Collaborating to address

LOSS OF CONTROL IN-FLIGHT

Upset Prevention and Recovery Training Workshop

Module 1 – Day 1

UPRT Provisions: What do they say?

Thanks to:

Content developers

AIRBUS
BOEING
CAE
FEDERAL AVIATION ADMINISTRATION
IATA
ICAO • OACI • ИКАО
I·F·A·L·P·A
The Global Voice of Pilots

Overview

- Why do we need UPRT SARPs?
- How did we proceed?
- What do the ICAO provisions say?
- What are the big changes?
- What are the implications?
- What guidance is out there?
- Example of implementation

Why do we need UPRT SARPs?

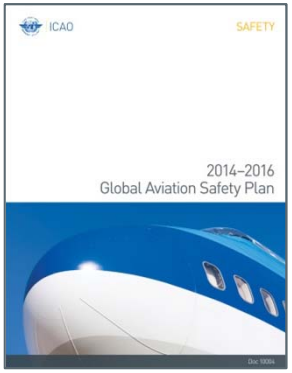
- Mitigating loss of control in-flight accidents is an *ICAO Safety Priority*

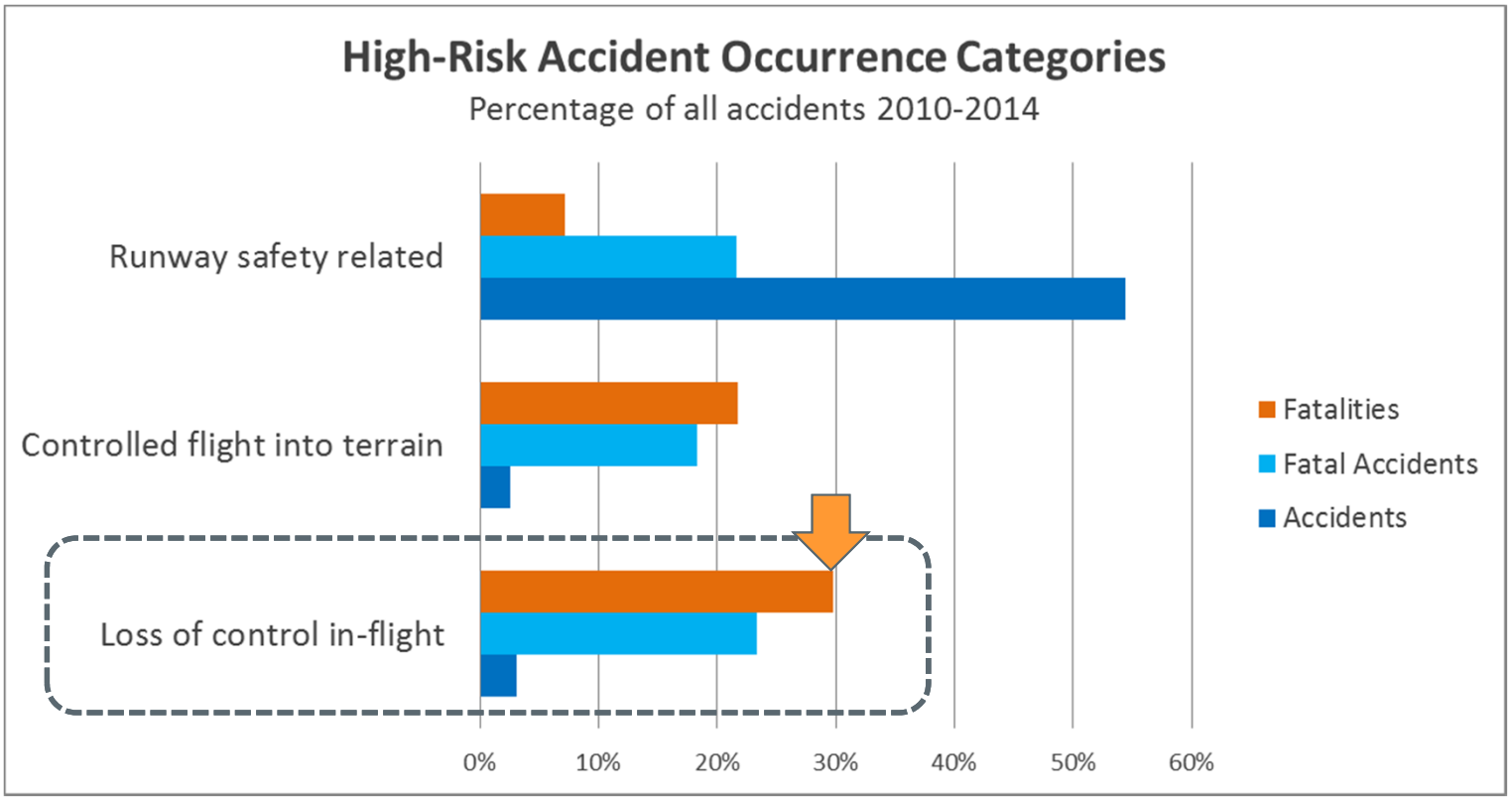
- Upset prevention and recovery training (UPRT) for pilots is **one means to address this priority**.

Why do we need UPRT SARPs?

- Only **aeroplane pilots** were considered:
  - Smaller 'loss of life' numbers in other categories (helicopter, airship, powered-lift, glider, free balloon)
  - No expertise in helicopters and other categories
  - Other means being developed for helicopter

