

FAA Response to Recent Commercial Space Transportation Mishaps

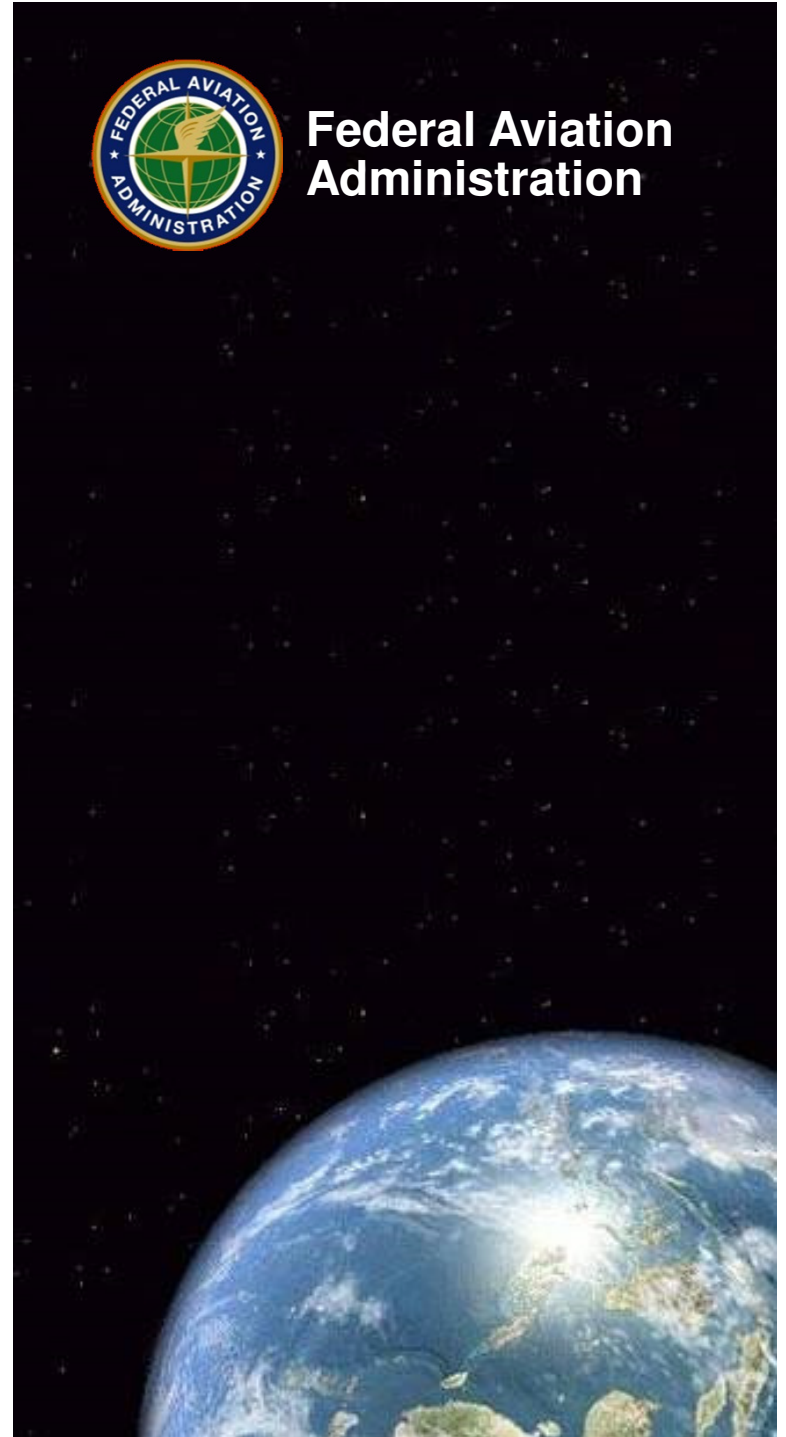
Presented to: COMSTAC

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**Federal Aviation
Administration**



