



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  
(Johannesburg, South Africa, 16-19  
October 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

Sponsored by:



Synopsis

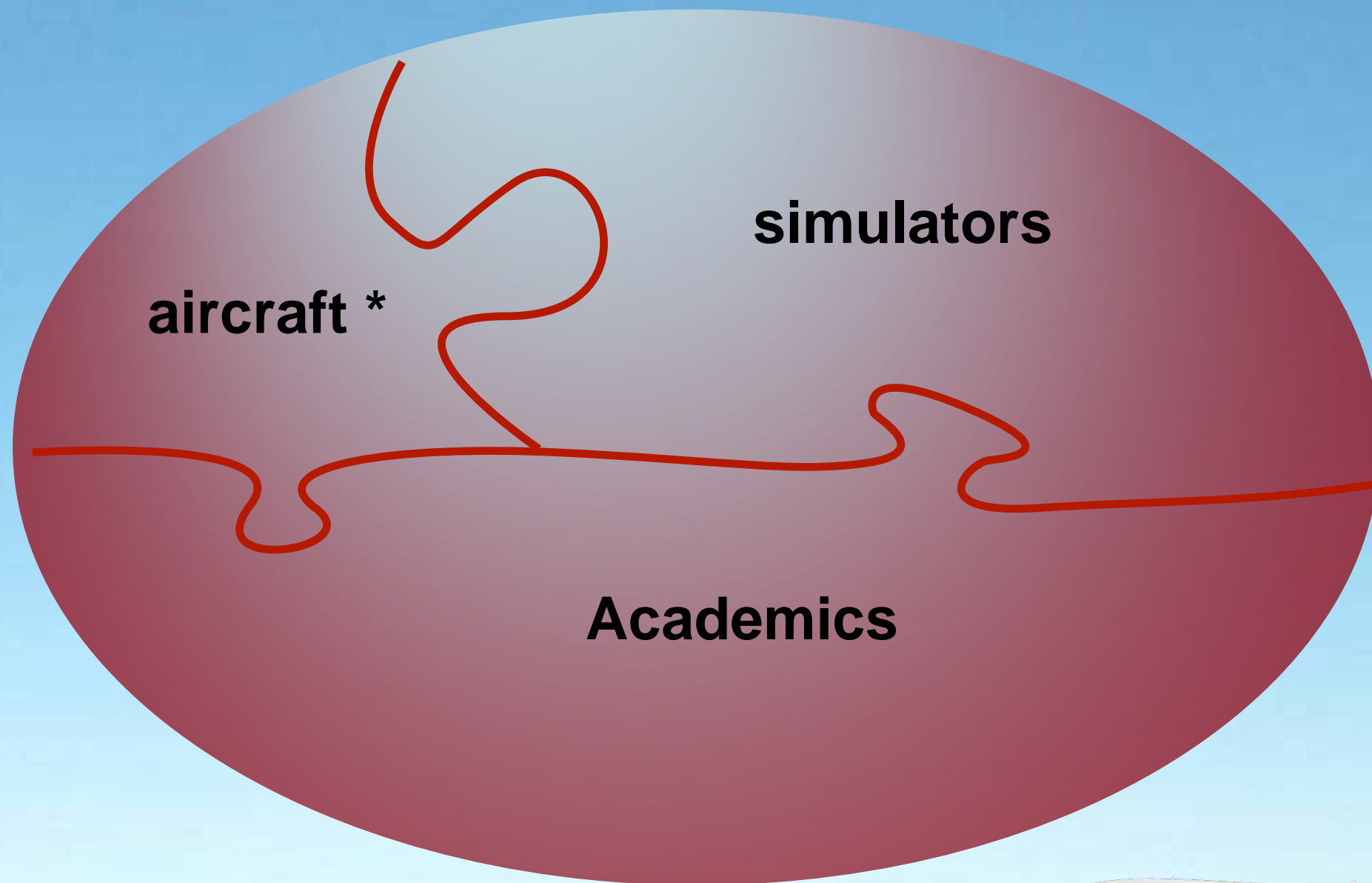
# Gap Analysis:

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

**UPRT Requires Integrated Training Elements**



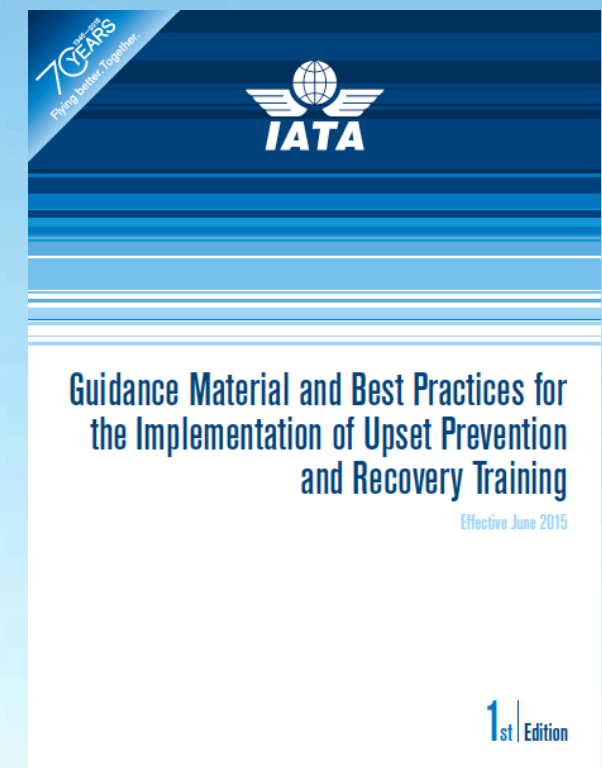
# Integrated Elements





# 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



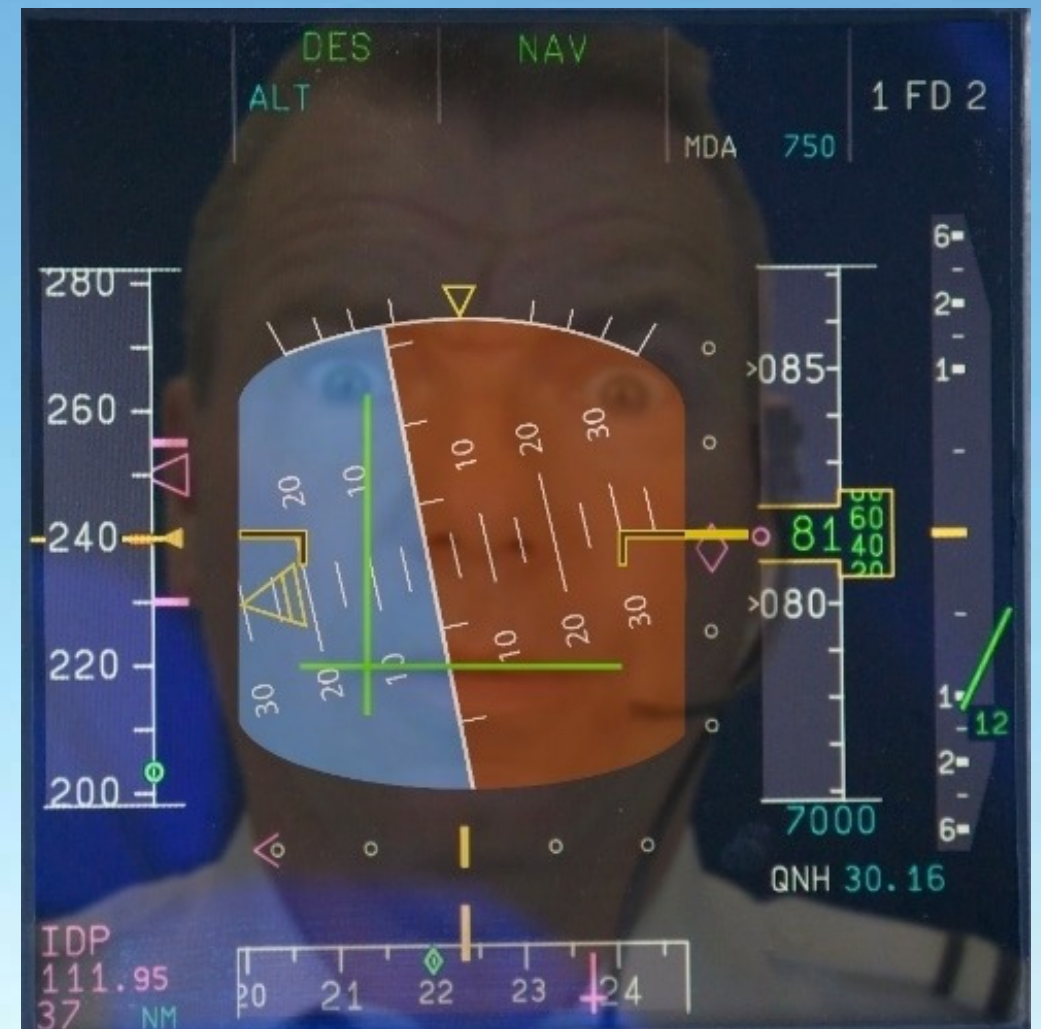
# What will airline UPRT look like?

