

SECTION I: SE OVERVIEW

Study Topic Overview Summary

CAST chartered the Airplane State Awareness (ASA) Joint Safety Analysis Team (JSAT) in August 2010 and the ASA Joint Safety Implementation Team (JSIT) in 2012 as a follow-on activity to the previous Loss of Control (LOC) JSAT in 2000. Historically, Loss of Control-Inflight (LOC-I) has been, and continues to be, one of the largest categories of commercial aviation fatal accidents. Loss of ASA is a subset of LOC-I accidents and incidents, defined as events in which the flightcrew lost awareness of the airplane’s attitude or energy state. Between 2001 and 2010, half of all LOC-I accidents involved loss of ASA. The ASA JSIT recommended, and CAST adopted, 19 ASA SEs, 5 of which focus on air carrier training.

The ASA JSAT’s study of 18 LOC accidents and incidents showed that, in many situations, the flightcrew failed to properly respond to and recover from an unexpected upset, approach to stall, or stall situation resulting from flightcrew loss of ASA.

SE Objective

CAST recommends air carriers conduct effective upset prevention and recovery training (UPRT), including approach-to-stall, in realistic scenarios, using qualified flight simulator training devices.

Primary Risks Mitigated

Loss of Control-Inflight (LOC-I)

Action	Organization(s)	Strategy	Description	Due Date
Action 1	Airplane and Simulator Manufacturers	Equipment	Determine whether training devices satisfactorily represent airplane characteristics for proposed training.	08/31/2014
<i>Comments: CAST closed this action.</i>				
Action 2	Air Carriers	Training	Revise recurrent and initial approach-to-stall training procedures so this training is conducted using realistic scenarios.	06/30/2016
<i>Comments: CAST closed this action.</i>				
Action 3	FAA AFS	Guidance	Publish guidance material to address UPRT, based on industry best practices.	02/28/2015
<i>Comments: CAST closed this action based on publication of Advisory Circular 120–111.</i>				
Action 4	Air Carriers	Procedures	Revise recurrent and initial UPRT procedures to be conducted using realistic scenarios based on industry best practices and FAA guidance material.	08/31/2016
<i>Comments: CAST closed this action.</i>				
Action 5	Airplane and Simulator Manufacturers	Equipment	Update training devices to satisfactorily represent airplane characteristics for additional proposed training scenarios.	08/31/2017
<i>Comments: CAST closed this action based on the requirements being satisfied in 14 CFR part 60.</i>				

See section II of this SE for detailed action descriptions.

References: The detailed analysis in the ASA JSAT Final Report (June 5, 2015) and the ASA JSIT Final Report (December 31, 2014) is available through CAST.



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SECTION III: SUPPLEMENTAL INFORMATION

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This section contains the following additional information that may be of interest to implementers:

- Source Study
- Related Initiatives
- Total Cost / Resource Overview

SECTION IV: REVISION LOG

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This section provides a history of revisions to this SE.



SECTION II: DETAILED ACTION INFORMATION

Action 1: Determine whether training devices represent airplane characteristics for proposed training

Primary Implementer Airplane and Simulator Manufacturers

Action Objective Airplane and simulator manufacturers determine whether training devices satisfactorily represent airplane characteristics for proposed training.

Action Timeline
Flow Time: 12 months
Due Date: 08/31/2014

Timeline/Flow for Future Adopters TBD

CAST Lead Aerospace Industries Association (AIA)

#	Organization(s)	Detailed Steps
1a	AIA	<p>Communicate with airplane and simulator manufacturers, explaining the analysis undertaken by CAST regarding loss of ASA and the need for representative airplane characteristics in the flight simulator devices to support the following proposed training scenarios:</p> <ul style="list-style-type: none"> a. Approach-to-stall (that is, up to the stall warning activation) scenarios: <ul style="list-style-type: none"> i. Approach-to-stall with the autopilot engaged (including autothrottles disengaged, inoperative or not installed), with emphasis on the effect of autopilot trim/auto-trim and combinations of autoflight modes that can lead to low energy state (for example, use of vertical speed modes in climb near the airplane’s performance ceiling). ii. A demonstration of recognition and recovery from initial improper response to approach-to-stall. iii. High-altitude approach-to-stall (service ceiling for the weight) to include recognition of low and high-speed buffet, performance capabilities of the engines and flight control sensitivity. iv. Low-altitude approach-to-stall (terrain critical) and recovery with ground proximity warning system (GWPS) alerts. v. Air data system failures that can present as, or lead to, stall. b. UPRT scenarios: <ul style="list-style-type: none"> i. Upsets encountered with and without autoflight engaged, ii. Upsets occurring in instrument meteorological conditions (IMC), iii. Sub-threshold roll (imperceptible roll rate) in IMC, iv. Pilot-induced upsets, and v. Air data system failures (for example, unreliable airspeed), with emphasis on subtle or intermittent types of failures that can be particularly difficult to recognize or diagnose.
<i>Complete.</i>		

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Note: See section III for detailed costs and resources.