Mishap and Accident Investigation Overview

- In the event of an accident, per a voluntary Memorandum of Agreement (MOA), the NTSB will likely be the lead investigative agency under NTSB protocols
- When mishaps do not meet the definition of an accident
 - AST may elect to conduct the investigation or authorize the launch operator to conduct the investigation under AST oversight
 - The decision authorizing an operator led investigation will be shared with interagency partners as appropriate
- Upon request and in accordance with existing agreements, AST may grant official observer status to other government organizations
 - E.g., NASA, USAF, NTSB mishap representatives

What We Have Learned

- **Since August 2014 there have been:**
 - 8 mishap investigations with FAA oversight
 - 1 accident investigation (conducted by the NTSB)
- **The commercial space transportation mishap investigation framework works**
 - FAA performs active oversight
 - Operators have demonstrated that they can conduct robust, credible, and complex investigations in this framework
- **The definitions of *accident* and *mishap* in the commercial space transportation regulations need to be revised**
 - Updates need to:
 - Reflect FAA's public safety mission
 - Ensure easy translation between NASA and USAF mission assurance-based definitions

Mishap Definition

The current regulatory definition is extremely broad

Mishap means

- (1) A launch or reentry accident, launch or reentry incident, launch site accident, failure to complete a launch or reentry as planned, or
- (2) an unplanned event or series of events resulting in:
 - A fatality or serious injury (as defined in 49 CFR 830.2), or
 - Greater than \$25,000 worth of damage to a payload, a launch or reentry vehicle, a launch or reentry support facility or government property located on the launch or reentry site.

Launch Accident Definition

Accidents are the highest consequence subset of mishaps

Launch accident means

- (1) An event that causes a fatality or serious injury (as defined in 49 CFR 830.2) to any person who is not associated with the flight;
- (2) An event that causes damage estimated to exceed \$25,000 to property not associated with the flight that is not located at the launch site or designated recovery area;
- (3) An unplanned event occurring during the flight of a launch vehicle resulting in the impact of a launch vehicle, its payload or any component thereof:
 - (i) For an expendable launch vehicle, outside designated impact limit lines; and
 - (ii) For a reusable launch vehicle, outside a designated landing site.
- (4) For a launch that takes place with a person on board, a fatality or serious injury to a space flight participant or crew member.

SpaceShipTwo Investigation & Response Timeline



FAA will submit updated responses to NTSB annually until recommendations are closed out

Summary of NTSB Recommendations

Number	Recommendation
A-15-19	In collaboration with the Commercial Spaceflight Federation, develop and issue human factors guidance for operators to use throughout the design and operation of a crewed vehicle. The guidance should address, but not be limited to, the human factors issues identified during the SpaceShipTwo accident investigation.
A-15-20	Implement steps in your evaluation of experimental permit applications to ensure that applicants have (1) identified single flight crew tasks that, if performed incorrectly or at the wrong time, could result in a catastrophic hazard, (2) assessed the reasonableness, including human factor considerations, of the proposed mitigations to prevent errors that could result from performing those tasks, and (3) fully documented the rationale used to justify related assumptions in the hazard analysis required by 14 CFR 437.55.
A-15-21	Develop a process to determine whether an experimental permit applicant has demonstrated the adequacy of existing mitigations to ensure public health and safety as well as safety of property before granting a waiver from the human error hazard analysis requirements of 14 CFR 437.55.
A-15-22	Develop and implement procedures and guidance for confirming that commercial space operators are implementing the mitigations identified in a safety-related waiver of federal regulations and work with the operators to determine the effectiveness of those mitigations that correspond to hazards contributing to catastrophic outcomes.

