

附錄一、UPRT training elements, components and platforms

本表提供完整全面的 UPRT 藍圖，第一欄列出主題及相關的訓練項目，第二~五欄標示對有效學習而言最適當的訓練項目與平台，第六欄提供 Airplane Upset Prevention and Recovery Training Aid (AUPRTA) 的對照章節。

AUPRTA 電子檔可從下列網址取得：

- For computers: <http://www.icao.int/safety/loci/AUPRTA/index.html>
- For tablets and smartphones: <http://www.icao.int/safety/loci/AUPRTATablet/index.html>

<i>Subjects and training elements</i>	<i>Academic training</i>	<i>On-aeroplane training – CPL(A)/MPL</i>	<i>Non-type-specific FSTD training – (CPL(A)/MPL)</i>	<i>Type-specific FSTD training</i>	<i>AUPRTA Revision 3, references</i>
A. <i>Aerodynamics</i>					section 6
1) general aerodynamic characteristics	•	•	•		
2) advanced aerodynamics	•	•	•	•	
3) aeroplane certification and limitations	•	•		•	
4) aerodynamics (high and low altitudes)	•	•	•	•	
5) aeroplane performance (high and low altitudes)	•	•	•	•	
6) angle of attack (AOA) and stall awareness	•	•	•	•	
7) stick shaker activation	•		•	•	
i) stick pusher activation	•		•	•	
ii) Mach effects – if applicable to aeroplane type	•		•	•	
8) aeroplane stability	•	•	•	•	
9) control surface fundamentals	•	•	•	•	
i) trims	•			•	
10) icing and contamination effects	•				
11) propeller slipstream (as applicable)	•		•	•	
B. <i>Causes and contributing factors of upsets</i>					section 5
1) environmental	•			•	
2) pilot-induced	•			•	
3) mechanical	•			•	
C. <i>Safety review of accidents and incidents relating to aeroplane upsets</i>	•	•		•	
D. <i>G-awareness</i>					sections 6.4.5 and 7.2.2
1) Positive/negative/ increasing/decreasing g-loads	•	•	•	•	
2) Lateral g-awareness (sideslip)	•	•	•	•	
3) G-load management	•	•	•	•	

<i>Subjects and training elements</i>	<i>Academic training</i>	<i>On-aeroplane training – CPL(A)/MPL</i>	<i>Non-type-specific FSTD training – (CPL(A)/MPL)</i>	<i>Type-specific FSTD training</i>	<i>AUPRTA Revision 3, references</i>
E. <i>Energy management</i> 1) kinetic energy vs. potential energy vs. chemical energy (power) 2) relationship between pitch and power and performance 3) performance and effects of differing engines	• • •	• • •	• • •	• • •	section 6.2
F. <i>Flight path management</i> 1) automation inputs for guidance and control 2) type-specific characteristics 3) automation management 4) manual handling skills	• • • •	• • •	• • •	• • • •	
G. <i>Recognition</i> 1) type-specific examples of instrumentation during developing and developed upset 2) pitch/power/roll/yaw 3) effective scanning (effective monitoring) 4) stall protection systems and cues 5) criteria for identifying stalls and upset	• • • • •	• • • • •	• • • • •	• • • • •	section 6.4.3–6.4.5
H. <i>Upset prevention and recovery techniques</i> 1) timely and appropriate intervention 2) nose-high/wings-level recovery 3) nose-low/wings-level recovery 4) high bank angle recovery techniques 5) consolidated summary of aeroplane recovery techniques	• • • • •	• • • • •	• • • • •	• • • • •	section 7.1 sections 7.3.2– 7.3.4
I. <i>System malfunction</i> 1) flight control anomalies 2) power failure (partial or full) 3) instrument failures 4) automation failures 5) fly-by-wire protection degradations 6) stall protection system failures, including icing alerting systems	• • • • • •	• • •	• • • • •	• • • • •	section 5.2

<i>Subjects and training elements</i>	<i>Academic training</i>	<i>On-aeroplane training – CPL(A)/MPL</i>	<i>Non-type-specific FSTD training – (CPL(A)/MPL)</i>	<i>Type-specific FSTD training</i>	<i>AUPRTA Revision 2, references</i>
J. <i>Specialized training elements</i>					sections 7.3.2– 7.3.4 and section 8
1) spiral dive (graveyard spiral)	•	•	•	•	
2) slow flight		•	•	•	
3) steep turns		•	•	•	
4) recovery from approach to stall		•	•	•	
5) recovery from stall, including uncoordinated stalls (aggravating yaw)		•	•	•	
6) recovery from stick pusher activation (as applicable)	•		•	•	
7) nose-high/high-speed recovery		•	•	•	
8) nose-high/low-speed recovery		•	•	•	
9) nose-low/high-speed recovery		•	•	•	
10) nose-low/low-speed recovery		•	•	•	
11) high bank angle recovery		•	•	•	
12) line-oriented flight training (LOFT) or line-operational simulation (LOS)			•	•	
K. <i>Human Factors</i>					
1) situation awareness					
i) human information processing	•	•	•	•	
ii) inattention, fixation, distraction	•	•	•	•	
iii) perceptual illusions (visual or physiological) and spatial disorientation	•	•	•	•	
iv) instrument interpretation	•	•	•	•	
2) startle and stress response					
i) physiological, psychological, and cognitive effects	•	•	•	•	
ii) management strategies	•	•	•	•	
3) threat and error management (TEM)					
i) TEM framework	•	•	•	•	
ii) active monitoring, checking	•	•	•	•	
iii) fatigue management	•	•	•	•	
iv) workload management	•	•	•	•	
v) crew resource management (CRM)	•	•	•	•	

附錄二、 On-aeroplane UPRT elements

<i>On-aeroplane UPRT</i>	
<i>Training element</i>	<i>Description</i>
A. <i>Aerodynamics</i>	The flight training should expose trainees to the limits of the aeroplane flight envelope to develop situation awareness and prevention capability, while keeping an appropriate safety margin. Training should enable pilots to understand basic aerodynamics and flight dynamics to mentally integrate an understanding of the aeroplane AOA and energy state throughout the part of the flight envelope used in normal operations. (Ref. AUPRTA — 6)
B. <i>Causes and contributing factors of upsets</i>	<p>Development and training on procedures for normal operations and deviation recovery should focus on upset prevention. Training should emphasize what to monitor during normal operations and during an upset recovery, how to identify deviations and effect recovery.</p> <p>Train pilots what to and when to monitor, including cross-checking and verification, during all phases of flight to prevent an upset event.</p> <p>Trainees should apply their academic training to prevent, and recover from, environmentally induced, aeroplane system-induced and pilot-induced upsets. (Ref. AUPRTA — 5)</p>
C. <i>Safety review of accidents and incidents relating to aeroplane upsets</i>	Demonstration of some of the actual upsets covered in academic training, with training of the prevention and proper recovery techniques.
D. <i>G-awareness</i>	<p>Training of g-awareness is required to expose the trainee to the physiological aspects of g-loading (positive/negative/lateral g) events to provide experience with the effects of sensory illusions.</p> <p>Positive and negative g-loading should be completed with pull-ups, various bank angles, and pushover(s) to develop awareness and manual handling skills to apply various levels of g-loading at various aeroplane attitudes, bank angles, and energy states within the aeroplane's flight envelope. Lateral g-loading should be demonstrated with steady state sideslip manoeuvring.</p> <p>Trainees need to develop the manual handling skills to be able to apply the appropriate amount of g-loading for a given situation to maintain the aeroplane performance within its designed certification envelope.</p>
E. <i>Energy management</i>	In order to fully understand the concepts discussed in the related academic training, trainees should practice and understand acceleration performance when on the back side of the power curve and how to use pitch/power to achieve best performance results.
F. <i>Flight path management</i>	Flight path management training should be developed with regard to manual handling skills.
1) Manual control inputs	The training objective with regard to manual control inputs addresses correct pilot control inputs to avoid or recover from undesired flight path deviations. This training objective should include the control strategies pilots should use in both developing and developed upset events. This should include primary/alternate control strategies and be in accordance with the recovery techniques of ICAO Doc 10011 section 3.5, as applicable.

On-aeroplane UPRT	
Training element	Description
2) Manual handling skills	<p>The objectives with regard to manual handling skills are to address correct pilot control inputs to avoid undesired flight path deviations. Refer to section G 2)</p> <p>Pitch/power/roll/yaw on how to develop pilot skills for making the correct control inputs to arrest the divergence or recover from the upset. UPRT improves manual handling skills for avoidance of, and recovery from, the edges of the flight envelope. These manual handling skills should be developed during the specialized training elements of section J below.</p> <p>Training should include the practice of manual handling at the operational edges. Pilots need to know the common errors to avoid and why they occur, as well as the importance of cross-checking and verification of inputs. One outcome is for pilots to know how the aeroplane responds to inputs across flight regimes.</p> <p>Manual handling training should include training on the use of up to full control inputs. Flight control inputs become less effective when the aeroplane is at or near its critical AOA or stalled. The tendency is for pilots not to use full control authority because they rarely are required to do so in normal operations. Pilots must overcome this habit when recovering from severe upsets. It is important to guard against control reversals. To maintain structural integrity, rapid full-scale reversal of control deflections should be avoided.</p> <p><i>Note 1. — Rudder control is still effective at a high AOA, and special care must be taken in the use of rudder during upset prevention and recovery.</i></p> <p><i>Note 2. — The objective of this manual is to reduce LOC-I accidents through training appropriate to commercial air transport aeroplanes. Consequently, manoeuvres tolerances should be tailored to the operating limitations of transport category aeroplanes.</i></p> <p>In addition, manual handling training (pitch/power/roll/yaw) should include training on non-intuitive factors. For example, it may be counter-intuitive to use greater unloading control forces when recovering from a high AOA, especially at low altitudes. If the aeroplane is stalled while already in a nose-down attitude, the pilot still needs to push the nose down (unload) in order to reduce the AOA. Altitude cannot be maintained in a stall and should be of secondary importance.</p>
G. Recognition	<p>Trainees should understand that anytime the aeroplane begins to diverge from the intended flight path or desired speed, they need to promptly identify and determine what, if any, action must be taken and then act accordingly.</p>
1) Aeroplane – specific examples of instrumentation/visual cues during developing and developed upset	<p>A key aspect to upset awareness, prevention, and recovery training is for trainees to recognize developing and developed upset conditions. The emphasis is on using examples of visual cues and available instrumentation to train awareness, recognition and prevention of a developing upset and recovery from a developed upset in order to acquire effective aeronautical decision-making skills.</p>

