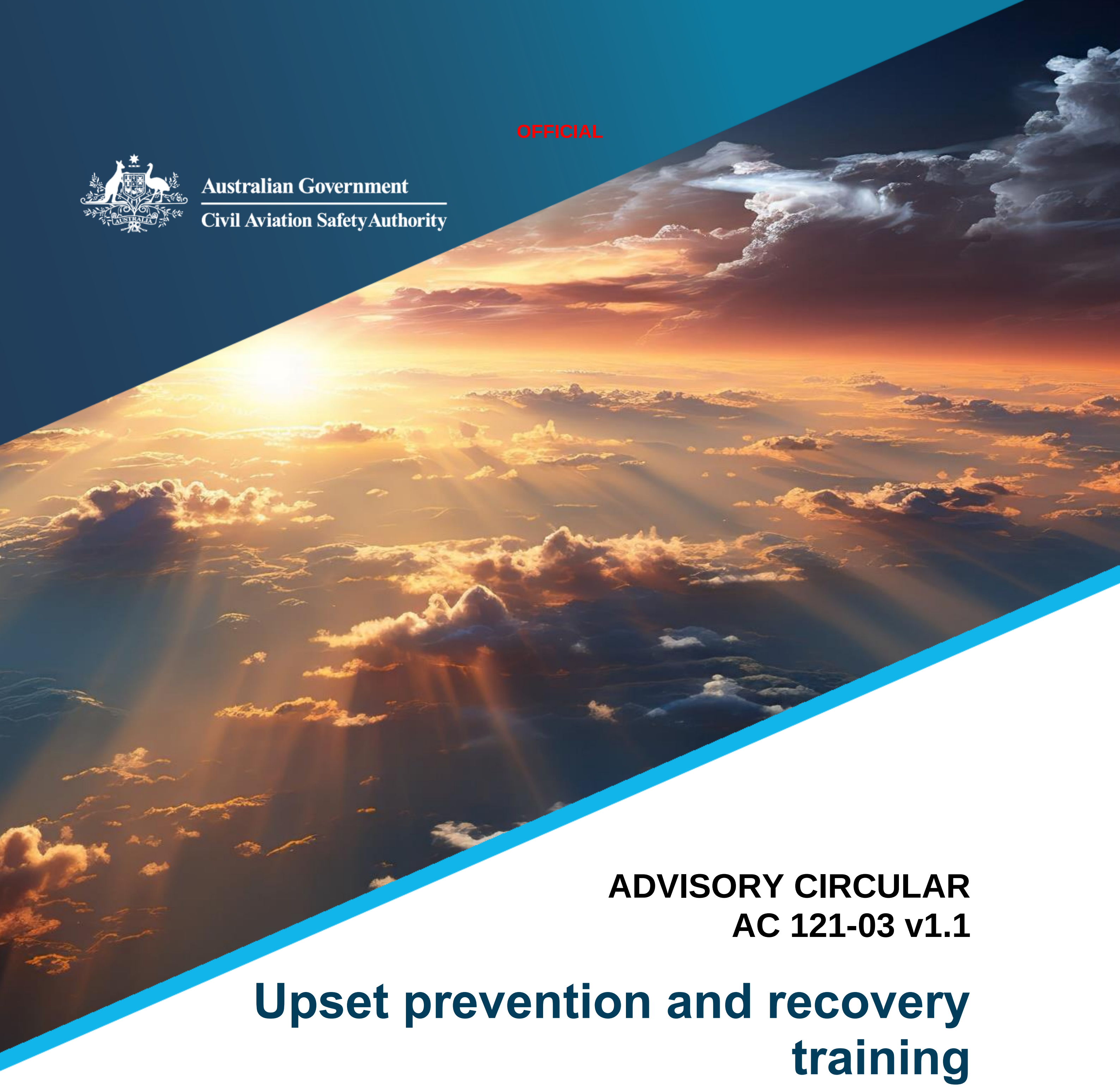

Australian Government
Civil Aviation Safety Authority

ADVISORY CIRCULAR
AC 121-03 v1.1

Upset prevention and recovery training

File ref: D24/332662

March 2025

Advisory circulars are intended to provide advice and guidance to illustrate a means, but not necessarily the only means, of complying with the Regulations, or to explain certain regulatory requirements by providing informative, interpretative and explanatory material.

Advisory circulars should always be read in conjunction with the relevant regulations.

Audience

The information in this Advisory Circular (AC) is expected to be of general interest to all aeroplane operators and training providers and of specific interest to:

- Air Operator's Certificate (AOC) holders operating aeroplanes of 30 seats or more, or above 8,618 kgs Maximum Take-Off Weight (MTOW) under Parts 119, 121, 135 and 138 of the *Civil Aviation Safety Regulations 1998 (CASR)*
- training providers conducting operations in accord with Parts 141 and 142 of CASR
- other organisations using type rated aircraft and required to have a training and checking system.

Purpose

The contents of this AC reflect CASA's pre-determined acceptable means of compliance (AMC) with requirements within the civil aviation legislation for certain aeroplane operators and training providers to conduct upset prevention and recovery training (UPRT) programs.

Note: At the time of publishing v1.1 of this AC, the only legislative requirements for the conduct of UPRT are within the Part 121 Manual of Standards (MOS).

Operators and training providers may propose alternative means of compliance (AMOC). However, they will need to provide significant explanation of how the proposed AMOC achieves equivalent safety outcomes and the proposed AMOC would need to ensure it encompassed the areas covered under each chapter heading in this AC.

This AC was written to provide guidance on general and specific elements of UPRT including:

- recognition and prevention of developing undesired and upset conditions to ensure that pilots are trained in the correct recovery responses
- instructor training on the uses and limitations of simulation
- pilot academic training on aerodynamic and human factors.

For further information

For further information or to provide feedback on this AC, visit CASA's contact us page.

Unless specified otherwise, all subregulations, regulations, Divisions, Subparts and Parts referenced in this AC are references to the *Civil Aviation Safety Regulations 1998 (CASR)*.

Status

This version of the AC is approved by the National Manager, Flight Standards Branch.

Note: Changes made in the current version are annotated with change bars.

Table 1: Status

Version	Date	Details
v1.1	March 2025	Minor changes to update legislation references and formatting.
v1.0	December 2020	Initial AC.

Contents

Acknowledgement of Country

The Civil Aviation Safety Authority (CASA) respectfully acknowledges the Traditional Custodians of the lands on which our offices are located and their continuing connection to land, water and community, and pays respect to Elders past, present and emerging.

Artwork: James Baban.

1 Reference material

1.1 Acronyms

The acronyms and abbreviations used in this AC are listed in the table below.

Table 2: Acronyms

Acronym	Description
AC	advisory circular
AMC	acceptable means of compliance
AMOC	alternative means of compliance
AOA	angle of attack
AUPRTA	airplane upset prevention and recovery training aid
AURTA	airplane upset recovery training aid
CASR	*Civil Aviation Safety Regulation 1998*
CBT	*competency and competency-based training*
CPL	Commercial Pilot licence
CRM	crew resource management
CTPP	*cyclic training and proficiency program*
EASA	*European Aviation Safety Agency*
EBT	*evidence based training*
EET	*extended envelope training*
FAA	Federal Aviation Administration
FSTD	flight simulation training device
FS	flight simulator
FTD	flight training device
ICAO	International Civil Aviation Organization
IOS	instructor operating station
LOCART	loss of control avoidance and recovery training
LOC-I	loss of control in flight
MPL	Multi-crew Pilot Licence
MBT	manoeuvre-based training
MOS	Manual of Standards
NTSB	National Transportation Safety Board

Acronym	Description
QTG	Qualification Test Guide
OEM	original equipment manufacturer
SBT	scenario based training
SARPs	standards and recommended procedures
SMS	safety management system
SOC	statement of compliance
UAS	undesired aircraft state
UPRT	upset prevention and recovery training
VTE	valid training envelope

1.2 Definitions

Terms that have specific meaning within this AC are defined in the table below. Where definitions from the civil aviation legislation have been reproduced for ease of reference, these are identified by 'grey shading'. Should there be a discrepancy between a definition given in this AC and the civil aviation legislation, the definition in the legislation prevails.

Table 3: Definitions

Term	Definition
aerodynamic stall	An aerodynamic loss of lift caused by exceeding the critical angle of attack (synonymous with the term “stall”).
aeroplane upset	Traditionally, an upset has been defined as exceeding fixed parameters (unintentional pitch beyond +25 or -10 degrees or bank angles greater than 45 degrees or speed inappropriate for the conditions). The AUPRTA Revision 3 (see below) defines an upset as: • “An undesired airplane state characterized by unintentional divergences from parameters normally experienced during operations. • An airplane upset may involve pitch and/or bank angle divergences as well as inappropriate airspeeds for the conditions” • Deviations from the desired airplane state will become larger until action is taken to stop the divergence. • Return to the desired airplane state can be achieved through natural airplane reaction to accelerations, auto-flight system response or pilot intervention. **Note:** Undesired airplane state is defined in the Line Operations Safety Audit (LOSA) manual, ICAO Doc 9803, 1st edition. It is important to understand that there is a relationship to the definitions of ‘stall’ and ‘upset’. Although not all aeroplane upset occurrences involve an aerodynamic stall, an unintentional stall is a form of upset.
Airplane Upset Recovery Training Aid	The Airplane Upset and Recovery Training Aid (AURTA) was developed by ICAO and industry representatives and released in its second edition in 2008. This

Term	Definition
	publication is foundational to UPRT programs and, as revised, is the core training and implementation document on UPRT referred to in ICAO Doc 10011. The third edition, Revision 3, was created by working groups from Airbus, Avions de transport régional (ATR), Boeing, Bombardier, Embraer and ICAO and added to the coverage provided by Revision 2. In addition the name was changed to Airplane Upset, Prevention and Recovery Training Aid (AUPRTA) in recognition of the importance of the Prevention task and the re-defining of the term “upset” to include the over-arching concept of undesired aircraft state.
alpha/beta plot	An FSTD Alpha/Beta plot provides the instructor with an Instructor Operating Station (IOS) display of the two-axis envelope provided by the wing angle of attack (Alpha) on the vertical axis and the degrees of sideslip (Beta) on the horizontal axis. This display shows the FSTD valid training envelope (VTE). **Note:** In the case of Airbus as a data provider, the FSTD validation envelope is represented as alpha-beta plot for the high lift configurations. For the clean configuration, Airbus provide two envelopes: one alpha-Mach and one beta-Mach. The reason is that the envelope becomes narrower when Mach number increases, and Airbus did not feel that an alpha-beta plot would have been as useful.
angle of attack	The angle between the oncoming air, or relative wind, and a reference line on the airplane or wing.
civil aviation legislation	See section 3 of the *Civil Aviation Act 1988*.
competency based training and assessment	Competency is a combination of skills, knowledge and attitudes required to perform a task to the prescribed standard. Competency-Based Training and Assessment is characterised by a performance orientation, the development of training to specified performance standards and the development of assessments to determine whether competencies have been achieved. .
competency standards	A level of performance that is defined as acceptable when assessing whether or not competency has been achieved.
correct trend and magnitude	A tolerance representing the appropriate general direction of movement of the aeroplane, or part thereof, with appropriate corresponding scale of forces, rates, accelerations, etc. This concept is used during initial FSTD evaluations especially where only a generic or representative level of fidelity is required. Refer to ICAO Doc 9625.
crew resource management	Effective use of all available resources: human resources, hardware, and information.
critical angle of attack	The angle of attack that produces the maximum coefficient of lift beyond which an aerodynamic stall occurs.
cyclic training and proficiency program	This term “cyclic” was associated with the former Civil Aviation Order (CAO) 40.2.1 and related to a continuing program of instrument rating recency and proficiency. For the purposes of certain provisions of Part 61 of CASR, the current equivalent term is ’an approved training and checking system’ with approval under the provisions of 61.040. Cyclic elements are also associated

Term	Definition
	with Part 121 recurrent training related to major system failures in section 12.20 of the Part 121 MOS.
deep stall	A Deep Stall, sometimes referred to as a Super Stall, is a particularly dangerous form of stall that results in a substantial reduction or loss of elevator authority making normal stall recovery actions ineffective. In many cases, an aircraft in a Deep Stall might be unrecoverable. This phenomenon affects certain aircraft designs, most notably those with a T-tail configuration. Aircraft with a T-tail design are often configured with a Stick Pusher system to help prevent the mainplane angle of attack from reaching a value that could result in a Deep Stall.
developing upset condition	Any time the aeroplane is diverging from the intended flightpath and has not yet exceeded the parameters or condition defining an upset.
distraction	The diversion of attention away from the primary task of flying.
engine and airframe icing	Ice accrual on engines and aerodynamic surfaces that can affect the performance and/or behaviour of these systems, and which in the case of lifting surfaces, can influence the stall angle-of-attack.
engineering simulation	An integrated set of mathematical models representing a specific aircraft configuration, typically used by an aircraft manufacturer or other approved data supplier for a wide range of engineering analysis tasks including engineering design, development and certification. It is also used to generate data for checkout, proof-of-match/validation and other training FSTD data documents. In cases where the use of engineering simulation data is envisaged, a complete proposal should be presented to the appropriate Civil Aviation Authorities (CAAs). Such a proposal would contain evidence of the engineering simulation data supplier's past achievements in high-fidelity modelling. Aircraft manufacturers or other data suppliers must be able to demonstrate that the predicted changes in aircraft performance are based on acceptable aeronautical principles with proven success history and valid outcomes. This must include comparisons of predicted and flight test validated data. Refer EASA CS-FSTD (A) AMC7 FSTD(A).300 and Attachment B to Part II of ICA0 Doc 9625 for discussions on engineering simulation validation data.
engineering simulator	A simulator developed by an aircraft manufacturer or other approved data supplier which typically includes a full-scale representation of the simulated aircraft flight deck, operates in real-time and can be flown by a pilot to subjectively evaluate the simulation. It contains the engineering simulation models, which are also released by the aircraft manufacturer or other approved modeler to the industry for FSTDs. The engineering simulator may or may not include actual on-board system hardware in lieu of software models.
evidence-based training	Training and assessment based on operational data that is characterized by developing and assessing the overall capability of a trainee across a range of core competencies rather than by measuring the performance of individual events or manoeuvres. The core principle of EBT is training to competency. It is based on a systematic approach through which assessment and training are based on the measurement of how well a trainee demonstrates a set of competencies. Refer to ICAO Docs 9868 and 9995.

