Commercial Aviation Safety Team

Aircraft Certification CAST Safety Portfolio

April 2020

REVISION LOG

Date	Updates
02/04/2016	SE 127 Action 3 completed and closed. SE 133 Action 3 and Action 4 withdrawn.
06/02/2016	No changes. SE decisions at the June 2016 CAST meeting do not affect this portfolio.
08/04/2016	No changes. SE decisions at the August 2016 CAST meeting do not affect this portfolio.
10/06/2016	SE 172 completed and closed. SE 214 completed and closed. SE 215 Action 1 completed and closed. SE 218 Action 2 completed and closed. SE 228 Action 1 added to portfolio. SE 229 Action 1 added to portfolio.
12/01/2016	SE 126 completed and closed.
02/02/2017	SEs 133 and 215 completed and closed. SEs 223, 224, and 225 added to portfolio.
04/06/2017	SE 196 completed and closed.
06/01/2017	No changes. SE decisions at the June 2017 CAST meeting do not affect this portfolio.
08/03/2017	SE 204 Action 2 and Action 3 completed and closed. SE 218 completed and closed.
10/05/2017	No changes. SE decisions at the October 2017 CAST meeting do not affect this portfolio.
12/07/2017	SE 219 completed and closed. SE 222 completed and closed.
02/01/2018	SE 203 Action 2 and Action 3 completed and closed.
04/05/2018	SE 228 completed and closed. SE 229 Action 1 completed and closed.
06/07/2018	No changes. SE decisions at the June 2018 CAST meeting do not affect this portfolio.
08/02/2018	No changes. SE decisions at the August 2018 CAST meeting do not affect this portfolio.
10/04/2018	SE 200 Action 1 completed and closed. SE 203 completed and closed. SE 204 completed and closed. SE 205 completed and closed. SE 209 Action 3 completed and closed. SE 210 completed and closed. SE 211 completed and closed.
12/06/2018	SE 226 Action 1 completed and closed.
02/06/2019	SE 224 Action 1 completed and closed.

Date	Updates
04/04/2019	No changes. SE decisions at the April 2019 CAST meeting do not affect this portfolio.
06/06/2019	No changes. SE decisions at the June 2019 CAST meeting do not affect this portfolio.
08/15/2019	No changes. SE decisions at the August 2019 CAST meeting do not affect this portfolio.
10/03/2019	No changes. SE decisions at the October 2019 CAST meeting do not affect this portfolio.
12/05/2019	SE 183 completed and closed.
02/06/2020	No changes. SE decisions at the February 2020 CAST meeting do not affect this portfolio.
04/02/2020	No changes. SE decisions at the April 2020 CAST meeting do not affect this portfolio.

In the wake of several accidents in the 1990s, in 1998 the U.S. Government and key industry stakeholders established the Commercial Aviation Safety Team (CAST) and set a goal to reduce the U.S. commercial aviation fatality rate by 80 percent by 2008. CAST achieved this goal. Its new goal is to reduce the U.S. commercial aviation fatality risk by at least 50 percent from 2010 to 2025.

To accomplish this goal, CAST adopted an integrated, data-driven strategy that targets specific areas for improvement in both operations and airworthiness. Specifically, CAST:

- Identifies top safety areas through the analysis of accident and incident data.
- Charters joint teams of experts to develop methods to fully understand the chain of events leading to accidents.
- Identifies and implements high-leverage interventions or safety enhancements (SEs) to reduce the fatality rate in these areas.

By implementing the most promising SEs, CAST helped reduce the U.S. commercial air travel fatality rate by 83 percent. As a follow-on goal, CAST now seeks to reduce the U.S. commercial aviation fatality risk by at least 50 percent from 2010 to 2025, and to continue working with international partners to reduce fatality risk in world-wide commercial aviation. CAST continues to evolve its approach to safety management, moving from a forensic approach to a more prognostic approach by leveraging the Aviation Safety Information Analysis and Sharing (ASIAS) program. ASIAS brings together voluntary safety data from across the industry to help monitor known risk, gauge the effectiveness of deployed mitigations, and identify emerging risk.

As of September 2013, CAST has adopted 86 voluntary SEs. The attached portfolio describes 24 of these activities[1], with specific focus on the actions that AIR and the manufacturing community voluntarily agreed to implement.

The record shows that CAST SEs, when implemented, contribute to our collective goal of reducing aviation fatalities. To that end, I ask you to include the appropriate CAST SEs in conversations with your OEMs and to encourage consider how we can work together to proactively improve system safety.

Thank you in advance for your support and, as always, thank you for all that you do.

Best,

Dorenda Baker
September 2013

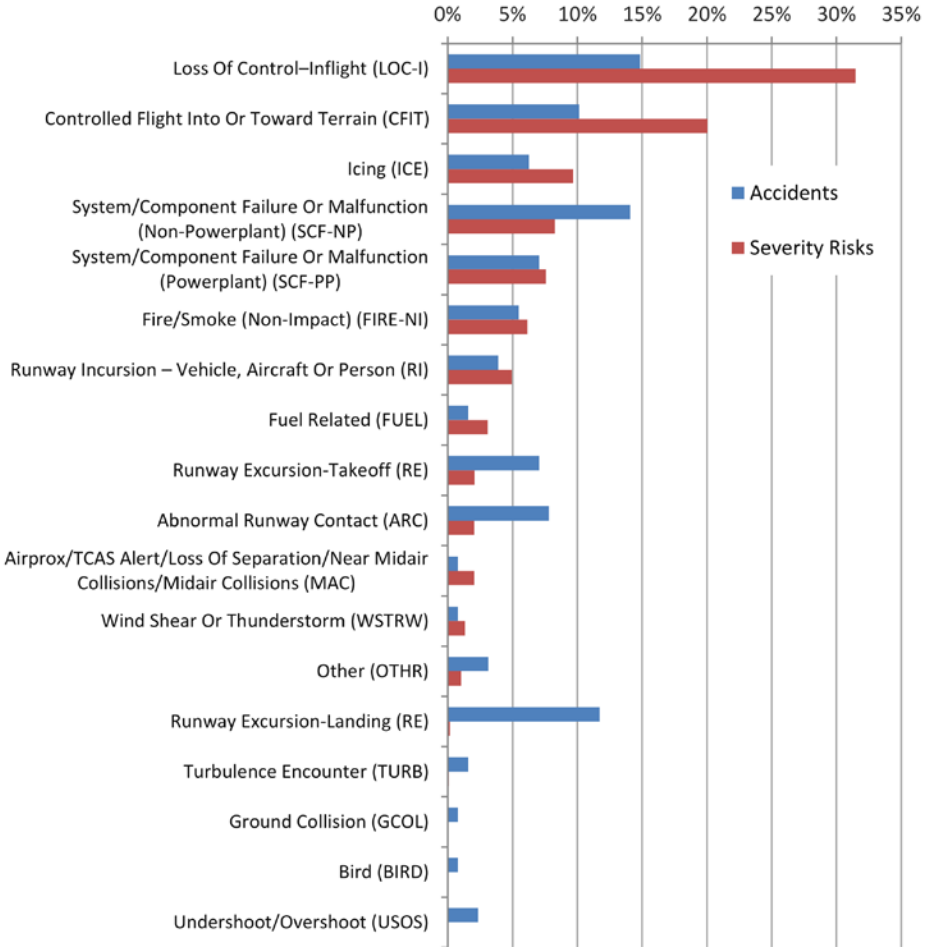
[1] As of April 2017, CAST has adopted 101 voluntary SEs, of which 38 are described in this portfolio.

1. INTRODUCTION

CAST OVERVIEW

The Commercial Aviation Safety Team (CAST) is a Government and industry collaboration of major organizations sharing the common aviation safety mission to reduce the commercial aviation accident rate.

CAST uses an integrated, data-driven strategy to reduce the U.S. commercial aviation fatality risk[2] and promote new Government and industry safety initiatives throughout the world. CAST prioritizes its efforts based on historical accident risk. The following bar chart displays 1987–2011 U.S. Hull Loss and Fatal Accidents and the percent of the total for each associated contributing factor.[3]



[2] Fatality risk is the fatal accident rate computed in terms of equivalent fully-fatal airplane loads. It does not include ramp or security-related fatalities. It does include cargo operations. An accident that is fatal to 50 percent of the people on board equates to a 0.50 fatality risk.

[3] CAST/International Civil Aviation Organization Common Taxonomy Team Aviation Occurrence Category definitions: http://www.intlaviationstandards.org/Documents/CICTTOccurrenceCategoryDefinitions.pdf.

As of April 2020, CAST has adopted 101 voluntary safety enhancements (SE), 88 completed and 13 underway. During the CAST studies, some potential mitigations were discussed that were not mature enough to add to the CAST Plan. These research and development (R&D) SEs do not directly reduce accident risk, but were adopted for further research or studies that CAST hopes will lead to opportunities for additional risk reduction. In the future, as the research is conducted, aspects of these R&D SEs may be added to the CAST Plan.

CAST seeks to have industry and Government voluntarily implement the SEs, which can be as effective as rulemaking, but take less time. Safety experts report the fatality risk for commercial aviation in the United States has been reduced by 83 percent from 1998 to 2008. Voluntary implementation of the CAST portfolio contributed to this reduction.

Current CAST goals include—

- Reducing the U.S. commercial aviation fatality risk by at least 50 percent from 2010 to 2025.
- Continuing to work with our international partners to reduce fatality risk in worldwide commercial aviation.