Summary of NTSB Recommendations *(continued)*

Number	Recommendation
A-15-23	Develop and issue guidance for experimental permit applications that (1) includes the information in Advisory Circular 413-1, "License Application Procedures," and (2) encourages commercial space vehicle manufacturers to begin the consultation process with the Office of Commercial Space Transportation during a vehicle's design phase.
A-15-24	Develop and implement a program for Office of Commercial Space Transportation inspectors that aligns them with individual operators applying for an experimental permit or a launch license to ensure that the inspectors have adequate time to become familiar with the technical, operational, training, and management controls that they will inspect.
A-15-25	Direct Office of Commercial Space Transportation (AST) management to work with AST technical staff to (1) develop clearer policies, practices, and procedures that allow direct communications between staff and applicants, (2) provide clearer guidance on evaluating commercial space transportation permits, waivers, and licenses, and (3) better define the line between the information needed to ensure public safety and the information pertaining more broadly to ensuring mission success.
A-15-26	In collaboration with the commercial space flight industry, continue work to implement a database of lessons learned from commercial space mishap investigations and encourage commercial space industry members to voluntarily submit lessons learned.

Recommendations Dealing with Human Factors & Human Error

- ***A-15-19: In collaboration with the Commercial Spaceflight Federation, develop and issue human factors guidance for operators to use throughout the design and operation of a crewed vehicle. The guidance should address, but not be limited to, the human factors issues identified during the SpaceShipTwo accident investigation.***
- ***A-15-20: Implement steps in your evaluation of experimental permit applications to ensure that applicants have***
 - ***(1) identified single flight crew tasks that, if performed incorrectly or at the wrong time, could result in a catastrophic hazard,***
 - ***(2) assessed the reasonableness, including human factor considerations, of the proposed mitigations to prevent errors that could result from performing those tasks, and***
 - ***(3) fully documented the rationale used to justify related assumptions in the hazard analysis required by 14 Code of Federal Regulations 437.55.***

FAA's Proposed Path Forward (A-15-19 & A-15-20)

- **FAA's response highlighted our mission to protect public safety, while encouraging the continuous improvement in occupant safety**
 - Consistent with the human space flight regulatory moratorium
- **Build upon *Recommended Practices for Human Space Flight Occupant Safety* (Aug '14)**
 - Starting point for voluntary consensus standards
- **FAA encouraged by progress of CSF and the COMSTAC Standards Working Group**
 - FAA will continue to support this industry activity
- **Examining current regulations & guidance**
 - Part 437 Experimental Permits, particularly hazard analysis requirements (§437.55)
 - Part 460 Human Factors
 - At minimum, expect to provide improved guidance material provided to industry
 - Role for voluntary consensus standards as an acceptable means of compliance
- **FY16 R&D project to support voluntary consensus standards and regulatory/guidance**
 - Identify best practice considerations for crew human factors for small, winged commercial space flight vehicles

Recommendation on Pre-Application Consultation

- ***A-15-23: Develop and issue guidance for experimental permit applications that***
 - ***(1) includes the information in Advisory Circular 413-1, "License Application Procedures," and***
 - ***(2) encourages commercial space vehicle manufacturers to begin the consultation process with the Office of Commercial Space Transportation during a vehicle's design phase..***

FAA's Proposed Path Forward *(A-15-23)*

- **Pre-application consultation is a regulatory requirement under §413.5**
 - A well-executed process benefits both the operator and the FAA
 - Reduced regulatory risk
 - Improved program and resource planning
 - Goals is to ensure compliance plan is well understood prior to application
 - Applicant understands the applicable regulations, policies & guidance
 - Early identification of novel or unique features of the vehicle or operation affecting licensing or permitting
 - Resolution of any potential issues that could affect applicant's ability to develop and submit an application that can be accepted for review
- **FAA working to make “pre-app” even more effective**
 - Internal P-011 pre-application process issued (March 2015)
 - Compliance checklists developed and issued for applicant use (Oct 2015)
 - Facilitates rapid, efficient summary of applicable requirements and corresponding means of compliance
 - Development of improved Advisory Circular to replace AC 413-1 is underway
 - Intended to provide a flexible and efficient means to meet the goals and requirements of §413.5 (and other relevant sections)

Recommendation on Voluntary Safety Data Sharing

- ***A-15-26: In collaboration with the commercial space flight industry, continue work to implement a database of lessons learned from commercial space mishap investigations and encourage commercial space industry members to voluntarily submit lessons learned.***