Top 3 Safety Priorities





** Accidents involving scheduled commercial air transport with maximum take-off weight exceeding 5 700 kg*

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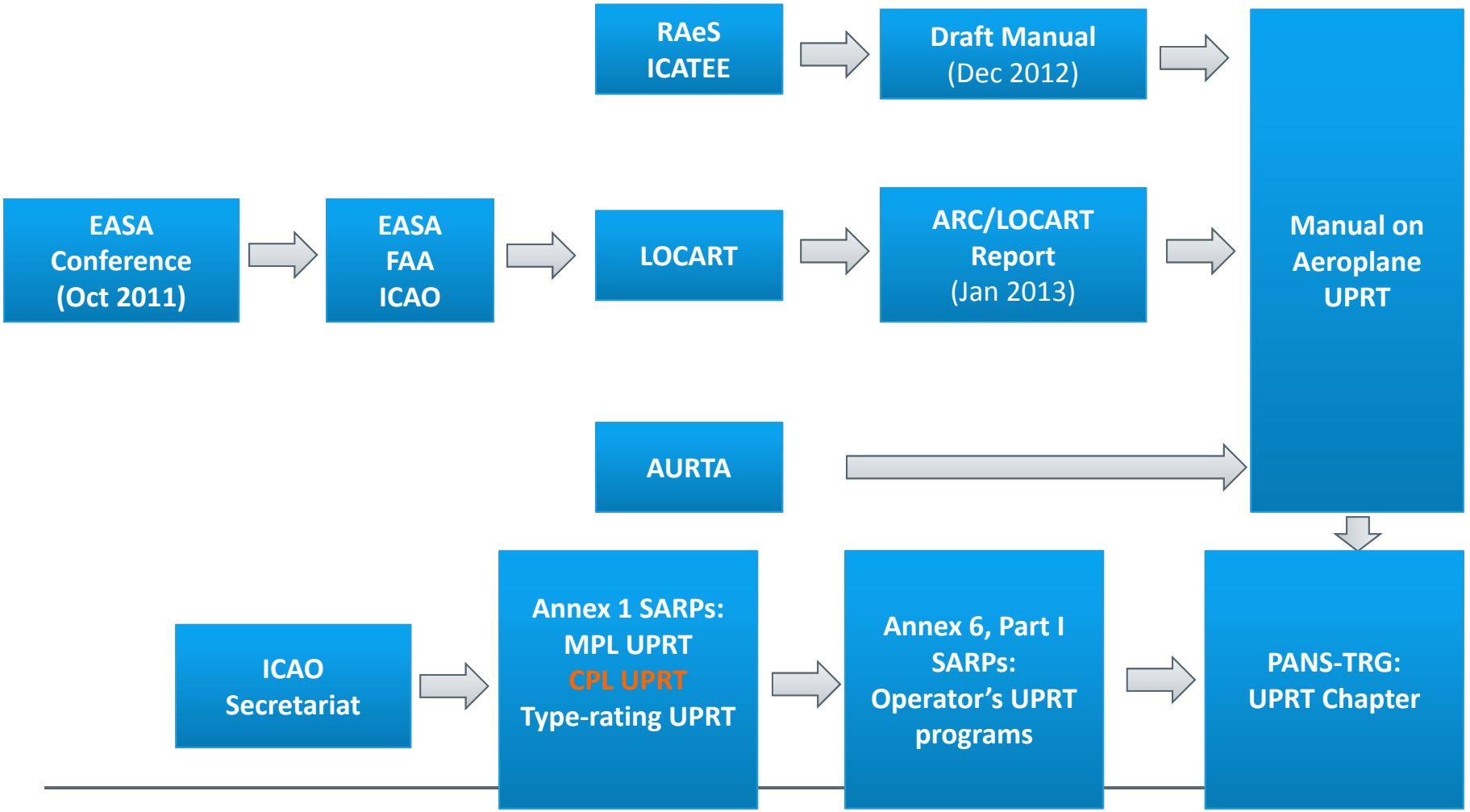
How did we proceed?

- Identified training concerns:
  - **Insufficient knowledge** of high altitude aerodynamics and upset threats
  - **Wrong emphasis** on minimizing altitude loss during recovery from approach to stall
  - **Current training** concentrated in a small domain of the operational envelope

How did we proceed?

- Process used:
  - Build on existing industry initiatives
    - RAeS's ICATEE
    - LOCART initiative
    - Existing Airplane Upset Recovery Training Aid (AURTA)
  - Integration of material
    - Annex and PANS-TRG amendments
    - Guidance material

How did we proceed? - *Process used*



UPRT: *One Aspect of a Global Approach*

- Collaborative approach:
  - Information sharing
  - Lifecycle model for pilot training
  - Implement UPRT
  - Outreach

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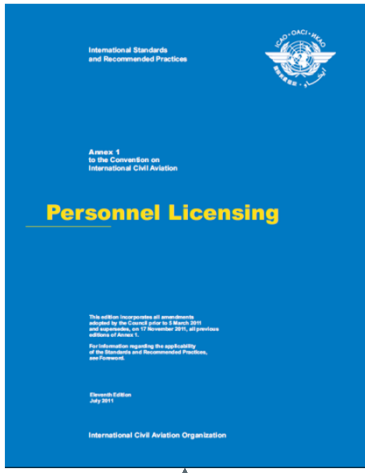
What the SARPs say:

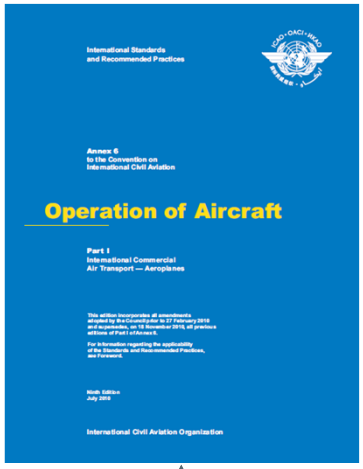
- Pilots must be trained in upset *prevention* and recovery in order to meet:
  - Licensing requirements for CPL and MPL
    - MPL *must* include on-aircraft UPRT to be conducted by an ATO (Standard)
    - CPL *should* include on-aircraft UPRT to be conducted by an ATO (RP)
  - Licensing requirements for multi-crew type-rating
  - Commercial air transport pilot training programme requirements
- Applicable: 13 Nov 2014
- Where?

ICAO UPRT Provisions



Annex 1

UPRT requirements for MPL and the type rating of multi-crew aeroplanes + RP for CPL



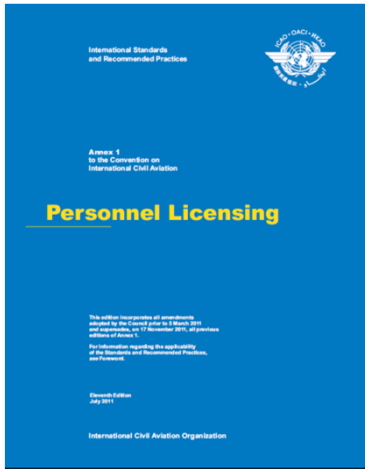
Annex 6, Part I

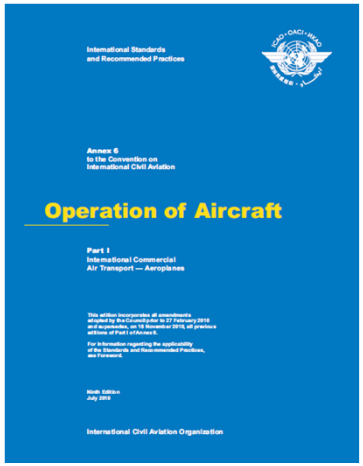
UPRT requirements for flight crew training