<i>On-aeroplane UPRT</i>	
<i>Training element</i>	<i>Description</i>
2) Pitch/ power/roll/yaw	A key aspect of upset awareness, prevention and recovery training is for trainees to recognize developing and developed upset conditions so they can make control inputs based on desired aeroplane reaction. Control deflections at one point in the flight envelope might not be appropriate in another part of the flight envelope. Pilots need to have a fundamental understanding of instrumentation and flight dynamics in pitch/power/roll/yaw in order to recognize the current state of the aeroplane and make the correct control inputs to arrest the divergence or recover from the upset. (Ref. AUPRTA — 6.4.3 to 6.4.5)
3) Effective scanning (effective monitoring)	Effective instrument scanning techniques should be trained as appropriate to recognize normal states and divergence from normal flight parameters. To avoid upsets related to an inadequate monitoring of aeroplane state, pilots should be trained on what to monitor and when, during all phases of flight. Pilots need to create a mental picture of the aeroplane status and keep it updated and cross-checked. Pilots should also be aware of the effects of fatigue on their ability to monitor effectively.
4) Stall protection systems	Accurate and early recognition of all available aural, visual and tactile alerts to both an approaching stall and, with due consideration to maintaining adequate safety margins, an aerodynamic stall. Particular attention must be given to aeroplane stall characteristics in the absence of a stall warning indication. (Ref. AUPRTA — 6.4.1)
H. <i>Upset prevention and recovery techniques</i>	Upset prevention and recovery techniques should be accomplished in an aeroplane using published flight manual upset prevention and recovery procedures. The training organization should include these techniques in their training and procedures manual and use OEM recommendations for upset prevention and recovery when available. In as much as the flight manual procedures allow, these techniques should be in accordance with the recommended techniques in ICAO Doc 10011 section 3.5, where applicable. The academic portion of the training should discuss these techniques, which will be applied practically during flight training.
1) Timely and appropriate intervention	<p>Training should emphasize the need for the pilot to recognize a divergence as early as possible and immediately take corrective action to return the aeroplane to a stabilized flight path. The corrective action should include managing the energy, arresting the flight path divergence and recovering to a stabilized flight path.</p> <p>The amount and rate of control input to counter a developing upset should be proportional to the amount and rate of pitch, roll and/or yaw experienced. If the aeroplane is stalled during the divergence from the intended flight path, then the training should also stress the importance of first applying and maintaining nose-down elevator until recovery from the stall is complete.</p>
2) Nose-high/wings- level recovery	See ICAO Doc 10011 section 3.5 for OEM recommended recovery techniques. (Ref. AUPRTA — 7.3.3)
3) Nose-low/wings- level recovery	See ICAO Doc 10011 section 3.5 for OEM recommended recovery techniques. (Ref. AUPRTA — 7.3.4)
4) High bank angle recovery techniques	

<i>On-aeroplane UPRT</i>	
<i>Training element</i>	<i>Description</i>
5) Consolidated summary of aeroplane recovery techniques 6) Stall event	(Ref. AUPRTA – 7.3.2) Training for: awareness of the distinction between aircraft attitude and AOA; aggravating effect of side slip; energy management and trading altitude for speed; awareness of the correlation between stall speed and g-load and the capability to reduce stall speed by unloading; stall recovery technique (see ICAO Doc 10011 section 3.5).
I. <i>System malfunction</i>	<p>Trainees should understand the systems of their aeroplane relevant to UPRT and how these systems can cause or contribute to an upset. Simulated system malfunctions should be introduced in flight with an emphasis on preventing an upset. Extreme care should be taken to ensure any risks associated with the simulated malfunctions are addressed and mitigated. OEMs, if available, should be consulted for possible system malfunctions that could cause or contribute to an upset.</p> <p>System malfunctions include flight control anomalies, power failure, icing and stall alerting system failures, and instrument failures, as applicable to the aeroplane. (Ref. AUPRTA — 5.2)</p>
J. <i>Specialized training elements</i> 1) Spiral dive 2) Slow flight 3) Steep turns 4) Recovery from approach-to-stall	<p>These are several specific elements to be incorporated into the training that teach a specific skill set to help trainees prevent, and if needed, recover from an upset.</p> <p>In this manoeuvre, sometimes called a graveyard spiral, the aeroplane is at a high bank angle and descending. Trainees will learn in this situation that applying up-elevator in an attempt to arrest both the increasing speed and sink rate causes the spiral to tighten. The skill learned is that it is imperative to get the wings close to level before beginning any pitching-up manoeuvre. Trainees must decrease the bank angle and then apply up-elevator to recover. If g-loading is large the pilot will need to first unload some g to regain adequate roll control for wings levelling.</p> <p>Slow flight exposes the trainee to flight right above the stall speed of the aeroplane and to manoeuvring the aeroplane at this speed without stalling. The purpose is to reinforce the basic stall characteristics learned in academics and allow the pilot to obtain handling experience and motion sensations when operating the aeroplane at slow speeds during the entire approach-to-stall regime in various aeroplane attitudes, configurations and bank angles.</p> <p>Steep turns provide the trainee with practical experience of load factor and manoeuvring the aeroplane at higher than normal bank angles.</p> <p>Particular emphasis should be placed on the early recognition of those symptoms associated with approaching a stall as well as the recognition of stall warning system activation. Trainees should be made to understand that recovery action involving a deliberate and smooth application of nosedown pressure should be performed immediately upon recognition of the presence of stall-related symptoms or the activation of a stall alerting device.</p>

<i>On-aeroplane UPRT</i>	
<i>Training element</i>	<i>Description</i>
5) Recovery from stall	With due regard to adequate safety margins, stall recovery training should focus on developing the awareness of stall-related cues such as buffet, degradation of control responsiveness in the pitch and roll axis, as well as the inability to arrest descent. Respecting the limitations of the aeroplane, the training should also include recovery from accelerated stalls and stalled conditions involving side slip. The recovery portion of the training should constantly stress the primary importance of a smooth and deliberate reduction in the angle of attack sufficient to break the stalled condition and completing the recovery in compliance with aeroplane-specific recommended techniques.
6) Noise high/ high speed	<p>This training will provide the trainees with the experience of conditions close to the limits of the operating envelope and high bank angles as well as demonstrate appropriate recovery techniques that should also be compliant with the guidance in ICAO Doc 10011 section 3.5.</p> <p>The on - aeroplane training should include a variety of developing and developed upset conditions, with focus on pitch, power, roll, and yaw. This on - aeroplane training should include demonstrations and practice for various upset scenarios, to include nose-high and nose-low scenarios with various bank angles and speeds. High bank angle recovery exercises should be practised in both nose-high and nose-low situations. This training should be done in both visual and simulated instrument conditions to allow the trainee to practice recognition and recovery, as well as experience and recognize some of the physiological factors related to each condition. (Ref. AUPRTA — 7.3.2 to 7.3.4)</p> <p>High bank angle recovery training (for consideration by the CAA and approved training organizations):</p> <p>A review of transport category aeroplane major incidents and accidents shows that bank angles have exceeded 90° in some upsets.</p> <p>Studies show that most pilots who went into inverted flight for the first time during training incorrectly added back pressure even though they received instructions in academic training and briefings before flight not to increase back pressure.</p> <p>The use of an aeroplane capable of delivering inverted manoeuvre training would be helpful to meet the optimum objectives. For such on-aeroplane training, additional measures should be taken to ensure safety by only using aeroplanes suitable for the training tasks and appropriately qualified instructors.</p> <p>Furthermore, because type rating training should include recommended recovery training from high bank angles (beyond 90°) in an FSTD, initial skill development for those who have never been exposed to such advanced training could be further enhanced using a suitable aeroplane before conducting their type-rating training in an FSTD.</p> <p>Given the availability of capable aeroplanes in the State, the safety benefits, and the additional costs, the CAA should consider whether these inverted manoeuvres, providing for an optimum on aeroplane UPRT experience, are to be required for the issue of either a CPL(A) or MPL.</p>
7) Noise high/ low speed	
8) Noise low/ high speed	
9) Noise low/ low speed	
10) High bank angle recovery	

<i>On-aeroplane UPRT</i>	
<i>Training element</i>	<i>Description</i>
K. <i>Human Factors</i>	Human Factors are an overarching, integral part of UPRT. The Human Factors in UPRT address the physiological responses in the event of a flight path divergence or a sudden upset. Integrating Human Factors into UPRT is also important to help develop airmanship, which requires perceptual, cognitive, and psychomotor knowledge and skills. Human Factors for on-aeroplane training include, but are not limited to, the cognitive process, the learning process and the ability of the trainees to recall and apply appropriate knowledge and skills at a later stage of their career.
1) Threat and error management (TEM)	<p>TEM as it relates to upset prevention and recovery should be integrated in the UPRT. TEM training should include: threat identification, the aeroplane normal states, detection of deviations, interpretation of the meaning of the deviation, decision on how to respond, and the response. It is a crucial means of addressing Human Factors training elements.</p> <p>The pilots' capacity to think effectively in flight conditions to which they have not previously been exposed may be challenged during an upset event. Pilots should focus on stabilizing the aeroplane. Training should define which control inputs are appropriate and how to prioritize the tasks to avoid overloading.</p> <p>TEM requires effective monitoring and for that, methods and training should be provided and include appropriate assessment techniques (i.e. what to monitor and when, what to cross-check, ensuring proper verification) during all phases of flight to prevent an upset event and during recovery efforts.</p>
2) Human information processing	<p>For pilots to understand how to respond appropriately and why they sometimes fail to do the correct action, they must understand how they process information. These are the "building blocks" of knowledge that allow a better understanding of how to maintain or improve such areas as communication, decision-making, situation awareness, and team dynamics.</p> <p>Those areas involved in all human information processing include:</p> <ul style="list-style-type: none"> i) attention — the sensing and retrieval of relevant information from the environment; ii) perception — understanding that information which has been retrieved; iii) interpretation — associating the information which is relevant and the knowledge required for the task at hand; iv) judgement — aligning the requirement for action with the correct response; v) decision-making — assessing the correct response needed for the outcome required or an alternative; vi) action — implementing the response chosen; and vii) feedback — checking that the response action meets the correct requirements of the task.

