



Original Helicopter Safety Enhancements-Summation Report

HISTORY:

In 2017, the United States Helicopter Safety Team (USHST) adopted the Commercial Aviation Safety Team (CAST)/General Aviation Joint Safety Committee (GAJSC) approach to analyzing safety data and developing intervention strategies. USHST Safety Analysis Team (SAT) evaluated 104 U.S. civil helicopter fatal accidents that occurred in the five calendar years covering 2009 through 2013. As a first step, the SAT used the CAST/ICAO Common Taxonomy Team (CICTT) aviation occurrence categories to prioritize where future safety enhancement could have the most impact. Every fatal accident was individually reviewed and a single “priority” aviation occurrence category was assigned for each event. The CICTT provides definitions and usage notes for each CICTT aviation occurrence category and that resource helped ensure standardization. Through this process, the SAT identified that three occurrence categories each accounted for comparable percentages of fatal accidents and, when combined, those three categories accounted for 50% (52 of 104) of the fatal accidents. The three categories were: Loss of Control-Inflight, Unintended Flight into Instrument Meteorological Conditions, and Low Altitude Operations.

In parallel with the use of the aviation occurrence categories, the SAT also examined the distribution of fatal accidents for the same five-year period according to industry sector. The top four industries (Personal/Private, Helicopter Air Ambulance, Commercial, and Aerial Application) comprised 59% of the fatal accidents (61 out of 104). The SAT then cross examined the fatal accidents in the top four industries (61 fatal accidents) by aviation occurrence category. The SAT observed that the same three categories of Loss of Control-Inflight, Unintended Flight into Instrument Meteorological Conditions, and Low Altitude Operations were present in 52% of the fatal accidents. This was consistent with what had been observed in the larger data set (104 fatal accidents) across all industry sectors.

In the next step, the USHST assembled a cross-functional working group of twenty-five to thirty subject matter experts from manufacturers, industry groups, operators, and government organizations to conduct a deeper level of analysis on the 52 fatal accidents from the sub-set of data identified as Loss of Control-Inflight, Unintended Flight into Instrument Meteorological Conditions, and Low Altitude Operations events. The intent of this deeper analysis was to “score” potential solutions to prevent future fatal accidents. The scoring process would eventually lead to a rank ordered list of proposed helicopter safety enhancements. To score an accident, the working group began by reviewing the accident information available through the NTSB’s final report and public docket system. Through the review, the working group assigned “Standard Problem Statements” (SPSs) to describe the specific problems (e.g., what things went wrong and contributed to the fatal outcome?) underlying the accident and any contributing factors, if applicable. For each SPS, the working group assigned at least one, but sometimes many, intervention strategies (ISs). In many cases, an SPS or IS created for one accident was applicable to another fatal accident in the data set. By the conclusion of the working group’s effort, 117 unique ISs

were developed. After identifying the potential problems and potential interventions, the group then scored each standard problem statement on a scale of 0 to 6 for:

- P1 (Power1): The importance of the SPS in contributing to the particular fatal accident being analyzed.
- A (Applicability): The applicability of the SPS in contributing to all future fatal accidents/fatalities.

Each intervention also was scored on a scale of 0 to 6 for:

- P2 (Power2): In the “perfect” world, how effective will the IS be in eliminating fatal accidents/fatalities related to this SPS.
- C (Confidence): In the “real” world, how effective will the IS be in eliminating fatal accidents/fatalities related to this SPS.

The P1, A, P2, and C values were input into a mathematical formula, developed previously by the CAST and the GAJSC, to calculate Overall Effectiveness (OE).

Each IS was further scored for Feasibility on a scale of 1 to 3 across six factors (technical, financial, operational, schedule, regulatory, and sociological), which were averaged. The final score for each IS was the product of the Overall Effectiveness and Feasibility ($OE * F$). The final scores were used to rank the ISs. The working group set a “Mendoza Line,” or cut-off point, at twenty-five ISs, to determine which the USHST would implement. The cut-off was based in part by an observed drop-off in the final score. It was also influenced by the USHST’s available personnel resources to implement safety enhancements since implementing all 117 ISs would not have been possible.