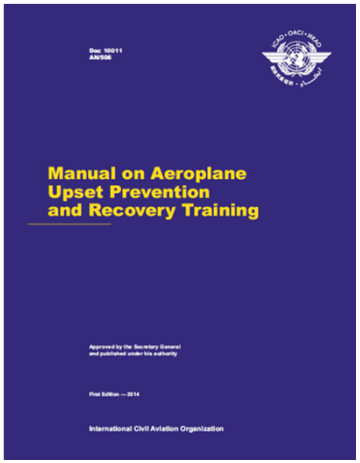
PANS-TRAINING

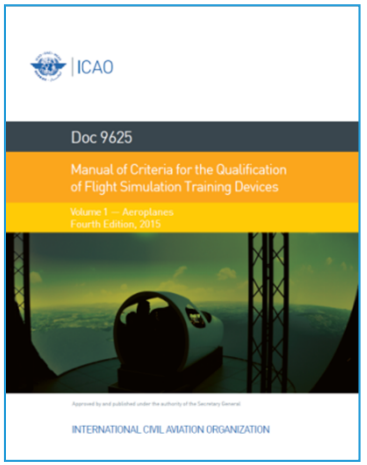
New Chapter to support Annex requirements

ICAO UPRT Provisions









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What are the big changes?

1. Professional pilots to be trained in upset *prevention* and recovery:
   - Licensing
     - *On-Aeroplane:* MPL
       CPL should be trained
     - *In FSTD:* Multi-crew type rating

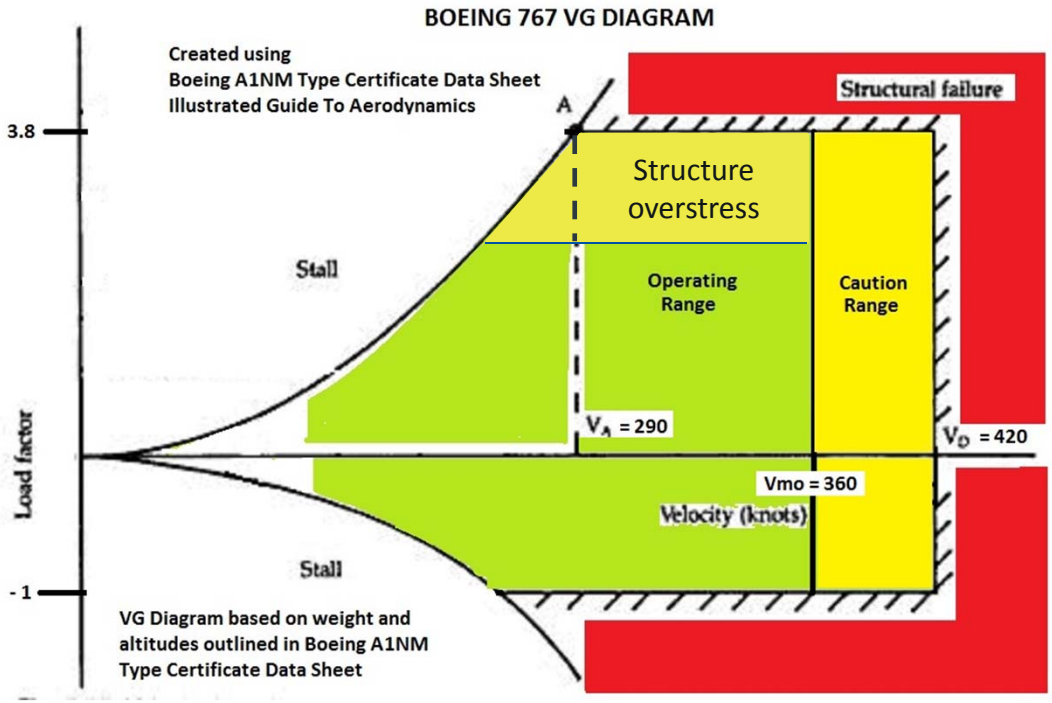
   Approved UPRT in an Approved Training Organization (ATO)

   - Commercial air transport training programmes in FSTD
     - Initial (conversion)
     - Recurrent

   Approved UPRT by air operator or in an ATO

What are the big changes?

2. Pilots must be trained *throughout* the normal flight envelope (green), including the outer edges.
   - Approach to stall
   - High Altitude



What are the big changes?

2. Pilots must be trained *throughout* the normal flight envelope (green), including the outer edges.

Why not outside the envelope?

- **Potential for negative transfer of training:**
  - Out-of-envelope aircraft responses can be random
  - FSTD responses do not replicate aircraft responses faithfully
- **Globally, training benefits do not outweigh safety risks**

What are the big changes?

3. UPRT is about *training, not checking*

What are the big changes?

4. Cost-benefit assessment – Personnel costs

- Of on-aircraft and FSTD UPRT
- Resources and context
  - Airline bridge training required for existing pilots

What are the big changes?

4. Cost-benefit assessment – Personnel costs

Licence/ Rating/ Training	# of individuals (Doc 9956)	Training type	Knowledge USD costs per individual	Aircraft/ FSTD USD costs per individual	Pilot salary (100,000 USD/ year)	Instructor costs (USD)	Total (m USD)	Remarks
CPL	50,000 yearly	On-aircraft	200	1000 (4 hrs)		150	67.5	Recommended practice — yearly licensing costs
MPL	300 yearly	On-aircraft					0.08	no additional costs (except type-rating)
Type-rating	100,000 yearly	FSTD	200	500	65	150	59.0	1 hour per type rating
Recurrent training	450,000 yearly	FSTD		250	32	60	84.2	30 minutes per year
Operator training	450,000	FSTD	200	2000	260	1000	882.0	4 hours once — Non recurrent — Bridge-trg
Instructor	50,000	UPRT qualif.	400	2500	500	1000	119.2	Instructor qualification — non recurrent
						TOTAL	**210.8** **1,001.2**	**Recurrent** **Non recurrent**

What are the big changes?

4. Cost-benefit assessment – FSTD Costs

– From NPRM FAA-2014-0391 (simplified/global) – includes UPRT and icing upgrade

Estimated FSTD Type VII Upgrade Costs (USD)					
FSTD	**Development Costs**	**Implementation Costs**	**Loss of productivity**	**Affected # of FSTD**	**Total (m USD)**
Old	24 000	72 000	23 000	381	45.4
Newer	6 500	40 000	23 000	442	30.7

What are the big changes?