<i>On-aeroplane UPRT</i>	
<i>Training element</i>	<i>Description</i>
3) Crew resource management (CRM)	CRM is as much about the trainee knowing how to manage themselves when they are the only crew member (single pilot) as it is about working as part of a team. Areas of importance for on-aeroplane training include managing workload, and vocalizing the analysis of the aeroplane status and its energy state and keeping it updated and cross-checked.
4) Situation awareness	<p>Pilots need to maintain situation awareness at all times through effective monitoring (see the training element “Recognition” in this table). Pilots do this by maintaining a mental model while creating mental pictures of developing situations. A breakdown of a pilot’s mental model or picture, which can be caused by several factors, such as spatial disorientation from in-flight perceptual illusions, being startled, inattention and complacency, can lead to a loss of situation awareness.</p> <p>Training should include how to maintain situation awareness and what to monitor to prevent, and recover from, upsets.</p> <p>After a deviation, it is important that the first actions be correct and timely to avoid the recovery from one upset leading to a new upset. Troubleshooting the cause of the upset is secondary and can wait. The situation analysis process includes:</p> <ul style="list-style-type: none"> i) determining the bank angle; ii) determining the pitch attitude; iii) confirming the attitude by reference to other indicators, as available; and iv) assessing the energy state.
5) Decision-making	Pilots should focus on stabilizing the aeroplane. They should know the appropriate pitch and power targets for stabilization and take the appropriate corrective action. To do so, trainees should be aware of what information they need to make the optimum decision for action, as well as of those factors, such as cognitive biases, that affect decision-making.
6) Problem-solving	Training should improve the problem-solving competency and recognize those factors that can impede a trainee’s ability to solve a problem, such as fatigue, fear, work overload. In particular, UPRT should emphasize the importance of evaluating whether a solution is working and of not rushing into an action that may be detrimental.
7) Startle and stress response	<p>Training should include strategies to deal with the range of physiological, psychological and cognitive effects associated with the human stress response to unexpected threatening events.</p> <p>Pilots may be startled when an unexpected event during flight contradicts their expectations. If an unexpected event is sufficiently serious and/or arises during a critical phase of flight, the correct response to that uncertainty becomes vital for survival.</p>

<i>Training element</i>	<i>Description</i>
8) Physiological factors	<p>UPRT is different from aerobatic training. In aerobatics training, the pilot knows what the manoeuvre is and is expecting it, so there is no threat of consequences or perception of undue risk by the pilot. While respecting the need to ensure adequate safety margins, upset training should strive to include the element of “unexpectedness” that pilots will experience in a real world application.</p> <p>Recognizing the effects of visual and vestibular (angular and linear) illusions and responding appropriately is a key aspect of UPRT. Areas to be addressed during on-aeroplane training include:</p> <ul style="list-style-type: none"> i) conditions which can lead to spatial disorientation and the use of instrument interpretation to manage spatial disorientation; ii) avoiding errors in adjusting attitude/power; iii) avoiding, and recovering from, pilot-induced oscillations (PIOs); and iv) recognizing and managing sensory illusions in flight. <p>All of these items should be covered in academic training, but some training in the aeroplane can target some of them, especially spatial disorientation.</p>

附錄三、 Non-type-specific FSTD multi-crew UPRT elements

<i>Non-type-specific FSTD multi-crew UPRT</i>	
<i>Training element</i>	<i>Description</i>
A. <i>Aerodynamics</i>	<p>Trainees should be knowledgeable about aerodynamic effects at both high and low altitudes. The FSTD training should be accomplished at high altitude (at or near max cruise level) and at low altitude (below 3 000 m (10 000 ft) above mean sea level) to reinforce the academic training described in ICAO Doc 10011 section 3.2.</p> <p>Trainees should also be trained with respect to the aircraft handling effects of operating at low speeds or high Mach, as applicable to the FSTD, including:</p> <ul style="list-style-type: none"> i) demonstration of Mach tuck, if applicable, and Mach buffet; ii) recognition of high speed/Mach buffet and low speed buffet; and iii) awareness of control surface effectiveness at low and high speeds. <p>Trainees should also be trained to control the energy state of the aeroplane using elevator inputs and thrust. They should understand aeroplane performance across all flight phases, including how to respond as pilot flying (PF) and pilot monitoring (PM). They should apply their basic aerodynamics and flight dynamics knowledge to mentally integrate an understanding of the aeroplane AOA and energy state throughout the normal envelope of operations and should be able to communicate that awareness to the other pilot. (Ref. AUPRTA — 6)</p>
B. <i>Causes and contributing factors of upsets</i>	<p>Development and training on procedures, including PF and PM roles, for normal operations and deviation recovery should focus on upset prevention. The training should emphasize what to monitor during normal operations and during an upset recovery, how to identify and communicate deviations between pilots and how to effect recovery.</p> <p>Train pilots in what to monitor and when, including cross-checking and verification, during all phases of flight to prevent an upset event. Stress communication behaviour between pilots to share an understanding of aeroplane state so that both pilots recognize when either of them might be introducing a pilot-induced upset.</p> <p>Trainees should apply their academic training to prevent, and recover from, environmentally induced, pilot-induced and aeroplane system-induced upsets. (Ref. AUPRTA — 5)</p>
C. <i>Safety review of accidents and incidents relating to aeroplane upsets</i>	<p>Demonstration of some of the actual upsets of transport category aeroplanes covered in academic training, with training of the prevention and proper recovery techniques.</p>
D. <i>G-awareness</i>	<p>Most FSTDs cannot replicate sustained g-forces; therefore, the cockpit situation must be envisioned during flight when not under traditional 1 g environment and trainees trained accordingly. For example, in an actual upset in flight, the pilot may be floating up against the shoulder harness and seat belt making it difficult for the pilot to apply proper control inputs. Unsecured items may also be flying around the cockpit.</p>

<i>Non-type-specific FSTD multi-crew UPRT</i>	
<i>Training element</i>	<i>Description</i>
	If any practical exercise regarding g-awareness is accomplished in an FSTD, careful consideration should be taken to avoid negative training. Because there is a visual and sensory aspect associated with g-loading, the training programme will need to validate whether the g-awareness training in the FSTD will be effective and can be accomplished without negative training.
E. <i>Energy management</i>	<p>The training should include integrated CRM training for developing crew knowledge and skills for energy management, as well as techniques for reducing pilot error, including what to monitor during an event and how the PM should coach the PF in the recovery using appropriate callouts and other verbal feedback.</p> <p>Training should cover accelerations from low to high speed at both low and high altitudes and develop the trainees' ability to understand and manage the difference between kinetic, potential and chemical energy and the relationship between pitch, power and performance.</p>
F. <i>Flight path management</i>	<p>Flight path management training should be developed with regard to which automated systems are on the FSTD being used for the specific training.</p> <p>1) Manual or automation inputs for guidance and control</p> <p>The training objective related to the manual or automation inputs for guidance and control addresses correct pilot control inputs to avoid or recover from undesired flight path deviations.</p> <p>This training objective should include the control strategies pilots should use in both developing and developed upset events. Pilots need to know the conditions under which it is best to allow automated systems to control the aeroplane and those under which manual intervention by the pilot is best. This should include primary/alternate control strategies and how to interpret instrument displays to recognize, prevent or recover from upsets. It should also include relevant considerations when disconnecting the automation.</p> <p>Integrated CRM training should include communication between pilots of their understanding of the current aeroplane state. Pilots should be able to work as a crew to be aware of, recognize and prevent upsets.</p> <p>2) Automation management</p> <p>The automation management training objective addresses correct pilot inputs to avoid undesired flight path deviations.</p> <p>Pilots need to know how to use the automation systems (if installed) during prevention and recovery from an upset event. This training should include the following:</p> <ul style="list-style-type: none"> i) common errors to avoid and why they occur; ii) cross-check and verification of mode use; iii) advantages and disadvantages of using automated systems for upset prevention and recovery; and iv) the importance of ensuring correct pilot inputs to the automation systems and the consequences of failing to do so.

Non-type-specific FSTD multi-crew UPRT	
Training element	Description
3) Manual handling skills	<p>This training objective should include the control strategies pilots should use in both developing and developed upset events.</p> <p>Pilots should know the common errors to avoid, why they occur, the importance of cross-checking and verification of inputs, as well as have a common understanding between them of why it may be a better practice to continue flying the aeroplane through automation in the particular circumstances.</p> <p>It is imperative that the PF keep the aeroplane in trim while flying with an engine inoperative on a multi-engine aeroplane. At slow speed and high thrust on the remaining engine(s), the autopilot (A/P) on some aeroplanes is generally incapable of holding the correct attitude against an adverse yaw condition, which may result in an upset.</p> <p>The manual handling skills objectives are to address correct pilot control inputs to avoid undesired flight path deviations. Refer to the discussion in section G 2) Pitch/power/roll/yaw on how to develop pilot skills for making the correct control inputs to arrest the divergence or to recover from the upset.</p> <p>These manual handling skills should be developed during the specialized training elements in section J below.</p> <p>Pilots should know the common errors to avoid, why they occur, the importance of cross-checking and verification of inputs, as well as have a common understanding between them of why it may be a better practice to fly the aeroplane manually. Pilots should develop an understanding of how the aeroplane responds to inputs across all flight regimes.</p> <p>Manual handling training should include training on the use of full control inputs. Flight control inputs become less effective when the aeroplane is at or near its critical AOA or stalled. The tendency is for pilots not to use full control authority because they rarely are required to do so. Pilots need to overcome this habit when recovering from severe upsets.</p> <p><i>Note 1.— Rudder control is still effective at a high AOA, and special care must be taken in the use of rudder during upset prevention and recovery.</i></p> <p><i>Note 2.— Excessive use of pitch trim or rudder during the recovery may aggravate the upset condition and/or may result in exceeding aeroplane structural limitations.</i></p> <p>It is also important to guard against control reversals. To maintain structural integrity, rapid full-scale reversal of control deflections should be avoided.</p> <p>In addition, manual handling training (pitch/power/roll/yaw) should include training on non-intuitive factors. For example, it may be counter-intuitive to use greater unloading control forces when recovering from a high AOA, especially at low altitude. If the aeroplane is stalled while already in a nose-down attitude, the pilot still needs to push the nose down (unload) in order to reduce the AOA. Altitude cannot be maintained in a stall and should be of secondary importance.</p> <p>The training should highlight when it is appropriate to fly manually versus through automation.</p>