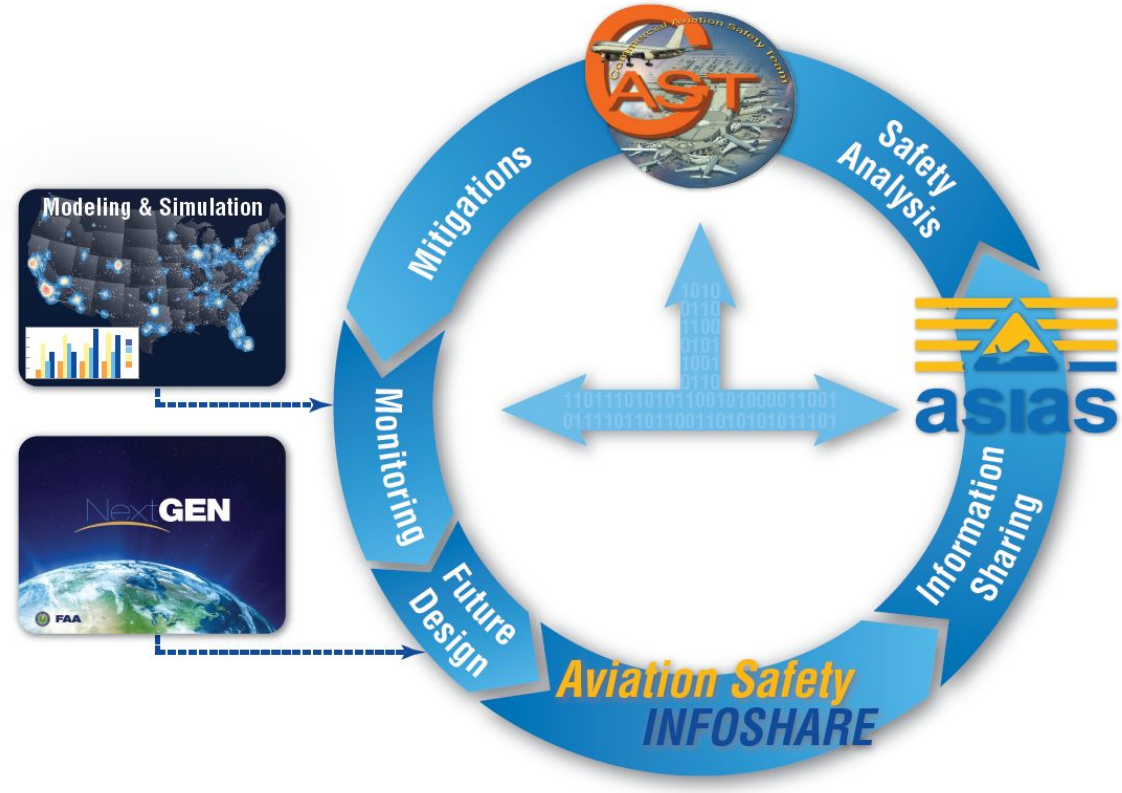
ASIAS Overview

The Federal Aviation Administration (FAA) created Aviation Safety Information Analysis and Sharing (ASIAS) as a means to provide a national resource for data analysis to discover common, systemic safety problems spanning multiple aspects of the global air transportation system. ASIAS uses safety data collected from the public sector and internal FAA databases, and proprietary data from industry stakeholders (air carriers and manufacturers) to assess identified safety issues and monitor multiple data sources for potential high-risk safety vulnerabilities. Proprietary ASIAS data is governed by policies that protect the interests of the supplier(s) while allowing the broader aviation community to benefit from aggregate data analysis. Data from the public sector is available online at http://www.asias.faa.gov. Additional data is available on the ASIAS extranet portal after requesting an individual account through any of the following methods:

- Accessing https://extranet.asias.faa.gov/.
- Calling ASIAS directly at 1–800–842–8736 extension 34247.
- Emailing ASIAS directly at ASIAS@faa.gov.

The FAA Office of Accident Investigation and Prevention (AVP) acts as a facilitator and is an available resource to FAA personnel. AVP analysts are available to assist FAA personnel with accessing proprietary ASIAS data and information beyond what is publicly available.

CAST, ASIAS, AND INFOSHARE—A SYSTEM-WIDE SAFETY MANAGEMENT SYSTEM



Aviation Safety InfoShare (InfoShare) is a semiannual event where air carriers, manufacturers, and others come together in an open environment to voluntarily share safety findings and potential issues. InfoShare is a vital part of the aviation safety community. By participating in InfoShare, air carriers can fulfill the Title 14, Code of Federal Regulations (14 CFR) § 13.401[4] requirement for disclosing Flight Operational Quality Assurance (FOQA) data.

CAST, ASIAS, and InfoShare together are part of the global Safety Management System (SMS) process. ASIAS uses all available data to study systemic issues raised at InfoShare and better understand the underlying contributing factors. When appropriate, ASIAS shares its directed studies with CAST for potential mitigation. CAST develops voluntary SEs to mitigate potential fatality risk threats. CAST also monitors implementation and effectiveness of its safety plan to ensure it is adopted in a manner consistent with the agreed-to plan and CAST goals. The ultimate goal is to generate corrective actions before new types of accidents emerge.

This document will help explain CAST and the CAST Safety Plan to the entire FAA workforce. By sharing information about all safety-related activities, the FAA hopes to make even more informed, connected decisions. Inspectors should work with manufacturers to encourage voluntary incorporation of the CAST SEs in their manufacturing processes. In addition, inspectors should review the CAST SEs in this document and assess whether the FAA could refine any of its design and certification processes to prevent future concerns.

[4] Flight Operational Quality Assurance Program: Prohibition against use of data for enforcement purposes.

PORTFOLIO LAYOUT

This portfolio summarizes 38 of the 101 CAST voluntary SEs, and 12 of the 21 R&D SEs.

This portfolio will be updated after each CAST meeting (typically every 2 months) to reflect the status of SEs in the CAST Plan. The summary is intended to clearly explain the SEs as it pertains to manufacturers and/or FAA Aircraft Certification Service (AIR). A complete listing of all CAST SEs, in their original formatting and language, is available at the website: http://www.skybrary.aero/index.php/Portal:CAST_SE_Plan.

Each SE may involve several actions needed from multiple sources, such as regulators, manufacturers, or air carriers, for successful implementation. This portfolio focuses on all SEs with manufacturer actions, as well as open AIR actions.

Fourteen SEs in this portfolio are considered "underway" (8 CAST voluntary SEs and 6 R&D SEs). Specific actions of these SEs may already be complete; however, the SE as a whole is not.

Thirty-six SEs in this portfolio are considered "completed." Because CAST SEs are voluntary, the classification "completed" does not mean every manufacturer and/or regulator implemented the SE as specified.

Inspectors should work with their manufacturers to see whether the SEs have been implemented. If the SEs have not been implemented, inspectors should encourage their manufacturer to review the SEs and evaluate whether implementing them would improve their safety margin.

The following is a list of the CAST voluntary SEs and R&D SEs included in this portfolio.

Topic	*Completed*	*Underway*	*Category*
SE 1: Terrain Avoidance Warning System (TAWS)	X		*Airworthiness*
SE 8: Precision-like Approach Implementation	X		*Operations*
SEs 14–16: Policies for ALAR (Safety Culture)	X		*Operations*
SE 21: Flight Deck Equipment Upgrades/Installation To Improve Altitude Awareness and Checklist Completion	X		*Airworthiness*
SE 24: Aircraft Design	X		*Airworthiness*
SE 27: Risk Assessment and Management	X		*Operations*
SE 28: Policies	X		*Operations*
SE 30: Human Factors and Automation	X		*Airworthiness*
SE 32: Autoflight Features in New Airplane Designs	X		*Airworthiness*
SE 34: Display and Alerting Features in New Airplane Designs	X		*Airworthiness*
SE 39: Criteria for Flight in Icing Conditions for New Airplane Designs	X		*Airworthiness*
SE 40: Flight Envelope Protection in New Airplane Designs	X		*Airworthiness*

Topic	Completed	Underway	Category
SE 85: Vertical Situation Displays—All Airplane Designs	X		Airworthiness
SE 101: Advanced Circuit Protection	X		Airworthiness
SE 120: TAWS Improved Functionality	X		Airworthiness
SE 126: Mitigations for Hazardous Material Fires	X		Research
SE 127: Cargo Fire Management		X	Airworthiness
SE 133: Turboprop Aircraft Ice Detection Systems	X		Airworthiness
SE 134: Avionics	X		Airworthiness
SE 170: OEM Continuous Monitoring of Service History	X		Operations
SE 172: Gap Analysis of Existing Airplane Maintenance Process & Follow on Action Plan	X		Airworthiness
SE 175: Flight Critical Configurations Changes Made During Maintenance	X		Operations
SE 183: Cockpit Moving Map Display and Runway Awareness System	X		Airworthiness
SE 191: New TCAS/NextCAS Equipment	X		Airworthiness
SE 196: Effective Upset Prevention and Recovery Training, Including Approach-to-Stall	X		Operations
SE 200: Virtual Day-VMC Displays		X	Airworthiness
SE 201: Bank Angle Alerting and Recovery Guidance Systems		X	Airworthiness
SE 202: Bank Angle Protection		X	Airworthiness
SE 203: Features for Current Production/In-Development Fly-by-Wire Airplane Designs	X		Research
SE 204: Features for Existing non-Fly-by-Wire Airplane Designs	X		Research
SE 205: Features for Out-of-Production Airplane Designs		X	Research
SE 207: Attitude and Energy State Awareness Technologies		X	Research
SE 208: Airplane Systems Awareness		X	Research
SE 209: Simulator Fidelity		X	Research
SE 210: Flight Crew Performance Data	X		Research
SE 211: Training for Attention Management	X		Research
SE 214: Procedures and Standards to Improve Path Compliance for STARs and RNAV Departures	X		Airworthiness
SE 215: Landing Distance Assessment	X		Airworthiness
SE 216: Flight Crew Landing Training		X	Airworthiness
SE 218: Overrun Awareness and Alerting Systems	X		Airworthiness

Topic	*Completed*	*Underway*	*Category*
SE 219: Policies, Procedures, and Training to Prevent Runway Excursions	X		*Airworthiness*
SE 222: Airplane-Based Runway Friction Measurement and Reporting	X		*Research*
SE 223: Hazardous Material Fires – Prevention and Mitigation		X	*Airworthiness*
SE 224: Hazardous Material Fires – Enhanced Fire Detection Systems		X	*Research*
SE 225: Hazardous Material Fires – Containment and Suppression		X	*Research*
SE 226: Hazardous Material Fires – Enhanced Protection of Occupants and Aircraft		X	*Airworthiness*
SE 228: Airplane Design Features to Facilitate Proper Takeoff Configuration	X		*Airworthiness*
SE 229: Takeoff Configuration Warning System Maintenance and Operational Assurance		X	*Airworthiness*

Section 2 of this portfolio includes a list and summary of the airworthiness CAST voluntary SEs, with associated manufacturer and/or AIR actions.