SECTION II: DETAILED ACTION INFORMATION

1b	Manufacturers	<p>Review these training scenarios and determine, in conjunction with the FAA National Simulator Program (NSP), the suitability for using their most current simulation models for the performance of the training. Airplane and simulator manufacturers will then—</p> <ul style="list-style-type: none"> a. Identify those scenarios for which the current simulation models adequately represent airplane flight characteristics. b. Identify those training scenarios for which each current model is not representative of the airplane flight characteristics, and for each scenario— <ul style="list-style-type: none"> i. Identify feasible revisions the manufacturers can make to the models to improve their capability to satisfactorily represent airplane characteristics for the scenarios, ii. Define changes to the scenario that the current models could support, or iii. Make other recommendations, as applicable.
<i>Complete.</i>		
1c	Manufacturers	Communicate this information to customer air carrier training organizations, air carrier industry associations, and AIA.
<i>Complete.</i>		
1d	AIA	Track implementation and report to JIMDAT and CAST when all aircraft and simulator manufacturers of Title 14, Code of Federal Regulations (14 CFR) part 25 airplanes currently used in 14 CFR part 121 operations have completed review of the most current simulation models for these airplanes and have communicated the results to air carriers.
<i>Complete.</i>		

Notes

Note: See section III for detailed costs and resources.



SECTION II: DETAILED ACTION INFORMATION

Action 2: Revise approach-to-stall training procedures based on best practices

Primary Implementer

Air Carriers

Action Objective

Air carriers should revise recurrent and initial approach-to-stall training procedures so that this training is conducted using realistic scenarios, incorporating proper stall recovery technique emphasizing reduction of angle of attack.

Action Timeline

Flow Time: 22 months (from completion of [Action 1](#))

- o 6 months to modify training in accordance with guidance material
- o 18 months for all pilots to receive training (initial or recurrent)

Due Date: 06/30/2016

Timeline/Flow for Future Adopters

TBD

CAST Lead

Regional Airline Association (RAA)

#	Organization(s)	Detailed Steps
2a	Air Carrier Industry Assns.	Communicate with members, explaining the analysis undertaken by CAST regarding loss of ASA, the role of improper stall or upset prevention and recovery procedures in contributing to the events, and the purpose of the CAST SE.
		<i>Complete.</i>
2b	Air Carriers	<p>Review FAA Advisory Circular (AC) 120–109, Stall and Stick Pusher Training, and revise training programs as necessary to ensure the following components are included in recurrent and initial training approach-to-stall and stall recovery training:</p> <ol style="list-style-type: none"> a. The key concept that reduction of angle of attack is the most important response when confronted with a stall event. The training should emphasize treating an approach to stall the same as a full stall, executing the stall recovery at the first indication of the stall and emphasizing that reduction of angle of attack is the most important response. b. Airline Transport Pilot and Aircraft Type Rating Practical Test Standards (PTS), recently revised, as they relate to checking approach to stall recognition and recovery, including evaluation criteria for a recovery from a stall or approach-to-stall that does not mandate a predetermined value for altitude loss and should consider the multitude of external and internal variables which affect the recovery altitude. c. Academic training on specific aircraft characteristics that identify a stalled condition, the characteristics that can predict an imminent stall departure, and the role air data system failures can play in contributing to a stall and the proper diagnosis and response to these failures. d. Realistic scenarios that could be encountered in operational conditions. The scenarios should be performed in flight simulator devices validated by airplane and simulator manufacturers as capable of replicating actual airplane flight characteristics, as determined in Action 1. Proposed scenarios include, but are not limited to— <ol style="list-style-type: none"> i. Approach-to-stall with the autopilot engaged (including autothrottles disengaged, inoperative or not installed), with emphasis on the effect of autopilot trim/auto-trim and combinations of autoflight modes that can lead to low energy state

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Note: See section III for detailed costs and resources.