<i>Non-type-specific FSTD multi-crew UPRT</i>	
<i>Training element</i>	<i>Description</i>
G. <i>Recognition</i>	<p>Trainees should understand that anytime the aeroplane begins to diverge from the intended flight path or speed they need to promptly identify and determine what, if any, action must be taken, and then act accordingly.</p> <p>1) Examples of instrumentation during developing and developed upset</p> <p>A key aspect to UPRT is for trainees to recognize developing and developed upset conditions. The emphasis is on using examples of instrumentation and visual cues to train awareness, recognition and prevention of a developing upset and recovery from a developed upset in order to improve effective aeronautical decision-making to prevent upset events.</p> <p>2) Pitch/power/roll/yaw</p> <p>A key aspect of UPRT is for trainees to recognize developing and developed upset conditions so they can make control inputs based on desired aeroplane reaction. Control deflections at one point in the flight envelope might not be appropriate in another part of the flight envelope. Pilots need to have a fundamental understanding of instrumentation and flight dynamics in pitch/power/roll/yaw in order to recognize the current state of the aeroplane and make the correct control inputs to arrest the divergence or recover from the upset. The attitude director indicator (ADI) is the primary control instrument for recovery from an upset as, due to varying visibility conditions in operations, one cannot depend on having adequate outside visual references. (Ref. AUPRTA — 6.4.3 to 6.4.5)</p> <p>3) Effective scanning (effective monitoring)</p> <p>Effective instrument scanning techniques should be trained as appropriate to recognize normal states and divergence from normal flight parameters. Pilots should be trained on what to monitor and when, including cross-checking and verification, during all phases of flight, to identify the precursors and the initial development of an upset and then use that recognition to make timely and appropriate responses to bring the aeroplane back to the desired path. Pilots should also be aware of the effects of fatigue on their ability to monitor effectively.</p> <p>Training should also be provided on communicating the current aeroplane state between pilots, including callouts to improve situation awareness. Pilots should be able to create a mental picture of the aeroplane state and keep it updated and cross-checked with the other pilot throughout the flight. The PM should know how to assist the PF to return the aeroplane to a stable state.</p> <p>4) Stall protection systems</p> <p>Accurate and early recognition of all available aural, visual and tactile alerts to both an approaching stall and an aerodynamic stall. Particular attention must be given to aeroplane stall characteristics in the absence of a stall warning indication. (Ref. AUPRTA — 6.4.1)</p>
H. <i>Upset prevention and recovery techniques</i>	<p>Upset prevention and recovery techniques should be accomplished in an FSTD qualified for the training, using the training organization's upset prevention and recovery procedures published in the training and procedures manual. These procedures should follow the OEM recommendations for upset prevention and recovery (see ICAO Doc 10011 section 3.5).</p>

<i>Non-type-specific FSTD multi-crew UPRT</i>	
<i>Training element</i>	<i>Description</i>
1) Timely and appropriate intervention	<p>Training should emphasize the need for the PF or PM to recognize a divergence as early as possible and immediately ensure corrective action is taken to return the aeroplane to a stabilized flight path, including appropriate crew interaction. The corrective action should include managing the energy, arresting the flight path divergence and recovering to a stabilized flight path. If the aeroplane is stalled during the divergence from the intended flight path, then the training should also stress the importance of first applying and maintaining nose-down elevator until recovery from the stall is complete.</p> <p>The amount and rate of control input to counter a developing upset should be proportional to the amount and rate of pitch, roll and/or yaw experienced.</p> <p>The ADI is the primary control instrument for recovery from an upset, as adequate outside visual references may not be available or may be misleading.</p>
2) Nose-high/wings-level recovery	See ICAO Doc 10011 section 3.5 for OEM recommended recovery techniques. (Ref. AUPRTA — 7.3.3)
3) Nose-low/wings-level recovery	See ICAO Doc 10011 section 3.5 for OEM recommended recovery techniques. (Ref. AUPRTA — 7.3.4)
4) High bank angle recovery techniques	(Ref. AUPRTA – 7.3.2)
5) Consolidated summary of aeroplane recovery techniques	
6) Stall event	
	<p>Awareness of the distinction between aircraft attitude and AOA. Energy management trading altitude for speed. Awareness of the correlation between stall speed and g-load and the capability to reduce stall speed by unloading. Stall recovery technique (see ICAO Doc 10011 section 3.5). Suggested training exercises are detailed in ICAO Doc 10011 section 3.4.2.</p>
I. <i>System malfunction</i>	<p>Trainees should understand the systems relevant to UPRT used in the FSTD and how these systems can cause or contribute to an upset. Upset-inducing failures/malfunctions related to systems, instruments, power and automation should be incorporated into training, whenever applicable. Trainees should be made particularly aware of the insidious nature of inaccurate information (e.g. unreliable airspeed, failures of stall and icing-alerting devices, degradation of envelope protection systems), so that trainees are trained to recognize the problem/error, prevent an upset and maintain control of the aeroplane.</p> <p>System malfunctions may also be used in scenarios with the aim of introducing a startle factor, either by distracting the flight crew when the simulated aeroplane encounters upset inducing conditions or by triggering an unforeseen upset condition. (Ref. AUPRTA — 5.2)</p>

Non-type-specific FSTD multi-crew UPRT	
Training element	Description
J. <i>Specialized training elements</i>	<p>These are several specific elements to be incorporated into the training that teach a specific skill set to help trainees prevent, and if needed, recover from an upset.</p> <p><i>Note. — Communicating the current aeroplane state between pilots, including callouts to improve situation awareness, is essential. The PM should know how to effectively assist the PF to return the aeroplane to a stable state.</i></p>
1) Spiral dive	In this manoeuvre, sometimes called a graveyard spiral, the aeroplane is at a high bank angle and descending. Trainees will learn in this situation that applying up-elevator in an attempt to arrest both the increasing speed and sink rate causes the spiral to tighten. The skill learned is that it is imperative to get the wings close to level before beginning any pitching-up input. Trainees must decrease the bank angle and then apply up-elevator to recover. If g-loading is large the pilot will need to offload some g to regain adequate roll control.
2) Slow flight	Slow flight exposes the trainee to flight right above the stall speed of the aeroplane and to manoeuvring the aeroplane at this speed without stalling. The purpose is to reinforce the basic stall characteristics learned in academics and allow the pilot to obtain handling experience and motion sensations (as available) when operating the aeroplane at slow speeds during the entire approach-to-stall regime in various aeroplane attitudes, configurations and bank angles.
3) Steep turns	Steep turns provide the trainee with practical experience of manoeuvring the aeroplane at higher than normal bank angles (see section D of this table for FSTD limitations).
4) Recovery from approach-to-stall	Particular emphasis should be placed on the early recognition of those symptoms associated with approaching a stall as well as on the recognition of stall warning system activation. Trainees should be made to understand that recovery action involving a deliberate and smooth application of nose-down pressure should be performed immediately upon recognition of the presence of stall-related symptoms or the activation of a stall alerting device.
5) Recovery from stall	<p>With due regard to fidelity limitations of the FSTD in use, this portion of the training would normally be performed as a demonstration exercise only highlighting the following:</p> <ul style="list-style-type: none"> i) recovery training from an aerodynamic stall should focus on developing the awareness of stall-related cues such as buffet, degradation of control responsiveness in the pitch and roll axis, as well as the inability to arrest descent; and ii) the recovery portion of the training should constantly stress the primary importance of a smooth and deliberate reduction in the angle of attack sufficient to break the stalled condition and completing the recovery in compliance with aeroplane specific recommended techniques, with due consideration of the effect of thrust on pitch control in aeroplanes with underslung engines. The maintenance of a wings level condition during the recovery is secondary to the reduction in the angle of attack.

<i>Non-type-specific FSTD multi-crew UPRT</i>	
<i>Training element</i>	<i>Description</i>
6) Recovery following stick pusher activation (if equipped)	Stick pusher activation is a sudden event that often startles the crew and is usually followed by an almost overpowering urge to pull back on the controls in an attempt to overcome the sharp nose-down movement of the elevator. Training in the FSTD should focus on developing a proper pilot response to such an occurrence recognizing that the stick pusher is a valued aid in the recovery from an aerodynamic stall.
7) Noise high/ high speed	The FSTD training should include a variety of developing and developed upset conditions with focus on pitch, power, roll and yaw. It should include demonstrations and practice recovery techniques for various upset scenarios, to include nose-high and nose-low scenarios with various bank angles and speeds, including bank angles greater than 90°. Trainees should practice high bank angle recovery exercises in both nose-high and nose-low situations. FSTD manoeuvres training should be done in both visual and instrument conditions to allow trainees to practice recognition and recovery under both conditions and to train them to recognize some of the physiological factors. Upset training in an FSTD that exceeds the VTE increases the risk of negative training. See ICAO Doc 10011 section 3.5 for OEM recommended recovery techniques. (Ref. AUPRTA — 7.3.2 to 7.3.4 and 8)
8) Noise high/ low speed	
9) Noise low/ high speed	
10) Noise low/ low speed	
11) High bank angle recovery	
12) Line-oriented flight training (LOFT) or line-operational simulation (LOS)	Training should expose trainees, through LOFT or LOS scenarios, to situations or malfunctions, which could cause an upset if not properly managed. The focus of each scenario should be awareness and prevention of the upset.
K. <i>Human Factors</i>	Human Factors are an overarching, integral part of UPRT. The Human Factors in UPRT address the physiological and crew responses in the event of a flight path divergence or a sudden upset. Integrating Human Factors into UPRT is also important to help develop airmanship, which requires perceptual, cognitive and psychomotor knowledge and skills. Human Factors include, but are not limited to, CRM, the cognitive process, the learning process and the ability of the trainees to recall and apply appropriate knowledge and skills at a later stage of their career.
1) Threat and error management (TEM)	<p>TEM as it relates to upset prevention and recovery should be integrated in the UPRT. TEM training should include: communication/interaction techniques between pilots and between pilots and the aeroplane, the aeroplane normal states, identification and management of environmental threats that might induce an upset, detection of deviations, interpretation of the meaning of the deviation, decision on how to respond, and response. TEM is a crucial means of addressing Human Factors training elements.</p> <p>The flight crew's capacity to think effectively in flight conditions to which they have not previously been exposed may be challenged during an upset event and should be developed through UPRT. Training should define which control inputs are appropriate and how to prioritize the tasks to avoid overloading.</p> <p>TEM requires effective monitoring and for that, methods and training should be provided and include appropriate assessment techniques (i.e. what to monitor and when, what to cross-check, ensuring proper verification) during all phases of flight to prevent an upset event and during recovery efforts.</p>

<i>Non-type-specific FSTD multi-crew UPRT</i>	
<i>Training element</i>	<i>Description</i>
2) Human information processing	<p>For pilots to understand how to respond appropriately and why they sometimes fail to do the correct action, they must understand how they process information. These are the “building blocks” of knowledge that allow a better understanding of how to maintain or improve such areas as communication, decision-making, situation awareness, and team dynamics.</p> <p>Those areas involved in all human information processing include:</p> <ul style="list-style-type: none"> i) attention — the sensing and retrieval of relevant information from the environment; ii) perception — understanding that information which has been retrieved; iii) interpretation — associating the information which is relevant and the knowledge required for the task at hand; iv) judgement — aligning the requirement for action with the correct response; v) decision-making — assessing the correct response needed for the outcome required or an alternative; vi) action — implementing the response chosen; and vii) feedback — checking that the response action meets the correct requirements of the task.
3) Crew resource management (CRM)	<p>Pilots should focus on stabilizing the aeroplane as a team, with clearly defined PF and PM roles, especially if one pilot becomes fixated.</p> <p>Training should include:</p> <ul style="list-style-type: none"> i) development and application of appropriate communication patterns between pilots for a shared understanding of the current aeroplane state; and ii) how to identify and communicate deviations and guide recovery in both PF and PM roles. <p>Training should define how to distribute the tasks between the PF and the PM to avoid overloading either pilot.</p> <p>Pilots should be able to create a mental picture of the aeroplane and its energy state and keep it updated and cross-checked with the other pilot throughout the flight. Crew callouts according to standard operating procedures (SOPs) will assist in communication, leading the flight crew to implement a recovery strategy as necessary.</p>