The twenty-five ISs were assigned to an individual expert or a team of subject matter experts from the working group to develop each IS into a detailed helicopter safety enhancement or H-SE. The writers tasked with developing each H-SE had to evolve the original IS from a two or three sentence concept into a detailed plan for implementation. In the past, the USHST had struggled to transition from analysis to prioritized implementation. Development of the H-SEs allowed this obstacle to be overcome through prioritized, detailed implementation plans. During H-SE development, some of the interventions were combined, reducing the total to twenty-two. After some of the early H-SE efforts were launched, it became apparent to the USHST that some of the work on separate H-SEs was proceeding along parallel, redundant tasks. To streamline use of resources, several of the original H-SEs were combined. This further reduced the total number of H-SEs to 16 total.

During the development of the H-SEs, our FAA partners, in good faith, agreed to the modification of existing handbooks, policies, and other guidance resulting from the H-SE work. However, due to the FAA’s need to prioritize resources, some of the modifications could not be accomplished. Rather than leave the H-SEs open for a potentially indefinite period of time, the USHST Steering Committee voted to reduce the scope of several H-SEs to actions that could be managed solely within the USHST membership and would not be limited by delays or resource scarcity within the FAA. Consequently, some of the H-SEs were closed without some of the originally conceived outputs accomplished. For more details on these cases please see the “Notes” under the list of each applicable H-SE that follows later in this document.

The USHST completed implementation of the last of the original H-SEs in February 2023. However, outreach on the completed work has continued and is planned to continue for as long as the content is relevant to reducing fatal helicopter accidents. This is done directly by the USHST through recurring USHST webinars. The efforts are further supported by the work of the Vertical Aviation Safety Team (VAST.AERO), Helicopter Association International (ROTOR.ORG), helicopter/vertical lift manufacturers,

and other safety focused entities who use their own safety promotion activities to promote the safety products that resulted from the USHST's H-SEs.

The following is a summation of each H-SE.

H-SE 13A, Utilities and Construction Practice Guide

- Original Enhancement Action: Outreach: Industry to promote the recommended practice guides for utility patrol operations within industry and its customers.
- Result: A "UPAC Safety Guide for Helicopter Operators" has been written and is available at https://ushst.org/H_SE/UPAC_GUIDE072020R.pdf.

H-SE 19A, Safety Culture and Professionalism

- Original Enhancement Action: Government and industry to develop a definition of an effective safety culture that is more applicable and relatable to the day-to-day work of frontline helicopter professionals, and promote an understanding of this application-based definition to the helicopter community.
- Result: "Go Local" Helicopter Safety Webinars were held in conjunction with the FAA FAAST Team.

H-SE 22A, Detection and Management of Risk Level Changes During Flight by Pilots and Nonflying Crew

- Original Enhancement Action: Outreach: Industry to develop and promote recommended practices for pilot and nonflying crewmembers to (1) detect increased risk levels during the course of a flight, (2) effectively communicate the increased risk level to each other, and (3) make a decision on the appropriate risk mitigation.
- Result: The following documents were written and available:
 - Recommended Practice, Detection and Management of Risk Level Changes During Flight by Pilots and Non Flying Crew (https://ushst.org/Rec_Prac22A_CRM_FINAL.pdf)
 - Recommended Practice: U.S. Army Aircrew Coordination Training (<https://ushst.org/wp-content/uploads/2020/09/USHST-H-SE-22A-Recommended-Practice-US-Army-Aircrew-Coordination-Training.pdf>)
 - Helicopter Facts: Using Crew Resource Management on All Helicopter Flights (For Helicopter Air Ambulance and Other Civil Crewmember Operations) https://ushst.org/Press_Releases/FACTS%20crew%20resource%20management%20HSE%2022A.pdf
 - Sample Crew Resource Management Briefing Card (https://ushst.org/Repository/CRM_BRIEFING_CARD.pdf)