Section 3 of this portfolio includes a list and summary of the operations CAST voluntary SEs, with associated manufacturer and/or AIR actions.

Section 4 of this portfolio includes a list and summary of the R&D SEs, with associated manufacturer and/or AIR actions.

FEEDBACK

If you have questions or suggested changes on the utility of the information, please email your feedback to ASIAS@faa.gov.

2. Safety Enhancements—Airworthiness

SE 127: Cargo Fire Management (Underway)

This SE is underway. Aspects of this SE are being worked on and will be altered from this draft version once they are complete.

This SE is designed to reduce cargo fires through new or revised standards for the construction of standardized and improved cargo containers, including fire-suppression or fire-containment systems.

This SE calls for the development of improved fire containment/suppression systems in Class B, E, or F cargo areas. These systems could include—

- Improved unit load device (ULD) containers capable of internally containing or suppressing a fire;
- Fire containment covers (FCC) or bags/blankets that would be used to cover palletized, netted cargo or ULD containers; or
- Fire suppression systems external to the pallets/ULDs.

These improved containment/suppression systems should be implemented when available.

Action 2

AIR reviewed and determined if the methods of cargo fire protection/suppression proposed by the FAA Technical Center are feasible. AIR tasked a Society of Automotive Engineers (SAE) industry standards committee to develop and/or revise standards for FCCs to suppress Class A fires within palletized and netted ULDs carried in Class B, E, or F cargo areas.

The SAE published a standard for FCCs on August 6, 2013. These standards could become the basis for a revised or new technical standard order (TSO) for FCCs. AIR should determine if the standards should be incorporated into TSO–C90d, Cargo Pallets, Nets, and Containers (Unit Load Devices) or new TSO if applicable.

(See SAE AS6453, Fire Containment Cover—Design, Performance, and Testing Requirements, http://standards.sae.org/as6453/)

AIR published TSO–C203 for FCCs on July 1, 2014.

(See FAA TSO–C203, Fire Containment Covers (FCC), http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgTSO.nsf/0/40602449e2c3af8086257d09004eb95a/$FILE/TSO-C203.pdf)

Action 3

Manufacturers should develop standardized fire suppression and/or containment systems in accordance with the standards developed and incorporated into TSO–C203, published July 1, 2014.

Completed and closed February 4, 2016.

Action 6

Based on the outcome of Joint Implementation Measurement Data Analysis Team (JIMDAT) monitoring the ongoing activity and development of new fire-resistant ULD container capabilities and upon CAST approval, AIR should task an SAE industry standards committee to develop and/or revise standards for fire-resistant ULD containers capable of internally containing a Class A fire. AIR should task the committee for such duration as necessary to ensure continued safe flight and landing after detection of the fire.

SAE standards should include detection and alerting criteria, a minimum demonstrated containment time, and a standardized flammability test that shows the product can meet the required containment time. These standards could become the basis for a revised or new TSO for ULD containers. AIR should develop and publish the TSO.

Action 8

Manufacturers of ULD containers should develop new fire-resistant ULD containers per TSO standards, capable of either—

- Internally containing a Class A fire for such duration as necessary to ensure continued safe flight and landing after detection of the fire.
- Suppressing a fire through an internal fire suppression system installed inside the ULD container.

SE 200: VIRTUAL DAY-VMC DISPLAYS (UNDERWAY)

This SE is underway. Aspects of this SE are being worked on and will be altered from this draft version once they are complete.

This SE is designed for manufacturers to use to develop and implement virtual day-visual meteorological conditions (VMC) display systems, such as synthetic vision or equivalent systems, that will support flightcrew attitude awareness similar to a day-VMC-like environment, in applicable new transport category airplane (TCA) programs.

Action 1

Industry research programs should assist the National Aeronautics and Space Administration (NASA) in reviewing, sponsoring, and coordinating projects studying the effectiveness of virtual day-VMC displays in improving flightcrew awareness of airplane attitude as a function of various system characteristics.

Completed and closed October 4, 2018, based on completed NASA research.

Action 2

AIR should formally task the appropriate industry standards activity (for example, RTCA–213 or SAE) to incorporate the research from Action 1 into an appropriate document standards document (for example, DO–315). The standards should define the tradeoffs between

effectiveness of virtual day-VMC displays in improving flightcrew awareness of airplane attitude with system design variables and specifying minimum requirements for these parameters, including but not limited to—

- Field of view;
- Presentation/removal of virtual day-VMC displays in unusual attitudes;
- Image minification;
- Optical flow cues, including—
  - Display elements over water or featureless terrain, and
  - Use of color and texture; and
- Potential unintended consequences (for example, attentional issues and crew resource management (CRM) impacts)

AIR should review the standards and publish appropriate guidance material or TSOs, as applicable.

AIR should track implementation and report progress to JIMDAT and CAST.

Action 3

Airplane manufacturers should review and incorporate, as applicable, study results and recommendations from the research conducted under Action 1 and the standards produced under Action 2.

Airplane manufacturers should implement virtual day-VMC displays in applicable new TCA programs in accordance with each manufacturer's design philosophy and product development strategy and contingent (as applicable) on internal manufacturer review and acceptance of the research findings and standards developed in Actions 1 and 2.

AIA should track implementation and report progress to CAST.

SE 201: Bank Angle Alerting and Recovery Guidance Systems (Underway)

This SE is underway. Aspects of this SE are being worked on and will be altered from this draft version once they are complete.

This SE is designed to provide assistance during recovery from unusual bank angles and reduce fatal accidents due to spatial disorientation by implementing bank angle alerting and recovery guidance display systems on all applicable new TCA programs.

Action 1

AIA should communicate with manufacturers that are currently producing or are expected to produce TCAs for use in U.S. part 121 operations, and explain the Airplane State Awareness (ASA) Joint Safety Implementation Team (JSIT) Design Team Analysis and the role of spatial disorientation in ASA accidents.

Airplane manufacturers should review the CAST ASA study and recommendations, and should respond to AIA by indicating their intention to incorporate bank angle alerting and recovery guidance display systems into all applicable new TCA type designs and programs launched after January 1, 2015.

Completed and closed August 6, 2015.

Action 2

Airplane manufacturers should review and incorporate, as appropriate, study results/recommendations from applicable industry R&D efforts, such as NASA Spatial Disorientation/Loss of Energy State Awareness study.

Airplane manufacturers should implement bank angle alerting and recovery guidance display systems on applicable new TCA programs launched after January 1, 2015.

(See Loss of Control Prevention and Recovery: Onboard Guidance, Control, and Systems Technologies, http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20120014593_2012014936.pdf)

SE 202: Bank Angle Protection (Underway)

This SE is underway. Aspects of this SE are being worked on and will be altered from this draft version once they are complete.

This SE is designed to reduce fatal accidents due to loss of airplane state awareness by including bank angle protection on all new fly-by-wire (FBW) TCA programs.

Action 1

AIA should communicate with airplane manufacturers that are currently producing or are expected to produce FBW TCAs for use in U.S. part 121 operations, and explain the ASA JSIT Design Team Analysis and the role of bank angle protection in preventing ASA accidents.

Manufacturers should review the CAST ASA study and recommendations, and respond to AIA, indicating their intention to incorporate bank angle protection into applicable new FBW TCA programs launched after January 1, 2014.

Completed and closed April 2, 2015.

Action 2

Airplane manufacturers should implement bank angle protection on applicable new FBW TCA programs launched after January 1, 2014.

SE 216: Flight Crew Landing Training (Underway)

This SE is underway. Aspects of this SE are being worked on and will be altered from this draft version once they are complete.

This SE is designed to reduce runway excursion (RE) accidents by air carriers defining, publishing, and training proper techniques for stabilized approach, flare, touchdown, and use of available airplane stopping devices for landing scenarios with reduced or minimal landing distance margins.

Action 1

Airplane manufacturers should provide air carriers with guidance to ensure air carrier policies are consistent with operating procedures, as related to the proper use of available airplane stopping devices, such as arming speedbrakes for auto–deploy, awareness of the circumstances that can by design inhibit auto-deploy of speedbrakes, or timely deployment of reverse thrust before point where the engine drops to ground idle setting.

Action 2

Airplane manufacturers should provide air carriers with guidance to ensure air carrier policies are consistent operating procedures as related to airplane performance in crosswinds, including—

- Maximum demonstrated crosswind values;
- Airplane-specific flight handling characteristics in gusty crosswind conditions;
- Airplane-specific ground handling characteristics on wet/contaminated runways when operating in gusty crosswind conditions;
- Emphasis on proper use of tiller during ground rollout, including the risk of nose gear steering malfunctions or over control if the tiller is used at high speeds; and
- Potential effects of Minimum Equipment List conditions on directional control, such as single reverser in-operational).

SE 223: Hazardous Material Fires – Prevention and Mitigation (Underway)

This SE is underway. Aspects of this SE are being worked on and will be altered from this draft version once they are complete.

This SE is designed to encourage air carriers, aircraft manufacturers, lithium battery manufacturers, and shippers of hazardous materials to develop and implement means to prevent fires involving hazardous materials from occurring on board aircraft, or to prevent any fires that do occur from endangering the aircraft or its occupants.

Action 2

The FAA should develop performance-based fire mitigation standards for hazardous materials packaging.

Action 4

The FAA should publish guidance material for a risk assessment process that enables air carriers to determine the amount and type of hazardous materials that, if carried on an aircraft and involved in a fire, results in a fire that can be managed by the air carrier's fire protection methodologies.

SE 226: Hazardous Material Fires – Enhanced Protection of Occupants and Aircraft (Underway)

This SE is underway. Aspects of this SE are being worked on and will be altered from this draft version once they are complete.

This SE is designed to encourage air carriers to provide additional training and equip their fleets (as feasible) with systems to enhance the protection of occupants and aircraft and increase the flightcrew's ability to continue safe flight and landing in response to an onboard fire involving hazardous materials, including lithium batteries.

Action 1

Aircraft manufacturers should implement in new type designs and existing in-production type designs, as feasible, the installation of a single full-face crew smoke mask/oxygen system with state-of-the art communications technologies that accommodate glasses at each critical flightdeck position.