FAA's Proposed Path Forward *(A-15-26)*

- **FAA recognizes the profound impact voluntary safety data sharing has had in aviation**
 - Significant potential for emerging commercial human spaceflight operations
- **Between Sept '14 – Aug '15 FAA performed internal feasibility study for voluntary safety data sharing between industry members and the FAA**
- **Identified challenges included:**
 - De-identification & protection of proprietary data
 - Creating non-punitive environment
 - Availability of data-mining and analysis tools
- **Stepped (multi-year) approach recommended to address challenges**
 - Focus on sub-orbital human space flight
 - Research extension of tools FAA developed for aviation to space applications
 - FOQA – Flight Operations Quality Assurance – is parametric data collected from each flight, aggregated and analyzed to identify trends and other precursors
 - ASAP – Aviation Safety Action Program – reports from individuals (e.g., crew) to identify confusion, errors or other issues that could lead to safety consequences
 - Programs extended to other areas such as maintenance and Air Traffic Control (ATSAP)

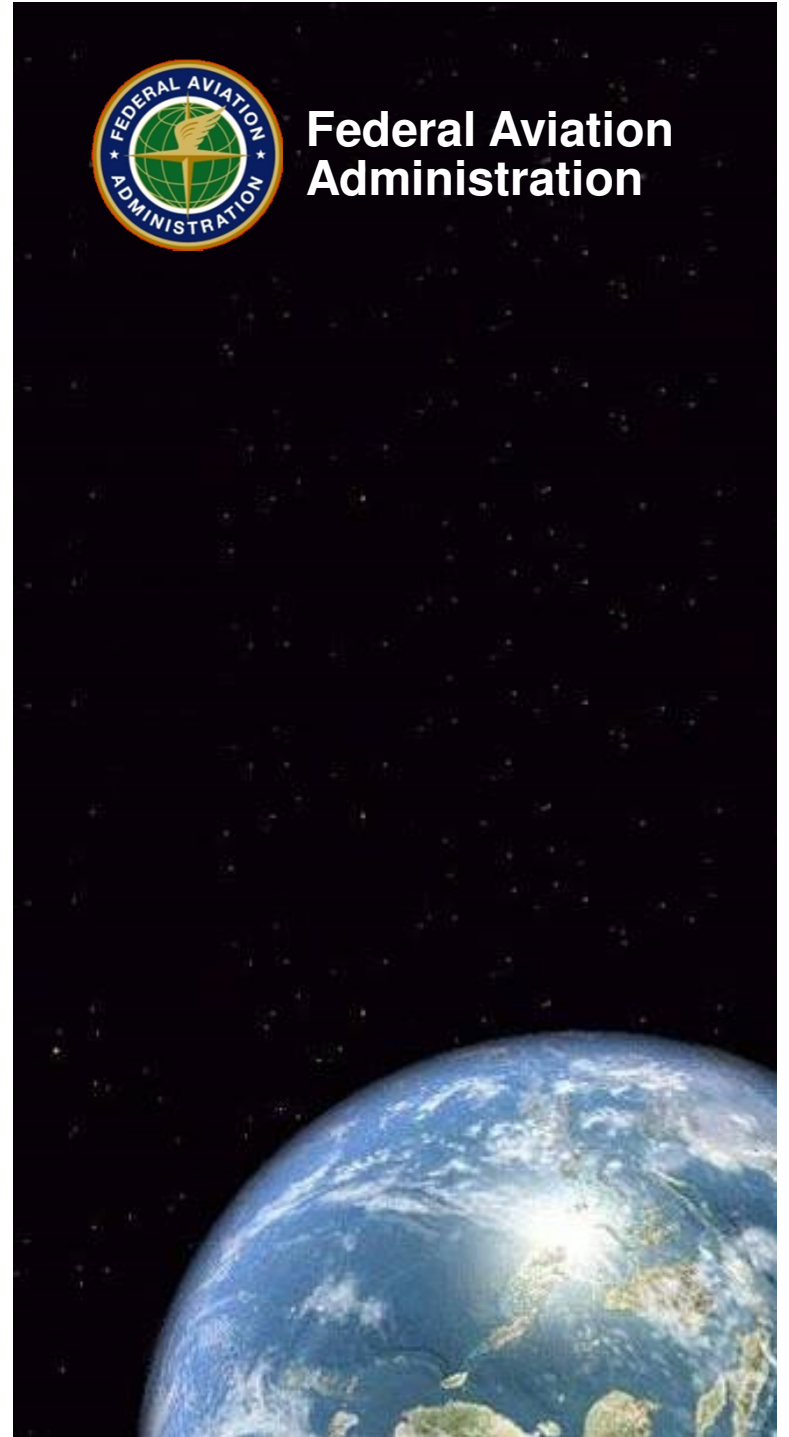
FAA's Proposed Path Forward *(A-15-26 – cont -)*