H-SE 28, Helicopter Final Walk Around/Security of External Cargo

- Original Enhancement Action: Outreach: Industry and the FAA to (1) develop guidelines/recommended practices for helicopter preflight inspection, final walk around, and postflight inspection and (2) to promote the guidelines/recommended practices to the training community and general pilot community.
- Result: The following documents were written and available
 - Recommended Practice, Helicopter Preflight, Final Walk Around and Postflight Inspection Guidelines (<https://vast.aero/archives/Recommended/Rec%20Prac%2028%20Walk%20Around%20FINAL.pdf>)
 - Helicopter Facts, 12 Rules to Live by for Your Pre-Flight Helicopter Inspection These One Dozen Actions May Save Your Life (https://vast.aero/archives/Fact_Sheets/Walk_Around_fact_sheet.pdf)
 - Poster: One Last Look (https://ushst.org/wp-content/uploads/2021/02/2019_One-Last-Look.jpg)

H-SE 30, Develop/Publish ACS Rotorcraft-Helicopter Series

- Original Enhancement Action: Policy: FAA, with support from industry, to develop and publish the new Airman Certification System (ACS) Rotorcraft-Helicopter series to replace the current Practical Test Standards (PTS) for internal and external industry stakeholders for airman certification.
- Results: The USHST had multiple representatives on the FAA's ACS, Rotorcraft-Helicopter Aviation Rulemaking Advisory Committee. This committee made recommendations to the FAA concerning the development and publication of the Rotorcraft-Helicopter ACS.
- Result: The following documents were written and available:
 - Airmanship Safety Bulletin, Vortex Ring State (https://vast.aero/archives/Airmanship_%20Bulletins/Airmanship%20Vortex%20Ring%20State%20Part%201.pdf)
 - Airmanship Safety Bulletin, Power Available Limitations (https://vast.aero/archives/Airmanship_%20Bulletins/Airmanship%20Power%20Available%20Part%202.pdf)

H-SE 37, Add Progressive Approach to Training Autorotations to Helicopter Flying Handbooks

- Original Enhancement Action: FAA to amend Helicopter Flying Handbook (FAA-H-8083-21A) to incorporate progressive approach to training autorotations.
- Result: For purposes of efficiency and prioritization of limited USHST resources, the intent of the H-SE was incorporated into the work of H-SE 30.

H-SE 70, Stability Augmentation System (SAS)/Autopilot

- Original Enhancement Action: Technology/Equipment: Industry and FAA to encourage development and installation of a stability augmentation system (SAS) and/or simple autopilot in light helicopters.
- Results: Report, Loss-of-Control In-Flight Mitigation through Installation of Stability Augmentation and Autopilot Systems in Light Helicopters (<https://ushst.org/wp-content/uploads/2021/02/HSE-70-Autopilot-Stability-Augmentation.pdf>)
- NOTES:

- Note 1: The H-SE 70 team modified the scope slightly to focus solely on Part 27 integration to improve the likelihood of follow-on FAA action. Some information may, however, facilitate future efforts of Part 29 stakeholders seeking similar objectives.
- Note 2: The USHST acknowledges that further refinement and implementation of concepts, solutions, and capabilities proposed in this document require joint development by qualified government and industry stakeholders.

H-SE 75, Technology to Prevent Unintended Loss of Engine Power

- Original Enhancement Action: Technology/Equipment: Industry and FAA to encourage development and installation of Full Authority Idle Protection devices to prevent unintended loss of engine power.
- Results: For purposes of efficiency and prioritization of limited USHST resources, the intent of the H-SE was incorporated into the work of H-SE 123.

H-SE 81, Improve Simulator Modeling for Outside-the-Envelope Flight Conditions

- Original Enhancement Action: Technology/Equipment: FAA and industry to provide recommendations for improving simulator mathematical physics models for level A-D Full Flight Simulators (FFSs), basic and advanced Aviation Training Devices (ATDs), and Level 4-7 Flight Training Devices (FTD) for outside-the-envelope flight conditions.
- Results: Output Report, Improve Simulator Modeling for Outside-the-Envelope Flight Conditions (https://ushst.org/wp-content/uploads/2023/02/USHST_H-SE_Device-Fidelity-Model-Improvements-Output-Report.pdf)
- Notes:
 - Of the three outputs, the output report documents the progress made regarding Output #1.
 - Output #2 has not been attempted due to the complexity associated with the modeling efforts in Output #1 and that this output cannot be accomplished solely within the USHST membership.
 - Output #3 was accomplished through the individuals on the H-SE Team who have conducted informal outreach activities with various operators and training entities.