Term	Definition
extended envelope training	For the FAA (refer FAR 121.423) this includes the following manoeuvres conducted in a Level C or higher flight simulator which include UPRT manoeuvres but also include additional elements: • Manually controlled slow flight • Manually controlled loss of reliable airspeed • Manually controlled instrument departure and arrival • Upset recovery manoeuvres • Recovery from bounced landing • Instructor-guided hands on experience of recovery from full stall and stick pusher activation (if equipped).
flight simulation training device	means: a. a qualified flight simulator; or b. a qualified flight training device; or c. a synthetic trainer that is approved under Civil Aviation Order 45.0; or d. a device that meets the qualification standards prescribed by a legislative instrument under regulation 61.045; or e. a device that is qualified (however described) by the national aviation authority of a recognised foreign State. **Note:** CAO 45.0 has been withdrawn and is no longer in force. Paragraph "c" of this definition will be deleted at the next available regulation amendment opportunity. FSD-2 standards will be prescribed under paragraph "d". The relevant legislative instrument will be available on the CASR Part 60 and 61 webpages on the CASA website once it is finalised. As of publishing v1.1 of this AC, this instrument had not yet been published.
flight simulator	for a specific type (or a specific make, model and series) of aircraft: a. means a simulator that simulates the aircraft in ground and flight operations and comprises: i a full size replica of the flight deck of the aircraft; and ii a visual system providing an out of the flight deck view; and iii a force cueing motion system; and b. includes the necessary software and equipment, and the way that the equipment is interconnected. **Note:** Used for aircraft-specific flight training under rules of the appropriate NAA. Under these rules, relevant aircraft systems must be fully simulated, and a comprehensive aerodynamic model is required.
flight training device	for a specific type (or a specific make, model and series) of aircraft: a. means a device that: i simulates the aircraft in ground and flight operations to the extent of the systems installed in the device; and ii comprises a full size replica of the instruments, equipment, panels and controls in an open flight deck area, or an enclosed flight deck, of the aircraft; and iii does not, in every respect, simulate the aircraft in ground and flight operations; and b. includes the necessary software and equipment, and the way that the equipment is interconnected.

Term	Definition
	Note: Used for either generic or aircraft specific flight training. Comprehensive flight, systems, and environmental models are required but a representative motion model is not a requirement.
flightpath management	Active manipulation, using either onboard avionics systems or manual handling, to command the aircraft flight controls to direct the aircraft along a desired trajectory in the lateral and vertical planes.
footprint test	Where no OEM data is available for the development of some parts of a flight model (e.g. for expansions to the valid training envelope for UPRT purposes) regulatory authorities may make provision for subjective evaluations by a suitably qualified SME for some parts of an evaluation. This evaluation can be used to develop a “footprint test”, generated from recording the parameters involved in the SME pilot evaluation of certain manoeuvres assessed on the basis of “Correct Trend and Magnitude” (CT &M), aimed at seeing whether a non-OEM based model is satisfactorily close to the aircraft concerned. This recording will preferably be made automatically and will be the benchmark basis for future evaluations of the device concerned in the areas referenced in the original SME evaluation. Footprint tests are intended for use in recurrent evaluations at least to ensure repeatability. Note that the use of CT&M is not to be taken as an indication that certain areas of simulation can be ignored. It is imperative that the specific characteristics are present, and incorrect effects would be unacceptable.
FSTD validation envelope	The FSTD validation envelope refers to the domain in which the FSTD has been demonstrated as being capable of being flown with a degree of confidence that the FSTD responds similarly to the aeroplane. This is the same as the FSTD training envelope. For UPRT events this envelope can be further divided into three subdivisions: • Flight test validated region. • Wind tunnel and/or analytical region. • Extrapolated region. A Statement of Compliance is required that defines the source data used to construct the FSTD validation envelope. A UPRT instructor should be provided with tools at the IOS to ensure that the training mission takes place within the validation envelope. The IOS information should be in the form of an alpha/beta envelope providing the instructor real-time feedback on the simulation during a manoeuvre.
full stall	Any single, or combination of, the following characteristics: • an uncommanded nose-down pitch that cannot be readily arrested, which may be accompanied by an uncommanded rolling motion; • buffeting of a magnitude and severity that is a strong and effective deterrent to further increase in AOA; • no further increase in pitch occurs when the pitch control is held at the full aft stop for 2 seconds, leading to an inability to arrest descent rate; • activation of a stick pusher, Refer to FAA AC 120-109A.

Term	Definition
full-stall training	Training manoeuvres in the recognition cues and recovery procedures from a fully stalled flight condition (including recovery from a stick pusher activation) at angles of attack beyond the activation of the stall warning system. Full stall training is an instructor-guided, hands-on experience of applying the stall recovery procedure and will allow the pilot to experience the associated flight dynamics from stall onset through the recovery". Refer to FAA AC 120-109A.
instructor operating station	The computer interface panel between the FSTD instructor and the FSTD. For an instructor to provide feedback to the trainee during UPRT sessions, additional information must be accessible at an IOS display showing the fidelity of the simulation, the magnitude of flight control inputs and aeroplane operational limits. The training provider must ensure that UPRT instructors have been properly trained to interpret the data provided by these IOS feedback tools.
loss of control in flight	A categorization of an accident or incident resulting from a deviation from the intended flightpath.
manoeuvre-based training	Training that focuses on a single event or manoeuvre. For example, recovery from an inadvertent excursion into the post stick shaker regime. This is a foundational level of training and typically precedes or is integrated with scenario based training.
negative training	Training which unintentionally introduces incorrect information or invalid concepts, which could actually decrease rather than increase safety.
negative transfer of training	Negative transfer of training refers to the inappropriate generalization of a knowledge or skill to a situation or setting on the job that does not equal the training situation or setting.
operational flight envelope	Aeroplanes are designed to be operated in well-defined envelopes of airspeed and altitude. Within these limits, the airplanes have been demonstrated to exhibit safe flight characteristics. OEM and regulatory test pilots have evaluated the characteristics of airplanes in conditions that include inadvertent exceedances of these operational flight envelopes to demonstrate that the airplanes can be returned safely to the operational flight envelopes.
original equipment manufacturer (OEM)	OEM is a commonly used abbreviation referring to the source of a particular aircraft component including the aircraft as a whole, flight test data, software and subsequent modifications. OEM provided data and recommendations play a very significant role in UPRT. The guidance on UPRT in ICAO Doc 10011 and the AURTA has been influenced by the recommendations of the major OEMs of transport aeroplanes. These OEMs may develop specific guidance for their types. In such instances, OEM recommendations take precedence.
prevention	Actions and awareness to avoid any divergence from a desired aeroplane state.

Term	Definition
quality assurance	Quality assurance is the activity of providing, through an audit process, the evidence needed to establish that all activity is being conducted in accordance with the applicable requirements, standards and procedures. It should be carried out by a unit which is fully independent of the executive management who have responsibility for delivering the function being assessed. For UPRT, the QA system includes all the planned and systematic actions necessary to provide adequate confidence that all activities satisfy given standards and requirements, including the ones specified by the training organization in relevant manuals.
quality management system	A quality management system should be established and maintained by the FSTD operator to ensure the correct maintenance and performance of the FSTD. The quality management system may be based upon established industry standards and must be approved by CASA. A configuration management system will be required by the QMS and should be established and maintained to ensure the continued integrity of the hardware and software as from the original qualification standard, or as amended or modified through the same system. Quality management focuses on the means to achieve product or service quality objectives through the use of four key components: quality planning; quality control; quality assurance; and quality improvement.
quality system	Quality system is an over-arching term describing the aggregate of all the organization’s activities, plans, policies, processes, procedures, resources, incentives and infrastructure working in unison towards a total quality management approach. It requires an organizational construct complete with documented policies, processes, procedures and resources that underpin a commitment by all employees to achieve excellence in product and service delivery through the implementation of best practices in quality management. **Note:** This definition is specific to ICAO Doc 10011.
safety management system	A systematic approach to managing safety, including the necessary organizational structures, accountability, responsibilities, policies and procedures. Refer to ICAO Doc 9859.
scenario based training	Training integrated into realistic scenarios rather than as stand-alone manual handling events. For example: a scenario involving crew distraction and an unexpected stall event conducted during take-off and/or departure. SBT would normally be used after a pilot demonstrates proficiency in manoeuvre-based training and during advanced stages of training, such as upgrade training and recurrent training.
stall	An aerodynamic loss of lift caused by exceeding the critical AOA. A stalled condition can exist at any altitude and airspeed, and may be recognised by continuous stall warning activation accompanied by at least one of the following: • Buffeting, which could be heavy at times • Lack of pitch authority and/or roll control; and • Inability to arrest the decent rate.

Term	Definition
	Transport aircraft are typically required to be equipped with some form of stall protection system. The indication system may include a stick shaker. Many types also incorporate a stick pusher. Stall recognition systems are typically unable to take account of the effect of contaminated surfaces and the effect of non-symmetrical contamination. The principal source of guidance on stall indications and responses is the OEM. Also see "Full Stall" definition above.
stall event	An occurrence whereby the aeroplane experiences conditions associated with an approach to stall or an aerodynamic stall.
stall identification angle of attack	The stall identification angle of attack is defined as the point where the behaviour of the airplane gives the pilot a clear and distinctive indication through the inherent flight characteristics or the characteristics resulting from the operation of a stall identification device (e.g., a stick pusher) that the airplane has stalled. Refer to Attachment 1 to Appendix A, FAR Part 60.
stall recovery procedure	The manufacturer-approved aeroplane specific stall recovery procedure. If a manufacturer-approved stall recovery procedure does not exist, the aeroplane specific stall recovery procedure may be developed by the operator based on the stall recovery template contained in the FAA advisory circular, AC 120-09A or other similar EASA document.
stall warning	ICAO Doc 10011 defines stall warning as a natural or synthetic indication provided when approaching a stall that may include one or more of the following indications: • aerodynamic buffeting (some aeroplanes will buffet more than others) • reduced roll stability and aileron effectiveness • visual or aural cues and warnings • reduced elevator pitch authority • inability to maintain altitude or arrest rate of descent and • stick shaker activation (if installed).
standards and recommended practices	Technical specifications adopted by ICAO in order to achieve "the highest practicable degree of uniformity in regulations, standards, procedures and organization in relation to aircraft, personnel, airways and auxiliary services in all matters in which such uniformity will facilitate and improve air navigation".
startle	An uncontrollable, automatic muscle reflex, raised heart rate, blood pressure, etc., elicited by exposure to a sudden, intense event that violates a pilot's expectations.
statement of compliance (SOC)	A declaration that specific requirements have been met. For a statement relating to the development of a simulator flight model the SOC should refer to sources of information and show compliance rationale to explain how the referenced material is used, applicable mathematical equations and parameter values and conclusions reached. As an example, traditionally, models based on flight test collected data have been the preferred data source for the objective evaluation required for FSTD qualification. It is recognized, however, that strict time-history-based evaluation against flight test data may not adequately validate the aerodynamics model. As a result, the SOC-based approach for evaluating the aerodynamics model at