If this SE is implemented and results in new equipment, air carriers operating airplanes with new full-face crew smoke mask/oxygen systems will need to train crews on its use.

Completed and closed December 6, 2018, based on the CAST-represented manufacturers reporting they offer single full-face crew smoke/oxygen mask with integrated communications on all current in-production airplanes.

Action 2

Air carriers should implement in existing type designs a means to maintain pilots' view of necessary flight information and, where possible, visual references outside the aircraft in dense continuous smoke conditions on the flightdeck, in new type designs.

Air carriers and manufacturers of this equipment should also study the feasibility of implementing such systems in existing in-production and out-of-production airplane designs.

SE 229: Takeoff Configuration Warning System Maintenance and Operational Assurance (Underway)

This SE is underway. Aspects of this SE are being worked on and will be altered from this draft version once they are complete.

This SE is designed to mitigate the risk of flightcrews attempting to take off with flaps in an improper setting by ensuring air carrier maintenance programs include appropriate actions and procedures to ensure proper operation of the takeoff configuration warning system (TCWS).

Action 1

Manufacturers should review their TCWS designs and maintenance programs to—

- Ensure acceptable in-service reliability in accordance with AC 25.703–1.
- Determine which circuit breakers, if pulled, could directly or indirectly disable the TCWS.
- Ensure no approved items in the Master Minimum Equipment List could affect TCWS availability.

Completed and closed April 5, 2018, based on manufacturers reporting they have reviewed the maintenance intervals and in-service reliability of TCWSs and made changes where required.

SE 1: Terrain Avoidance Warning System (TAWS) (Completed)

This SE is designed to substantially reduce or eliminate controlled flight into terrain (CFIT) accidents by improving pilot situational awareness. This SE also establishes appropriate procedures for the installation and use of TAWS equipment.

Action 3

Manufacturers should use a standard practice of installing TAWS equipment in all newly manufactured aircraft under 14 CFR part 121. Manufacturers must receive AIR approval when applying for type certificates (TC) or amended TCs.

(See 14 CFR § 121.354 (65 FR 16755, March 29, 2000), http://www.gpo.gov/fdsys/pkg/CFR-2011-title14-vol3/pdf/CFR-2011-title14-vol3-sec121-355.pdf)

(See TSO–C151c, Terrain Awareness and Warning System (TAWS), dated June 27, 2012, http://www.gpo.gov/fdsys/pkg/FR-2012-02-03/html/2012-2464.htm)

Action 4

Manufacturers should use a completed retrofit program, which includes certification and installation of TAWS equipment in existing aircraft.

Manufacturers must receive AIR approval when applying for supplemental type certificates (STC) or amended TCs.

Action 5

Manufacturers should use a comprehensive system to support TAWS. The system should include information on installation, maintenance, training, and use of TAWS equipment.

Advisory Circular for 14 CFR part 25 (ANM–100). See AC 25–23, Airworthiness Criteria for the Installation Approval of a Terrain Awareness and Warning System (TAWS) for Part 25 Airplanes, May 22, 2000. (http://www.faa.gov/documentLibrary/media/Advisory_Circular/AC25-23.pdf)

Advisory Circular for 14 CFR part 23 (ACE–100). See AC 23–18, Installation of Terrain Awareness and Warning System (TAWS) Approved for Part 23 Airplanes, June 14, 2000. (http://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentID/22312)

Action 6

The AIR Systems and Equipment Standards Branch (AIR–130) and Transport Airplane Directorate (ANM–100) developed metrics and reporting methodology for validation of TAWS project effectiveness.

With the establishment of ASIAS, CAST is now leveraging ASIAS data to evaluate metrics for its safety portfolio. The CAST metric monitoring work group evaluates all metrics, including TAWS, on a quarterly basis.

SE 21: Flight Deck Equipment Upgrades/Installation To Improve Altitude Awareness and Checklist Completion (Completed)

This SE is designed to ensure altitude awareness and accomplishment of checklist items. This will be accomplished through the development of guidelines and procedures for a flight deck smart-alerting system design and supporting operational procedures and training. Incorporation of procedures and operational training should be based on—

- The installation of automated checklist devices to provide a positive means for checklist completion (described in Human Performance Considerations in the Use and Design of Aircraft Checklists, issued January 1995, http://www.skybrary.aero/bookshelf/books/1566.pdf;
- Research and assessment of existing technology in flight deck smart-alerting system design; and
- The installation of equipment to provide automatic aural altitude alert callouts on final approach or other such altitude alerting systems.

Action 1

AIR and industry developed advisory material defining the characteristics of interactive checklist and smart alerting systems for all new type designs, and developed compatible operational guidance.

Manufacturers should design and install the interactive checklists and smart alerting systems, defined by the FAA and industry, on new type design aircraft.

(See AC 25.1322–1, Flightcrew Alerting, December 13, 2010, is available for guidance: https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_25.1322-1.pdf)

Actions 2 and 4

Manufactures should evaluate and consider, during checklist design, the principles contained in the FAA Human Performance Considerations in the Use and Design of Aircraft Checklists; the NASA Contractor Report 177642, On the Design of Flight-Deck Procedures; and the NASA Human Factors of Flight-Deck Checklist: The Normal Checklist.

Manufacturers and air carriers should analyze and review checklists and revise as necessary.

(See Human Performance Considerations in the Use and Design of Aircraft Checklists, http://www.skybrary.aero/bookshelf/books/1566.pdf; On the Design of Flight-Deck Procedures, http://ti.arc.nasa.gov/m/profile/adegani/Flight-Deck_Procedures.pdf; and Human Factors of Flight-Deck Checklists: The Normal Checklist http://ti.arc.nasa.gov/m/profile/adegani/Flight-Deck_Checklists.pdf)

Action 3

Manufacturers should design and install automatic aural altitude callouts on final approach, defined by the FAA in advisory material, for all new type design aircraft (including arrival at minimum descent altitude (MDA)/decision height (DH)).

AIR should develop advisory material defining the standards for automatic aural altitude callouts on final approach (including arrival at MDA/DH) for all new type aircraft designs.

AC 120–29A, Criteria for Approval of Category I And Category II Weather Minima for Approach, paragraph 6.1.5, provides acceptance criteria for aural altitude callouts on final approach, whether given by an automatic system or by the flightcrew. AIR uses this guidance to determine compliance to 14 CFR § 25.1301, Function and installation.

SE 24: AIRCRAFT DESIGN (COMPLETED)

This SE is designed to incorporate fault-tolerant design principles for flight-critical system components and to facilitate critical-point, flight-realistic condition, and certification testing/analysis.

Action 1

AIR should develop a process to identify key safety information (KSI) during airplane systems development and certification at the manufacturers. The process will ensure effective communication and protection of such information during maintenance, operation, and training functions at air carriers and maintenance and repair organizations.

AIR should issue guidance instituting the KSI process as recommended by the Certification Process Study. The KSI identifies areas that should not be modified without thorough review and understanding of the original basis of certification.

AIR completed a white paper on the KSI process instead of an AC on March 13, 2007.

Action 2

AIR should issue design guidance to ensure flight-critical system components are fault tolerant and are subjected to critical-point, flight-realistic-condition, and certification testing/analysis.

AIR should review the following ACs to ensure they adequately address flight-critical component fault tolerance, error tolerance, unintended functions, and hazard assessment to include critical point flight envelope testing (including computer modeling and simulation) and reliability requirements.

- AC 23.1309–1E, System Safety Analysis and Assessment for Part 23 Airplanes, November 17, 2011, http://www.faa.gov/documentLibrary/media/Advisory_Circular/AC%2023.1309-1E.pdf;
- AC 25.1309–1A System Design and Analysis, June 21, 1988, https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_25_1309-1A.pdf; and
- AC 25–7C, Flight Test Guide for Certification of Transport Category Airplanes, October 16, 2012, http://www.faa.gov/documentLibrary/media/Advisory_Circular/AC%2025-7C%20.pdf.

AIR should issue new guidance on the control of design changes to flight-critical components, including STCs and parts manufacturer approvals.

Action 3

Manufacturers should review SAE Aerospace Standards Aerospace Recommended Practice (ARP) 5150, Safety Assessment of Transport Airplanes in Commercial Service, to ensure their continuing airworthiness processes incorporate risk management techniques and help ensure the original design level of safety is not degraded.

The review was completed June 30, 2007.

SE 30: HUMAN FACTORS AND AUTOMATION (COMPLETED)

This SE is designed to reduce loss of control accidents by improving the overall performance of flightcrews to recognize and prevent loss of control accidents through effective use of automation.

Action 1

Manufacturers should provide to ATO copies of their current policies and procedures pertaining to the use of automation for mode awareness and energy state management.

Action 4

Manufacturers should review the generic automation policies as published and implement them as appropriate.

Guidance can be found in SE 30, Mode Awareness and Energy State Management Aspects of Flight Deck Automation, final report:
http://www.cast-safety.org/pdf/cast_automation_aug08.pdf.

SE 32: Autoflight Features in New Airplane Designs (Completed)

This SE is designed to reduce fatal accidents due to loss of control through the development of regulations and guidance material that ensure or encourage autoflight (autopilot and autothrust) systems in new airplane designs.

Action 1

Manufacturers should incorporate autoflight systems in new airplane designs that assist the pilot in potential loss-of-control situations and minimize the potential of causing or contributing to loss of control.

The ARAC Flight Guidance System Harmonization Working Group (FGSHWG) final report submission to the FAA and Joint Aviation Authority includes specific recommendations for amending Federal Aviation Regulation (FAR) 25.1329, Joint Aviation Requirement (JAR) 25.1329, AC 25.1329, and ACJ 25.1329.

AIR should take rulemaking action as appropriate and produce accompanying guidance material.

(See Additional Recommendations for Submission to FAA with the FGSHWG Work Package, April 4, 2002,
http://www.faa.gov/regulations_policies/rulemaking/committees/documents/media/TAEfgshT1-082897.pdf)

SE 34: Display and Alerting Features in New Airplane Designs (Completed)

This SE is designed to reduce fatal accidents due to loss of control through display and alerting systems in new airplane designs.

Action 1

AIR should task the ARAC Avionics Systems Harmonization Working Group to elevate the priority of its AC 25–11 revision, and to include the JSIT display and alerting features in the scope of this task. After ARAC provides its recommendations, AIR should develop guidance material as appropriate.

