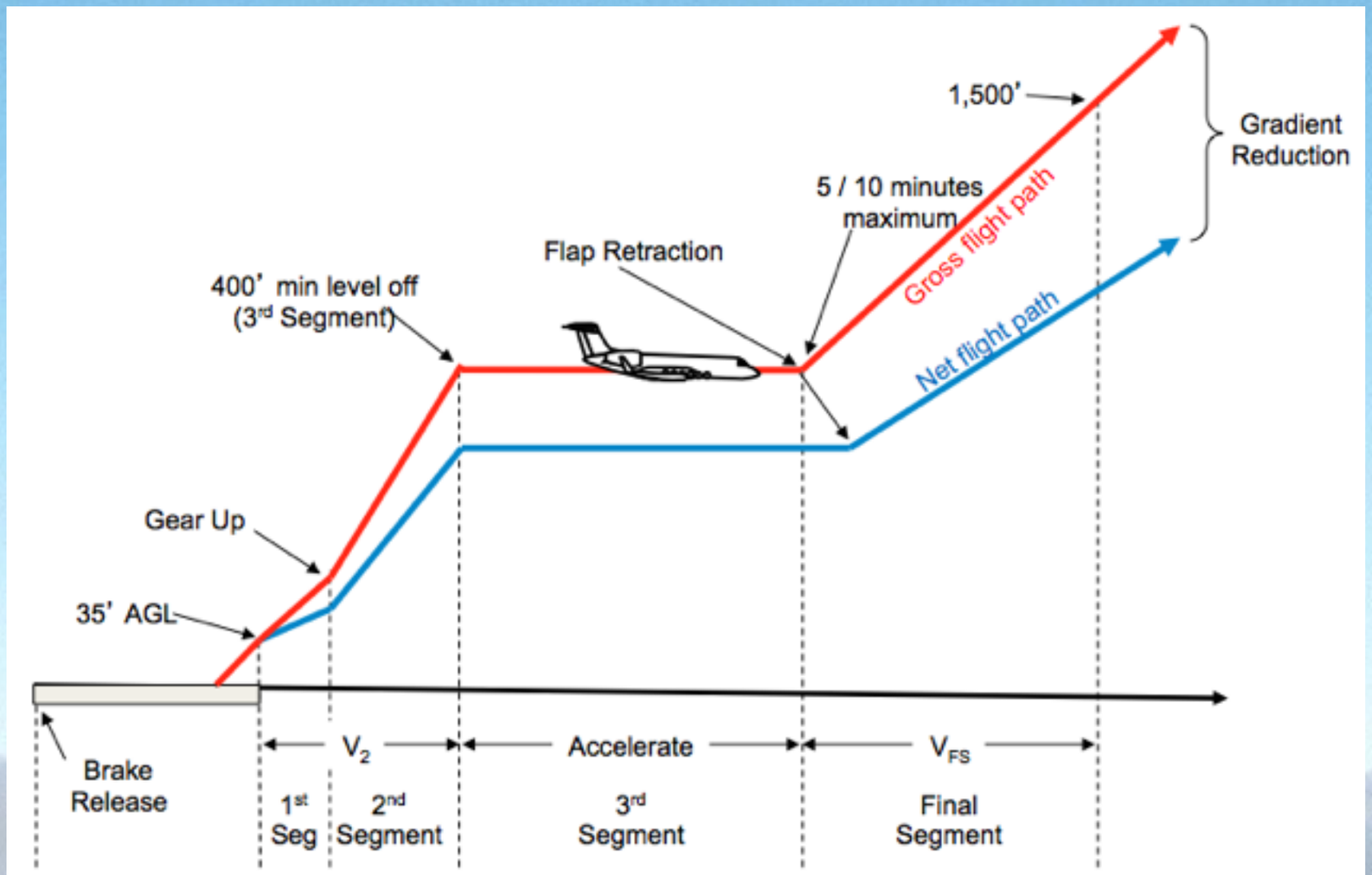
(5-1) *The **Enroute Swath** indicates the area mapped by the VSD. The display is inhibited both on takeoff and approach when the aircraft is within 6 nm of the runway and less than 3000 ft AFE. The swath width is dependent upon RNP value selected (swath is equal to 1x RNP value) and will adjust proportionally 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

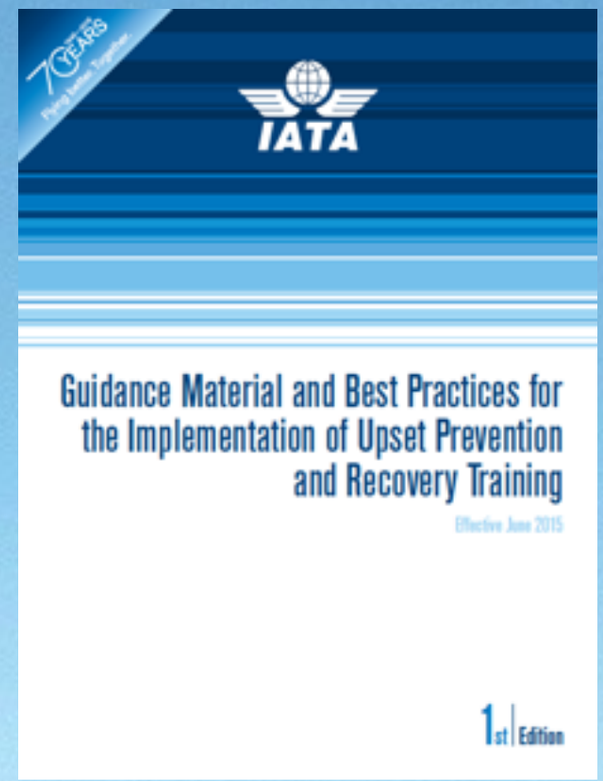


Goals for UPRT: Will this work for you?

- Start with your current training infra-structure
- 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



Lets Go Fly some UPRT!

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