5. Safety considerations for on-aeroplane training

- Effective SMS
- Qualified instructors
- Aeroplane capabilities appropriate to the training tasks
- Operational control procedures

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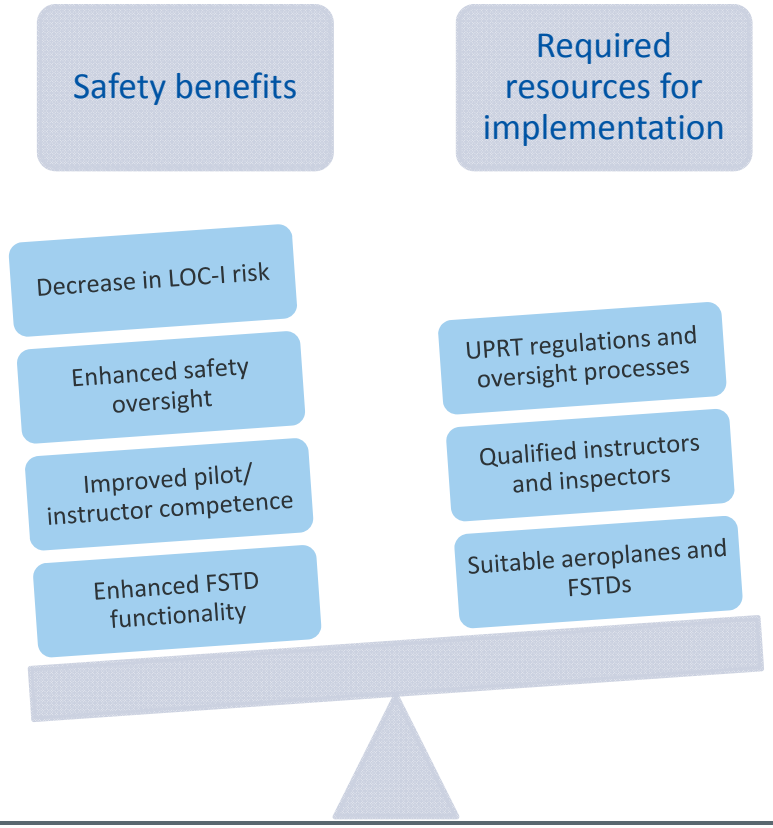
Implications

- Optimise safety outcomes within available resources



Implications

- Additional theoretical training for all pilots
- Bridge-training for current airline pilots
- Many FSTDs will need an update to qualify for the full range of UPRT tasks
- Need to balance cost/benefits for delivery of on-aircraft UPRT:
  - SMS considerations
  - Aerobatic aircraft are recommended but not the only option
- Instructors will need further training described in PANS-TRG and Doc 10011 to meet Annex 1 authorization requirements

Proper authorization shall comprise: ... **the authority to act as an agent of an approved organization authorized** ... **to carry out flight instruction**; or a specific authorization...

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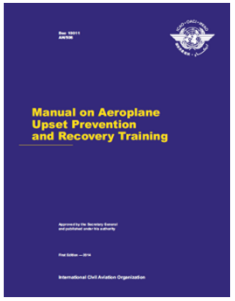
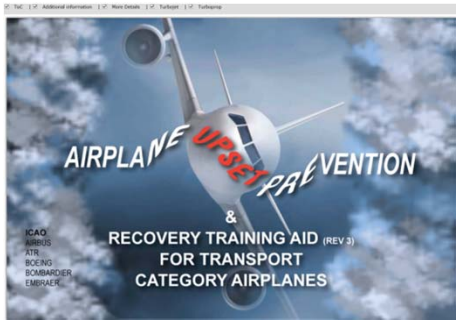
What guidance is out there?

- Manual on Aeroplane Upset Prevention and Recovery Training (Doc 10011)



- Airplane Upset Prevention and Recovery Training Aid – Rev 3

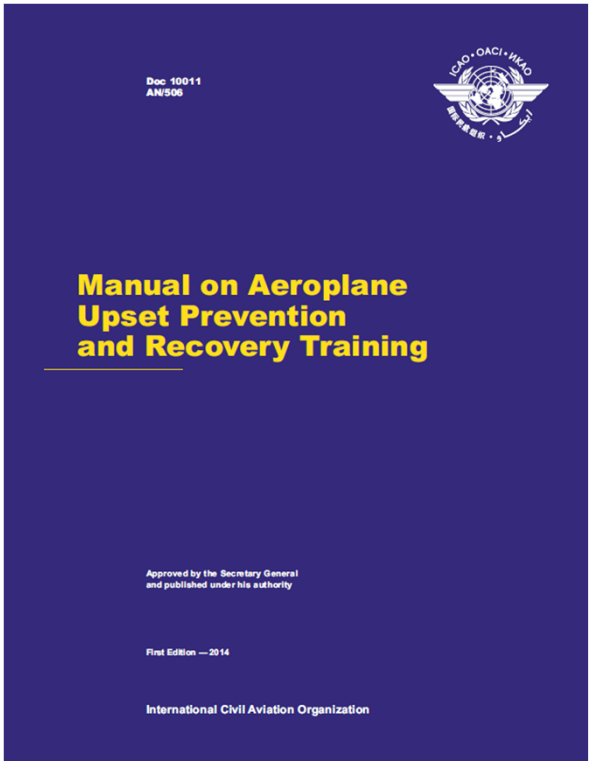


- Manual of Criteria for the Qualification of FSTDs (Doc 9625)

- LOC-I Website

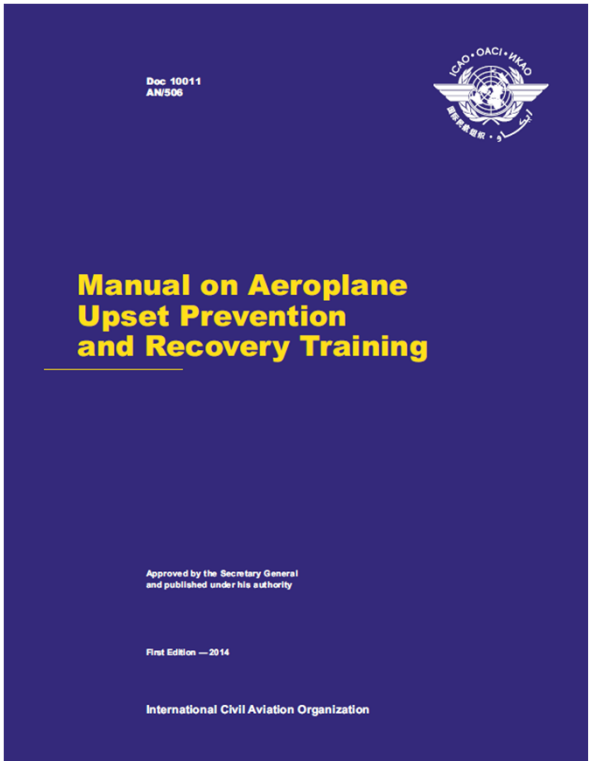
Manual on Aeroplane Upset Prevention and Recovery Training *(Doc 10011)*