Term	Definition
	angles of attack approaching the stall was implemented to allow for the aerodynamics modeller and data provider to develop enhanced exemplar stall models which are based upon generally accepted engineering and scientific principles.
stick pusher	A device that, automatically applies a nose down movement and pitch force to an aeroplane's control columns, to attempt to decrease the aeroplane's AOA. Device activation may occur before or after aerodynamic stall, depending on the aeroplane type.
subject matter expert pilot (SME)	In order to qualify as an acceptable SME to evaluate an FSTD's stall characteristics in the absence of objective testing based on OEM flight test data, both EASA and the FAA require an SME pilot to meet the following requirements: • Has held a type rating/qualification in the aircraft being simulated; • Has direct and significant experience in conducting stall manoeuvres in an aircraft that shares the same type rating as the make, model, and series of the simulated aircraft. This stall experience must include hands on manipulation of the controls at angles of attack sufficient to identify the stall (e.g., deterrent buffet, stick pusher activation, etc.) through recovery to stable flight; • Must be familiar with the intended stall training manoeuvres to be conducted in the FSTD (e.g., general aircraft configurations, stall entry methods, etc.) and the cues necessary to accomplish the required training objectives. • An SME cannot be self-proclaimed. The designation of an SME is related to a certain type of aeroplane and manoeuvres and is linked to the SME's recency of experience in the manoeuvres on the aeroplane type. Refer to the FAA's NSP Guidance Bulletin 14-01 for description of how an SME pilot is involved in the Statement of Compliance, confirming the subjective evaluation of the FSTD by the SME pilot possessing direct knowledge of the aircraft's stall characteristics.
surprise	An unexpected event that violates a pilot's expectations and can affect the mental processes used to respond to the event.
train to proficiency	Training designed to achieve performance objectives, providing sufficient assurances that the trained individual is capable to consistently carry our specific tasks safely and effectively.
transfer of training	The ability of a trainee to apply knowledge, skills, and behaviour acquired in one learning environment (e.g., classroom or FSTD) to another environment (e.g., flight). In this context, "negative transfer of training" refers to the inappropriate transfer of knowledge or skills to line operations.
undesired aircraft state	Undesired aircraft states are flight crew-induced aircraft position or speed deviations, misapplication of flight controls, or incorrect systems configuration, associated with a reduction in margins of safety. Undesired aircraft states that result from ineffective threat and/or error management may lead to compromising situations and reduce margins of safety in flight operations. Often considered at the cusp of becoming an incident or accident, undesired aircraft states must be managed by flight crews (ICAO Doc 9868). The Line Operations Safety Audit (LOSA) manual, ICAO Doc 9803, 1st edition defines an "Undesired Aircraft State" as: • "An outcome in which the aircraft is unnecessarily placed in a

Term	Definition
	compromising situation that poses an increased risk to safety. An "Undesired Aircraft State" occurs when the flight crew places the aircraft in a situation of unnecessary risk. For instance, an altitude deviation is an Undesired Aircraft State that presents unnecessary risk. An Undesired Aircraft State may occur in response to a crew action or inaction (error)". Also refer to definition of Aeroplane Upset (above).
upset prevention and recovery training (UPRT)	A program of theory and practical training providing exposure to aeroplane upset conditions as defined in the Airplane Upset Prevention and Recovery Training Aid Revision 3.
valid training envelope	This refers to the region within which a simulator has been verified as offering adequate fidelity for training and within which UPRT activity should take place. This includes the areas of the simulation model validated by the flight test and wind tunnel data.
v-n diagram	The V-n diagram on UPRT compliant Instructor Operating Stations depicts the variation of load factor with speed. The V-n diagram offers a visual depiction of the boundary of safe operation beyond which there is the risk of structural damage.

1.3 References

Legislation

Legislation is available on the Federal Register of Legislation website https://www.legislation.gov.au/

Table 4: Legislation references

Document	Title
Part 60 of CASR	Synthetic Training Devices
Part 61 of CASR	Flight Crew Licencing
Part 61 MOS	Flight Crew Licencing Manual of Standards
Part 91 of CASR	General operating and flight rules
Part 119 of CASR	Australian air transport operators—certification and management
Part 121 of CASR	Australian air transport operations — larger aeroplanes
Part 121 MOS	Australian air transport operations — larger aeroplanes
Part 135 of CASR	Air transport operations - small aeroplanes
Part 141 of CASR	Recreational, private and commercial pilot flight training, other than certain integrated training courses
Part 142 of CASR	Integrated and multi-crew pilot flight training, contracted recurrent training and contracted checking

International Civil Aviation Organization documents

International Civil Aviation Organization (ICAO) documents are available for purchase from http://store1.icao.int/

Many ICAO documents are also available for reading, but not purchase or downloading, from the ICAO eLibrary (https://elibrary.icao.int/home).

Table 5: ICAO references

Document	Title
ICAO Doc 9625	The Manual of Criteria for the Qualification of Flight Simulation Training Devices (ICAO Doc 9625 4th Edition, 2015) addresses the use of Flight Simulation Training Devices (FSTDs) representing aeroplanes (Volume I) and helicopters (Volume II). The methods, procedures and testing standards contained in this manual are the result of the experience and expertise provided by Civil Aviation Authorities (CAA) and aeroplane and FSTD operators and manufacturers. The 4th Edition of Volume 1 includes UPRT requirements for FSTDs.
ICAO Doc 9683	The Human Factors Training Manual (ICAO Doc 9683) provides guidance material for the design of training programs to develop knowledge and skills in human performance. The material in this manual is essentially an edited compilation of the series of ICAO Human Factors digests. Its target audience includes senior training, operational and safety personnel in industry and regulatory bodies.
ICAO Doc 9803	Line Operations Safety Audit (LOSA) manual, International Civil Aviation Organization (ICAO) Doc 9803, 1st edition.
ICAO Doc 9841	The Manual on the Approval of Training Organizations (Doc 9841) provides information and guidance on the implementation of the Standards of Annex 1 (Personnel Licensing) related to the approval of training organizations. The first edition was focused exclusively on flight training entities. The latest edition is significantly expanded in scope and now deals with the approval of training organizations which provide training services for the issue of an aviation personnel licence or rating. This manual should be used in conjunction with Annex 1.
ICAO Doc 9859	ICAO Safety Management Manual (SMM).
ICAO Doc 9868	Guidance material on the different means used to assess competence can be found in the Attachment to Chapter 2 of the Procedures for Air Navigation Services — Training (ICAO Doc 9868). This manual specifies training procedures for aeronautical personnel. It contains procedures for the development and implementation of competency-based training programs and the methodologies to successfully introduce aeroplane UPRT at the commercial pilot and MPL levels, as well as providing UPRT in a flight simulation training device at the commercial air transport pilot and type rating level.
ICAO Annexes 1, 6 and 19	These have been revised to include UPRT and references to related ICAO material.
ICAO Doc 9995	Guidance material to design flight crew training programs can be found in the ICAO Doc 9995, the Manual of Evidence-based Training.
ICAO Doc 10011	Guidance on UPRT can be found in the Manual on Aeroplane Upset Prevention and Recovery Training (ICAO Doc 10011). ICAO has developed training requirements for UPRT on-aeroplane training at the commercial pilot and multi-crew pilot level and training in a flight simulation training device at the airline transport pilot and type rating level. These are promulgated in Annexes 1 and 6 as well as in ICAO Doc 9868, with an applicability date of 13 November 2014.

Document	Title
	Note: ICAO is considering revisions to Doc 10011 to increase the focus on competency based training.
ICAO Doc 10070 (in draft form as at 2016)	ICAO Manual on the Competencies of Civil Aviation Safety Inspectors.
AURTA and AUPRTA	The Airplane Upset and Recovery Training Aid (AURTA) was developed by ICAO and industry representatives and was released in its second edition in 2008. This publication is foundational for the development of UPRT programs and, along with later revisions, is the core training and implementation document on UPRT, ICAO Doc 10011. Revision 3 (released in 2017) was created by working groups from Airbus, ATR, Boeing, Bombardier, Embraer and ICAO and saw the name changed to Airplane Upset, Prevention and Recovery Training Aid (AUPRTA) in recognition of the importance of the Prevention task and to include transport category straight wing turbo-prop aeroplanes and regional jet types. www.icao.int/safety/LOCI/AUPRTA/index.html A .pdf version may be found at: https://skybrary.aero/bookshelf/books/4173.pdf

Advisory material

CASA's advisory materials are available at https://www.casa.gov.au/publications-and-resources/guidance-materials

Table 6: Advisory material references

Document	Title
AC 1-02	Guide to the preparation of expositions and operations manuals
AC 11-04	Approvals under CASR Parts 91, 103, 119, 121, 129, 131, 132, 133, 135, 138 and 149 (including MOS)
AC 61-08	Teaching and assessing non-technical skills for single-pilot operations
AC 61-09	Competency-based training and assessment for flight crew
AC 119-01	Safety management systems for air transport operations
AC 119-07 and 138-03	Management of change for aviation organisations
AC 119-11 and 138-02	Training and checking systems
AC 119-12	Human factors principles non-technical skills training assessment for air transport operations
AMC/GM Part 119	Australian air transport operators — certification and management
AMC/GM Part 121	Australian air transport operations—larger aeroplanes

Other references

- EASA
  - EASA's standards are contained in CS-FSTD (A) Issue 2 released in 2018. The Explanatory Note to Decision 2018/006/R "Update of flight simulation training device requirements" for UPRT was released with the changes from Issue 1.
- UK CAA
  - https://www.caa.co.uk/Commercial-industry/Pilot-licences/Training-organisations/Upset-prevention-and-recovery-training-on-flight-simulation-training-devices/
  - http://publicapps.caa.co.uk/docs/33/InformationNotice2016044.pdf
- FAA
  - Appendix A to FAR Part 60–Qualification Performance Standards for Airplane Full Flight Simulators
  - FAA AC 120-111 CHG 1- UPRT
  - FAA AC 61-138 ATP Certification Training Program
  - FAA AC 120-109A (CHG 1) Stall Prevention and Recovery Training
  - FAA FSTD Directive No. 2
  - FAA Qualification Guidance Bulletin 11-05 "FSTD Evaluation and Qualification for UPRT Tasks" and similar bulletins for other extended envelope training tasks.
  - Flight Simulation Training Device Qualification Standards for Extended Envelope and Adverse Weather Event Training Tasks
  - FAA AC 120-71B on crew monitoring
  - An Evaluation of Several Stall Models, a paper presented at the American Institute of Aeronautics and Astronautics Modeling and Simulation Technologies conference in 2014
  - An overview of the occurrence of stalls in Australian operations can be found in the ATSB report "Stall warnings in high capacity aircraft: The Australian context 2008 to 2012"
  - IATA UPRT Implementation Guidance Material and Best Practices 2nd Edition 2018
  - Royal Aeronautical Society (RAeS) International Committee on Aviation Training in Extended Envelopes (ICATEE) Reports

2 Introduction

2.1 Background

2.1.1 Between 2001 and 2011, aeroplane accidents resulting from a loss of control in flight (LOC-I) event were the leading cause of fatalities in commercial aviation. LOC-I accidents often have catastrophic results with very few, if any, survivors.

2.1.2 The causes of inflight Loss of Control, whether transitory or extended, are many and include:

- loss of Situational Awareness (especially through distraction but also complacency)
- wind shear or Clear Air Turbulence
- structural or power plant damage caused by, for example, a bird strike, severe turbulence, or collision with another aircraft
- intended or unintended mishandling
- attempted flight with total load or load distribution outside of safe limits
- mismanagement of pressurisation systems
- inadequate de-icing before take-off
- airframe or engine icing
- attempting to manoeuvre an aeroplane outside its capabilities
- in-flight fire
- fuel exhaustion or starvation
- false instrument readings
- wake turbulence
- malicious interference.

Refer: https://www.skybrary.aero/articles/loss-control

2.1.3 Following a conference in June 2009 on aeroplane upsets and LOC-I, the Royal Aeronautical Society (RAeS) initiated a study to investigate the LOC-I phenomena and make recommendations on mitigating strategies, notably with respect to potential improvements to international civil aviation standards and guidance material. This work was undertaken by the RAeS International Committee on Aviation Training in Extended Envelopes (ICATEE), with ICAO support.

2.1.4 ICATEE concluded that most effective way to defining training solutions is to first clearly delineate the training needs, which can be defined as the difference between the current capabilities of an individual and the desired performance objective.

2.1.5 Analysis of LOC-I accident data indicated that contributory factors can be categorised as being any, or a combination of, the following:

- aeroplane systems induced
- environmentally induced
- pilot/human induced.

2.1.6 Of the three factors, pilot-induced accidents represented the most frequently identified cause of the event, principally resulting from one or more of the following reasons:

- application of improper procedures, including inappropriate flight control inputs
- one or more flight crew members becoming spatially disoriented
- poor aeroplane energy management
- one or more flight crew pilot members being distracted
- improper training.