H-SE 82, Helicopter Flight Data Monitoring

- Original Enhancement Action: Technology/Equipment: FAA and industry promote installation and use of data recording devices (e.g., HFDM, camera recording) for purposes of: (1) detection and monitoring of aircraft and engine limitations that were exceeded, (2) collecting and preserving more data relevant to accident investigation, and (3) detecting and correcting procedural noncompliance.
- Results:
 - Helicopter Flight Data Monitoring Quick Start Guide (https://ushst.org/wp-content/uploads/2023/04/USHST_H-SE-82_HFDM_Quick-Start-Guide.pdf)
 - Summary Report, Helicopter Flight Data Monitoring (https://ushst.org/wp-content/uploads/2023/04/USHST_H-SE-82_HFDM_19-April-2023.pdf)
- Notes:
 - All Output #2 actions are for the FAA to undertake and methods of promoting the installation and use of recording devices. To prevent indefinite delays, the USHST Steering Committee voted to reduce the scope of this H-SE in 2022 and limit it to only the outputs that could be managed solely within the USHST membership.

H-SE 90, UAS in High Risk Environments

- Original Enhancement Action: Technology/Equipment: FAA and industry to encourage the increased use of UAS (Unmanned Aircraft Systems), and continued development and integration of OPA (Optionally Piloted Aircraft) or autonomy-enabled helicopters, to supplement and support manned operations in high-risk operations or environments.
- Results:
 - Formal Report: Identifying How UAS/OPA Can Reduce Fatal Accidents in High Risk Manned Helicopter Operations (<https://ushst.org/Repository/H-SE%2090%20Formal%20Report.pdf>)
 - Bulletin: UAS and OPA Technology-Integrating into Helicopter Operations (<https://ushst.org/wp-content/uploads/2020/09/BULLETIN-UAS-integration.pdf>)
 - Helicopter Safety News Release: USHST Sees Safety Benefits of Integrating UAS and OPA Technology into Helicopter Operations (<https://ushst.org/wp-content/uploads/2020/09/RELEASE-UAS-Safety-Benefits.pdf>)
 - Article: Unmanned Systems Can Save Lives In High-Risk Manned Operations (<https://rotormedia.com/unmanned-systems-save-lives-in-high-risk-manned-operations/>)

H-SE 91, Enhanced Helicopter Vision Systems

- Original Enhancement Action: FAA and industry to research, develop, and promote the use of enhanced helicopter vision systems (EHVS) technologies (e.g., Night Vision Goggles, Enhanced Vision Systems, Synthetic Vision Systems, Combined Vision Systems, etc.) to assist in recognizing and preventing unplanned flight into degraded visibility conditions due to weather and to increase safety during planned flight at night.
- Results: Output Report: Helicopter Safety Enhancement No. 91 (https://ushst.org/wp-content/uploads/2023/02/USHST_H-SE-91_Enhanced_Helicopter_Vision_Systems.pdf)
- Notes: The output report addresses Output #1 (Research and evaluate helicopter vision-enhancing technologies and operational concepts for advanced vision systems). This will require communication with existing industry vision system manufacturers to get a well-informed perspective of currently available technology and Output #3 (Industry and FAA to develop and conduct outreach program to promote use of vision-enhancing technologies.). Output#2 has not been attempted due to the lack of industry push towards using vision-enhancing devices for operational credit. Also, to prevent indefinite delays, the USHST Steering Committee voted to reduce the scope of this H-SE in 2022 and limit it to only the outputs that could be managed solely within the USHST membership.

H-SE 115 and 128, Threat and Error Management for Initial and Recurrent Pilot Training

- Original Enhancement Action: Training: FAA and industry to develop best practices for, and promote, the teaching of Threat and Error Management (TEM) as part of initial and recurrent pilot training.
- Result: For purposes of efficiency and prioritization of limited USHST resources, the intent of the H-SE was incorporated into the work of H-SE 30.