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		<p>(for example, use of vertical speed modes in climb near the airplane’s performance ceiling);</p> <ul style="list-style-type: none"> ii. A demonstration of recognition and recovery from initial improper response to approach-to-stall; iii. High-altitude approach-to-stall (service ceiling for the weight) to include recognition of low- and high-speed buffet, performance capabilities of the engines and flight control sensitivity; iv. Low-altitude approach-to-stall (terrain critical) and recovery with ground proximity warning system (GPWS) alerts; or v. Air data system failures that can present as, or lead to, stall.
		<i>Complete.</i>
2c	Air Carriers	Coordinate with pilot labor organizations to communicate these revisions and the rationale supporting them to the line pilot community.
		<i>Complete.</i>
2d	Air Carriers	Conduct approach-to-stall recovery training for line pilots in initial and recurrent training, in accordance with these revisions, in appropriately qualified flight simulator devices. Air carriers will undertake simulator qualification through normal procedures in coordination with the FAA National Simulator Program (NSP), using available guidance bulletins for approach-to-stall and stall recovery maneuvers.
		<i>Complete.</i>
2e	Air Carriers	<p>Air carrier actions are complete when the air carrier has—</p> <ul style="list-style-type: none"> a. Revised its approach-to-stall training, as necessary, to reflect the guidance material and industry best practices. b. Trained all its pilots (initial or recurrent).
		<i>Complete.</i>
2f	Air Carrier Industry Assns.	Track implementation of member air carriers and report progress to JIMDAT and CAST.
		<i>Complete.</i>

Notes

Assumes the following:

- No increase in training footprint, only revision and improvement of currently performed approach-to-stall training.
- Training revisions will occur as part of normal air carrier training program update cycle.



SECTION II: DETAILED ACTION INFORMATION

Action 3: Publish UPRT guidance material

Primary Implementer Flight Standards Service, Safety Standards (AFS)

Action Objective FAA AFS should publish guidance material to address UPRT, based on industry best practices.

Action Timeline
Flow Time: 18 months
Due Date: 02/28/2015

Timeline/Flow for Future Adopters TBD

CAST Lead FAA AFS

#	Organization(s)	Detailed Steps
3a	FAA AFS	<p>Publish guidance material for training upset prevention and recovery. The guidance will take into consideration industry recommendations and best practices as follows:</p> <ul style="list-style-type: none"> a. Airplane Upset Recovery Training Aid, revision 2, from November 2008; b. High Altitude Operations: Supplement 1 to the Airplane Upset Recovery Training Aid; c. The recommendations of the Section 208 Aviation Rulemaking Committee; d. The recommendations of the International Civil Aviation Organization (ICAO) Loss of Control Avoidance and Recovery Training (LOCART) initiative; e. Use of realistic scenarios and situations that have resulted in loss of ASA and led to accidents or major incidents, including but not limited to— <ul style="list-style-type: none"> i. Upsets encountered with and without autoflight engaged, ii. Upsets occurring in instrument meteorological conditions (IMC), iii. Sub-threshold roll (imperceptible roll rate) in IMC, iv. Pilot-induced upsets, and v. Air data system failures (for example, unreliable airspeed), with emphasis on subtle or intermittent types of failures that can be particularly difficult to recognize or diagnose.
<i>Complete.</i>		
3b	FAA AFS	Report completion and publication of the guidance material to JIMDAT and CAST.
<i>Complete.</i>		

Notes FAA to determine appropriate form of guidance material during development.

Note: See section III for detailed costs and resources.



SECTION II: DETAILED ACTION INFORMATION

Action 4: Revise UPRT procedures based on best practices and FAA guidance

Primary Implementer

Air Carriers

Action Objective

Air carriers should revise recurrent and initial UPRT procedures to be conducted using realistic scenarios based on industry best practices and FAA guidance material.

Action Timeline

Flow Time: 18 months (from completion of [Action 3](#))

- o 6 months to revise training
- o 18 months for pilots to receive training (initial or recurrent)

Due Date: 08/31/2016

Timeline/Flow for Future Adopters

TBD

CAST Lead

Regional Airline Association (RAA)