- Introduction:
  - Upset defined, history & applicability
- Training programme requirements
- Training:
  - Academic training
  - On-aeroplane training
  - FSTD training
    (non-type-specific and type-specific FSTD)
  - OEMs:
    - Recommendations and training scenarios
    - Upset recovery techniques



Manual on Aeroplane Upset Prevention and Recovery Training *(Doc 10011)*

- FSTD fidelity requirements for UPRT *(see later)*
- UPRT Instructors:
  - academic, on-aeroplane, FSTD
- Regulatory oversight
- Appendix:
  - Competency-based UPRT programmes



Manual on Aeroplane Upset Prevention and Recovery Training *(Doc 10011) – Academic and Practical Topics*

- *Aerodynamics*
- *Causes and contributing factors of upsets*
- *Safety review of accidents & incidents relating to aeroplane upsets*
- *G-awareness*
- *Energy management*
- *Flight path management*
- *Recognition*
- *Upset prevention and recovery techniques*

Manual on Aeroplane Upset Prevention and Recovery Training *(Doc 10011) – Academic and Practical Topics*

- *System malfunction*
- *Specialized training elements*
- *Human Factors:*
  - situation awareness
  - startle and stress response
  - threat and error management (TEM)

Examples of training *–Practical FSTD Exercise*

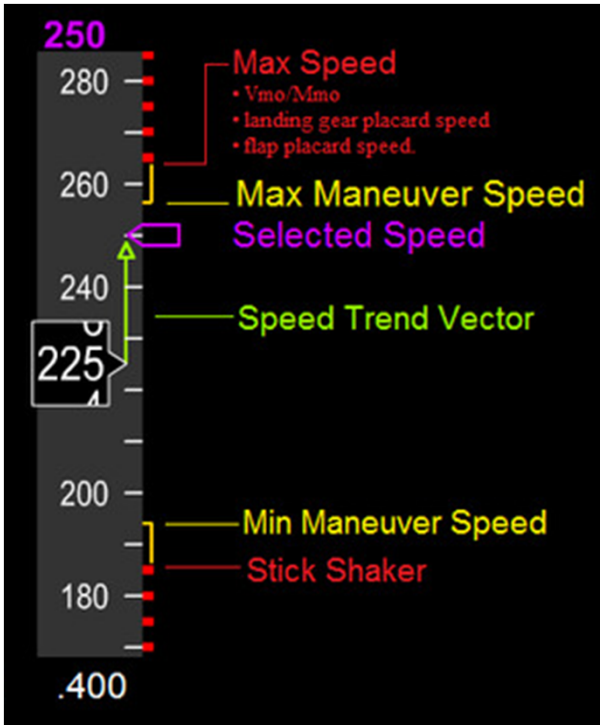
- *Objective: to experience and understand thrust availability*
- *Exercise:* acceleration performance from second regime at low altitude and high altitude, e.g. 210-260 KIAS @ 5000/20000/35000ft
- *Conditions: manual flying; max cruise thrust; ISA+10C*
- *Outcomes:*
  - *Times: 20s/50s/>6 minutes or not possible → demonstrate trading altitude for speed*
  - *Demonstrate difference between max cruise/max continuous/max rated thrust*
  - *Note pitch coupling effect differences with altitude at thrust increase*
  - *Note reduced damping at high altitude + greater effects of pitch attitude change*

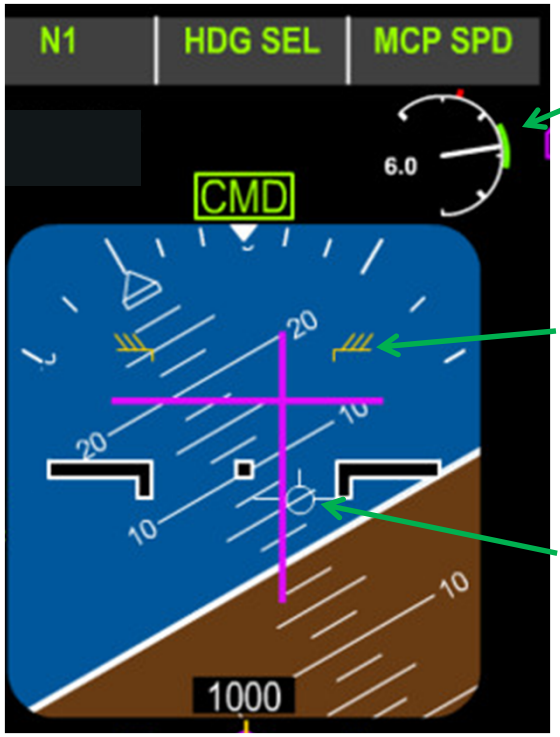
Examples of training *–FSTD Manoeuvre Exercise*

- *Any UPRT programme being considered by an ATO/airline should be submitted to the OEM for a "No-Technical Objection" statement, if using scenarios not included in Doc 10011 or the Airplane Upset (Prevention and) Recovery Training Aid (Rev 2 or 3)*
- *Two videos:*
  - Provided by *Alaska Airlines* on B737-NG UPRT
  - Example of a UPRT exercise that airlines may wish to develop
  - Not an approved training exercise
  - Illustrates instructor interaction and inputs, as well as trainee understanding
  - Uses B-737 PFD symbols, described on next slide

Examples of training –*FSTD Manoeuvre Exercise*

- *To help in understanding the videos, here are symbols of the B737-800 PFD for the speed tape/ADI:*





AOA (Cpt)