(See AC 25–11A, Electronic Flight Deck Displays, June 21, 2007,[5] http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgAdvisoryCircular.nsf/list/AC%2025-11A/$FILE/AC%2025-11A.pdf)

SE 40: Flight Envelope Protection in New Airplane Designs (Completed)

This SE is designed to reduce fatal accidents due to loss of control by including angle-of-attack/low-speed protection, thrust asymmetry compensation, and bank angle protection, using hard or soft limits on new airplane designs. FBW active flight envelope protection technology does not exist for turboprop airplanes. Turboprop manufacturers should strive to fully provide the protection benefits of these systems in their new airplane designs.

Action 1

AIA should communicate with manufacturers, encouraging them to incorporate angle-of-attack/low-speed protection, thrust asymmetry compensation, and bank angle protection into all new airplane designs as defined by published guidance material.

Manufacturers should respond by indicating they will agree to incorporate angle-of-attack/low-speed protection, thrust asymmetry compensation, and bank angle protection. Manufacturers should incorporate flight envelope protection into future airplane designs.

SE 39: Criteria for Flight in Icing Conditions for New Airplane Designs (Completed)

This SE is designed to reduce fatal accidents due to loss of control through the development of amended icing certification criteria. The amended criteria will be for new airplane designs not equipped with evaporative systems, which include performance and handling qualities requirements. New designs for airplanes not equipped with evaporative systems accommodate flight in an expanded icing envelope and additional deice/anti-ice system malfunctions.

Action 1

Based on the Aviation Rulemaking Advisory Committee (ARAC) Ice Protection Harmonization Working Group published recommendations that address an expanded icing envelope, and the ARAC Flight Test Harmonization Working Group published recommendations that address airplane performance and handling characteristics in icing conditions, AIR issued regulatory and guidance material as appropriate.

See final rules on Airplane Performance and Handling Qualities in Icing Conditions (72 FR 44656, August 8, 2007), http://www.gpo.gov/fdsys/pkg/FR-2007-08-08/pdf/E7-14937.pdf, and Activation of Ice Protection (74 FR 38328, August 3, 2009), http://www.gpo.gov/fdsys/pkg/FR-2009-08-03/pdf/E9-18483.pdf .

[5] This AC was cancelled October 7, 2014, by the publication of AC 25–11B (https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_25-11B.pdf).

See final rule on Airplane and Engine Certification Requirements in Supercooled Large Drop, Mixed Phase, and Ice Crystal Icing Conditions (75 FR 37311, November 4, 2014), http://www.gpo.gov/fdsys/pkg/FR-2014-11-04/pdf/2014-25789.pdf.

SE 85: Vertical Situation Displays—All Airplane Designs (Completed)

This SE is designed to reduce fatal accidents due to loss of control by modifying all airplane designs, if feasible, to include a real-time graphical depiction of their vertical situation.

Action 1

AIA should communicate with manufacturers, encouraging them to incorporate vertical situation displays into new airplane designs.

Manufacturers should respond and agree to incorporate vertical situation displays into new airplane designs.

SE 101: Advanced Circuit Protection (Completed)

This SE is designed to develop and install advanced circuit protection technology for use in commercial airplanes where appropriate, including new type designs, current production, and retrofit. This work includes research for product development, development of industry standards, qualification, airplane maintenance practices, and certification. This work may require in-service evaluation of development hardware and should include research and development of tools to isolate the location arc source once an arc fault breaker has tripped.

Action 1

Airframe manufacturers, circuit breaker manufacturers, and AIR should continue to support general development and qualification activities of advanced circuit protection technology for use on commercial airplanes. This support includes development of arc fault circuit breaker technology and technology used to determine the location of the fault source on commercial airplanes for maintenance.

Airframe manufacturers, AIR, SAE, operators, and circuit breaker manufacturers should develop advanced circuit protection. Airframe manufacturers should test equipment. Manufacturers and the FAA Technical Center should continue research into developing circuit protection and fault isolation technology.

Action 2

AIA should issue a letter to manufactures to encourage them to incorporate advanced circuit protection.

Airframe manufacturers should respond and agree to incorporate advanced circuit protection technologies in new type designs as appropriate and feasible.

Airframe manufacturers and AIR should work with circuit breaker manufacturers to develop and certify the technology for installation into new type designs where appropriate and feasible.

Airframe manufacturers, breaker manufacturers, and AIR should complete the development and certification of advanced circuit protection on new type designs.

Action 3

Airframe manufacturers and AIR should work with circuit breaker manufacturers to develop and certify the technology for installation into current production commercial airplanes where appropriate and feasible.

Airframe manufacturers, breaker manufacturers, and AIR should complete the development process and certification of advanced circuit protection on current production airplanes.

Action 4

Airframe manufacturers and the FAA should work with circuit breaker manufacturers to develop/certify the technology for retrofit where appropriate and feasible.

Airframe manufacturers, breaker manufacturers, and AIR should complete the development process and certification of advanced circuit protection where appropriate and feasible on in-service airplanes.

SE 120: TAWS Improved Functionality (Completed)

This SE is designed to increase the potential safety impact of SE 1, Terrain Avoidance Warning System (TAWS), by developing procedures to include Global Positioning System (GPS) sensors for TAWS, and to ensure updates to terrain databases, alerting algorithms, and new options to TAWS are incorporated as soon as possible.

Action 2

Manufacturers should install, or provide options to install, GPS sensors on all current production model airplanes and all new type designs. Manufacturers should provide information outlining the safety benefits of GPS to their customers if GPS is an option.

Action 4

TAWS manufacturers should provide recommendations for incorporation of TAWS terrain database updates to operators.

Action 5

Manufacturers, in conjunction with operators, should review, form a consensus on, and implement updates to TAWS operating algorithms that are considered beneficial to enhancing CFIT protection. Manufacturers should incorporate those TAWS alerting algorithms updates into production airplanes. Manufacturers, operators, and the FAA should work together to enable the efficient incorporation of desired changes.

Action 6

Manufacturers should develop service bulletins for retrofitting existing airplanes where applicable. Manufacturers should work to encourage customers to select such options on production airplanes and new type designs. Manufacturers, operators, and the FAA should work together to enable efficient activation of those TAWS features that operators desire to enhance CFIT protection.

SE 133: Turboprop Aircraft Ice Detection Systems (Completed)

This SE is designed to prevent fatal accidents caused by in-flight icing encounters, for all turboprop aircraft with non-evaporative ice protection systems and non-powered flight controls used in 14 CFR part 121 operations.

Action 1

AIA should encourage manufacturers to adapt existing ice detection probe technology to provide measurement capability of icing conditions for turboprop aircraft that exceed the conditions for which the aircraft is certified.

Manufacturers of affected turboprop airplanes should respond to the AIA letter and agree to implement ice detection and alerting systems on new type designs.

Action 2

AIR should review guidance material regarding certification of automatic ice detection and alerting systems.

AIR should review pertinent aircraft certification policy and guidance material, including Advisory Circular (AC) 25.1419–1A, Certification of Transport Category Airplanes for Flight in Icing Conditions, May 7, 2004, and determine if revisions should be made to address certification of the ice detection and alerting systems proposed by this SE.

AIR should develop a plan and initial schedule for making revisions to guidance material that is compatible with icing rulemaking activity recommended in SE 39, Criteria for Flight in Icing Conditions for New Airplane Designs, and share this information with CAST.

SE 134: Avionics (Completed)

This SE is designed to prevent fatal accidents and incidents by improving situational awareness during low visibility operations and flight in icing conditions.

Action 1

AIA should communicate with manufacturers, encouraging them to incorporate upgraded pitch guidance software into their new airplane type designs.

Manufacturers should respond and agree to develop and install smart pitch guidance systems into new airplane type designs. If manufacturers determine upgraded pitch guidance for icing is not necessary, the determination must be based on a technical justification.

Airframe manufacturers should develop, incorporate, and certify pitch guidance requirements that provide flight guidance information, the current aircraft energy state, and performance margins with respect to stall speed and maximum angle of attack, appropriate to aircraft type for all icing conditions for which the aircraft has been certified.

SE 172: Gap Analysis of Existing Airplane Maintenance Process & Follow-on Action Plan (Completed)

This SE is designed to identify and correct gaps within and between the maintenance processes that could otherwise inhibit the intended design level of safety from being sustained throughout the airplane life.

Action 1

The manager of the FAA Flight Standards Service Aircraft Maintenance Division (AFS–300) should convene a task force that will perform a gap analysis between the certified level of design system reliability and maintaining this reliability with current maintenance and oversight practices and processes.

Action 2

AIR, AFS–300, and the International Air Transport Association should coordinate with current rulemaking and guidance material update schedules to implement mitigations to close gaps as identified in "Scoping Study - Gap Analysis of Existing Airplane Maintenance Processes."

SE 183: Cockpit Moving Map Display and Runway Awareness System (Completed)

This SE is designed to reduce wrong runway departures and runway incursions by encouraging the installation of ownship moving map display and/or runway awareness systems.

Action 3

The Aerospace Industries Association (AIA) should establish a joint team, determining the members to consist of industry and Government, and obtain commitments from each to participate. The team should conduct meetings to review and develop recommendations related to issues including, but not limited to, connectivity, capability growth, egress, location in field of view, and display size of class II electronic flight bags (EFB). The team will produce a report and submit it to AIA for distribution to the industry.

Action 4

AIR–1 should evaluate the AIA report developed from Action 3 and revise applicable guidance material.

SE 191: New TCAS/NextCAS Equipment (Completed)

This SE is designed to conduct the necessary study and research to determine if the currently available versions of the Traffic Alert and Collision Avoidance System (TCAS) are adequate to support the traffic levels predicted in the Next Generation Air Transportation System (NextGen) and to create a strategy for development of the NextGen Collision Avoidance System (NextCAS).

Action 1

AIR should develop a workgroup charter for a team to complete a study determining if the currently available versions of TCAS are adequate to support the traffic levels predicted in NextGen. The study should include recommendations to Government and industry on standards and requirements for NextCAS. Recommendations should be made with consideration of the results of the TCAS directed study in SE 188, Modifying ATC Procedures and Airspace Design.