#	Organization(s)	Detailed Steps
4a	Air Carrier Industry Assns.	Communicate with member air carriers when the FAA has completed development of the guidance material for UPRT in Action 3. <i>Complete.</i>
4b	Air Carriers	Assess training programs to ensure recurrent and initial training include the principles in the guidance, and revise training programs as necessary. <i>Complete.</i>
4c	Air Carriers	Conduct revised UPRT for line pilots in initial and recurrent training in appropriately qualified flight simulator devices. Air carriers undertake simulator qualification through normal procedures in coordination with the FAA National Simulator Program (NSP), using available guidance bulletins for upset prevention and recovery. Proposed scenarios include but are not limited to the following: <ol style="list-style-type: none"> a. Upsets encountered with and without autoflight engaged, b. Upsets occurring in instrument meteorological conditions (IMC), c. Sub-threshold roll (imperceptible roll rate) in IMC, d. Pilot-induced upsets, and e. Air data system failures (for example, unreliable airspeed), with emphasis on subtle or intermittent types of failures that can be particularly difficult to recognize or diagnose. <i>Complete.</i>
4d	Air Carriers	Coordinate with pilot labor organizations to communicate these revisions and the rationale behind them to the line pilot community. <i>Complete.</i>
4e	Air Carriers	Air carrier actions are complete when the air carrier has— <ol style="list-style-type: none"> a. Revised its UPRT, as necessary, to reflect the guidance material and industry best practices. b. Trained all its pilots (initial or recurrent). <i>Complete.</i>

Note: See section III for detailed costs and resources.



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4f	Air Carrier Industry Assns.	Track implementation and report progress to JIMDAT and CAST.
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Complete.

Notes

Assumes the following:

- Amended training does not add additional time to current flightcrew training footprint; rather, current training is revised and improved.
- Revised concepts will be included in initial and recurrent training.
- Training revisions will occur as part of normal air carrier training program update cycle.



SECTION II: DETAILED ACTION INFORMATION

Action 5: Update training devices to represent airplane characteristics for additional training scenarios

Primary Implementer Airplane and Simulator Manufacturers

Action Objective Airplane and simulator manufacturers should update training devices, as feasible and necessary, to satisfactorily represent airplane characteristics for additional proposed training scenarios.

Action Timeline

Flow Time: 36 months (from completion of [Action 1](#))

- o 24 months to update simulators
- o 36 months for air carriers to incorporate revisions to simulators and training

Due Date: 08/31/2017

- o 08/31/2016
- o 08/31/2017

Timeline/Flow for Future Adopters TBD

CAST Lead Aerospace Industries Association (AIA)

#	Organization(s)	Detailed Steps
5a	Airplane and Simulator Manufacturers	Based on the results of Action 1, Subaction 1b, implement revisions to flight simulator devices as feasible and necessary to enable air carriers to provide realistic training for additional scenarios for which current models are not representative. <i>Complete.</i>
5b	Simulator Manufacturers	Disseminate the updated models to customers as the revisions are implemented. <i>Complete.</i>
5c	Air Carriers	Implement the changes as necessary and make additional revisions to training programs to support the additional scenarios and communicate these actions to the industry associations. <i>Complete.</i>
5d	AIA	Track and communicate availability of updated simulator models, and the scenarios they are capable of supporting, to JIMDAT, CAST, and the air carrier industry associations. <i>Complete.</i>
5e	AIA, Air Carrier Industry Assns.	Report to JIMDAT and CAST when the following have occurred: a. All feasible revisions identified by manufacturers in Action 1, Subaction 1b, are complete, and b. The updates are implemented at each air carrier. <i>Complete.</i>

Notes Assumes training revisions will occur as part of normal air carrier training program update cycle.

Note: See section III for detailed costs and resources.



SECTION III: SUPPLEMENTAL INFORMATION

Source Study ASA Joint Safety Analysis Team (JSAT) Final Report (June 5, 2014)
ASA Joint Safety Implementation Team (JSIT) Final Report (December 31, 2014)

Related Initiatives

- Industry guidance on UPRT
 - Airplane Upset Recovery Training Aid, Revision 2 (November 2008)
 - High Altitude Operations: Supplement 1 to the Airplane Upset Recovery Training Aid
- CAST SE 31, LOC Training – Advanced Maneuvers – Implement Ground and Flight Training
- CAST SE 209 ASA – Research – Simulator Fidelity
- FAA AC 120–109, Stall and Stick Pusher Training
- FAA Air Transport Pilot Practical Test Standards (PTS)
- International Air Transport Association (IATA) Unreliable Airspeed Effort
- ICAO Loss of Control Avoidance and Recovery Training (LOCART) initiative
- International Committee for Aviation Training in Extended Envelopes (ICATEE)
- U.S. Public Law 111–216, the Airline Safety and Federal Aviation Administration Extension Act of 2010
- FAA National Simulator Program (NSP) Flight Simulation Training Device (FSTD) Guidance Bulletin 14–01, FSTD Evaluation Guidelines for Full Stall Training Maneuvers
- FAA NSP FSTD Guidance Bulletin 11-05, Evaluation Recommendations for Upset Recovery Training Maneuvers