2.1.7 In response to the 1996 National Transportation Safety Board (NTSB) recommendations relating to LOC-I accidents, in 2004 a Federal Aviation Administration (FAA) sponsored working group developed the Airplane Upset Recovery Training Aid (AURTA-Revision 1). This document is now in its third revision. To reflect the criticality of recognition and prevention it has been re-named, Airplane Upset Prevention and Recovery Training Aid (AUPTRA).

2.1.8 The release of the AURTA followed NTSB recommendations that pilots should possess a thorough understanding of airplane performance capabilities, limitations, and high-altitude aerodynamics. Following publishing of the AURTA, industry began attempting to curb LOC-I through UPRT programs.

2.1.9 Following the ICATEE work, with reduction in LOC-I accidents a high priority, ICAO developed UPRT Standards and Recommended Practices (SARPs) in Annex 1 - Personnel Licensing and Annex 6 - Operation of Aircraft to the Convention on International Civil Aviation (the Chicago Convention). These prescribe that:

- UPRT shall be integrated in aeroplane type rating program (or immediately after)
- UPRT is recommended for Commercial Pilot licence (CPL) and is mandatory for Multi-crew Pilot Licence (MPL) and Type Rating training
- Operators shall establish and maintain UPRT ground and flight training programs.

2.2 Training objectives

2.2.1 A UPRT program should include clear training objectives stating what the trainee is expected to perform, the desired learning outcomes and the CBT focus of the training.

2.2.2 To meet the requirement for a compliant UPRT program, the training required by CASA will follow the prescription in Section 208 of the United States' "Airline Safety and Federal Aviation Administration Extension Act of 2010’’.

2.2.3 Section 208 prescribes that for the FAA's Part 121 carrier's flight crew members must be provided with ground training and flight training or flight simulator training:

- to recognise and avoid a stall of an aircraft or if not avoided, to recover from the stall
- to recognise and avoid an upset of an aircraft or if not avoided, to execute such techniques as available data indicate are appropriate to recover from the upset in a given make, model, and series of aircraft.

2.2.4 Previously, a significant proportion of upset events (and hence a key UPRT focus) involved the traditional understanding of “upsets” as relating to physical conditions (unintentional pitch beyond +25 or -10 degrees, bank angles greater than 45 degrees or speed inappropriate for the conditions). Recovery training was initiated only after exceeding these parameters, without paying attention to the reasons of these diversions.

2.2.5 Current thinking (refer AUPRTA Revision 3) now includes a wider definition of upsets and uses the established concept of undesired state and the pilot's awareness of this, regardless of airspeed or specific pitch and/or bank angle parameters.

2.3 Human factors

2.3.1 Human factors training is central to a successful UPRT program. FAA research (AC 120-111 Change 1) shows that in many loss of control in-flight (LOC-I) incidents and accidents, the monitoring pilot may have been more aware of the aeroplane state than the pilot flying. Training should emphasise crew interaction (including augmented flight crews) to identify and vocalise any divergence from the intended flightpath. A progressive intervention strategy is initiated by communicating a flightpath deviation (alert), then suggesting a course of action (advocacy and assertion) and then directly intervening, if necessary.

3 Considerations regarding UPRT implementation

3.1 Applicability of this AC

3.1.1 The contents of this AC reflect CASA's pre-determined acceptable means of compliance (AMOC) with the regulatory requirements for certain aeroplane operators and training providers, to provide UPRT programs as laid out in the civil aviation legislation.

3.1.2 Operators and training providers may propose alternative means of compliance (AMOC), however, will need to provide significant explanation of how the proposed AMOC achieves equivalent safety outcomes and the proposed AMOC would need to ensure it encompassed the areas covered under each chapter heading in this AC.

3.1.3 CASA has adopted a phased approach to UPRT implementation. In the first phase CASA will require a UPRT program for the following:

- Part 121 operations for aeroplanes 30 seats and above and MTOW greater than 8,618 kgs
- any other operations as directed by CASA where a safety requirement becomes apparent.

3.1.4 Requirements for UPRT for an implementation phase covering operations not included in the above, will be developed and promulgated at a later date following consultation and significant industry involvement.

3.2 Expectations for the first phase of UPRT implementation

Note: The 2021 dates listed below only apply to pilots that are conducting active line operations. For a pilot who was not conducting active line operations, for example due to COVID-19, then an operator would be expected to propose an alternative schedule to CASA in relation to these pilots.

3.2.1 For domestic and international operations, all pilots should have:

- completed a UPRT theory course (including CASA on-line training)

  or

- commenced, or re-commenced participation in an operator's UPRT theory program by the end of 31st March 2021.

3.2.2 Operators and training providers should identify and remove negative training as soon as practicable. Before commencement of any UPRT program the initial group of instructors must complete a "Train the Trainer" course acceptable to CASA[1]. The operator should also inform CASA of the specific instructors that will be conducting UPRT[2]. From 1 April 2021 an operator

[1] In this context, acceptable to CASA means that the operator has provided CASA with details of the course and CASA has not issued a formal legal direction to the operator that the course is unsuitable.

[2] CASA will not be formally approving UPRT instructors. However, noting the criticality of this training, operators should inform CASA (whether via specific listing of instructors in an operator manual / exposition or via written communication to CASA) of the specific instructors. If CASA determined that certain instructors were unsuitable for the nominated role, CASA would be required to issue legal directions to the operator that certain instructors were unsuitable.

or training provider delivering any part of a UPRT program must have a sufficient number of instructors trained using an acceptable course to deliver theory and practical UPRT programs (refer Section 14 of this AC).

3.2.3 For international operations, all pilots should have commenced or re-commenced participation in a UPRT practical handling course by 31 March 2021.

3.2.4 For domestic operations, all pilots should have commenced or re-commenced participation in a UPRT practical handling course by 31 December 2021.

3.2.5 Operators and training providers should have a UPRT program by 31 March 2022.

3.3 Focus of training

3.3.1 Continued emphasis on stall and recovery training is warranted in training programs to undo years of applying incorrect stall or upset recovery procedures and use of training devices incapable of adequately representing the characteristics of the aeroplane in the post-stall warning regime.

3.3.2 Operators should review current training practices, as un-noticed or un-addressed negative training poses a threat to flight safety. Part of an operator's UPRT development and implementation program should include advising CASA of the outcome of such training reviews and ensuring they document and follow their proposed mitigation procedures.

3.4 Threats to successful implementation

3.4.1 Clearly identified threats to standardised UPRT implementation include:

- untrained instructor with insufficient knowledge about UPRT theory and practical training
- trained but under-supervised instructor deviating from standardised methods and practices without notice by management and/or QA processes
- inappropriate, inadequate or poorly focused syllabi with emphasis on, for example, minimising altitude loss during stall recovery and/or training concentrated in an invalid or very small part of the flight envelope
- training that does not adequately focus on manual handling
- unsuitable use of flight simulation training devices and lack of real time feedback information at the IOS
- lack of appropriate theory and practical human factors training
- extending simulated training beyond the capabilities of the aeroplane or instructor
- programs that do not allow the pilot to connect the UPRT theory elements through to the practical elements in a robust and thorough manner
- programs that do not allow or encourage training to proficiency, enabling the pilot to practice certain exercises to develop both cognitive and “muscle memory” skills
- training providers waiting to upgrade their devices before doing anything further
- training providers trying to cram their whole UPRT program into a single course, rather than integrate modules within the suite of initial and recurrent training programs
- an inflexible syllabus that is not upgraded, as better and more focused information becomes available (for example via the operator’s SMS after training and accident reports)

- lack of robustness in post-implementation governance and/or oversight by the regulatory authority.
- post-implementation "drift" if under-supervised instructors move away from the UPRT standards and syllabus requirements initially approved.

4 Training standards for UPRT Instructors

4.1 General

4.1.1 UPRT programs will be competency-based training only, except for some UPRT-related elements of type rating and licence programs which may require demonstrated competency in a proficiency test. This will not include proficiency requirements for manoeuvres beyond the initial stall indication.

4.2 Instructors

4.2.1 Regardless of background, all instructors providing training in a UPRT program (including UPRT training in a Part 142 Type rating program) must successfully complete instructor qualification training (i.e. via an acceptable "Train the Trainer" course, in accordance with the applicable requirements in ICAO Docs 9868 and 10011) (refer to Section 14 of this AC).

4.2.2 In accordance with the provisions of ICAO Annex 1, CASA, having issued a pilot licence, shall not permit the holder thereof to carry out flight instruction required for the issue of a pilot licence or rating, unless such holder has received proper authorisation from CASA. Proper authorisation shall comprise one of the following:

- a flight instructor rating on the holder's licence
- the authority to act as an agent of an approved organisation authorised by CASA to carry out flight instruction
- a specific authorisation granted by the State which issued the licence.

4.2.3 Forthcoming amendments to the Part 61 Manual of Standards (MOS) are expected to add the requirement for all Part 61 instructors involved in aeroplane type rating training, to be trained to deliver UPRT-related theory and practical elements as required, including in-seat demonstrations in a qualified flight simulator (refer to Section 15 of this AC).

4.2.4 Training organisations wishing to conduct on-aeroplane UPRT training will need to obtain a specific approval under the provisions of Part 141 or 142 and must comply with the requirements listed in Chapters 2, 3 and 5 of ICAO Doc 10011. Special attention must be given to the training, qualifications, competencies, safety and risk management relating to on-aeroplane UPRT instruction and training program management.

4.2.5 For training and checking systems for operations involving aeroplanes with 30 seats or more or MTOW above 8,618 kgs (this will be simulator training), operators are required by the Part 121 MOS to provide induction and recurrent UPRT training. This will require instructors specifically trained to deliver UPRT. These instructors may be either of the following:

- the holder of the training endorsement mentioned in Item 4 (multi-crew pilot training endorsement) and / or Item 5 (type rating training endorsement) of Table 61.1235 of CASR
- a pilot who has been specified in and has completed the acceptable course of training specified in, the operator's exposition.

4.3 Training for licence issue

4.3.1 Initial UPRT training for MPL will be conducted by qualified instructors within Part 142 organisations.

4.3.2 Initial UPRT is not yet required but is recommended for CPL trainees. If provided, it should be conducted by qualified and approved instructors within Part 141 or Part 142 training organisations.

4.4 Training for type ratings

4.4.1 Part 142 training providers may elect to provide UPRT modules (academic and practical) within their type rating programs (in the same way that MCC, EDTO or Low Visibility operations may be included in the syllabus even though not required for the Part 61 MOS requirements for the type rating). Such training must be in accordance with the contents of this AC. CASA expects to amend the Part 61 MOS to specify the elements required for instructors delivering UPRT programs (Refer subsection 4.2 and Section 15 of this AC).

4.4.2 It would be expected that a type rating UPRT program would include significant emphasis on the following:

- Causes and Contributing Factors: environmental, failures and pilot induced
- Safety Review and Demonstration (in seat instructor guided)
- Upsets and Energy Management (kinetic, potential, chemical)
- Energy: relationship between pitch, power, performance
- Energy: performance and effects of differing engines
- Recognition: Pitch/Power/Roll/Yaw.

4.4.3 If training for the type rating does not include UPRT modules the trainee will be required complete those modules in an induction program on entry (or return) to Part 121 operations.

4.4.4 Part 142 course completion certificates must indicate whether UPRT modules were delivered.

Note: CASA will regard the implementation of a UPRT training program within a Part 142 training organisation as a significant change as defined in paragraph 142.030 of the CASR.

5 Training program development considerations

5.1 Background

5.1.1 Many LOC-I accident investigations revealed the affected flight crew had received misleading information from well-meaning training staff or their organisations. ICAO Doc 9868 notes that some existing training practices were found to be ineffective and a contributory factor to the inappropriate responses by some flight crews.

5.1.2 For example, in certain cases the methodologies being applied in the training and checking of a recovery from an approach to stall condition of flight, were based on the pilot being able to achieve recovery with a minimal loss of altitude. This resulted in training practices which emphasised the importance of a rapid application of power with the least amount of reduction in angle of attack (AOA) to minimise the loss of altitude, rather than appreciating the importance of reducing the AOA to effectively increase the ability of the wing to restore its capability to generate lift.

5.2 Outcomes from a UPRT program

5.2.1 The elements in a UPRT program will provide pilots with the knowledge and skills to prevent an upset or if not prevented, to recover from an upset.

5.2.2 Trainees will receive theory and practical competency-based training in the three key areas that comprise a compliant UPRT package:

- Upset Awareness
- Upset Prevention
- Upset Recovery.

5.2.3 Classroom training will be followed by practical training in the required array of manual skills in Manoeuvre Based Training (MBT) modules. The training can then move progressively to Scenario Based Training (SBT) modules. CASA will:

- adopt a case-by-case risk-based approach to the assessment of UPRT programs for “lower end” multi-crew aeroplanes for which a simulator may not be available
- allow lower level devices (including simulators with motion off) to be used for UPRT academic training prior to exposure to the full flight simulator.