<i>Non-type-specific FSTD multi-crew UPRT</i>	
<i>Training element</i>	<i>Description</i>
4) Situation awareness	<p>Pilots need to maintain situation awareness at all times through effective monitoring (see the training element “Recognition” in this table). Pilots do this by maintaining a mental model while creating mental pictures of developing situations. A breakdown of a pilot’s mental model or picture, which can be caused by several factors, such as spatial disorientation from in-flight perceptual illusions, being startled, inattention and complacency, can lead to a loss of situation awareness.</p> <p>Training should include how to maintain situation awareness and what to monitor to prevent, and recover from, upsets. Trainees should learn how the PM should assist/coach the PF in the recovery using appropriate callouts and other verbal feedback.</p> <p>After a deviation, it is important that the first actions be correct to prevent the recovery effort from developing into an even more serious situation. In order to accomplish that objective, the accurate and timely determination of the actual flight condition and energy state during the upset is of paramount importance. Troubleshooting the cause of the upset is secondary and can wait.</p> <p>Pilots should use the primary flight instruments because darkness, weather conditions, and the limited view from the cockpit may make it difficult/impossible to effectively use the outside horizon. The ADI is the primary reference.</p> <p>The situation analysis process includes:</p> <ul style="list-style-type: none"> i) communicating with other flight crew members; ii) locating the bank indicator on the ADI and determining the bank angle; iii) determining the pitch attitude (from the ADI primarily); iv) confirming the attitude by reference to other indicators; and v) assessing the energy state.
5) Decision-making	<p>Training should stress the importance of the pilots effectively communicating verbally and nonverbally. Another important subject is the criteria for a PM to decide whether to take control of the aeroplane if the PF is overwhelmed and unresponsive. The pilots should use a shared decision-making process where both are engaged in the outcome.</p> <p>The pilots should focus on stabilizing the aeroplane. They should understand the role of the PM in coaching the PF to a stable state. They should know the generic pitch and power targets for stabilization and take the appropriate action. To do so, trainees should be aware of what information they need to make the optimum decision for action as well as of those factors, such as cognitive biases, that affect decision-making.</p>
6) Problem-solving	<p>Training should improve the problem-solving competency and recognize those factors that can impede a trainee’s ability to solve a problem, such as fatigue, fear and work overload. In particular, UPRT should emphasize the importance of evaluating whether a solution is working and of not rushing into an action that may be detrimental.</p> <p>Pilots should be able to communicate verbally or nonverbally to the other pilot if stress overwhelms them. Training should include how to self-assess impending incapacitation because of stress. This includes detecting and avoiding fixation on a particular item.</p>

<i>Non-type-specific FSTD multi-crew UPRT</i>	
<i>Training element</i>	<i>Description</i>
7) Startle and stress response	<p>Training should include strategies to deal with the range of physiological, psychological and cognitive effects associated with the human stress response to unexpected threatening events with the pilots applying their competencies to maintain safe flight and crew coordination.</p> <p>Pilots may be startled when an unexpected event during flight contradicts their expectations. If an unexpected event is sufficiently serious and/or arises during a critical phase of flight, the correct response to that uncertainty becomes vital for survival.</p> <p>Upset training should strive to include the element of “unexpectedness” that pilots will experience in a real world application.</p>
8) Physiological factors	<p>Recognizing the effects of visual and vestibular (angular and linear) illusions and responding appropriately is a key aspect of UPRT. Areas to be addressed during on-aeroplane training include:</p> <ul style="list-style-type: none"> i) conditions which can lead to spatial disorientation and the use of instrument interpretation to manage spatial disorientation; ii) avoiding errors in adjusting attitude/power; iii) avoiding, and recovering from, PIOs; and iv) recognizing and managing sensory illusions in flight. <p>All of these items should be covered in academic training, but training in an FSTD can target some of them. Spatial disorientation has been a significant factor in many aeroplane upset accidents. The definition of spatial disorientation is the inability to correctly orient oneself with respect to the earth’s surface. Pilots who are unable to resolve a perceived conflict between bodily senses and flight instruments are spatially disoriented. Allowed to continue, spatial disorientation may lead to aeroplane upset. Attention to flight instruments and a good cross-check are the keys to remaining spatially oriented.</p> <p>A review of aeroplane upsets reveals that inattention or neglecting to monitor the aeroplane’s performance can lead to upsets. Neglecting to monitor the appropriate instruments or fixating on a certain instrument can lead to performance deviations. Distractions can be very subtle, such as warning or caution lights illuminating during critical phases of flight. Many aeroplane upsets occur while the pilot is engaged in some task that takes attention away from monitoring the aeroplane state.</p>

附錄四、 Type-specific FSTD UPRT elements

<i>Type-specific FSTD UPRT elements</i>	
<i>Training element</i>	<i>Description</i>
A. <i>Aerodynamics</i>	<p>Trainees should be knowledgeable about aerodynamic effects at both high and low altitudes. The FSTD training should be accomplished at both high altitude (within 1 500 m [5 000 ft] of the service ceiling of the aeroplane) and at low altitude (below 3 000 m [10,000 ft] above mean sea level) to reinforce the academic training described in ICAO Doc 10011 section 3.2. High-altitude training should be conducted at normal operational cruise altitudes.</p> <p>Trainees should also be trained with respect to the handling effects of operating at low speeds and high Mach, including:</p> <ul style="list-style-type: none"> i) demonstration of Mach tuck and Mach buffet (if applicable to the aeroplane type); ii) understanding of the change in aeroplane stability at high altitude; iii) recognition of high speed/Mach buffet (as applicable to the aeroplane type) and low speed buffet; iv) the altitude necessary to effectively recover from a stall event at high altitudes; and v) awareness of control surface effectiveness at low and high speeds. <p>Trainees should apply their aerodynamic knowledge by including the following in FSTD training:</p> <ul style="list-style-type: none"> i) practice in manoeuvring the simulated aeroplane at high altitude at various speeds and automation levels — the pilot will apply the aerodynamic principles acquired in the academic training to prevent an upset; ii) trainees should be aware of the AOA from available data shown on the flight deck and demonstrate the use of those data to prevent an upset or recover from one; iii) practice of speed controlled by elevator inputs or speed controlled by thrust, and understanding of aeroplane energy state as it pertains to the type being flown — trainees should demonstrate use of that knowledge to avoid or recover from an upset; and iv) trainees should demonstrate knowledge of the type-specific systems that use AOA with emphasis on warning systems and the limitations of those systems; for example, recognizing an indication in the flight deck that “continuous ignition” has turned on without the system being manually selected on. <p>They should understand aeroplane performance across all flight phases, including how to respond as PF and PM.</p> <p>They should apply their basic aerodynamics and flight dynamics knowledge to mentally integrate an understanding of the aeroplane AOA and energy state throughout the part of the flight envelope used in normal operations and should be able to communicate that awareness to the other pilot. (Ref. AUPRTA — 6)</p>

<i>Type-specific FSTD UPRT elements</i>	
<i>Training element</i>	<i>Description</i>
B. <i>Causes and contributing factors of upsets</i>	<p>Development and training on procedures, including PF and PM roles, for normal operations and deviation recovery should focus on upset prevention. The training should emphasize what to monitor during normal operations and during an upset recovery, how to identify and communicate deviations between pilots and how to recover.</p> <p>Train pilots in what to monitor and when, including cross-checking and verification, during all phases of flight to prevent an upset event. Stress communication behaviour between pilots to share an understanding of the aeroplane state so that both pilots recognize when either of them might be introducing a pilot-induced upset.</p> <p>Trainees should apply their type-specific academic training to prevent, and recover from, environmentally induced, pilot-induced and aeroplane system-induced upsets. (Ref. AUPRTA — 5)</p>
C. <i>Safety review of accidents and incidents relating to aeroplane upsets</i>	Demonstration of some of the actual upsets of transport category aeroplanes covered in academic training, with training of the prevention and type-specific recovery techniques.
D. <i>G-awareness</i>	<p>It must be emphasized that g-loading in transport category aeroplanes feels significantly more pronounced than in other aeroplanes, due specifically to the cockpit environment.</p> <p>Commercial air transport pilots are normally uncomfortable (for the sake of passenger comfort and safety) reacting appropriately to changing g-forces on a large aeroplane. Pilots should be trained to overcome this inhibition when faced with the necessity to promptly deal with any excess external forces.</p> <p>Most FSTDs cannot replicate sustained g-forces; hence, the limitations of the device to adequately represent the actual g-environment during upset conditions must be well understood by both the instructor and the trainee. If any practical exercise regarding g-awareness is accomplished in an FSTD, careful consideration should be taken to avoid negative training. Because there is a visual and sensory aspect associated with g-loading, the training programme will need to validate whether the g-awareness training in the FSTD will be effective and can be accomplished without negative training.</p>
E. <i>Energy management</i>	<p>The training should include integrated CRM training for developing crew knowledge and skills for energy management, as well as techniques for reducing pilot error, including what to monitor during an event and how the PM should coach the PF in the recovery using appropriate callouts and other verbal feedback.</p> <p>To fully understand the concepts discussed in academic training, trainees should be trained in the following:</p> <ul style="list-style-type: none"> i) acceleration between two speeds of which the aeroplane is capable at low, medium and high altitude (e.g. 200–250 KIAS at low altitude, medium and high altitude with corresponding Mach numbers at high altitude); ii) acceleration performance from second regime (back side of power curve) at low altitude and high altitude;

<i>Type-specific FSTD UPRT elements</i>	
<i>Training element</i>	<i>Description</i>
	<ul style="list-style-type: none"> iii) the relationship between maximum cruise/climb/continuous thrust and take-off/go-around thrust at low and high altitude; iv) acceleration capabilities through descent versus power/thrust application; v) understanding and managing the type-specific differences between kinetic, potential and chemical energy and the relationship between pitch, power and performance; vi) roll rate performance of the aeroplane at different speeds, altitudes and configurations and with flight spoilers retracted/extended (as applicable) if a difference exists; and vii) pitch rate performance of the aeroplane at different speeds, altitudes and configurations and with flaps retracted/extended; also, demonstration of an aft centre of gravity (CG) versus a forward CG flying qualities, if these are significantly different and the effect of thrust on pitch control in aeroplanes with underslung engines.
F. Flight path management	<p>Flight path management training should be developed with regard to which automated systems are on the type of aeroplane, including type-specific automation challenges.</p>
1) Manual or automation inputs for guidance and control	<p>The training objective related to the manual or automation inputs for guidance and control addresses correct pilot control inputs to avoid or recover from undesired flight path deviations.</p> <p>This training objective should include the control strategies pilots should use in both developing and developed upset events. Pilots need to know the type-specific conditions under which it is best to allow automated systems to control the aeroplane and those under which manual intervention by the pilot is best. This should include primary/alternate control strategies.</p>
2) Type-specific characteristic	<p>Training provided on type-specific characteristics will help avoid inadvertent upset events because of automation surprise. Integrated CRM training should include communication between pilots of their understanding of the current aeroplane state. Pilots should create a mutual mental picture of aeroplane state and keep it updated. In addition, pilots must be able to work as a crew to be aware of, recognize and prevent upsets. This will include instrument interpretation as it applies to recognizing upset events.</p>
3) Automation management	<p>The automation management training objective addresses correct pilot inputs to avoid undesired flight path deviations.</p> <p>Pilots need to know how to use the automation systems during prevention and recovery from an upset event. This training should include the following:</p> <ul style="list-style-type: none"> i) common errors to avoid and why they occur; ii) specific automation modes to use for specific contexts; iii) the cross-check and verification of mode use and understanding of how the mode used has been directed to command the aeroplane; iv) control strategies pilots should use in both developing and developed upset events.