Pitch Limit Indicator

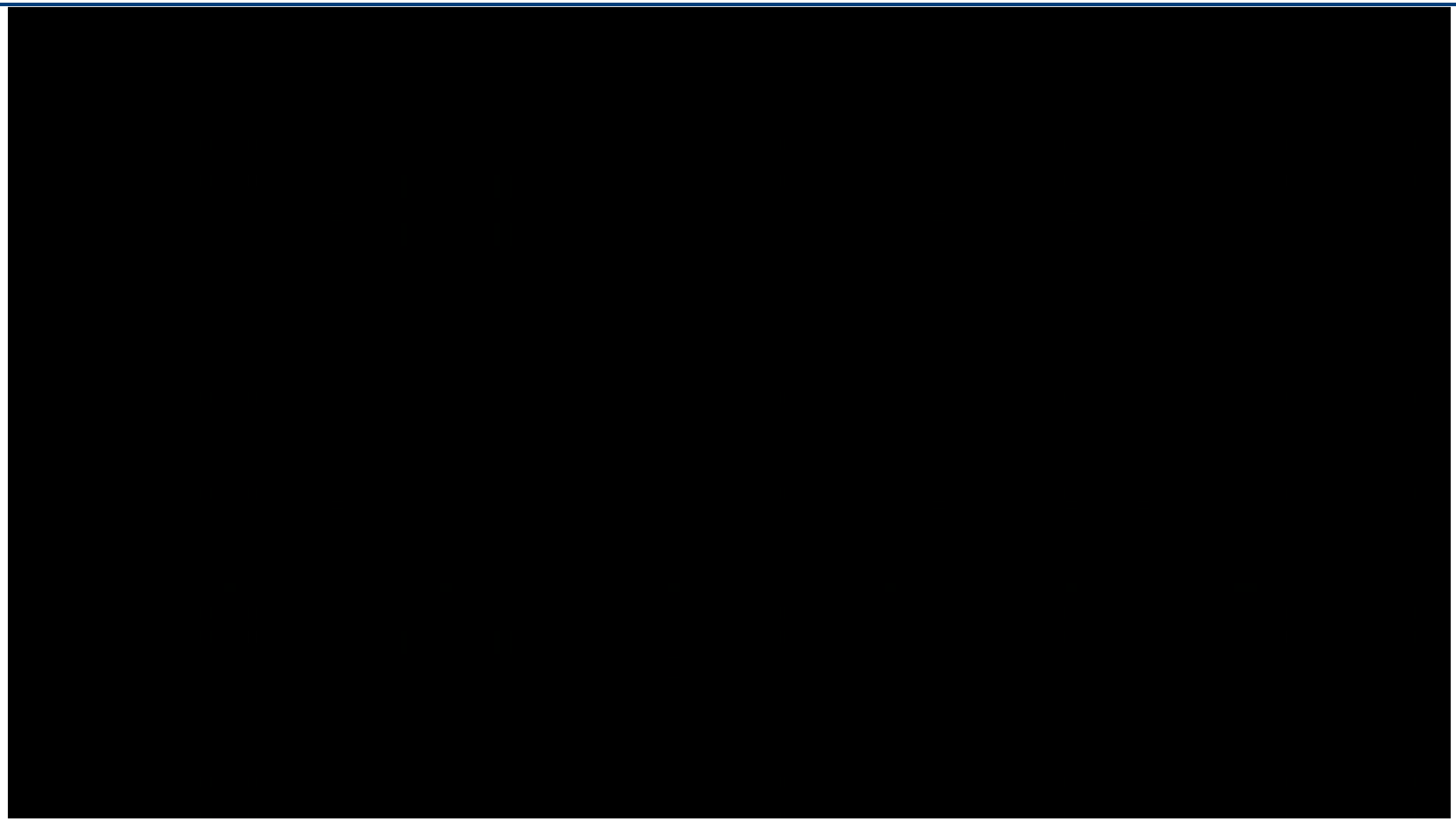
Flight Path Vector

Examples of training *–FSTD Manoeuvre Exercise*

Video 1

Examples of training *–FSTD Manoeuvre Exercise*

Video 2



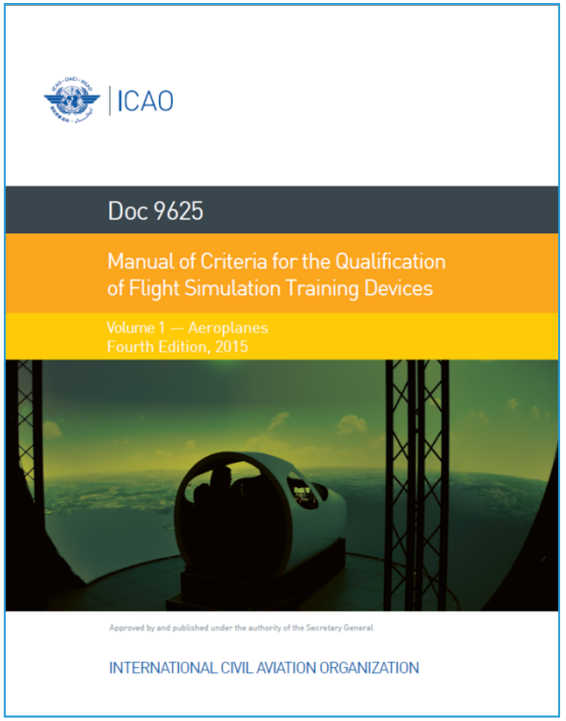
Airplane Upset Recovery Training Aid

- Revision 2 updated → Airplane Upset Prevention and Recovery Training Aid (Rev 3)
  - By OEMs and with ICAO support
  - Covering turboprop and smaller aeroplanes
  - Free and easily accessible
  - User-friendly format
  - **Published as ICAO doc in Q1 2017 accessible from:** https://www.icao.int/safety/LOCI/Pages/default.aspx
  - A version for download to mobiles (iPad…) is available as "AUPRTA" on iTunes and APPLE STORE for IOS devices, and on Google Play and Play Store for Android devices


AIRPLANE UPSET PREVENTION
&
RECOVERY TRAINING AID (REV 3)
FOR TRANSPORT
CATEGORY AIRPLANES
ICAO
AIRBUS
ATR
BOEING
BOMBARDIER
EMBRAER