5.3 Device requirements

5.3.1 Initial and recurrent UPRT programs for type rated aeroplanes must be conducted in a suitably equipped and approved Level C or D flight simulator.

5.3.2 For the introductory and theory components of a UPRT program, many of the required UPRT tasks and demonstrations relating to recognition, awareness and prevention, can be completed in a non-upgraded flight simulator or flight training device.

5.3.3 Recognising that fully developed stalls remain the leading cause of loss-of-control accidents, training must include:

- significant “hands-on” exposure to stalls that are fully developed
- stalls that are unexpected and involve autopilot disengagement

- where applicable, the provision of stick-pusher familiarisation training including an in-depth understanding of the system and the activation logic.

5.3.4 One of the strong foundational pieces of the requirement is that training and demonstrations in approach to and recovery from a fully-developed stall, should only be completed in training devices with a high level of fidelity in those parts of the flight envelope.

5.3.5 Most aeroplane types exhibit flight dynamics and control characteristics that are different at and beyond the stall angles of attack as compared to angles of attack related to stall warning activation. These characteristics exhibited beyond the stall indication are almost always degraded in comparison with pre-stall behaviour and are exemplified by reduced and sometimes negative stability and diminished control effectiveness.

5.4 Syllabus development

5.4.1 Syllabus development should be in accordance with ICAO Doc 10011 and the Airplane Upset Prevention and Recovery Training Aid (Rev 3) and follow the guidance for training programs and related matters in ICAO Doc 9868.

5.4.2 Training developers may also wish to refer to AURTA Revision 2 in so far as the guidance is not revised in Revision 3. The training elements in ICAO Doc 10011 Table 2-1, are simply a means to develop the appropriate proficiencies and assist in developing training programs. They should not lead to a tick box approach to completing a syllabus.

5.4.3 Training providers should consider establishing the entire program over a set of multiple modules, each with specific exercises. This enables the training to be readily integrated within ongoing recurrent simulator training sessions. More importantly, it encourages a training-to-proficiency paradigm rather than attempting to cover all UPRT elements into a single course.

5.4.4 Training providers should consider an immediate start to training in UPRT theory (including human factors), reinforced by awareness and prevention exercises, in order to be ready for more advanced recovery situations in later training modules.

5.4.5 Training providers should develop close relationships with relevant original equipment manufacturers (OEMs). Manufacturers have typically devoted significant resources to the development of type-specific UPRT programs and these must be taken as primary.

5.4.6 Operators should work with their aeroplane manufacturer(s) to ensure they have the manufacturer-approved, aeroplane-specific upset prevention and recovery guidance and techniques in their exposition or operations manual.

5.4.7 Where a training provider desires to use a different technique from what is published in ICAO Doc 10011 and/or the AUPRTA, a determination of “no-technical- objection” must be obtained from the applicable OEM unless that specific technique is published in the appropriate aeroplane flight manual.

5.4.8 The most fundamental take home message for training sequences near, at or beyond the stall, is recognition and deliberate action to reduce AOA, thereby “unloading the wing”. Emphasis needs to be on:

- the recognition, prevention and when needed, recovery methods, rather than undue focus on how the aeroplane entered the condition
- pilot understanding of the difference between attitude and AOA as this difference is often misunderstood.

5.4.9 UPRT should include instructor guided practice of manual handling at the edges of the flight envelope.

> **Note:** Training using procedures from one type may have a detrimental effect if carried over to a different type even if there are superficial similarities.

5.5 Knowledge levels

5.5.1 Care must be taken at the early stages of UPRT implementation not to assume the existence of a comprehensive level of UPRT-related knowledge, particularly at the type rating and recurrent training levels.

5.5.2 Accident data strongly indicates even highly experienced flight crews exhibited signs of shortcomings in understanding and reacting to their predicament, indicating potential knowledge deficiencies. It is realistically impossible for pilots to recognise and respond correctly to an undesired aircraft state, without having practical knowledge of the performance and handling characteristics available (or not available) to them throughout the entire operational flight envelope.

5.5.3 Trainees should be knowledgeable about aerodynamic effects at both high and low altitudes. The FSTD training should be accomplished at both high altitude (within 5,000 ft of the service ceiling of the aeroplane) and at low altitude (10,000 ft above mean sea level) to re-enforce the academic training described. High-altitude training should be conducted at normal operational cruise altitudes.

5.5.4 Some stalls and upsets are not associated with inaccurate information (such as an unreliable airspeed indication) and can be instantaneous and require deliberate inputs. Once positively identified, the recovery from these types of stalls and upsets, is often at a slower rate than the initiation of the problem. These situations can be extremely challenging, requiring recognition and recovery without creating stresses beyond certification limits.

5.5.5 It is known that when an upset occurs in actual flight, pilots often do not respond as they were trained. In such instances, the common belief is that “startle” and “surprise” were critical factors. In time-critical events, an incorrect reaction may worsen the situation and make recovery (both mentally and aerodynamically) more challenging. Fatigue and emotional stress can exacerbate this situation.

5.5.6 The tools pilots require to manage such sudden onset situations are knowledge and training to analyse and to resolve the problem. These tools should include procedures/techniques to recognise the stall event/upset and apply recovery in an appropriate manner.

5.5.7 Unfortunately, many airline pilots, including instructors, have not been in an actual stall since the single-engine flights in their early training. Compounding this, the aviation community has had a history of erroneously emphasising “minimum loss of altitude” over immediate AOA reduction.

6 Preparation for Implementation

6.1 Preparation steps expected of operators and training providers

6.1.1 Establishment of a UPRT implementation program team should involve the following:

- design and implementation of the operator's UPRT program and implementation schedule
- provision for the UPRT core group to undergo high-level UPRT academic and practical training and a CASA approved "Train the Trainer" course
- conduct of a gap analysis of actual versus desired UPRT status, with the aim of identifying and removing negative training and reporting on progress through the training organisation's SMS and/or quality management systems
- development of the operator's type-specific UPRT programs for each fleet and training program (in cooperation with the OEMs) and submission for review by CASA
- completion of the initial instructor-training program for each fleet including assurance of capability for delivery of standardised instructor-guided hands-on experience of recovery from full stall (and stick pusher activation, if so equipped) on a compliant FSTD with a UPRT capable IOS
- commence awareness and prevention within existing or extended validation envelopes
- development and operations of the post implementation governance program including QA and SMS activities.

6.2 Preparation timelines

Refer to Section 3.2 of this AC.

7 Implementation of a Compliant UPRT program

7.1 Overview of requirements

7.1.1 The requirements for a UPRT program are found in Chapter 2 of ICAO Doc 10011. The training elements and the appropriate training media are outlined in Chapter 3 of Doc 10011. Both areas are amplified in the AUPRTA.

7.1.2 The recommendations in Doc 10011 provide a comprehensive training program framework to mitigate the risk of LOC-I accidents. However, the material may include training elements which could be affected or invalidated by future aircraft-specific technology or other developments of an operational nature.

7.1.3 Although consulted throughout development of Doc 10011, aeroplane OEMs may at some point develop differing guidance regarding procedures to address these areas of training. In such instances, OEM's recommendations take precedence over any differing information contained within more general guidance material.

7.2 Elements of a compliant program

7.2.1 The loss of control avoidance and recovery training (LOCART) initiative[3] determined that the approach in mapping out a UPRT program should focus its design into satisfying three distinct areas/objectives:

a) *heightened awareness* — of the potential threats from events, conditions or situations

b) *effective avoidance* — at early indication of a potential upset-causing condition

Prevention

c) *effective and timely recovery* — from an upset to restore the aeroplane to safe flight parameters.

Figure 1: Recommended focus areas for UPRT program development
Source: Paragraph 2.1.1 ICAO Doc 10011 Manual of Aeroplane Upset Prevention and Recovery Training.

[3] In 2011, the Federal Aviation Administration (FAA) of the United States of America commissioned an aviation rulemaking committee (ARC) to develop effective upset prevention and recovery training methodologies. In 2012, ICAO, the European Aviation Safety Agency (EASA) and the FAA decided to combine efforts to identify and establish an acceptable approach to reduce such occurrences. ICAO sponsored seven meetings in 2012 during which Civil Aviation Authorities (CAAs), the FAA ARC and subject matter experts were encouraged to participate in focused discussions. Also, as several initiatives were underway simultaneously that sought to reduce the number of LOC-I events, ICAO brought many of the groups involved with these efforts into the ensuing discussions under what became known as the loss of control avoidance and recovery training (LOCART) initiative.

7.3 Need for an integrated program

7.3.1 Effective UPRT program development and supporting regulatory frameworks require an integrated comprehensive approach to ensure standardisation in the levels of knowledge and skill sets within the pilot community.

7.3.2 An integrated UPRT program should comprise the following UPRT components:

- academic (theory) training — designed to equip pilots with the knowledge and awareness needed to understand the threats to safe flight and the employment of mitigating strategies
- practical training — designed to equip pilots with the required skill sets to effectively employ upset avoidance strategies and, when necessary, effectively recover the aeroplane to the originally intended flight path.

7.3.3 The practical training component should cover all elements, further broken down into the two distinct subcomponents in ICAO Doc 10011 Tables 2-1 and 3-3 (as revised) involving:

- FSTD training on specific or generic aeroplane types to build on knowledge and experience and
- application of training to the multi-crew crew resource management (CRM) environment, at all stages of flight, and in representative conditions, with appropriate aeroplane and system performance, functionality and response.

Instruction should only be provided by appropriately qualified instructors.

Note: On-aeroplane training during CPL(A) or MPL training will be the subject of specific approvals. Such training will be carried out in suitably capable light aeroplanes and conducted by appropriately qualified instructors. The aim will be to develop the knowledge, awareness and experience of aeroplane upsets and unusual attitudes, and training in how to effectively analyse an upset event and then apply correct recovery techniques. CASA will develop specific requirements for on-aeroplane training at a later date.

7.4 Elements of an Integrated program

7.4.1 The following are the deliverables CASA will expect from the theory and practical components of an integrated UPRT program:

- provision of comprehensive academic training covering the broad spectrum of issues surrounding aeroplane upsets, at the earliest stages of commercial pilot development, during type rating training and throughout the professional career, at scheduled recurrent training intervals
- provision of UPRT manual handling programs for MPL licensing levels on light aeroplanes, which are capable of performing the recommended manoeuvres while maintaining acceptable margins of safety
- provision of UPRT conducted in non-type-specific FSTDs when introducing multi-crew operations at the CPL(A) or MPL licensing level
- provision of training scenarios involving conditions likely to result in upsets, as part of regular initial type rating and recurrent training exercises in type-specific FSTDs
- implementation of standards that require UPRT to be delivered by appropriately qualified and competent instructors
- implementation of standards that require UPRT in FSTDs to be conducted in an appropriately qualified device using the highest level of fidelity available

- provision of conditions under which FSTD instructors are trained and able to provide feedback in real time, using UPRT- specific debriefing tools of the instructor operating station (IOS).

7.4.2 Bridging training for existing holders of relevant type ratings and existing instructors may be conducted within a Part 121 operator's training and checking system or a Part 142 organisation.

7.4.3 Existing instructors involved in any form of pilot training in Part 141 and 142 operations will be expected to eventually upgrade their knowledge and skill sets. The requirements for instructor competencies in UPRT will be prescribed in a future amendment to the Part 61 MOS. Guidance on the detail of the expected required standards may be found in ICAO Documents 9868 and 10011.

7.4.4 The IATA Guidance Material and Best Practices for the Implementation of Upset Prevention and Recovery Training (UPRT). 2nd Edition (2018) offers useful guidance for UPRT implementation and should be read in conjunction with the AUPRTA and ICAO Documents 9868 and 10011 when the implementation plan is being developed.

8 Flight Simulator qualification

Unless the UPRT FSTD's simulation model satisfactorily represents the aeroplane's behaviour and performance during an aerodynamic stall, training demonstrating conditions beyond the critical angle of attack can create harmful misperceptions about such an event and the recovery experience.

ICAO Doc 10011 section 4.1

8.1 Overview

8.1.1 Most current flight simulators can be used satisfactorily to conduct unusual attitude recovery training tasks, awareness and AOA related training and a significant portion of recognition, prevention and upset training not involving full stalls. Until now only approach-to-stall training was necessary in FSTDs and as such, FSTD data packages did not necessarily concentrate on flight characteristics at angles of attack beyond the first indication of a stall.

8.1.2 While current simulators are typically capable of supporting brief excursions beyond the initial stall indications, until UPRT upgrades began, simulation flight models were usually found to be deficient in adequately representing the post-stall indication regime.