Type-specific FSTD UPRT elements	
Training element	Description
4) Manual handling skills	<p>v) advantages and disadvantages of using automated systems for upset prevention and recovery; and</p> <p>vi) the importance of ensuring correct pilot inputs to the automation systems and the consequences of failing to do so.</p> <p>It is imperative that the PF keep the aeroplane in trim while flying with an engine inoperative on a multi-engine aeroplane. At slow speed and high thrust on the remaining engine(s), the A/P on some aeroplanes is generally incapable of holding the correct attitude against an adverse yaw condition, which may result in an upset.</p> <p>The manual handling skills objectives are to address correct pilot control inputs to avoid undesired flight path deviations. Refer to the discussion in section G 2) Pitch/power/roll/yaw on how to develop pilot skills for making the correct control inputs to arrest the divergence or to recover from the upset. These manual handling skills should be developed during the specialized training elements in section J below.</p> <p>UPRT should include the practice of manual handling at the edges of the flight envelope.</p> <p>Pilots should know the common errors to avoid, why they occur, the importance of cross-checking and verification of inputs, as well as have a shared understanding among the pilots of why the pilot is flying the aeroplane manually. Pilots should develop an understanding of how the aeroplane responds to inputs across all flight regimes.</p> <p>Manual handling training should include training on the use of full control inputs, if necessary to counter adverse external forces. For instance, flight controls become less effective when the aeroplane is at or near its critical AOA or stalled. The tendency is for pilots not to use full control authority because they rarely are required to do so in normal operations. Pilots need to overcome this habit when recovering from severe upsets.</p> <p><i>Note 1.— Rudder control is still quite effective at a high AOA, and special care must be taken in the use of rudder during upset prevention and recovery.</i></p> <p><i>Note 2.— Excessive use of pitch trim or rudder during the recovery may aggravate the upset condition and/or may result in exceeding aeroplane structural limitations.</i></p> <p>It is also important to guard against control reversals. To maintain structural integrity rapid full-scale reversal of control deflections should be avoided.</p> <p>In addition, manual handling training should include training on non-intuitive factors. For example, it may be counter-intuitive to use greater unloading control forces when recovering from a high AOA, especially at low altitude. If the aeroplane is stalled while already in a nose-down attitude, the pilot still needs to push the nose down (unload) in order to reduce the AOA. Additionally, for underwing mounted engines it may be necessary to reduce thrust in order to reduce the AOA due to the strong pitch-up forces from added thrust. Altitude cannot be maintained in a stall and should be of secondary importance.</p> <p>The training should highlight when it is appropriate to fly manually versus through automation. Specific aspects of the transition from automated to manual flight, and vice-versa, should also be covered.</p>

<i>Type-specific FSTD UPRT elements</i>	
<i>Training element</i>	<i>Description</i>
G. <i>Recognition</i>	<p>Trainees should understand that anytime the aeroplane begins to diverge from the intended flight path or speed they need to identify and determine what, if any, action must be taken, and then act accordingly.</p>
1) Type-specific examples of instrumentation during developing and developed upset	<p>A key aspect to UPRT is for trainees to recognize developing and developed upset conditions. The emphasis is on using examples of type-specific instrumentation and visual cues to improve awareness, prevention and recognition of a developing upset and recovery from a developed upset in order to train effective aeronautical decision-making to prevent upset events.</p> <p>This training should include visual representations of the outside view and type-specific instrument indications of a variety of developing and developed upset conditions, with a focus on pitch, power and roll, and on what is happening to the airspeed.</p>
2) Pitch/power/roll/yaw	<p>A key aspect of UPRT is for trainees to recognize developing and developed upset conditions so they can make control inputs based on desired aeroplane reaction. Control deflections at one point in the flight envelope might not be appropriate in another part of the flight envelope. Pilots should have a fundamental understanding of instrumentation and flight dynamics in pitch/power/roll/yaw in order to recognize the current state of the aeroplane and make the correct control inputs to arrest the divergence or recover from the upset. The ADI is the primary control instrument for recovery from an upset as, due to varying visibility conditions in operations, one cannot depend on having adequate outside visual references. (Ref. AUPRTA — 6.4.3 to 6.4.5)</p>
3) Effective scanning (effective monitoring)	<p>Effective instrument scanning techniques should be trained as appropriate to recognize normal states and divergence from normal flight parameters. Pilots should be trained on what to monitor and when, including cross-checking and verification, during all phases of flight, to identify the precursors and the initial development of an upset and then use that recognition to make timely and appropriate responses to bring the aeroplane back to the desired path. Specifically, to reduce delays in detecting a deviation and mitigate surprise events, pilots should be trained on a type-specific description of what instrumentation to monitor during developing and developed upsets, and during the recovery phase. Pilots should also be aware of the effects of fatigue on their ability to monitor effectively.</p> <p>Training should also be provided on communicating the current aeroplane state between pilots, including callouts to improve situation awareness. Pilots should be able to create a mental picture of the aeroplane state and keep it updated and cross-checked with the other pilot throughout the flight. The PM should know how to effectively assist the PF to return the aeroplane to a stable state.</p> <p>To improve the detection and interpretation of deviations, pilots should know the aeroplane normal states (particularly in pitch and power levels), detect deviations, interpret the meaning of the deviation, communicate effectively as a crew, decide on a response, and take action.</p>
4) Stall protection systems	<p>Accurate and early recognition of all available aural, visual and tactile alerts to both an approaching stall and an aerodynamic stall. Particular attention must be given to aeroplane stall characteristics in the absence of a stall warning indication. (Ref. AUPRTA — 6.4.1)</p>

<i>Type-specific FSTD UPRT elements</i>	
<i>Training element</i>	<i>Description</i>
H. <i>Upset prevention and recovery techniques</i>	<p>Upset prevention and recovery techniques should be accomplished in the highest fidelity FSTD qualified for the training, using the operator's upset prevention and recovery procedures published in the operations manual. These procedures should follow the OEM recommendations for upset prevention and recovery (see ICAO Doc 10011 section 3.5).</p>
1) Timely and appropriate intervention	<p>Training should emphasize the need for the PF or PM to recognize a divergence as early as possible and immediately ensure corrective action is taken to return the aeroplane to a stabilized flight path, including appropriate crew interaction. The corrective action should include managing the energy, arresting the flight path divergence and recovering to a stabilized flight path. If the aeroplane is stalled during the divergence from the intended flight path, then the training should also stress the importance of first applying and maintaining nose-down elevator until recovery from the stall is complete.</p> <p>The amount and rate of control input to counter a developing upset should be proportional to the amount and rate of pitch, roll and/or yaw experienced. If pilots' inputs do not arrest the divergence, then pilots should follow the aeroplane's flight manual recommended guidance.</p> <p>The ADI is the primary control instrument for recovery from an upset, as adequate outside visual references may not be available or may be misleading.</p>
2) Nose-high/wings-level recovery	See ICAO Doc 10011 section 3.5 for OEM recommended recovery techniques. (Ref. AUPRTA — 7.3.3)
3) Nose-low/wings-level recovery	See ICAO Doc 10011 section 3.5 for OEM recommended recovery techniques. (Ref. AUPRTA — 7.3.4)
4) High bank angle recovery techniques	Ref. AUPRTA – 7.3.2
5) Consolidated summary of aeroplane recovery techniques	
6) Stall event	<p>Awareness of the distinction between aircraft attitude and AOA. Energy management trading altitude for speed. Awareness of the correlation between stall speed and g-load and the capability to reduce stall speed by unloading. Stall recovery technique (see ICAO Doc 10011 section 3.5). Suggested training exercises are detailed in ICAO Doc 10011 section 3.4.2.</p>
I. <i>System malfunction</i>	<p>Trainees should understand the systems of their aeroplane and how these systems can cause or contribute to an upset. FSTDs allow instructors to induce malfunctions that cannot be safely trained for in the aeroplane. Operators should refer to OEM checklists and procedures, which cover system and component failures. Upset-inducing failures/malfunctions related to systems, instruments, power, and automation should be incorporated into training, whenever applicable. Trainees should be made particularly aware of the insidious nature of inaccurate information (e.g. unreliable airspeed, failures of stall and icing alerting devices, degradation of envelope protection systems), so that trainees are trained to recognize the error, prevent an upset and maintain control of the aeroplane.</p>

Type-specific FSTD UPRT elements	
Training element	Description
	System malfunctions may also be used in scenarios with the aim of introducing a surprise or startle factor, either by distracting the flight crew when the simulated aeroplane encounters upset-inducing conditions or by triggering an unforeseen upset condition. (Ref. AUPRTA — 5.2)
J. <i>Specialized training elements</i>	<p>These are several specific elements to be incorporated into the training that teach a specific skill set to help trainees prevent, and if needed, recover from an upset.</p> <p><i>Note. — Communicating the current aeroplane state between pilots, including callouts to improve situation awareness, is essential. The PM should know how to effectively assist the PF to return the aeroplane to a stable state.</i></p> <p>1) Spiral dive</p> <p>In this manoeuvre, sometimes called a graveyard spiral, the aeroplane is at a high bank angle and descending. Trainees will learn in this situation that applying up-elevator in an attempt to arrest both the increasing speed and sink rate causes the spiral to tighten. The skill learned is that it is imperative to get the wings close to level before beginning any pitching-up manoeuvre. Trainees must decrease the bank angle and then apply up-elevator to recover. If g-loading is large, the pilot will need to offload some g to regain adequate roll control.</p> <p>2) Slow flight</p> <p>Slow flight exposes the trainee to flight right above the stall speed of the aeroplane and to manoeuvring the aeroplane at this speed without stalling. The purpose is to reinforce the basic stall characteristics learned in academics and allow the pilot to obtain handling experience and motion sensations when operating the aeroplane at slow speeds during the entire approach-to-stall regime in various aeroplane attitudes, configurations and bank angles.</p> <p>3) Steep turns</p> <p>Steep turns provide the trainee with practical experience of manoeuvring the aeroplane at higher than normal bank angles (see section D of this table for FSTD limitations).</p> <p>4) Recovery from approach-to-stall</p> <p>Particular emphasis should be placed on the early recognition of those symptoms associated with approaching a stall as well as on the recognition of stall warning system activation. Trainees should be made to understand that recovery action involving a deliberate and smooth application of nose-down pressure should be performed immediately upon recognition of the presence of stall-related symptoms or the activation of a stall alerting device.</p> <p>5) Recovery from stall</p> <p>With due regard to fidelity limitations of the FSTD in use, this portion of the training would normally be performed as a demonstration exercise only, highlighting the following:</p> <p>i) recovery training from an aerodynamic stall should focus on developing the awareness of stall-related cues such as buffet, degradation of control responsiveness in the pitch and roll axis, as well as the inability to arrest descent; and</p>