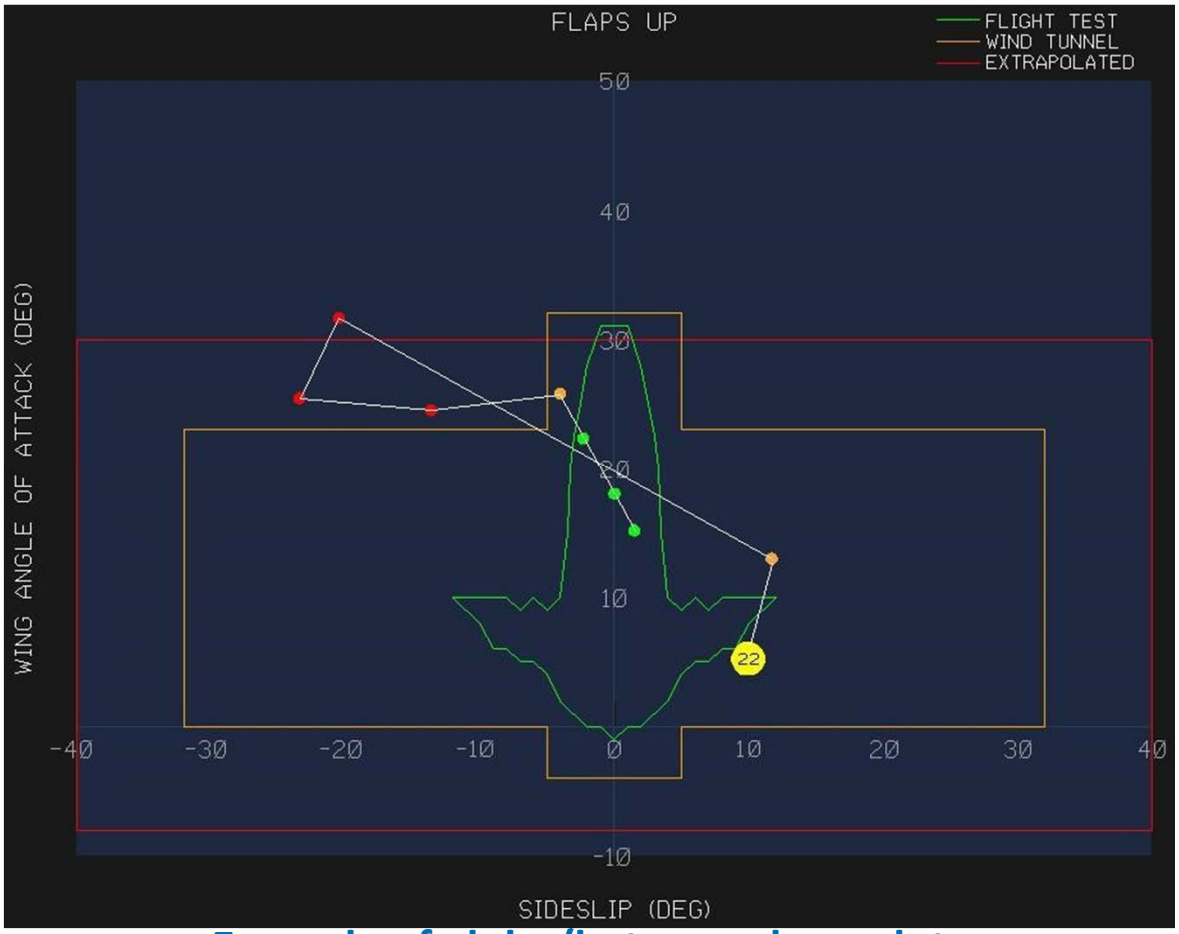
Manual of Criteria for the Qualification of FSTD *(Doc 9625)*

- 4th edition (August 2015)
- New attachment P has guidance for UPRT: Models and qualification tests or requirements for -
  - Aeroplane type-specific recognition cues of the first indication of the stall (stall warning, aerodynamic buffet…)
  - Aeroplane type-specific recognition cues of an impending aerodynamic stall
  - Exemplar recognition cues and handling qualities from the stall break through recovery *if prescribed by regulations*
  - Engine and airframe icing evaluation



Manual of Criteria for the Qualification of FSTD *(Doc 9625)*

- UPRT instructor tools:
  - IOS displays
  - Recording manoeuvres for debrief



Example of alpha/beta envelope plot

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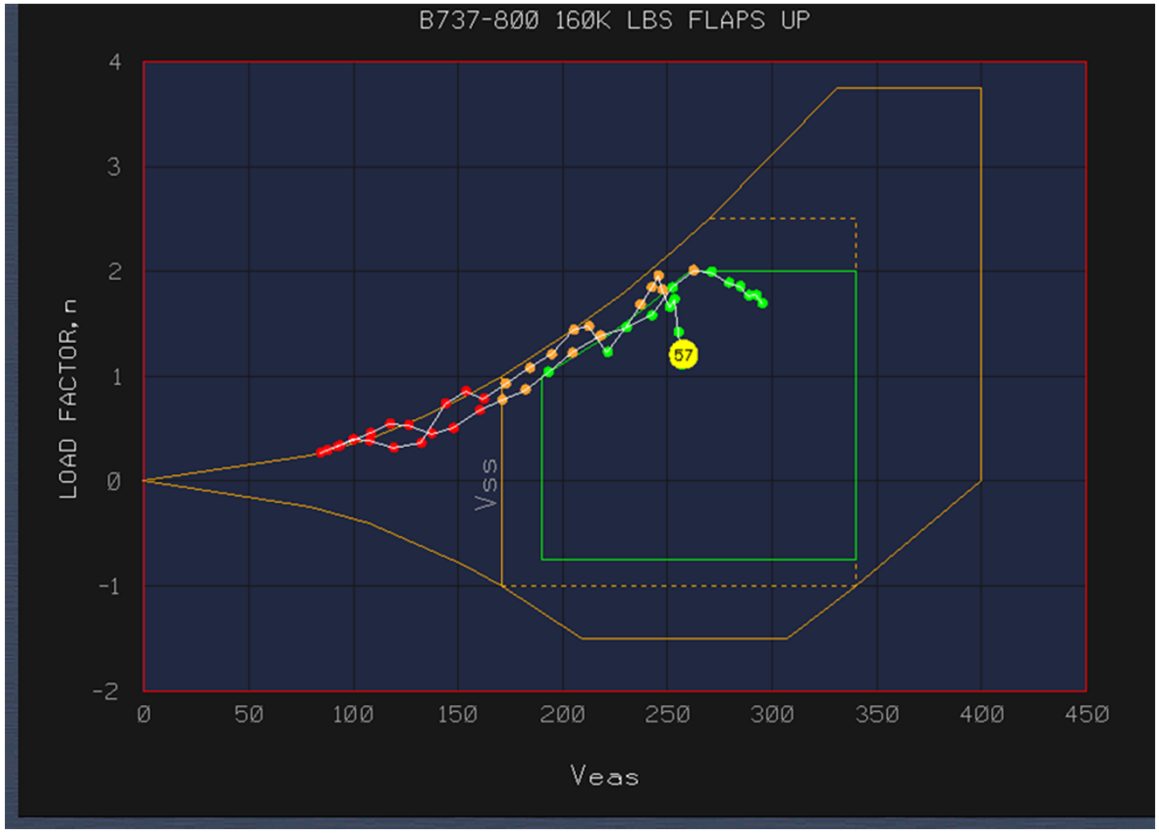