8.1.3 Before being upgraded for UPRT, most simulators have not provided the cues and performance degradation needed, to train in recognition of an impending aerodynamic stall or in recovery techniques from a stalled condition. Instead the simulators presented dynamic characteristics in the stall and post-stall regimes that were easier to recover from than in the actual aeroplane. In particular, the wing drop that may accompany a stall was seldom modelled.

8.1.4 The use of a simulator beyond the capabilities and fidelities necessary to complete the required training, can pose a significant threat to the achievement of the desired outcomes and ultimately, a threat to flight safety.

8.1.5 The development and utilisation of a “type-representative post-stall aerodynamic model” to support demonstrations beyond the critical AOA is necessary, for such demonstrations and practice to be properly conducted.

8.1.6 The need to have FSTDs qualified for UPRT (including full stall) brings with it the requirement for fidelity levels adequate to support recognition cues, performance and handling qualities of a developing stall, through and beyond the stall identification AOA and recovery.

8.1.7 As the buffet associated with a developing stall may exceed the expectations of pilots and instructors not ordinarily exposed to buffet beyond the initial stall indications, care (such as thorough briefings and mandatory use of seat belts during stall training) should be taken to avoid physical injury within the simulator.

8.1.8 Many current FSTDs lack enhanced instructor feedback tools to allow for a complete and accurate assessment of the trainee's performance. Until the progressive implementation of upgrades to simulators is complete, these fidelity and IOS limitations, if not fully appreciated by training program designers and instructional staff, can result in the serious and long-term repercussions of trained flight crews and instructors with significant misunderstandings of upset events.

8.1.9 Traditionally flight test has been the preferred data source for FSTD objective evaluation and it is expected that best endeavours will be made by FSTD modellers to secure flight test data. However even if the traditional array of flight test data is available, strict time-history-based evaluations against that data may not adequately validate the aerodynamic model in an unsteady and potentially unstable flight regime, such as stalled flight.

8.2 Statement of Compliance (SOC)

8.2.1 As objective testing requirements do not prescribe strict tolerances at angles of attack beyond the stall identification, in lieu of objective tolerances, an SOC will be required to define the source data and methods used to develop the stall aerodynamic model, and hence construct the FSTD validation envelope.

8.2.2 The SOC must verify that each UPRT feature programmed at the IOS and the associated training manoeuvre, has been evaluated by a suitably qualified SME pilot. The SOC must confirm that the recovery manoeuvre can be performed such that the FSTD does not exceed the validation envelope, or when exceeded, that it is within the realm of confidence in the simulation accuracy.

8.2.3 Where it is impractical to develop and validate a stall model with flight-test data (for example, due to safety concerns involving the collection of flight test data past a certain AOA), the data provider is expected to make a reasonable attempt to develop a stall model through the required AOA range, using analytical methods and utilisation of the best available data.

8.2.4 The FSTD operator must declare the range of AOA and sideslip where the aerodynamic model remains valid for training.

8.2.5 For stall recovery training tasks, satisfactory aerodynamic model fidelity must be shown through at least 10 degrees beyond the stall identification AOA.

8.2.6 The model must be capable of capturing the variations seen in the stall characteristics of the aeroplane concerned (for example, the presence or absence of a pitch break, deterrent buffet or other indications of a stall where present on the aircraft).

8.2.7 Where OEM-supplied flight test-based data is not available or is incomplete, alternative sources of data used to construct the FSTD validation envelope may be acceptable (and documented in the SOC) using the following hierarchy of preferences:

a. stall models developed using the aeroplane OEM’s engineering simulation

a. wind tunnel or established analytical methods to extend stall modelling sufficiently, to achieve an exemplar full stall and recovery

b. input from an SME pilot with full-stall experience in the aeroplane being simulated

c. unpublished sources acceptable to CASA (for example, calculations, simulations, video or other simple means of flight test analysis or recording).

> **Note:** If engineering simulator data or other non-flight-test data are used as an allowable form of reference data the data provider must supply a well-documented mathematical model.

8.2.8 The SOC must address, and the aerodynamic model must incorporate, the following stall characteristics where applicable (with explanation of methodology):

- degradation in static/dynamic lateral-directional stability
- degradation in control response (pitch, roll, yaw)
- uncommanded roll acceleration or roll-off requiring significant countering control deflection
- apparent randomness or non-repeatability
- changes in pitch stability
- stall hysteresis
- mach effects
- stall buffet

- angle of attack rate effects
- engine effects (power reduction/variation, vibration, etc. if applicable).

8.2.9 Where known limitations exist in the aerodynamic model for particular stall manoeuvres (such as aircraft configurations and stall entry methods), these limitations must be declared in the SOC.

8.2.10 The SOC will only be required at the time the FSTD is initially qualified, as long as the stall model remains unmodified from what was originally qualified.

8.3 The training focus in evaluation

8.3.1 From the training perspective the requirements for the evaluation of stall training manoeuvres are intended to ensure adequate levels of fidelity for the following:

- type specific recognition cues of the first indication of the stall (such as the stall warning system or aerodynamic stall buffet)
- type specific recognition cues of an impending aerodynamic stall
- demonstrate aircraft performance degradation in the stall
- recognition cues and handling qualities from the stall break through to recovery that are sufficiently similar to the characteristics of the aeroplane being simulated, to allow successful completion of the stall recovery training tasks.

8.3.2 The FSTD validation envelope may be thought of as the entire realm in which the FSTD may be flown as a function of AOA and sideslip and with a degree of confidence that the FSTD responds similarly to the aeroplane. The envelope can be divided into three subdivisions:

- **Flight test validated region:** The region of the flight envelope validated with flight test data, typically by comparing the performance of the FSTD against flight test data through tests incorporated in the Qualification Test Guide (QTG) and other flight test data utilised to further extend the model beyond minimum requirements. Within this region, there is high confidence that the simulator responds similarly to the aircraft.
- **Wind tunnel and/or analytical region:** This is the region of the flight envelope for which the FSTD has not been compared to flight test data, but for which there has been wind tunnel testing or the use of other reliable predictive methods (typically by the aircraft manufacturer) to define the aerodynamic model. Within this region, there is moderate confidence that the simulator will respond similarly to the aircraft.
- **Extrapolated:** The region extrapolated beyond the flight test validated and wind tunnel/analytical regions. It is a “best guess” only and within this region there is low confidence that the simulator will respond similarly to the aircraft.

8.3.3 For simulators upgraded to capability for high-AOA modelling the model must support stall training manoeuvres in the following flight conditions:

- stall entry at wings level (1g)
- stall entry in turning flight of at least 25degree bank angle (accelerated stall)
- stall entry in a power-on condition (required only for propeller driven aircraft)
- aircraft configurations of second segment climb, high altitude cruise (near performance limited condition), and approach or landing.

8.3.4 In lieu of objective testing for the high-altitude cruise and turning flight stall conditions, these manoeuvres may be subjectively evaluated by a qualified SME pilot and addressed in the required SOC.

8.3.5 Objective testing for characteristic motion vibrations is not required where the FSTD’s stall buffets have been subjectively evaluated by an SME pilot.

8.3.6 Where aerodynamic modelling data is not available or insufficient to meet the requirements of FAA Directive 2, CASA may limit qualified engine and airframe icing manoeuvres to scenarios where sufficient aerodynamic modelling data does exist.

8.3.7 During the initial evaluation, a footprint test should be documented with an associated SME pilot subjective "sign off" of the model, as being fully representative. For the purposes of stall manoeuvre evaluation, the term 'representative' is defined as a level of fidelity that is type-specific of the simulated aeroplane, to the extent that the training objectives can be satisfactorily accomplished.

8.3.8 Where correct trend and magnitude is used it is strongly recommended that an automatic recording system be used to 'footprint' the baseline results, thereby avoiding the effects of possible divergent subjective opinions on recurrent evaluation.

8.3.9 It is imperative that specific characteristics are shown to be present, and incorrect effects would be unacceptable. (for example, if the aeroplane has a weak positive spiral stability, it would not be acceptable for the simulator to exhibit neutral or negative spiral stability).

8.3.10 Numerical tolerances are not applicable past the stall AOA but must demonstrate correct trend through the recovery.

8.3.11 The provisions for high AOA modelling should be applied to evaluate the recognition cues as well as performance and handling qualities of a developing stall, through the stall identification AOA and stall recovery.

8.3.12 In lieu of mandating such objective tolerances, an SOC should define the source data and methods used to develop the aerodynamic stall model.

8.3.13 The provisions for the evaluation of full stall training manoeuvres should provide the following levels of fidelity:

- aeroplane-type-specific recognition cues of the first indication of the stall (such as the stall warning system or aerodynamic stall buffet)
- aeroplane-type-specific recognition cues of an impending aerodynamic stall.

8.3.14 Where correct trend and magnitude is used, it is strongly recommended that an automatic recording system be used to footprint the baseline results, thereby avoiding the effects of possible divergent subjective opinions on recurrent evaluations.

8.3.15 Where qualification is being sought to conduct full stall training tasks in accordance with FAA Directive 2, the FSTD operator must conduct the required evaluations and modifications as prescribed in Directive 2 and report compliance to CASA's Flight Simulation Team on the UPRT application form. At a minimum the operator must supply the following information:

- a description of any modifications to the FSTD necessary to meet the requirements of Directive 2
- statements of Compliance (High Angle of attack Modelling/Stick Pusher System) – as per Table A1A, Section 2.m., 3.f., and Attachment 7 to FAR Part 60
- statement of Compliance (SME Pilot Evaluation) – See FAR Part 60 Table A1A, Section 2.m. and Attachment 7
- copies of the required objective test results.

8.4 Instructor operating station requirements

Refer to Section 13 of this AC.

9 Envelope protection

9.1 Background

9.1.1 For many decades, aeroplanes have been equipped with various devices and systems capabilities aimed at modifying natural aerodynamic characteristics, and/or protecting the aircraft from exceeding defined aerodynamic or structural limitations. These devices and systems have included:

- yaw dampers
- rudder load limiters
- mach trim compensators
- flight control software (with roll and pitch protection functions)
- stick pushers
- powered elevators (for stall recovery, e.g. DC-9).

9.1.2 In addition, there are systems to aid the pilot in normal flight activities and handling tasks. These include:

- powered controls
- auto-throttle
- auto-pilot
- powered control trims.

9.2 Knowledge

9.2.1 Trainees should understand envelope protection systems and associated failure modes relevant to UPRT and how these systems can cause or contribute to an upset or simply increase the likelihood of an upset. Upset-inducing failures/malfunctions related to systems, instruments, power and automation should be incorporated into training whenever applicable, if specified or approved by the OEM.

9.2.2 Trainees should be made particularly aware of the insidious nature of inaccurate information (for example, unreliable airspeed, failures of stall and icing alerting devices, degradation of envelope protection systems), so they are trained to recognise the problem/error, prevent an upset and maintain control of the aeroplane.

9.3 Simulation considerations

9.3.1 To adequately support UPRT activity a compliant simulator must demonstrate an acceptable level of capability and fidelity in areas of the training envelope beyond the protection and operational limits where history (and OEM advice) show that unexpected or inadvertent flight may occur. In addition, the IOS must be capable of readily providing feedback to the instructor on control inputs and the position of the aeroplane in relation to the flight envelope.

9.3.2 History has shown that system failure (full or partial) or flight with some form of degraded control capability is often the precursor to an upset event. These situations can include:

- mechanical or systems failure (either directly or through the failure of a supporting system such as an air-date computer)
- inappropriate pilot actions (for example, pulling circuit breakers during pilot-initiated fault diagnosis in-flight other than as directed by a Non-Normal Checklist)

- aircraft inadequately de-iced before departure
- incorrect performance calculations (for example, entering incorrect Zero Fuel Weight)
- inappropriate aircraft loading leading to out of envelope centre of gravity
- incorrect configuration for phase of flight.

9.3.3 Unless specified as a required training exercise by the OEM, for aeroplanes so equipped, there is no UPRT requirement to disable or override the stick pusher to get closer to or beyond the aerodynamic stall. The ICAO standard is that the aerodynamic model must extend to at least 10 degrees beyond the stall identification AOA, which is generally the stick pusher activation on stick pusher equipped aircraft. This standard is central to the FAA FSTD Directive 2 (refer paragraph 9.4.7 below).

9.3.4 While training requirements only go to stick-pusher activation then recovery, in practice, pilots may overshoot beyond the activation AOA, possibly a significant overshoot, hence the need for simulator fidelity well beyond the stick pusher.

Notes:

1. From observations, most instructors state that, regardless of previous academic training, pilots usually resist the stick pusher on their first encounter.
2. Usually, trainees immediately pull back on the control yoke/stick rather than releasing pressure. This issue has been a factor in a number of LOCI accidents.