- ***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





# Example of New UPRT Instructor Pages: CAE B-737-900

Overview

Simulation Set

Lesson Plans Training Aids

UPRT

Failures & Radio STNS

COMMS

Maps, Plots & Storms

Recording Control

SIM Controls & MAINT

Scenarios & Events

Alpha-Beta Plot

V-n Plot

Synoptic

PFD

A-B V-n Synoptic PFD

Time History

## P4801 SCENARIOS & EVENTS

MOFT SCENARIOS	LOFT EVENTS
40 deg Nose Up Wings Level Va +50 CAS	Left Bank
25 deg Nose Down Wings Level Vmo -10 kt	Right Bank
30 deg Nose Up 60 deg Bank 200 KCAS	Airspeed Decrease
20 deg Nose Down 65 deg Bank Va	Airspeed Increase
20 deg Nose Down 125 deg Bank Va	
Level Flight Va	
L/D Max at Max ALT	

Bank

Left
 Right

ALTITUDE	EXECUTE	INTENSITY	ACTIVATE
FL100                              FL200                              FL350	Execute	Light                              Moderate                              Severe	Activate

16-Sep-2014
16:57:59
C:FLT
F:FLT

FLT  
FRZ

Record

Review  
Mode

300 sec  
Time Range

Start  
Event

End  
Event

Mark  
Event

	0.27		
	-0.05	-0.31	
G load	CUR	MIN	MAX
AOA	-0.18	-0.61	1.79 g
IAS	185	181	264 kt
Sideslip	-2	-23	4 deg
Pedal Force	L0	L0	L0 lbf