AIR should develop a workgroup charter to complete this action and present it to CAST for approval. After CAST approves or modifies the workgroup charter, the workgroup should convene per the charter and conduct the study. The workgroup should develop a report to include recommendations to Government and industry on standards and requirements for NextCAS. The Workgroup should present its report to CAST for approval.

Action 2

AIR should develop a workgroup charter to develop a "Strategy for NextCAS" based on the results of the study and recommendations from SE 191 Action 1. The Strategy for NextCAS should consider aligning TCAS alerting algorithms with current air traffic control separation policies (500 ft).

AIR should develop a workgroup charter for a team to complete this action and present it to CAST for approval. After CAST approves or modifies the workgroup charter, the workgroup should convene per the charter and develop the strategy. The workgroup should develop a report to include recommendations. The workgroup should present the report to CAST for approval.

SE 214: Procedures and Standards To Improve Path Compliance for STARs and RNAV Departures (Completed)

This SE is designed to reduce deviations from the intended path. The FAA, air carriers, and manufacturers should implement procedural and standards improvements to consistently execute departure or arrival procedures as published.

Action 1

Manufacturers should assist the FAA Flight Standards Service (AFS) in—

- Developing aircraft, operator, and procedure design criteria for aircraft performance on arrival and departure procedures under the expected range of operational conditions.

- Defining aircraft qualification criteria and operating guidance to reflect the in-flight performance of airplanes, including autoflight and navigation system performance, on arrivals and departures.
- Modifying procedure design criteria from an enhanced airplane performance evaluation module considering the full range of performance for flying arrivals and departures and integrating the use of this module into the Performance-Based Navigation (PBN) procedure design processes.

Action 2

AIR should support the development of aircraft and avionics standards to improve path conformance and reduce pilot automation errors on STAR and RNAV departures for new aircraft and new equipment.

RTCA, Inc. special committee SC–227 should revise DO–283, Minimum Operational Performance Standards for Required Navigation Performance for Area Navigation, and DO–236, Minimum Aviation System Performance Standards (MASPS) Required Navigation Performance for Area Navigation.

Manufacturers should standardize against FAA baseline performance standards derived from SC–227 for vertical navigation systems in new aircraft and new equipment.

SE 215: Landing Distance Assessment (Completed)

This SE is designed to improve flightcrew awareness of their landing distance margin and the factors and variables that can affect those margins.

Action 1

AFS is developing guidance material incorporating the Takeoff and Landing Performance Assessment (TALPA) Aviation Rulemaking Committee (ARC) recommendations addressing procedures for conducting a landing distance assessment.

Manufacturers should provide AFS a standardized set of landing distance performance data that will support the new landing distance calculation standard as defined by guidance material.

Completed and closed October 6, 2016.

Action 3

AIR should develop guidance material for how manufacturers should provide airplane landing distance data consistent with TALPA ARC recommendations, including for contaminated surfaces.

AIR should develop two new advisory circulars containing—

- Standards for manufacturer-provided landing distance data, including descriptions of content and accuracy required for factors that affect the landing distance; and
- Standards for assignment of a braking coefficient to reported braking conditions.

AIR should communicate completion of the guidance material to JIMDAT, CAST, industry associations, and manufacturers.

Action 6

AIA should communicate with manufacturers currently producing or expected to produce airplanes for use in part 121 operations, explaining the background for the guidance in Action 3.

Airframe manufacturers should develop and provide to operators landing performance data for each of their aircraft types consistent with the standards in the FAA guidance from Action 3.

AIA should track implementation and report to JIMDAT and CAST when complete.

SE 218: Overrun Awareness and Alerting Systems (Completed)

This SE is designed to reduce landing overrun accidents through the development by manufacturers and the implementation by manufacturers and operators of onboard technologies to reduce or prevent landing overruns on new and existing airplanes and airplane designs, as applicable and as feasible.

Action 1

AIA should communicate with manufacturers that are currently producing or are expected to produce TCAs for use in part 121 operations, explaining the RE Joint Safety Analysis and Implementation Team (JSAIT) analysis and the recommended action from industry reports regarding technologies to reduce or prevent landing overruns.

Airplane manufacturers should review the CAST RE JSAIT study and recommendations, and respond to AIA by indicating their intention to develop and make available onboard technology to reduce or prevent landing overruns for all applicable new TCA programs launched after June 1, 2015.

AIA should report results to JIMDAT and CAST.

Completed and closed August 6, 2015.

Action 2

AIA should communicate with manufacturers producing TCAs for use in part 121 operations, to explain the RE JSAIT analysis and encourage them to study the feasibility of implementing onboard technology to reduce or prevent landing overruns on current production, in-development, and out-of-production airplane programs.

Airplane manufacturers, in conjunction with avionics suppliers, should conduct model-by-model feasibility studies on the implementation of onboard technology to reduce or prevent landing overruns on current production, in-development, and out-of-production airplanes, as noted in the Action Notes, and report results to AIA.

AIA will track progress of feasibility studies and report results to JIMDAT and CAST.

Completed and closed October 6, 2016.

SE 219: Policies, Procedures, and Training To Prevent Runway Excursions (Completed)

This SE is designed to reduce the risk of RE accidents through the development or modification by FAA Air Traffic Organization (ATO) of policies, procedures, and training-related factors that contribute to the risk of REs.

Action 3

AIR should consult with ATO Safety and Technical Training (AJI) in the development and implementation of training for air traffic controllers on significant factors that that can contribute to the risk of RE.

Completed and closed April 7, 2016.

SE 228: Airplane Design Features to Facilitate Proper Takeoff Configuration (Completed)

This SE is designed to encourage manufacturers to develop and make available enhanced airplane design features on new transport category airplanes that increase flightcrew awareness of system failures or incomplete/incorrect takeoff configuration before taking the active runway. Applicable new aircraft programs include—

- New type certificate programs, and
- Major derivative, amended type certificate programs involving redesign of flightdeck avionics.

Action 1

Manufacturers should develop and make available enhanced airplane design features that increase flightcrew awareness of system failures or an incomplete/incorrect takeoff configuration.

Completed and closed April 5, 2018, based on manufacturers reporting the intent of the SE is met by features in new type designs.

3. Safety Enhancements—Operations

SE 8: Precision-like Approach Implementation (Completed)

This SE is designed to identify the means by which all flightcrews can fly an appropriate stabilized vertical path to the runway end for all instrument approach procedures, thereby reducing the possibility of a CFIT accident.

Action 1

AIR should support the development of International Civil Aviation Organization (ICAO) Standards and Recommended Practices (SARPS) for Satellite Based Augmentation System (SBAS) and Ground Based Augmentation System (GBAS) by participating in the ICAO Global Navigation Satellite System Panel (GNSSP).

Action 3

AIR should support operators, manufacturers, and suppliers with the development of the business case for integrating SBAS and GBAS capability into current airplanes and for retrofit into in-service airplanes. AIR should also support the development of a Roadmap for progressive migration to a GBAS landing system (GLS) and identify the constraints and enablers for implementation.

SEs 14–16: Policies for ALAR (Safety Culture) (Completed)

The SE is designed to develop a strategy and promote a safety culture at each part 121 air carrier specifically targeting approach and landing accident reduction (ALAR). The goal of the SE is to ensure essential safety information generated by airplane manufacturers and the FAA is included in company operating manuals and in training programs for pilots and other appropriate employee groups.

Action 4

Manufacturers should supply the AFS Designee Standardization Branch (AFS–600) with all future aircraft flight manual (AFM) revisions for each model affected and all future Operator's Bulletins, or the equivalent, for each model affected to assist the FAA in fully implementing the AFM database for FAA inspector use.

SE 27: Risk Assessment and Management (Completed)

This SE is designed to identify, or develop and implement, methods for operators, regulators, and manufacturers to prioritize safety-related decisions. This SE will improve methods of risk assessment for operational issues related to service bulletins, aircraft accident/incident analysis, flight-critical safety information, and recurring intermittent failures related to dispatch.

Action 3

Manufacturer Directors of Safety, or their equivalents, should ensure all appropriate managers implement and use risk assessment tools to prioritize safety-related decisions.

(See Safety Management System, http://www.faa.gov/about/initiatives/sms/)

SE 28: Policies (Completed)

This SE is designed to ensure essential safety information and operational procedures, generated by airplane manufacturers, are included in operating manuals and training programs for pilots and other appropriate employee groups.

Action 1

Manufacturers should develop reliable processes to ensure flight operations and maintenance personnel are made aware of, and incorporate, essential operating information in a timely manner. Manufacturers should review their processes for distributing essential operating information to identify its significance**.**

AIA communicated with aircraft manufacturers the importance of timely dissemination of essential safety information and procedures to aircraft operators. As guidance, AIA distributed Handbook Bulletin Air Transportation (HBAT) 99–07, Flight Standards Policy Company Operating Manuals and Company Training Programs for Compliance with Current Airplane or Rotorcraft Revisions. This HBAT has since been cancelled.

SE 170: OEM Continuous Monitoring of Service History (Completed)

This SE is designed to reduce the number of fatal accidents due to improper maintenance, and to ensure that systems continue to function as designed.

Action 2

Original equipment manufacturers (OEM) should develop processes to follow the intent of best practice guidance material. OEMs will incorporate reported maintenance task difficulties into their continuing airworthiness/design review processes.

(See ATA[6] Spec 119, Continuous Monitoring of Maintenance Instructions, January 2014, http://www.skybrary.aero/bookshelf/books/2866.pdf)

SE 175: Flight Critical Configurations Changes Made During Maintenance (Completed)

This SE is designed to reduce accidents caused by loss of pitot static systems by providing visible tagging any time ports of the pitot static system are covered during maintenance or servicing. This SE is also designed to enhance preflight walk-around procedures to include specific verification that pitot static ports are uncovered.

Action 1

OEMs should review and amend maintenance procedures to ensure multiple levels of alerting, including visible tagging, are used anytime the pitot static system is covered. Such levels should include visible tagging or similar readily-visible alerting, a work card, and logbook entry.

AIA should communicate the contents of this action to Embraer and Bombardier.

Action 2

OEMs should ensure that pre-flight walk-around procedures ensure that pitot/static ports are uncovered.

AIA should communicate contents of this action to Embraer and Bombardier.