<i>Type-specific FSTD UPRT elements</i>	
<i>Training element</i>	<i>Description</i>
	<p>ii) the recovery portion of the training should constantly stress the primary importance of a smooth and deliberate reduction in the angle of attack sufficient to break the stalled condition and completing the recovery in compliance with aeroplane-specific recommended techniques. The effect of thrust/power application on pitch control capability should be covered for aeroplanes with underslung engines. The maintenance of a wings level condition during the recovery is secondary to the reduction in the angle of attack.</p>
6) Recovery following stick pusher activation (if equipped)	Stick pusher activation is a sudden event that often startles the crew and is usually followed by an almost overpowering urge to pull back on the controls in an attempt to overcome the sharp nose-down movement of the elevator. Training in the FSTD should focus on developing a proper pilot response to such an occurrence recognizing that the stick pusher is a valued aid in the recovery from an aerodynamic stall.
7) Noise high/ high speed	<p>The FSTD training should include a variety of developing and developed upset conditions with focus on pitch, power, roll and yaw. It should include demonstrations and practice recovery techniques for various upset scenarios, to include nose-high and nose-low scenarios with various bank angles and speeds, including bank angles greater than 90°. Trainees should practice high bank angle recovery exercises in both nose-high and nose-low situations. FSTD manoeuvres training should be done in both visual and instrument conditions to allow trainees to practice recognition and recovery under both conditions and to train them to recognize some of the physiological factors. Upset training in an FSTD, which exceeds the VTE of the aeroplane flight envelope data provided by the OEM and used for the FSTD qualification, could increase the risk of negative training.</p> <p>See ICAO Doc 10011 section 3.5 for OEM-recommended recovery techniques. (Ref. AUPRTA — 7.3.2 to 7.3.4 and 8)</p>
8) Noise high/ low speed	
9) Noise low/ high speed	
10) Noise low/ low speed	
11) High bank angle recovery	
12) Line-oriented flight training (LOFT) or line-operational simulation (LOS)	Training should expose trainees, through LOFT or LOS scenarios, to situations or malfunctions, which could cause an upset if not properly managed. The focus of each scenario should be awareness and prevention of the upset. The operator should integrate the various LOFT/LOS scenarios into the LOFT/LOS training and rotate them to ensure a wide exposure to a wide variety of possible upset scenarios.
K. <i>Human Factors</i>	Human Factors are an overarching, integral part of UPRT. The Human Factors in UPRT address the physiological and crew responses in the event of a flight path divergence or a sudden upset. Integrating Human Factors into UPRT is also important to help develop airmanship, which requires perceptual, cognitive, and psychomotor knowledge and skills. Human Factors include, but are not limited to, CRM, the cognitive process, the learning process and the ability of the trainees to recall and apply appropriate knowledge and skills in operations.
1) Threat and error management (TEM)	TEM as it relates to upset prevention and recovery should be integrated in the UPRT. The flight crew should identify and manage any threat that may contribute to an upset. TEM training should include: communication/interaction techniques between pilots and between pilots and the aeroplane, the aeroplane normal states, identification and management of environmental threats that might induce an upset, detection of deviations, interpretation of the meaning of the deviation, decision on how to respond, and response. TEM is a crucial means of addressing Human Factors training elements.

<i>Type-specific FSTD UPRT elements</i>	
<i>Training element</i>	<i>Description</i>
2) Human information processing	<p>The flight crew's capacity to think effectively in flight conditions to which they have not previously been exposed may be challenged during an upset event and should be developed through UPRT. Training should define which control inputs are appropriate and how to prioritize the tasks to avoid overloading.</p> <p>TEM requires effective monitoring and for that, methods and training should be provided and include appropriate assessment techniques (i.e. what to monitor and when, what to cross-check, ensuring proper verification) during all phases of flight to prevent an upset event and during recovery efforts.</p>
	<p>For pilots to understand how to respond appropriately and why they sometimes fail to do the correct action, they must understand how they process information. These are the "building blocks" of knowledge that allow a better understanding of how to maintain or improve such areas as communication, decision-making, situation awareness, and team dynamics.</p> <p>Those areas involved in all human information processing include:</p> <ul style="list-style-type: none"> i) attention — the sensing and retrieval of relevant information from the environment; ii) perception — understanding that information which has been retrieved; iii) interpretation — associating the information which is relevant and the knowledge required for the task at hand; iv) judgement — aligning the requirement for action with the correct response; v) decision-making — assessing the correct response needed for the outcome required or an alternative; vi) action — implementing the response chosen; and vii) feedback — checking that the response action meets the correct requirements of the task.
3) Crew resource management (CRM)	<p>Pilots should focus on stabilizing the aeroplane as a team, with clearly defined PF and PM roles, especially if one pilot becomes fixated.</p> <p>Training should include:</p> <ul style="list-style-type: none"> i) development and application of appropriate communication patterns between pilots for a shared understanding of the current aeroplane state; ii) how to identify and communicate deviations and guide recovery in both PF and PM roles; and iii) type-specific description of assessment techniques for the aeroplane state during developing and developed upset. <p>Training should define how to distribute the tasks between the PF and the PM to avoid overloading either pilot.</p>

<i>Type-specific FSTD UPRT elements</i>	
<i>Training element</i>	<i>Description</i>
4) Situation awareness	<p>Pilots should be able to create a mental picture of the aeroplane and its energy state and keep it updated and cross-checked with the other pilot throughout the flight. The training should also include appropriate communication techniques between the PF and PM for deviation avoidance and recovery. Crew callouts according to SOPs will assist in communication, leading the flight crew to implement a recovery strategy as necessary.</p> <p>Pilots need to maintain situation awareness at all times through effective monitoring (see the training element “Recognition” in this table). Pilots do this by maintaining a mental model while creating mental pictures of developing situations. A breakdown of a pilot’s mental model or picture, which can be caused by several factors, such as spatial disorientation from in-flight perceptual illusions, being startled, inattention and complacency, can lead to a loss of situation awareness.</p> <p>Training should include how to maintain situation awareness and what to monitor to prevent, and recover from, upsets. Trainees should learn how the PM should assist/coach the PF in the recovery using appropriate callouts and other verbal feedback.</p> <p>After a deviation, it is important that the first actions be correct to prevent the recovery effort from developing into an even more serious situation. In order to accomplish that objective, the accurate and timely determination of the actual flight condition and energy state during the upset is of paramount importance. Troubleshooting the cause of the upset is secondary and can wait. Pilots should use the primary flight instruments because darkness, weather conditions, and the limited view from the cockpit may make it difficult/impossible to effectively use the outside horizon. The ADI is the primary reference.</p> <p>The situation analysis process includes:</p> <ul style="list-style-type: none"> i) communicating with other flight crew members; ii) locating the bank indicator on the ADI and determining the bank angle; iii) determining the pitch attitude (from the ADI primarily); iv) confirming the attitude by reference to other indicators; and v) assessing the energy state.
5) Decision-making	<p>Training should stress the importance of the pilots effectively communicating verbally and nonverbally. Another important subject is the criteria for a PM to decide whether to take control of the aeroplane if the PF is overwhelmed and is unresponsive. This should include the case of a copilot (pilot monitoring) taking over from an overwhelmed pilot-in-command (pilot flying). These criteria should be outlined and documented in the SOPs used by the ATO or the operator. The pilots should use a shared decision-making process where both are engaged in the outcome.</p> <p>Pilots should focus on stabilizing the aeroplane. They should understand the role of the PM in coaching the PF to a stable state. They should know the appropriate pitch and power targets for stabilization and take the appropriate action. To do so, trainees should be aware of what information they need to make the optimum decision for action, as well as of those factors, such as cognitive biases, that affect decision-making.</p>

<i>Type-specific FSTD UPRT elements</i>	
<i>Training element</i>	<i>Description</i>
6) Problem-solving	<p>Training should improve the problem-solving competency, and recognize those factors that can impede a trainee's ability to solve a problem, such as fatigue, fear and work overload. In particular, UPRT should emphasize the importance of evaluating whether a solution is working and of not rushing into an action that may be detrimental.</p> <p>Pilots should be able to communicate verbally or nonverbally to the other pilot if stress overwhelms them. Training should include how to self-assess impending incapacitation because of stress. This includes detecting and avoiding fixation on a particular item.</p>
7) Startle and stress response	<p>Training should include strategies to deal with the range of physiological, psychological and cognitive effects associated with the human stress response to unexpected threatening events with the pilots applying their competencies to maintain safe flight and crew coordination. Pilots may be startled when an unexpected event during flight contradicts their expectations. If an unexpected event is sufficiently serious and/or arises during a critical phase of flight, the correct response to that uncertainty becomes vital for survival.</p> <p>Upset training should strive to include the element of "unexpectedness" that pilots will experience in a real world application.</p>
8) Physiological factors	<p>Recognizing the effects of visual and vestibular (angular and linear) illusions and responding appropriately is a key aspect of UPRT. Areas to be addressed during on-aeroplane training include:</p> <ul style="list-style-type: none"> i) conditions which can lead to spatial disorientation and the use of instrument interpretation to manage spatial disorientation; ii) avoiding errors in adjusting attitude/power; iii) avoiding and recovering from PIOs; and iv) recognizing and managing sensory illusions in flight. <p>All of these items should be covered in academic training, but training in an FSTD can target some of them. Spatial disorientation has been a significant factor in many aeroplane upset accidents. The definition of spatial disorientation is the inability to correctly orient oneself with respect to the earth's surface. Pilots who are unable to resolve a perceived conflict between bodily senses and flight instruments are spatially disoriented. Allowed to continue, spatial disorientation may lead to aeroplane upset. Attention to flight instruments and a good cross-check are the keys to remaining spatially oriented.</p> <p>A review of aeroplane upsets reveals that inattention or neglecting to monitor the aeroplane's performance can lead to upsets. Neglecting to monitor the appropriate instruments or fixating on a certain instrument can lead to performance deviations. Distractions can be very subtle, such as warning or caution lights illuminating during critical phases of flight. Many aeroplane upsets occur while the pilot is engaged in some task that takes attention away from monitoring the aeroplane state.</p>

附錄五、 FSTD 訓練情境

1. Environmental factors

Training Conditions	Training Description	Rationale
For example, mountain wave, rotor cloud, horizontal and vertical windshear.	Demonstrate how a rapid windshear can alter the flight path of an aeroplane operating at high altitude.	High-altitude upset with environmental factors as a causal factor.