Note G Load

Note Negative G

Note AOA

Note Speed



# 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





# Now



# 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

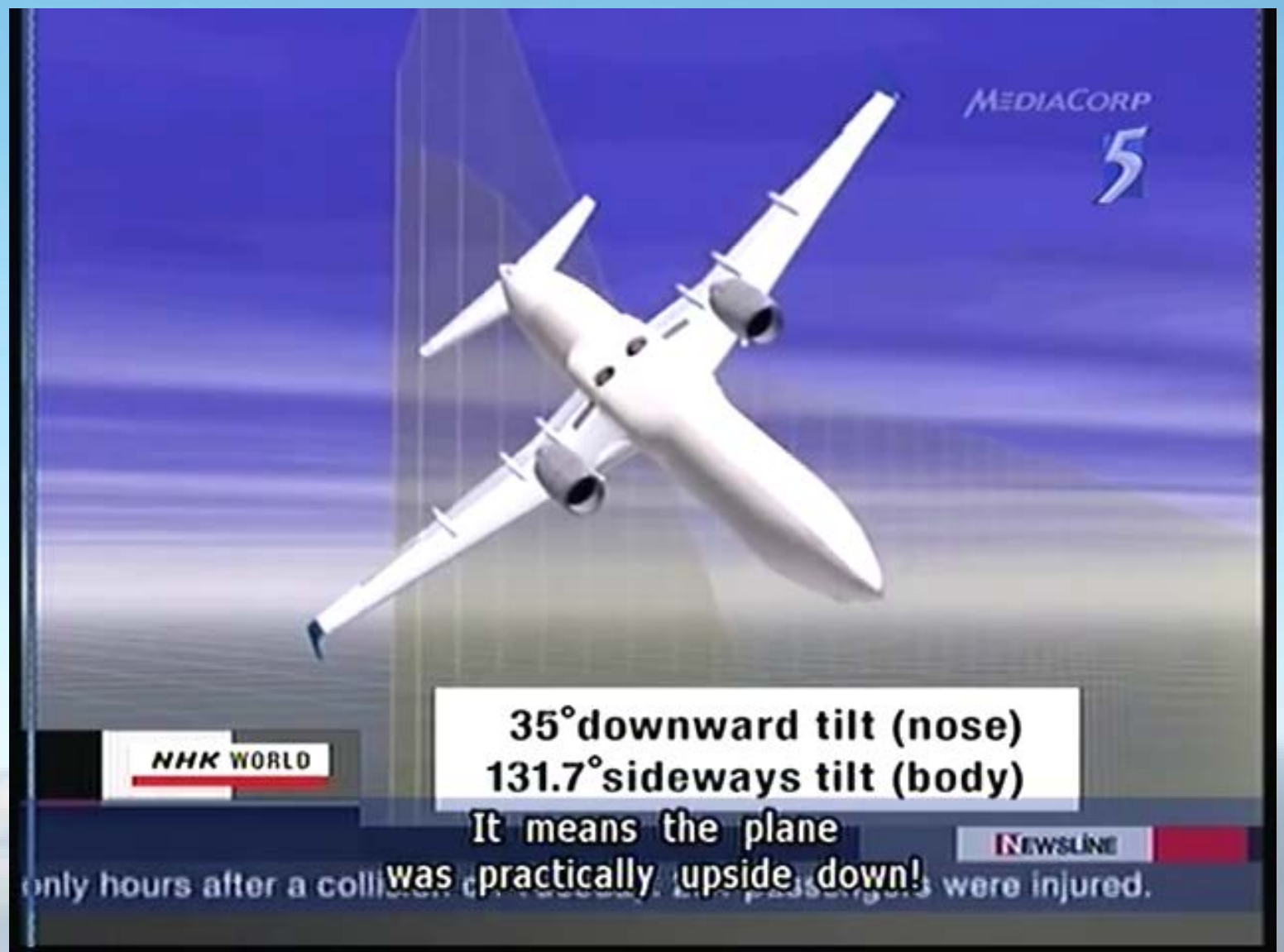
Un-Reliable Airspeed

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

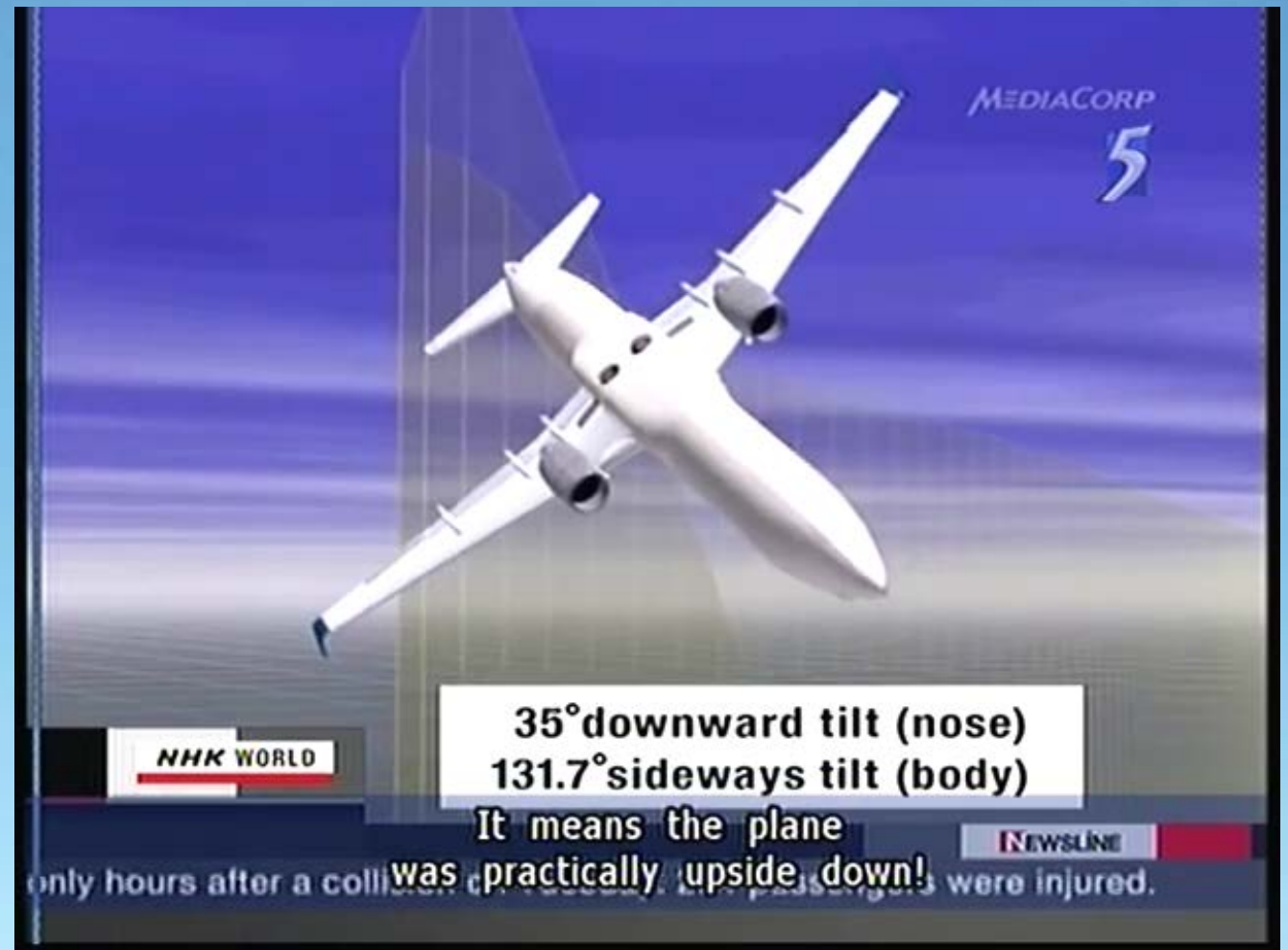
## Graduate Level Maneuver

- 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