SE 196: Effective Upset Prevention and Recovery Training, Including Approach-to-Stall (Completed)

This SE is intended to result in improved flightcrew training for upset prevention and recovery, including approach-to-stall, with emphasis on realistic scenarios. AIR actions in support of this SE are designed to ensure flightcrew training devices satisfactorily represent aircraft characteristics for the use during upset prevention and recovery training.

Action 1

AIA should communicate with airplane and simulator manufacturers, explaining the analysis undertaken by CAST regarding loss of airplane state awareness and the need for representative airplane characteristics in the flight simulator devices to support the following training scenarios:

- Approach-to-stall and full stall, and
- Upset prevention and recovery training (UPRT).

[6] Airlines for America, formerly known as Air Transport Association of America (ATA). The specifications are still known as "ATA specs."

Airplane and simulator manufacturers should review training scenarios described to them 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 should then—

- Identify those scenarios for which the current simulation models adequately represent airplane flight characteristics.
- Identify those training scenarios for which each current model is not representative of the airplane flight characteristics, and for each scenario either—
  - Identify feasible revisions the manufacturers can make to the models to improve their capability to satisfactorily represent airplane characteristics for the scenarios.
  - Define changes to the scenario that the current models could support.
  - Make other recommendations as applicable.

Airplane and simulator manufacturers should communicate this information to their customer air carrier training organizations, air carrier industry associations, and AIA.

Action 5

Airplane and simulator manufacturers should implement revisions to their flight simulator devices to enable air carriers to provide realistic training for the additional scenarios.

After simulator manufacturers have implemented the revisions, they should disseminate the updated simulator models to their customers.

Completed and closed April 6, 2017, based on the requirements being satisfied in 14 CFR part 60.

4. Safety Enhancements—Research

SE 207: Attitude and Energy State Awareness Technologies (Underway)

This SE is underway. Aspects of this SE are being worked on and will be altered from this draft version once they are complete.

This SE is designed for the aviation community (Government, industry, and academia) to perform research and enable development, implementation, and certification of technologies that enhance flightcrew awareness of airplane energy state and conditions likely to produce spatial disorientation.

Action 1

AIR should coordinate with NASA, manufacturer research organizations, and air carriers to develop and perform studies assessing the benefits, in terms of human performance, of using various forms of angle-of-attack (AOA) display to aid in upset recovery and diagnosis of air data system failures. The study should include the following:

- Literature review of previous studies on the subject of AOA indicator effectiveness and the types of indicators available for display of AOA,
- Identification of quantitative standards to assess pilot recovery performance,
- Training and proficiency requirements for various indicators,
- Development of specific upsets and air data scenarios to assess,
- Performance of tests, and
- Documentation of results in publicly available reports.

Research organizations should provide final reports of these studies to JIMDAT and CAST for review and reference.

Action 2

AIR and manufacturer research organizations should assist NASA in developing and performing studies to assess algorithms and display scenarios to provide control guidance to aid pilots in recovering from approach-to-stall and stall, consistent with amendment 25–131 to 14 CFR § 25.1322 and other time-critical flight deck alerting criteria.

Research organizations should provide final reports of these studies to JIMDAT and CAST for review and reference.

Action 3

AIR should coordinate with NASA and manufacturer research organizations to develop and perform studies to assess systems that predict the future aircraft energy state and/or autoflight configuration if the current course of action is continued and provide appropriate alerting, with an emphasis on—

- Effectiveness,
- Low cost,
- Alignment with current and expected future certification requirements (that is, 14 CFR §§ 25.1302, 25.1309, 25.1322, and 25.1329), and
- Potential for retrofit.

Research organizations should provide final reports of these studies to JIMDAT and CAST for review and reference.

Action 4

AIR and manufacturer research organizations should assist NASA in developing and performing studies to assess algorithms and displays that promote cost-effective and user-centered flight deck alerting systems that alert flightcrews to the disorientation-inducing conditions of sub-threshold roll and somatogravic illusion. These systems should be consistent with 14 CFR part 25 requirements in general, and amendment 25–131 to 14 CFR § 25.1322 and other time critical flight deck alerting criteria in particular.

Research organizations should provide final reports of these studies to JIMDAT and CAST for review and reference.

SE 208: AIRPLANE SYSTEMS AWARENESS (UNDERWAY)

This SE is underway. Aspects of this SE are being worked on and will be altered from this draft version once they are complete.

This SE is designed for the aviation community (Government, industry, and academia) to perform research to develop flight deck systems that enhance flightcrew awareness of system status and the interaction of systems, particularly in non-normal situations involving failures in one or more systems.

Action 1

AIR and manufacturer research organizations should assist NASA in developing and assessing displays that improve flightcrew awareness of current and future aircraft system state and interaction.

Research organizations should provide final reports to JIMDAT and CAST for review and reference.

Action 2

AIR and manufacturer research organizations should assist NASA in developing and assessing alerting methodologies that improve flightcrew awareness of aircraft system state and interaction.

Research organizations should provide final reports to JIMDAT and CAST for review and reference.

SE 209: Simulator Fidelity (Underway)

This SE is underway. Aspects of this SE are being worked on and will be altered from this draft version once they are complete.

This SE is designed for the aviation industry to improve pilot performance during recovery from a full stall by performing research to determine the benefits of using various levels of prototype advanced aerodynamic modeling of full stall characteristics to perform full stall recovery training.

Action 1

Airplane manufactures, simulator manufacturers, and AIR should assist AFS in developing learning objectives related to recovery from full aerodynamic stall.

Action 2

AIR and manufacturers should assist AFS in sponsoring and performing research to identify the benefits of using various levels of aerodynamic modeling to meet the learning objectives in Action 1.

Action 3

Manufacturer and FAA research organizations should assist NASA in sponsoring and performing research to define the aerodynamic model parameters, as well as their availability and associated uncertainties, necessary for replicating full stall flight characteristics of various aircraft models needed to satisfy the learning objectives in Action 1.

Completed and closed October 4, 2018, based on completed NASA research.

SE 224: Hazardous Material Fires – Enhanced Fire Detection Systems (Underway)

This SE is underway. Aspects of this SE are being worked on and will be altered from this draft version once they are complete.

This SE is designed for the aviation community (Government and industry) to perform research, development, and certification of technologies that enhance flightcrew awareness of smoke, fire, fumes, and/or other fire effects within the cargo compartments.

Action 1

The FAA should publish documentation of the types and quantities of fire byproducts and associated hazards (such as noxious gas, burn rate, and explosive tendency) the flightcrew will need to be aware of to make educated decisions on the effectiveness of suppression actions and further safe flight of the aircraft.

Completed and closed February 6, 2019, based on the June 2016 publication of FAA Tech Center TC–16/37, Summary of FAA Studies Related to the Hazards Produced by Lithium Cells in Thermal Runaway in Aircraft Cargo Compartments.

Action 2

The FAA should publish research results on fire detection and alerting systems installed within cargo containers, including collapsible containers and containers with rain covers, that provide timely alerting to the flightcrew.

Action 3

The FAA should publish research results on fire detection and alerting systems that can be installed within the aircraft and can detect fires within a container, on a pallet (with or without a fire containment cover (FCC)), or in a bulk load, and provide timely alerting to the flightcrew.

Action 4

The FAA should publish research results on optimization of a multi-criteria fire detection system on aircraft that can detect fires (including lithium battery fires) in a more timely manner than existing state of the art and that are less (no more) prone to false alarms.

Action 5

The FAA should publish research results characterizing the fire hazard associated with different battery chemistries (types), sizes, state of charge, and quantities, to include but not limited to temperature and flammable gas generation.

SE 225: Hazardous Material Fires – Containment and Suppression (Underway)

This SE is underway. Aspects of this SE are being worked on and will be altered from this draft version once they are complete.

This SE is designed to encourage air carriers, aircraft manufacturers, lithium battery manufacturers, shippers of hazardous materials, manufacturers of ULDs, and manufacturers of packaging for hazardous materials to conduct research and develop systems for mitigating the effects of a fire involving hazardous materials through improved containment and/or suppression.

Action 1

The FAA should develop standards and R&D results for containment and/or suppression solutions that are integrated into cargo containers and capable of mitigating hazardous material fires (including but not limited to those involving lithium batteries) for at least 6 hours.

Action 2

The FAA should develop standards and R&D results for containment and/or suppression systems that are integrated into the aircraft and capable of mitigating hazardous material fires (including but not limited to those involving lithium batteries) for at least 6 hours.

Action 3

The FAA should—

- Develop standards and R&D results for containment and/or suppression solutions that are integrated into hazardous material packaging and capable of mitigating hazardous material fires (including but not limited to those involving lithium batteries) for at least 6 hours.
- Implement performance-based fire mitigation standards for hazardous materials packaging.

Action 4

The FAA should develop—

- Standards for the exclusion of smoke in the cockpit when the smoke is produced from hazardous materials (including but not limited to those involving lithium batteries).
- R&D results on barriers and/or smoke removal systems with specific regards to smoke, pressure, temperature, and flammable vapors.

SE 126: Mitigations for Hazardous Material Fires (Completed)

This SE is designed to reduce the occurrence of accidents and incidents from fires involving high-consequence hazardous materials by developing systems to contain or suppress such fires as a final line of defense for personnel, equipment, and cargo. The system should be usable for both ground (for example, cargo loading/unloading and ramp movement) and flight operations.

Action 3

AIR should research plans for technology development to close gaps, identified by JIMDAT, between the causes and contributing factors of recent cargo fires that involved hazardous materials, and gaps of existing technologies to contain or extinguish such fires.

The plans to close identified gaps should include—

- Performing organizations,
- R&D expected outcomes,

- Funding sources,
- Performance monitoring,
- Regulatory impacts, and
- Technology readiness levels and transition to industry/manufacturers.

Affected organizations, including manufacturers, should commit to carry out the research and report back periodically to CAST.

SE 203: Features for Current Production/In-Development Fly-by-Wire Airplane Designs (Completed)

This SE is designed to significantly reduce the likelihood of accidents or incidents occurring because of flightcrew loss of ASA by manufacturers implementing several design features in current production and in-development FBW TCA type designs.