- **Stepped approach – continued**
 - Research extension of tools FAA developed for aviation to space applications
 - FAA will explore extending the WBAT (ASAP) tool under its FY16 research program
 - FAA would like to partner with industry
 - To prototype use of any newly developed tool(s)
 - Better understand current flight data analytics capability (which appears to be considerable) and whether additional needs exist
 - Determine need for legislative protections for voluntary submitted data
 - Legislation previously required for aviation – resulted in Part 193 protections

Questions



**Federal Aviation
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Back-up Slides



Investigations Overview

- Per 51 U.S.C. §50917 FAA/AST has statutory authority to conduct mishap investigations for all FAA licensed or permitted launch activities
- FAA regulations require an operator to have an accident or mishap investigation plan containing procedures for reporting, responding to, and investigating mishaps that occur during licensed or permitted activities
- Accident or mishap plan must also contain procedures to identify and adopt preventive measures for avoiding recurrence of the event
 - FAA reviews investigation results and corrective actions to ensure no licensing or permit issues before next launch.

Mishap Response

- Launch operator ultimately responsible for mishap response
 - Must implement a plan containing launch operator's procedures for reporting, responding, and investigating accidents
 - Plan includes designating the individual responsible for initiating the mishap response
- Onsite AST safety inspection personnel monitor implementation of the launch operator's plan
- AST Mishap Response Coordinator, in coordination with the Safety Inspection Division (AST-400) Manager, initiates and coordinates the Agency's response

Mishap Notification

- In the event of an accident, incident, or a mishap involving a fatality or serious injury
 - Operator is required to provide immediate notification to the FAA's Washington Operations Center (WOC)
 - Operator must provide notification within 24 hours to the AST-1 or the WOC in the event of a mishap that does not involve a fatality or serious injury
- Per AST procedure, the assigned Safety Inspector initiates AST's internal notification process
- AST's internal notification process does not relieve the launch operator of complying w/notification requirements

NTSB Investigations

- NTSB uses the “party system” for conducting investigations
- By statute, the FAA is a party to an NTSB investigation
 - FAA Investigator in Charge (IIC) assures access to all accident data collected by the NTSB
 - FAA representatives on each NTSB working group
- NTSB issues probable cause and recommendations as determined by its Board Members
- FAA reviews recommendations directed at Agency and determines its appropriate response
- FAA retains its regulatory authority
 - i.e., Operators still must meet all requirements and obtain FAA approval prior to close out and return to flight, regardless of NTSB findings and recommendations

Closing Out Mishap Investigations & Return to Operations

- Following conduct of investigation (with AST oversight) operator submits draft investigation report for FAA review
- AST reviews draft report for adequacy and provides feedback to operator
- Operator submits final report & briefs AST management
 - AST makes a determination on whether to accept report and close investigation
- Separately, any modifications to the license or permit are submitted to AST for evaluation
 - AST evaluates and approves these modifications prior to authorizing return to flight operations

Summary of Mishap Investigation Process

- AST retains oversight throughout investigation and close-out
- Operator responsible for conducting investigation in accordance with its AST- approved investigation plan
- AST makes a determination on whether to accept operator's report outlining root cause and corrective actions, and closing-out investigation
- Separately, any modifications to the license or permit are submitted to AST for evaluation
 - AST evaluates and approves these modifications prior to authorizing return to flight operations