Total Cost	\$8,200,000	<i>Note: For labor, 1 Full Time Equivalent (FTE) = \$250,000</i>	
Action 1	\$400,000	1.6 FTE	
Action 2	\$1,000,000	4.0 FTE	
Action 3	\$300,000	1.2 FTE	
Action 4	\$1,000,000	4.0 FTE	
Action 5	\$5,500,000	6.0 FTE	\$4,000,000 in simulator improvements, 6.0 FTE in other support

	Organization	Resources Needed
<i>Direct Resource Overview – Government</i>	FAA AFS	<ul style="list-style-type: none"> • Action 3: 1.0 FTE. • Actions 2, 4, and 5: Inspector resources required for normal review and approval of air carrier training programs as part of duties performed.
	FAA AIR	<ul style="list-style-type: none"> • Action 3: 0.2 FTE.
	Organization	Resources Needed
<i>Direct Resource</i>	AIA	<ul style="list-style-type: none"> • Action 1: 0.2 FTE for communication and tracking. • Action 5: 0.2 FTE for tracking and coordination.

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Organization	Resources Needed
<i>Overview – Industry</i>	
Air Carrier Industry Assns.	<ul style="list-style-type: none"> Action 2: 0.2 FTE (assumes ~0.05–0.1 FTE at each association for coordination). Action 4: 0.2 FTE (assumes ~0.05–0.1 FTE at each association for coordination). Action 5: 0.3 FTE for tracking and coordination. <p><i>Note: 55 air carriers are represented by three CAST-member air carrier industry associations:</i></p> <ul style="list-style-type: none"> Airlines for America (A4A), Regional Airline Association (RAA), and National Air Carrier Association (NACA).
Air Carriers	<ul style="list-style-type: none"> Action 2: 3.3 FTE (assumes 0.06 FTE at each air carrier to perform review and make revisions). Action 4: 3.3 FTE (assumes 0.06 FTE at each air carrier to perform review and make revisions). Action 5: 5.5 FTE (assumes ~0.1 FTE per air carrier to incorporate changes to simulators).
Labor Organizations	<ul style="list-style-type: none"> Action 2: 0.5 FTE (assumes 0.25 FTE at each organization for support and communication). Action 4: 0.5 FTE (assumes 0.25 FTE at each organization for support and communication). <p><i>Note: Two pilot labor organizations are represented at CAST:</i></p> <ul style="list-style-type: none"> Air Line Pilots Association (ALPA), and Coalition of Air Line Pilots Associations (CAPA).
Manufacturers	<ul style="list-style-type: none"> Action 1: 1.4 FTE (assumes 0.25 per aircraft manufacturer and 0.4 for simulator manufacturers to perform assessments of simulator capabilities and communicate results). Action 5: \$4,000,000 (assumes each manufacturer will invest up to \$1,000,000 in simulation improvements). <p><i>Note: Four manufacturers of part 25 airplanes operated in U.S. part 121 operations are represented at CAST:</i></p> <ul style="list-style-type: none"> Airbus (CAST member), Boeing (CAST member), Bombardier (represented by AIA), and Embraer (represented by AIA).

Indirect Resource Overview

The organizations identified in this section are not expected to incur direct costs associated with implementing this SE, but they may incur indirect costs within their normal line of work.

Organization	Description
N/A	N/A

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SECTION IV: REVISION LOG

Major revisions (whole numbers) represent CAST-approved changes to SE language. Minor revisions (decimals) represent minor changes to target dates or completion notes that do not affect implementer actions.

Revision	Date	Description
2.0	09/17/2018	New SE format. Content reorganized and terminology updated. No substantive changes.
1.4	04/06/2017	Action 5 closed.
1.3	10/06/2016	Action 4 closed. Action 2 closed at June 2016 CAST meeting.
1.2	04/07/2016	Action 1 closed 02/12/2015. Action 2 due date extended from 04/30/2016 to 06/30/2016.
1.1	02/04/2016	Action 2 due date extended from 02/29/2016 to 04/30/2016.
1.0	04/02/2015	Relation to Current Aviation Community Initiatives revised. Actions 1 and 3 closed at February 2015 CAST meeting.
Original	08/01/2013	CAST adopted SE 196.

SECTION IV