Action 1

AIA should communicate with airplane manufacturers that are currently producing or expected to produce FBW TCAs for use in U.S. part 121 operations, explaining the ASA analysis and encouraging them to study the feasibility of implementing features in current production and in-development FBW TCA type designs.

Manufacturers should agree to perform feasibility studies for implementing recommended features in current production and in-development FBW TCA type designs.

Action 2

Airplane manufacturers should perform an internal feasibility study on implementation of bank-angle protection into current production and in-development FBW TCA airplane designs, for both forward-fit and retrofit scenarios.

On completion of the feasibility studies, the manufacturers should respond to AIA with their findings. Manufacturers should consult with AIA and JIMDAT to estimate incremental values of expected risk resulting from implementation of the feature in their specific fleets.

Completed and closed February 1, 2018, based on aircraft manufacturer feasibility studies.

Action 3

Airplane manufacturers should perform an internal feasibility study on implementation of bank-angle alerting and recovery guidance in current production and in-development FBW TCA type designs, for both forward-fit and retrofit scenarios.

On completion of the feasibility studies, the manufacturers should respond to AIA with their findings. Manufacturers should consult with AIA and JIMDAT to estimate incremental values of expected risk resulting from implementation of the feature in their specific fleets.

Completed and closed February 1, 2018, based on aircraft manufacturer feasibility studies.

Action 4

Manufacturers should perform an internal feasibility study of cost of implementation of VMC displays, such as synthetic vision or equivalent systems, and the full-time presentation of energy state cues (flight path, acceleration, and speed deviation) in a manner similar to modern head-up displays, in current production and in-development FBW TCA type designs.

On completion of the feasibility studies, the manufacturers should respond to AIA with their findings. Manufacturers should consult with AIA and JIMDAT to estimate incremental values of expected risk resulting from implementation of the feature in their specific fleets.

Completed and closed October 4, 2018, based on manufacturers reporting requested technologies are already implemented where feasible and will be considered in future designs.

SE 204: Features for Existing non-Fly-by-Wire Airplane Designs (Completed)

This SE is designed to significantly reduce the likelihood of accidents or incidents occurring because of flightcrew loss of ASA by manufacturers implementing several design features in current production and in-development non-FBW TCA type designs.

Action 1

AIA should communicate with airplane manufacturers that are currently producing or expected to produce non-FBW TCAs for use in U.S. part 121 operations, explaining the ASA analysis and encouraging them to study the feasibility of implementing features in in current production and in-development non-FBW TCA type designs.

Manufacturers should agree to perform feasibility studies for implementing recommended features in current production and in-development non-FBW TCA type designs.

Action 2

Airplane manufacturers should perform an internal feasibility study on implementation of low airspeed caution alerting in current production and in-development non-FBW TCA type designs, for both forward-fit and retrofit scenarios.

On completion of the feasibility studies, the manufacturers should respond to AIA with their findings. Manufacturers should consult with AIA and JIMDAT to estimate incremental values of expected risk resulting from implementation of the feature in their specific fleets.

Completed and closed August 3, 2017, based on aircraft manufacturer feasibility studies.

Action 3

Airplane manufacturers should perform an internal feasibility study on implementation of bank-angle alerting and recovery guidance in current production and in-development non-FBW TCA type designs, for both forward-fit and retrofit scenarios.

On completion of the feasibility studies, the manufacturers should respond to AIA with their findings. Manufacturers should consult with AIA and JIMDAT to estimate incremental values of expected risk resulting from implementation of the feature in their specific fleets.

Completed and closed August 3, 2017, based on aircraft manufacturer feasibility studies.

Action 4

Manufacturers should perform an internal feasibility study of cost of implementation of VMC displays, such as synthetic vision or equivalent systems, and the full-time presentation of energy state cues (flight path, acceleration, and speed deviation) in a manner similar to modern head-up displays, in current production and in-development non-FBW TCA type designs.

On completion of the feasibility studies, the manufacturers should respond to AIA with their findings. Manufacturers should consult with AIA and JIMDAT to estimate incremental values of expected risk resulting from implementation of the feature in their specific fleets.

Completed and closed October 4, 2018, based on manufacturers reporting requested technologies are already implemented where feasible.

SE 205: Features for Out-of-Production Airplane Designs (Completed)

This SE is designed to significantly reduce the likelihood of accidents or incidents occurring because of flightcrew loss of ASA by manufacturers implementing several design features in current production and in-development TCA type designs.

Action 1

AIA should communicate with airplane manufacturers that are currently producing or expected to produce TCAs for use in U.S. part 121 operations, explaining the ASA analysis and encouraging them to study the feasibility of implementing features in in current production and in-development TCA type designs.

Manufacturers should agree to perform feasibility studies for implementing recommended features in existing out-of-production TCA type designs, pending results of SE 204 as applicable.

Action 2

Airplane manufacturers should perform an internal feasibility study on implementation of low airspeed caution alerting in current production and in-development TCA type designs, for both forward-fit and retrofit scenarios.

On completion of the feasibility studies, the manufacturers should respond to AIA with their findings. Manufacturers should consult with AIA and JIMDAT to estimate incremental values of expected risk resulting from implementation of the feature in their specific fleets.

Completed and closed October 4, 2018, based on manufacturers reporting incorporating low airspeed alerting is not feasible in out-of-production fleets.

Action 3

Pending the outcome of SE 204, manufacturers should study the feasibility and cost of implementing bank-angle alerting and recovery guidance display systems in existing out-of-production TCA type designs that have graphical primary flight display (PFD).

On completion of the feasibility studies, the manufacturers should respond to AIA with their findings. Manufacturers should consult with AIA and JIMDAT to estimate incremental values of expected risk resulting from implementation of the feature in their specific fleets.

Completed and closed October 4, 2018, based on manufacturers reporting bank angle alerting and recovery guidance system implementation is not feasible in out-of-production fleets.

Action 4

Pending the outcome of SE 204, manufacturers should study the feasibility and cost of implementing VMC conditions displays, such as synthetic vision or equivalent systems, and the full-time presentation of energy state cues (flight path, acceleration, and speed deviation) in a manner similar to modern head-up displays, in existing out-of-production TCA type designs that have graphical PFD.

Upon completion of the feasibility studies, the manufacturers should respond to AIA with their findings. Manufacturers should consult with AIA and JIMDAT to estimate incremental values of expected risk resulting from implementation of the feature in their specific fleets.

Completed and closed October 4, 2018 based on manufacturers reporting virtual day-VMC display implementation on out-of-production fleets is not feasible.

SE 210: Flight Crew Performance Data (Completed)

This SE is designed for the aviation community (Government, industry, and academia) to perform research to enhance tools and methods for collecting and analyzing flightcrew performance data in situations associated with loss of energy and/or attitude state awareness, suitable for use in the design process.

Action 1

FAA and manufacturer research organizations should assist NASA in acquiring available flightcrew performance data that captures flightcrew actions and responses in situations associated with loss of energy and/or attitude state awareness.

Research organizations should review results with the industry and FAA to ensure consensus regarding acceptability and confidence of the database and methods for its application.

Action 2

FAA and manufacturer research organizations should assist NASA in developing enhanced tools and methods for use in the design process to represent flightcrew responses in situations associated with loss of energy and/or attitude state awareness. These methods should incorporate

information from the flightcrew performance database developed in Action 1 to enhance or expand beyond current design methodologies, such as qualitative pilot-in-the-loop simulation evaluations

Research organizations should work with the industry and FAA to achieve consensus regarding the acceptability and applicability of these methods and guidelines for use in the design process.

Research organizations should publish findings in publicly available reports.

Completed and closed October 4, 2018, based on completed NASA research.

Action 3

AIR and manufacturer research organizations should assist NASA in further developing prototype technologies for detection and mitigation of attention issues for use in design evaluation. Technologies should include eye tracking, Functional Near Infrared Spectroscopy (fNIRS), heart rate variability (HRV), or other physiological measures.

Research organizations should evaluate prototype technologies with the FAA and the design/evaluation community, and publish findings in publicly available reports.

Completed and closed October 4, 2018, based on completed NASA research.

SE 211: Training for Attention Management (Completed)

This SE is designed for the aviation community (Government, industry, and academia) to perform research and develop and assess training methods and realistic scenarios that can address the attention-related human performance limitations observed in the ASA event data, including channelized attention, confirmation bias, startle/surprise, and diverted attention, with accompanying performance measures.

Action 1

Manufacturer research organizations should assist NASA in developing methods to detect and measure attention-related human performance limitations in pilots and validate those methods in simulator.

Research organizations should provide final reports to JIMDAT and CAST for review and reference.

Completed and closed October 4, 2018, based on completed NASA research.

Action 2

Manufacturer research organizations should assist NASA in developing methods for creating realistic, high workload scenarios that can incite human performance limitations, including channelized attention, confirmation bias, startle/surprise, and diverted attention. These methods should use the technologies developed in Action 1 for measuring human attention issues.

Research organizations, in conjunction with air carrier training organizations, should use these methods to develop scenarios and training-based mitigations, including but not limited to—

- Improved instrument-scanning behaviors in both nominal and off-nominal conditions, with emphasis on scan patterns for glass cockpits;
- Recognition of channelized or diverted attention in one flightcrew member by the other flightcrew member, and appropriate methods of intervention and correction;
- Self-diagnosis methods for flightcrew members to recognize and recover from channelized attention, confirmation bias, startle/surprise, and diverted attention; and
- Reinforcement of proper air carrier procedures regarding recognition of and response to flight deck alerts.

Research organizations and air carriers should assess the effectiveness of these scenarios and mitigations and report results to JIMDAT and CAST for review and reference.

Completed and closed October 4, 2018, based on completed NASA research.

SE 222: Airplane-Based Runway Friction Measurement and Reporting (Completed)

This SE is designed for the aviation community to conduct research to enable the development, implementation, and certification of onboard technologies to assess airplane braking action and provide data in real time to the pilot, other aircraft crews, air traffic controllers, and the airport operators.

Action 1

AIR should continue to support current research on onboard technologies to assess airplane braking action and provide the data in real time to the pilot, other aircraft crews, air traffic controllers, and the airport operators.

Research organizations should provide final reports to JIMDAT and CAST for review and reference.

Completed and closed December 7, 2017, based on completed research and associated final report (pending).