Example of V-n plot

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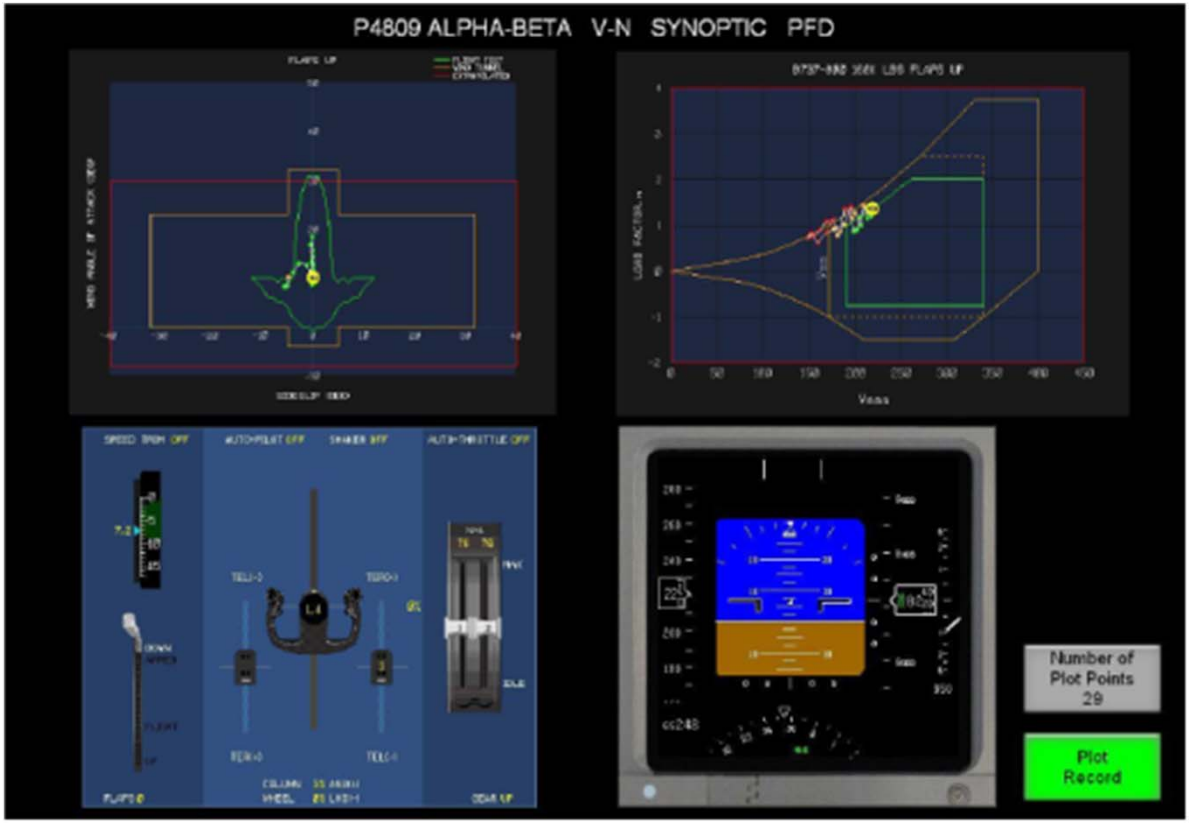

Example of instructor feedback display

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Case Study: US FAA implementation

New stall and UPRT requirements in the United States

- Congressional Direction
- Aviation Rulemaking Committee (International Harmonization)
- Public Comment
- Final Rule Publication
- Education (Public/Inspectors)

Congressional Direction

Airline Safety and FAA Extension Act of 2010 (P.L. 111-216) - 2010

- Added numerous measures (Sections) designed to improve aviation safety
- Required the FAA to establish:
  - Various multidisciplinary panels, ARCs, and/or task forces

Aviation Rulemaking Committee

- Requires a multidisciplinary panel (ARC) to study and report on methods to improve pilot familiarity with and response to stick pusher, icing, microburst and windshear events. (208)
- Report from FAA to Congress *Completed 2011*
- ARC expanded – global effort with ICAO and EASA to address LOC & upset prevention and recovery training (LOCART)

Final Rule Publication

- Requires part 121 air carriers to provide stall and upset prevention and recovery training.
  - Supplemental NPRM May, 2011 *Completed*
  - Public Comment 120 days *Completed*
  - Final rule published Nov, 2013 *Completed*
  - Effective 12 March 2019

5 Year Implementation

- Allows time for appropriate FSTD Changes
  - Part 60 NPRM
- Inspector Education
  - Necessity for standardization and consistency
- Public Education
  - Necessity for setting expectations

Rulemaking – Part 60 - FSTD

- Initiated to address simulator fidelity
  - Considers:
    - Full stall simulator evaluation criteria ← not an ICAO requirement
    - Upset prevention and recovery training
    - Enhanced Airborne Icing Modeling
  - NPRM conducted till January 6 2015
  - Part 60 standards published in March 2016 to allow time for operators to modify and evaluate FSTDs before the regulations' compliance date

Aligned with ICAO Doc 9625 – Types V and VII. Doc 9625 compliance = an AMOC

Inspector Education:

- Important and needed:
  - Briefings before the release of the final rule
  - On-line training sessions with field inspectors
  - Release of inspector guidance/job aids
  - Annual Principal Operations Inspector conference
  - POI FSTD Training (Stall and Upset Training)

Public Education for aviation industry

- Press Release
  - Inform the general public
- Public Awareness:
  - Publication of the rule in the federal register
  - Release of guidance documents (job aids, advisory circulars)
- Public Interest/Industry Groups
  - Multiple industry presentations to distribute information and discuss implementation expectations

2019 FAA Requirements

Stall Prevention

- At first maneuvers based
  - Takeoff
  - Clean
  - Landing
- Incorporate Scenarios
- Checking/Testing

Stall Recovery

- Only maneuvers based
- Instructor led
- Hands on pilot experience through recovery

Upset Prevention

- Manually controlled slow flight;
- Manually controlled loss of reliable airspeed;
- Manually controlled instrument departure and arrival

Upset Recovery

- Nose High
- Nose Low

Take-home messages

- Effective implementation of UPRT requires considerable planning and effort by:
  - ATO's
  - airline operators
  - CAAs
- Ineffective implementation of UPRT may result in negative safety outcomes
- UPRT = training not checking

WE NEED TO GET THIS RIGHT!

ICAO


North American Central American and Caribbean (NACC) Office Mexico City
South American (SAM) Office Lima
ICAO Headquarters Montréal
Western and Central African (WACAF) Office Dakar
European and North Atlantic (EUR/NAT) Office Paris
Middle East (MID) Office Cairo
Eastern and Southern African (ESAF) Office Nairobi
Asia and Pacific (APAC) Sub-office Beijing
Asia and Pacific (APAC) Office Bangkok
THANK YOU