9.3.5 Notwithstanding paragraph 9.3.4, CASA expects UPRT training providers to liaise with OEMs to ascertain the usefulness of development of relevant scenarios, where for demonstration purposes only, the disabling of appropriate envelope protection systems (for example by the failure of an input mode such as the pitot-static system) might allow the introduction of demonstrations of approach to, and recovery from, stall in various degraded modes. The primacy of the aeroplane OEM must be recognised in this, and operators must not independently develop their own training protocols and practices for this critical flight regime.

9.3.6 Safety considerations may mean that that the collection of data or obtaining SME experience beyond the pusher activation, will be very limited. However, simulator modelling beyond the stall indication AOA does not necessarily require flight test validation data. Wind tunnel and analytical methods may be used to develop an adequate representative model.

9.4 UPRT considerations

9.4.1 The model validity range must extend to 10 degrees AOA beyond the stall identification AOA, with the protection systems disabled or otherwise degraded (such as a degraded flight control mode as a result of a pitot/static system failure).

9.4.2 Training may not necessarily extend far into this range unless the OEM requires that protection systems be disabled for training purposes.

9.4.3 An assessment of the FSTD's stall characteristics should be accomplished by an SME pilot (see section 10) and where possible, should be complemented with aircraft OEM or other suitable documentation (such as flight test reports or aircraft certification data) that fully describes the stall characteristics of the simulated aircraft.

9.4.4 For 'fly-by-wire' aircraft the FSTD should be evaluated in both 'normal' and 'non-normal' control modes. Reversion to degraded control laws (such as secondary, alternate, or direct control laws) should be conducted with consideration of potential failure scenarios that may be encountered in an operational environment, or as necessary to support the operator's training requirements.

9.4.5 If necessary, an SME pilot will be expected to initiate "fine-tuning" of the operations of the aerodynamic model in the particular FSTD. This might include:

- minor longitudinal stability adjustment before stall
- adjustments to "roll-off" due to asymmetric stall
- adjustments to a randomiser algorithm.

9.4.6 For aeroplanes equipped with a stick pusher, the SOC should verify that the stick pusher system has been modelled, programmed and validated, using the aeroplane manufacturer's design data or other approved data source. At a minimum, the following characteristics should be addressed in the SOC:

- stick pusher activation logic
- stick pusher system dynamics, control displacement, and forces
- stick pusher cancellation logic.

9.4.7 The model must also be capable of simulating the dynamics of the aeroplane concerned as a result of a pilot initially (and possibly very forcefully) resisting the stick pusher in training.

9.4.8 Simulators may be used to demonstrate the activation of a stick pusher system, however, training providers are cautioned that the range beyond stick pusher activation, may not accurately represent the aeroplane unless the post-stick pusher regime is properly modelled and evaluated.

Attachment 7 to Appendix A of FAR Part 60:

"The model validity range must also be capable of simulating the airplane dynamics as a result of a pilot initially resisting the stick pusher in training. For aircraft equipped with a stall envelope protection system, the model validity range must extend to 10 degrees of angle of attack beyond the stall identification angle of attack with the protection systems disabled or otherwise degraded (such as a degraded flight control mode as a result of a pitot/static system failure)".

9.4.9 The FSTD sponsor/FSTD manufacturer may limit maximum buffet based on motion platform capability/limitations or other simulator system limitations.

9.4.10 Tests may be conducted at centres of gravity and weights typically required for airplane certification stall testing. Tolerances on stall buffet are not applicable where the first indication of the stall is the activation of the stall warning system (i.e. stick shaker).

9.4.11 As the pitch down from stick pusher activation or the buffet associated with a developing stall may exceed the expectations of pilots and instructors not ordinarily exposed to buffet beyond the initial stall indications, care (such as thorough briefings and mandatory use of seat belts during stall training) should be taken to avoid physical injury within the simulator

9.4.12 The stall model should be evaluated by an SME pilot with knowledge of the cues necessary to accomplish the required training objectives, and experience in conducting training and stalls in the type of aeroplane being simulated.

9.4.13 The purpose of the subjective evaluation is to provide an additional layer of protection to ensure FSTD fidelity. The intent is for the simulation to be qualified initially only once by an SME. Objective recording can then be made and used without an SME for initial or recurrent qualification of FSTDs for the same aeroplane make, model and series.

10 Subject Matter Expert pilot (SME)

To qualify as an acceptable SME to evaluate a FSTD's stall characteristics, an SME must meet the following requirements:

- have held a type rating/qualification in the aircraft being simulated
- have direct and significant experience in conducting stall manoeuvres in an aircraft that shares the same type rating as the make, model and series of the simulated aircraft. This stall experience must include hands on manipulation of the controls at angles of attack, sufficient to identify the stall (for example, deterrent buffet, stick pusher activation, etc.) through recovery to stable flight.
- be familiar with the intended stall training manoeuvres to be conducted in the FSTD (for example, general aircraft configurations, stall entry methods, etc.) and the cues necessary to accomplish the required training objectives
- cannot be self-proclaimed. The designation of an SME is related to a certain type of aeroplane and manoeuvres and is linked to the SME's recency of experience in the manoeuvres on the aeroplane type.

Where the SME's stall experience is on an airplane of a different make, model, and series within the same type rating, differences in aircraft specific stall recognition cues and handling characteristics must be addressed using available documentation. This documentation may include aircraft operating manuals, OEM flight test reports, or other documentation that describes the stall characteristics of the aircraft.

Where an SME pilot with the required qualifications is unavailable for a specific aircraft type, an FSTD operator should justify how equivalent safety outcomes will be achieved. This justification must include the following:

- demonstration that a suitably qualified pilot meeting the experience requirements of this section cannot be practically located
- alternative methods to subjectively evaluate the FSTD's capability to provide the stall recognition cues and handling characteristics needed to accomplish the training objectives.

SME pilots can be a valuable resource. They will be knowledgeable of the flight characteristics of the particular aeroplane and have significant stall experience in the aeroplane. However, the knowledge of an SME pilot will not be accepted as sufficient to build a model "from scratch". The use of an SME pilot requires the existence of a well-developed solid baseline model ready for small adjustments.

11 Icing models

In-flight icing is one of the environmentally-induced causes of aeroplane upsets. It represents a serious hazard (refer AUPRTA Section 6.6). By disturbing the smooth flow of air on the aeroplane icing will increase drag, decrease the ability of an airfoil to produce lift and degrade control authority.

The lift distribution characteristics along the wing may be affected by even trace amounts of ice contamination.

Unexpected handling characteristics can be expected with ice build-up. During the progression of a stall condition, flow separation on the contaminated aerofoil may be affected and the pitch and/or roll characteristics may be different from those of an uncontaminated wing.

Historically, the effects of icing were typically simulated by adding weight to the simulated aircraft without incorporating abnormal aerodynamic characteristics (such as aerodynamic changes as a result of ice accretion) or altered engine performance.

Studies of airplane accidents where loss of control (LOC) was attributed to icing, have suggested that existing FSTD icing models that do not capture additional effects may be inadequate for training.

Requirements for FSTD qualification for UPRT have been developed to define aeroplane-specific icing models that support training objectives for the recognition and recovery from an in-flight ice accretion event.

> **Note:** Refer FAA Guidance Bulletin 11-04 FSTD Evaluation and Qualification for Engine and Airframe Icing Training Tasks.

Icing models must be upgraded to simulate the aerodynamic degradation effects of ice accretion on the aircraft lifting surfaces. These effects should where possible, be consistent with performance degradations that accident investigation agencies have extracted during the investigations of icing-related accidents and incidents.

Systems (such as the stall protection system and auto-flight systems) must respond properly to ice accretion, consistent with the simulated aircraft. A description of the anti-ice system operation will be required to assist both instructors and trainees in interpreting FSTD behaviour.

Where a particular airframe has demonstrated vulnerabilities to a specific type of ice accretion (due to accident/incident history) which may require specific training (such as supercooled large-droplet icing or tail-plane icing), ice accretion models should be developed that address the training requirements.

Ice accretion models and the associated training cannot replicate all possible icing situations but should:

- demonstrate the cues necessary to recognise the onset of ice accretion on the airframe, lifting surfaces and engines
- have the capability of providing procedures for use of on-board anti-icing equipment and monitoring and maintaining appropriate airspeeds in icing conditions
- provide exemplar degradation in performance and handling qualities to the extent that a recovery can be executed
- provide procedures for responding to decaying airspeed situations, stall protection system activation and early stalls that can occur without stall protection system activation.

FSTD capability for stall-related training must also include the ability to simulate stall conditions and changes in handling characteristics arising from failures in ice-alerting systems. Trainees should be made particularly aware of the insidious nature of inaccurate information arising from such failures, to ensure they are trained to:

- recognise the error
- prevent an upset

- maintain control of the aeroplane.

An objective demonstration is required to demonstrate that ice accretion models as described in the SOC, have been implemented correctly and demonstrate the proper cues and effects as defined in the approved data sources.

An objective demonstration should include two tests to demonstrate engine and airframe icing effects as follows:

- The first test should demonstrate the FSTDs baseline performance without ice accretion.
- The second test should demonstrate the aerodynamic effects of ice accretion relative to the baseline test.

The outcome of the tests will include descriptions of the icing effects being demonstrated. These effects may include, but are not limited to, the following effects as applicable to the particular airplane type:

- decrease in stall angle of attack
- changes in pitching moment
- decrease in control effectiveness
- changes in control forces
- increase in drag
- change in stall buffet characteristics and threshold of perception
- engine effects (power reduction/variation, vibration, etc. where expected to be present on the aircraft in the ice accretion scenario being tested).

Evaluation requirements define a minimum level of fidelity required to adequately simulate the aircraft specific aerodynamic characteristics, of an in-flight encounter with engine and airframe ice accretion as necessary, to accomplish the required training objectives.

OEM data or other analytical methods must be utilised to develop ice accretion models. Acceptable methods may include wind tunnel and/or engineering analysis, coupled with tuning and supplemental subjective assessment by an SME pilot.

The SOC should explain the relevant source data, such as aeroplane OEM’s subjective evaluation guidance material, to the FSTD operator for evaluation of the implemented model.

12 Adherence to the FSTD training envelope

Most FSTDs can be used satisfactorily for AOA-related training and for a significant portion of upset training not involving full stalls. As long as the simulated aeroplane remains within its valid training envelope (VTE) (the aeroplane flight envelope data provided by the OEM and used for the FSTD qualification) for AOA and sideslip, upsets that subsequently have large (AOA or sideslip) excursions can be represented faithfully.

Use of FSTDs in regions of the flight envelope beyond the FSTD's ability to provide accurate fidelity, can result in a negative training experience and high risks. As an example refer to the American Airlines A300-600 accident in 2001, https://www.ntsb.gov/investigations/AccidentReports/Reports/AAR0404.pdf.

The FAA Handbook on Air Transport makes each operator responsible for ensuring that the simulators used beyond the "normal" events can accurately support the inclusion of added activities (see FAA HBAT 95-10).

While various levels of training devices may be appropriate for the illustration and practice of a variety of elements of UPRT, they should always be qualified appropriately for the delivery of UPRT-specific training.

13 The IOS

"The instructor must be provided with minimum feedback tools for the purpose of determining if a training manoeuvre is conducted within FSTD validation limits and the aircraft's operating limits" FAA FSTD Directive 2 and [FAR Part 60 Table A1A.]

13.1 Feedback to the instructor

13.1.1 For the instructor to provide feedback to the trainee during upset prevention and recovery training (UPRT), additional information should be accessible that indicates the fidelity of the simulation, the magnitude of trainee's flight control inputs and aeroplane operational limits that could potentially affect the successful completion of the manoeuvre(s). Specifically, this means that instructors should have available and be properly trained, to effectively utilise IOS tools that convey:

- when the simulator model is no longer valid
- when the aeroplane operational envelope is exceeded
- when inappropriate control inputs are used
- information to support adequate de-briefing, for example, whether and how far recovery went into the extrapolated envelope beyond the flight data validated envelope.

13.1.2 Incorrect recoveries from upsets in simulation can result in:

- excursions outside of the FSTD training envelope
- excursions outside the aeroplane's operational envelope
- inappropriate flight control inputs such as excessive rudder pedal inputs.

13.1.3 An IOS can be as simple as a low-cost hand-held tablet which gives the instructor the ability to activate the scenario, monitor pilot actions, then have immediate information regarding control inputs and forces.

13.1.4 Until IOS representation of the FSTD Training Envelope is provided, operators must ensure instructors are not training beyond the FSTD training envelope. Pro-active identification and removal of negative training should be undertaken even ahead of formal UPRT program development and approval.