2. Wake vortex

Training Conditions	Training Description	Rationale
Take-off and approach configuration – behind a heavy aeroplane.	Demonstrate how a prompt roll can alter the flight path of an aeroplane.	Awareness of how a vortex can affect the aeroplane, i.e. understanding that different roll capabilities and mass of the aeroplane would affect how a pilot would respond to a wake encounter with particular emphasis on time to transition through the vortex and effective mitigation strategies.

3. Mechanical/system-induced

Training Conditions	Training Description	Rationale
Upset as a function of roll, yaw and pitch path failures.	Demonstrate how a failure or degradation of flight controls affecting each axis can create an upset. Training has to be aeroplane-specific to correctly reflect failure mode of that aeroplane (e.g. hydraulics/fly-by-wire/A/P failure).	Aeroplane-specific training to demonstrate how a flight control failure can create an upset and how to mitigate the effect (for example, limited or uncontrollable flight control surface(s) or thrust asymmetry).

4. Stall recovery training

Training Conditions	Training Description	Rationale
<u>Condition 1</u> Clean configuration approach-to-stall (high altitude).	In level flight with the A/P on, introduce an event or reduce thrust to less than adequate for manoeuvring flight. Simulator	The trainee should be able to recognize the stall warning and immediately perform the stall recovery procedure.

	capabilities to induce approach-to-stalls may include use of airspeed slewing, attitude changes, aeroplane weight and CG changes, environmental changes and systems malfunctions (e.g. full or partial pitot/static blockage, artificial thrust reduction, surreptitious disabling of automation).	Demonstrate willingness to trade altitude for airspeed to accomplish an expeditious recovery from a stall event.
<u>Condition 2</u> Take-off or departure approach-to-stall with partial flaps.	The scenario will be conducted during take-off and/or departure at an altitude that will allow for a recovery. For unexpected approach-to-stall on departure prior to flaps being fully retracted crew distractions may be used as mentioned above.	Often pilots attempt recovery with no loss of altitude and without recognizing the importance of pitch control and AOA.
<u>Condition 3</u> Landing configuration approach-to-stall.	Implement scenarios that result in an unexpected approach-to-stall during an approach.	The trainee should be able to recognize the stall warning and immediately perform the stall recovery procedure, demonstrate a deliberate and smooth reduction of AOA and then commence a missed approach. Positive recovery from the aerodynamic stall or approach-to-stall takes precedence over minimizing altitude loss.
<u>Condition 4</u> Stick pusher demonstration only (if equipped).	In level flight at idle thrust with the autoflight system set up to maintain altitude, introduce an event or reduce airspeed to less than adequate for manoeuvring flight allowing the stick pusher to activate.	Often pilots attempt recovery by suddenly applying immediate back pressure to overcome the life-saving nose-down elevator force being applied by the stick pusher.

5. Pilot factors

Training Conditions	Training Description	Rationale
Loss of pilot situation awareness leading to LOC-I.	Highlight how a loss of situation awareness can allow a flight path degradation leading to LOC-I (e.g. disengagement of autothrottles; misusing pitch, roll or yaw trim; engine loss; airspeed loss from international standard atmosphere deviation when operating at too high an altitude; forgetting to re-engage autothrottle after making an entry in an engine monitoring log).	Recent accidents have shown a failure of the flight crews to effectively monitor their aeroplane energy state and/or understand system logic.

6. Energy management

Training Conditions	Training Description	Rationale
<u>Engine performance/power</u> Demonstrate acceleration between two speeds of which the aeroplane is capable at low, medium and high altitude; for example, 200 to 250 knots at low, medium and high altitude (where those speeds correspond to Mach numbers at high altitude).	Observe time to reach target speed in level flight and in descending flight.	Demonstrate and highlight the performance decrement at higher altitudes.
<u>Aeroplane acceleration</u> Demonstrate acceleration performance from the second regime (back side of the power curve) at low altitude and high altitude.	Observe capability and determine the only option (if available thrust will not permit acceleration, the only option will be to accelerate by descending).	Demonstrate the potentially different recovery technique from flight in the second regime at low altitude versus high altitude.
<u>High-altitude engine power management</u> Demonstrate the relationship between maximum cruise/climb/continuous thrust	Highlight to the trainee the practical relationship between available engine power modes at high altitude.	Teach the trainee that TOGA is not likely to produce significantly more thrust at maximum altitude than maximum cruise thrust, for

and takeoff/go-around (TOGA) thrust at high altitude.		example.
<u>High-altitude energy management</u> Demonstrate acceleration capabilities through descent versus power application.	The objective is to understand the advantage of using elevator instead of thrust levers to regain the desired energy state (observe a rapid acceleration during descent versus the slow acceleration previously demonstrated with only the use of power).	Demonstrate the inability of the aeroplane to power out of a high-altitude slowdown.

7. Flight control effectiveness

Training Conditions	Training Description	Rationale
Demonstrate a defined flight control deflection at a fixed speed V_c at both low altitude and high altitude.	Demonstrate how a fixed flight control deflection outcome is different at low and high altitude (for example, exercises a 2-cm deflection of pitch control at a common V_c and at both low altitude and maximum altitude and observe the difference in aeroplane reaction).	Trainee appreciation of high-altitude response differences to same flight control input.

8. Buffet

Training Conditions	Training Description	Rationale
Demonstrate high-speed buffet and low-speed buffet.	Demonstrate the aeroplane behaviour at the low- and high-speed buffet entry. Highlight how loading the aeroplane in a high-speed buffet will aggravate the condition.	Teach the trainee to correctly identify the low- and high-speed buffet with corresponding recovery techniques.

9. Roll capabilities

Training Conditions	Training Description	Rationale
Demonstrate roll rate performance of the aeroplane at different speeds and	Demonstrate roll response at V_{ref} versus clean configuration speed, and at 250 knots	Demonstrate what the full roll capabilities of the aeroplane are.

different configurations and with flight spoilers retracted/extended if a difference exists (e.g. on the B727).	indicated airspeed (IAS), Vmo and Mmo.	
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10. Pitch capabilities

Training Conditions	Training Description	Rationale
Demonstrate pitch-rate performance of the aeroplane at different speeds and different configurations and with flaps retracted/extended. Also, show pitch-rate performance at an aft CG versus a foreword CG if flight qualities are significantly different.	Demonstrate pitch response at Vref versus clean configuration speed, and at 250 knots IAS, Vmo and Mmo.	Demonstrate the full pitch capabilities of the aeroplane.

附錄六、 Nose High Recovery Recommendation

Recognize and confirm the developing situation. Announce: “ NOSE HIGH ” ¹	
Pilot Flying (PF)	Pilot Monitoring (PM)
Autopilot – DISCONNECT ²	MONITOR airspeed and attitude throughout the recovery and ANNOUNCE any continued divergence.
A/THR – OFF Note: <i>A/THR stands for autothrottle/autothrust.</i>	
PITCH – Apply as much nose-down control input as required to obtain a nose-down pitch rate.	
THRUST – Adjust (if required)	
ROLL – Adjust (if required) not to exceed 60°	
When airspeed is sufficiently increasing: RECOVER to level flight ³ Note: <i>Recovery to level flight may require use of pitch trim.</i>	
<div>1. If the autopilot and/or A/THR are responding correctly, it may not be appropriate to decrease the level of automation while assessing whether the divergence is being stopped.</div> <div>2. A large out-of-trim condition could be encountered when the autopilot is disconnected.</div> <div>3. Avoid stall because of premature recovery or excessive g-loading.</div>	

附錄七、 Nose Low Recovery Recommendation

Recognize and confirm the developing situation. Announce: “NOSE LOW” ¹	
Pilot Flying (PF)	Pilot Monitoring (PM)
Autopilot – DISCONNECT ²	MONITOR airspeed and attitude throughout the recovery and ANNOUNCE any continued divergence.
A/THR – OFF Note: A/THR stands for autothrottle/autothrust.	
RECOVER from stall if required	
ROLL in the shortest direction to wings level ³	
Thrust and drag – adjust (if required)	
Recover to level flight ⁴ Note: Recovery to level flight may require use of pitch trim.	
<ol style="list-style-type: none">1. If the autopilot and/or A/THR are responding correctly, it may not be appropriate to decrease the level of automation while assessing if the divergence is being stopped.2. A large out-of-trim condition could be encountered when the autopilot is disconnected.3. It may be necessary to reduce the g-loading by applying forward control pressure to improve roll effectiveness.4. Avoid stall because of premature recovery or excessive g-loading.	
WARNING: Excessive use of pitch trim or rudder may aggravate the upset situation or may result in high structural loads.	

附錄八、 UPRT Instructor training elements

<i>UPRT instructor training elements</i>	<i>UPRT academic instructor</i>	<i>UPRT aeroplane instructor</i>	<i>UPRT FSTD instructor</i>
Comprehensive knowledge of all applicable training elements (refer to 附錄一)*	•	•	•
Training platforms (aeroplanes and devices)			
1) Limitations of training platform		•	•
2) Operation of IOS and debriefing tools			•
Review of LOC-I accidents/incidents	•	•	•
Energy management factors*	•	•	•
Disorientation	•	•	•
Workload management	•	•	•
Distraction	•	•	•
OEM recommendations*	•		•*
UPRT recognition and recovery strategies*	•	•	•
How to do a flight risk assessment (aeroplane)	• (as applicable)	•	
Recognition of trainee errors	•	•	•
Intervention strategies		•	
Aeroplane type-specific characteristics*	•	•	•
Operating environment	•	•	•
How to induce the startle factor		•	•
Value and benefits of demonstration	•	•	•
How to assess pilot performance using core competencies if conducting CBT (competency based training)	•	•	•
* OEMs may at some point develop differing guidance regarding procedures to address these areas of training which may deviate from the material provided herein. In all cases, whenever type-specific UPRT is being conducted, training organizations should provide procedural training which conforms to the appropriate aeroplane flight manual.			