13.2 The IOS display

13.2.1 FSTDs qualified for full stall training tasks must meet the instructor operating station (IOS) requirements for upset prevention and recovery training (UPRT) tasks (as detailed in ICAO Doc 9625, 4th Edition, Volume 1, Part II, Section 3.3). The IOS must clearly display:

- FSTD validation envelope. The FSTD should employ a method to record the FSTD's fidelity with respect to the FSTD validation envelope.
- Flight control inputs. The FSTD should employ a method for the instructor/evaluator to assess the trainee's flight control inputs during the upset recovery manoeuvre.
- Aeroplane operational limits. The FSTD should provide the instructor/evaluator with information concerning the aeroplane operating limits

13.2.2 The IOS should represent load factor and speeds with a boundary of operational load and airspeed limits. This display should be constructed in accordance with OEM data and should incorporate OEM operating recommendations.

13.3 Additional IOS functions

13.3.1 If available, IOS selectable dynamic upsets must provide guidance to the instructor concerning the method(s) used to drive the FSTD into the upset condition, including any malfunction or degradation in the FSTD’s functionality required to initiate the upset.

Note: The unrealistic degradation of simulator functionality (such as degrading flight control effectiveness) to drive an airplane upset is generally not acceptable unless used purely as a tool for repositioning the FSTD with the pilot out of the loop.

14 “Train the Trainer”: Training UPRT Instructors

14.1 General

14.1.1 This material is adapted from IATA’s Guidance Material and Best Practices for the Implementation of Upset Prevention and Recovery Training.

14.1.2 When starting a UPRT project, operators should first select an individual or a team to be charged with the design and implementation of the program. This team should form the core-group of instructors to set up the UPRT program. As an example, operators with several fleets might select two instructors per fleet as core instructors.

14.1.3 The core-group of FSTD Instructors will have to complete an acceptable “Train-the-Trainer” course with the aim of qualifying them to deliver UPRT and enabling them to train the remaining regular instructors of the operator. As an example, the initial course for core-group FSTD instructors may include:

- identification of negative training and risk mitigation strategies
- pre-studies in UPRT theory
- academic instructor training
- on-aeroplane UPRT (if relevant)
- human factors
- FTSD training (use and limitations of simulators including the IOS).

14.1.4 The operator may build an “in-house” "Train-the-Trainer" course (preferably supported by the operator’s own or visiting experts, i.e. training captains with previous experience as test pilots, etc) or send the core-group to an experienced UPRT provider. The capabilities of such a provider and the course content, should be discussed with CASA before committing to the training course.

14.1.5 ICAO Doc 10011 Chapter 5 and FAA AC No: 120-111 Change 1 Chapter 2.5, describe training elements and subject areas of instructor training that will assist in ensuring the adequacy of UPRT instructor preparation and minimise the risk of negative transfer of training.

14.2 Training for the "core group"

14.2.1 On-aeroplane training for the core-group instructors is not a requirement. However, it is recommended to allow the core-group to acquire first-hand experience of the success-critical human factors during recoveries of upsets. The core-group will later train the operator’s regular FSTD instructor staff, who normally do not possess this experience and who will have to rely on the expertise of the core-group to compensate for this gap.

14.2.2 FSTD instructor training for the core-group should include a part where the instructor flies the recovery manoeuvres as a trainee, and a second part where he/she practices teaching under supervision. Such instructor training does not necessarily need to be type-specific. Once qualified, the core-group will develop the operator’s type-specific UPRT programs for each fleet (in cooperation with the OEMs) and finally submit them for approval to CASA.

14.2.3 Before qualifying the remaining regular FSTD instructors of the organisation, it would be beneficial for the core-group instructors to gain experience in the delivery of UPRT by teaching trainees for a certain time. Ideally this phase would be supervised/accompanied by an experienced mentor, preferably from the initial UPRT Train-the-Trainer course.

15 The UPRT Instructor

15.1 General

15.1.1 Instructor training is one of the most critical elements in a UPRT program. Training should be delivered within an approved Part 142 training organisation or as part of a training and checking system.

15.1.2 A simulator instructor may have little formalised training in on-aeroplane upset, may have never been beyond 60 degrees of bank angle, or flown beyond the initial indications of a stall in an aircraft. Due to lack of formal guidance, many instructors have been found to teach recovery techniques they personally decided as appropriate, without any quality assurance to prevent negative transfer of training.

15.2 Instructor selection

15.2.1 UPRT training for instructors will probably represent in whole or in part a new skill set. Such instructors must have the ability to impart the correct knowledge and skills to be used in times of distress. Instructors must:

- be selected to ensure the right attributes
- meet the requirements detailed in Chapter 5 of ICAO Doc 10011
- have the prerequisites detailed in Chapter 3 of ICAO Doc 9868
- be able to teach “hands on” human factors/NTS/MCC
- have thorough understanding of CBT for UPRT (refer Appendix to 10011: Competency Based UPRT)
- have knowledge and practical skills in both handling and human factors.
- have instructor training.

15.2.2 Instructors delivering FSTD based UPRT programs must be fully trained to deliver the training sequences and understanding in the AUPRTA. Initial and recurrent instructor training should address, as a minimum:

- Specific additional academic and practical training modules for the initial cadre of operator senior instructors (may include on-aeroplane training).
- Aerodynamics theory covering all areas of the operational envelope.
- Energy management.
- Demonstration of correct upset recovery techniques including early recognition.
- Improved manual handling skills, monitoring and understanding the consequences of inappropriate flight control inputs such as excessive rudder pedal inputs.
- Human factors and CRM including progressive intervention strategies.
- Capabilities and limitations of FSTDs and the risks of negative training inherent when any elements of training go beyond the VTE capabilities of the FSTD.
- Type-specific characteristics and the need to respect the operational envelope.
- Specific guidance on the flight configurations and stall manoeuvres that have been evaluated in the FSTD for use in training.
- Effective use of the Instructor Operating Station (IOS) for UPRT delivery and for providing accurate feedback on trainee performance.

- The importance of adhering to the FSTD Upset Recovery Training scenarios that have been validated by the training program developer, whether using AUPRTA, ICAO Doc 10011 or OEM recommendations and the consequences of excursions outside of the validated training envelope.
- Distinguishing between generic UPRT strategies and OEM specific recommendations.
- The ability to accurately deliver theory and assess levels of understanding while employing sound instructional techniques.
- The need for a “safety first” attitude and daily practice in simulator training where buffet levels, unusual attitudes and even the possibility of mechanical failure, require the routine use of full seat belts, seat locks and security of loose objects.

16 Human Factors and UPRT

16.1 The importance of human factors training

16.1.1 Human Factors (HF) are an integral part of UPRT. The focus of HF integration into UPRT is to address the pilot behaviours and physiological responses leading up to and in the event of, a flight path divergence or a sudden upset.

16.1.2 Until recently, initial and recurrent training did not promote and test the capacity to react to the unexpected. The vast proportion of training has involved standardised and predictable responses to non-normal events whether they involve weather, systems or human factors issues such as incapacitation.

16.1.3 This training, though worthwhile, has implicitly excluded “surprise” and “startle” events and hence has not provided crews with the opportunity to experience events with a significant “surprise and startle” factor. In particular, the rapid increase in crew workload and degradation of communications and coordination in sudden events is something that traditionally trained crews have rarely been exposed to. Analysis shows that in response to “startle” events, both pilots can attempt to take control and act with little co-ordination and lose their teamwork focus.

16.2 A human factors example

16.2.1 Most human factors issues required to be included in an UPRT program were encapsulated in the report on the Air France A330 accident over the Atlantic Ocean. The report noted that the “startle effect” has typically played a major role both in the de-stabilisation of the flight path and in the failures of crews to adequately comprehend and respond to the situation.

16.2.2 The final report recommended that EASA:

- Review the requirements for initial, recurrent and type rating training, in order to develop and maintain a capacity to manage crew resources when faced with the surprise generated by unexpected situations.
- Ensure that operators reinforce CRM training, to enable acquisition and maintenance of adequate behavioural automatic responses in unexpected and unusual situations with a highly charged emotional factor.
- Define instructor selection and recurrent training criteria, that would allow a high and standardised level of instruction to be maintained.
- Modify the basis of the regulations, in order to ensure better fidelity for simulators in reproducing realistic scenarios of abnormal situations.
- Ensure the introduction into the training scenarios of the effects of surprise, to train pilots to face these phenomena and work in situations with a highly charged emotional factor, taking into account the unique characteristics of the type being flown.

17 UPRT entry control methodology

17.1 General

17.1.1 For a new operator, UPRT assessments will be included in the wider assessment of an exposition under Part 119 or 142. Elements to be considered will follow the guidance in Chapter 6 of Doc 10011.

17.1.2 For an existing air transport (formerly charter or RPT) operator implementing their UPRT program prior to the commencement of Part 119 and 121, or an existing Part 142 training provider, CASA will work with each operator or training provider, to define an implementation strategy which will initially involve amendments to the existing training and checking program which would then become accepted elements of the operator's exposition. In the case of a Part 142 training provider, as earlier stated the introduction of the UPRT program would be regarded by CASA as a significant change. Approval to use an existing or upgraded FSTD will be managed in accordance with regulation 60.055 of CASR.

17.1.3 The world-wide shift towards systems-based approaches (for example, SMS and QA) requires the implementation and maintenance of good governance practices in UPRT by industry and authorities alike.

17.1.4 The UPRT implementation process should include a re-evaluation of documented policies, processes and procedures, to confirm that training providers have a well-articulated and developed SMS and QA (refer Doc 10011, for the specific UPRT-related definition of a quality system).

17.1.5 This quality-based approach should not be viewed simply as a paper exercise, where the training provider submits a copy of their quality and safety manuals to CASA for review. CASA will ensure that the documents are consistently being adhered to by all training personnel and their clients.

17.2 UPRT approvals

17.2.1 Acceptance of FSTD use in a specific UPRT program is separate to the qualification for UPRT. Regulation 60.015 of CASR defines 'user' and 'operator' of a qualified simulator or FTD as:

- **User** — the person who has a comprehensive quality system and uses the simulator or FTD in a training, testing or checking program (refer to the definition in regulation 60.010 of CASR)
- **Operator** — the person responsible for the maintenance and operation of the simulator or device (refer to the definition in regulation 60.015 of CASR).

17.2.2 CASA's UPRT "Assess and Accept" processes will involve reviewing the:

a. device qualification
b. training capability of the user.

17.2.3 These 2 items are pre-requisites for program acceptance and are part of the wider training and checking program acceptance.

17.2.4 In considering whether to grant an approval or modification to an existing approval for a training organisation to use a qualified device in a UPRT training program, under regulation 60.055, CASA must take into account:

- the capabilities of the training device
- the differences between the characteristics of the flight simulator or flight training device and the characteristics of a specific type (or a specific make, model and series) of aircraft, whether or not the user operates such an aircraft

- the proposed user's operating and training competencies
- any other matter that affects simulator or device operation or use.

17.3 Post-implementation oversight

17.3.1 The safety consequences of applying poor instructional technique or providing misleading information are arguably more significant with UPRT than in some other areas of training. Training must be effectively managed by the applicable quality and safety management related practices of the training provider, under the thorough oversight of the organisation's QA program activities.

17.3.2 The QA system of a UPRT training provider shall ensure that all UPRT instructors are qualified, competent and current in delivering the course material, and possess the ability to make accurate performance assessments and recommendations for remediation whenever necessary. Training delivered under a quality system as described in Appendix B to ICAO Doc 9841, should prevent instances of inappropriate or incomplete training.

17.3.3 As an example of the required 'thorough oversight", CASA would expect a training provider to be alert for any signs of developing non-standardisation in instructional technique or outcomes. Early "lessons learned" in worldwide UPRT program implementation regarding possible shortcomings by UPRT instructors, include the following:

- not noticing getting outside simulator envelope
- not diagnosing significant errors (for example, rolling pullouts, steps out of order)
- not understanding the new instructor operating station
- not training to proficiency
- not understanding what proficiency is.

17.3.4 CASA's oversight responsibilities include entry control (assess/approve/qualify as required) processes for training organisations and the continued surveillance of the training delivery after UPRT program approval. This surveillance aims to ensure that the training organisation is operating within the terms of its approval, and will include a review of the QA system, its training records and its operational activities.

17.3.5 The main elements of the UPRT-related training activities that are subject to CASA oversight include, as applicable, the following:

- staff adequacy in terms of number and qualifications
- validity of instructors' licences, certificates, ratings and authorizations
- logbooks
- appropriate and adequate facilities for the training and the number of students
- documentation process (for example, the review and update of the training and procedures manual), with particular emphasis on course documentation, including records of system updates, training/operations manuals, etc
- training delivery in the classroom and in simulation devices and, if applicable, flight instruction or on the-job training, including briefing and de-briefing
- instructor training
- QA practices
- SMS functionality, including pro-active flight data analysis
- evaluation (and checking, where applicable)
- training, examination and assessment records

- aircraft registration, associated documents and maintenance records
- training device qualification and approval.

18 Helicopter UPRT programs

18.1 Reserved

19 On-aeroplane UPRT programs

19.1 Reserved