H-SE 116, Improve Make/Model Transition Training

- Original Enhancement Action: Training: FAA and industry improve make/model transition by ensuring familiarity and understanding of new “model specific” equipment.
- Result:
 - Helicopter Transition Training Recommended Practices (https://ushst.org/wp-content/uploads/2022/12/USHST_H-SE_116_Introduction.pdf)
 - Helicopter Make/Model Transition and Differences Training Syllabus (<https://ushst.org/wp-content/uploads/2022/12/H-SE-116-USHST-Make-Model-Transition-Training-Syllabus.pdf>)
- Notes: Output #4 (Promote creation of helicopter type-specific groups [e.g., type clubs] to establish a more formalized network for ongoing information sharing regarding transition training) was not completed due to minimal interest from industry.

H-SE 117, Competency-based Training Assessments in Initial Pilot Training

- Original Enhancement Action: Training: FAA and industry to provide guidance on improved initial helicopter pilot training to competency in the following areas: (1) aircraft performance and limitations; (2) in-flight power and energy management training, to include prevention and recovery, if required, from settling with insufficient power; (3) basic maneuvers not defined in current guidance but essential to positive aircraft control; (4) threat and error management (see H-SE 115-128); (5) mission planning; (6) aircraft systems; and (7) familiarity with Pilot Operating Handbook
- Result: For purposes of efficiency and prioritization of limited USHST resources, the intent of the H-SE was incorporated into the work of H-SE 30).

H-SE 122, Recommended Practices for Standardization of Autorotation and Emergency Aircraft Handling Training

- Original Enhancement Action: Training: Convene team of training industry experts to develop consensus on recommended practices for standard training of the Certified Helicopter Flight Instructor on autorotations and emergency aircraft handling.
- Result: For purposes of efficiency and prioritization of limited USHST resources, the intent of the H-SE was incorporated into the work of H-SE 30.

H-SE 123, Increased Simulation/Education to Develop Safe Decision Making

- Original Enhancement Action: Training: FAA and industry to increase the use of relevant simulation to rehearse at risk scenarios to develop safe decision making and educate.
- Results:
 - Recommended Practice, Simulation Training for Aviation Decision Making (https://ushst.org/USHST_RP_Simulation_Training_for_DM2.pdf)
 - Video: “Simulation: Learn From Your Mistakes” (<https://www.youtube.com/watch?v=W55mZArDJco>)
- Notes: Output #2-(SME team will work to eliminate any barriers in existing guidance and oversight that may currently inhibit or discourage increased use of helicopter simulation devices. The specific intent is to prevent future fatal accidents by enabling a greater number of pilots to be safely educated on at risk scenarios at all levels of simulator training) was not pursued due to FAA legal review issues.

H-SE 124, Improve Understanding of Basic Helicopter Aerodynamics

- Original Enhancement Action: Training: FAA and industry to review and revise materials explaining basic helicopter aerodynamics to emphasize recognition of unsafe aerodynamic situations and apply appropriate corrective actions.
- Results:
 - Output #2- Revise to the Helicopter Flying Handbook, Helicopter Instructor's Handbook and pertinent ACs concerning unsafe aerodynamic situations, to include vortex ring state, low G mast bumping, and low RPM rotor stall guidance.
 - In 2019 the Helicopter Flying Handbook was revised.
(https://www.faa.gov/sites/faa.gov/files/regulations_policies/handbooks_manuals/aviation/helicopter_flying_handbook/helicopter_flying_handbook.pdf)
 - USHST Airmanship Safety Bulletin: Vortex Ring State:
(https://vast.aero/archives/Airmanship_%20Bulletins/Airmanship%20Vortex%20Ring%20State%20Part%201.pdf)
 - USHST Airmanship Bulletin: The Vuichard Recovery:
(<https://vast.aero/archives/Flysafe/AIRMANSHIP%20Vuichard.docx>)
 - NOTES: The FAA was unable to accomplish the remaining outputs.

H-SE 125, Preflight Risk Assessment for Student Flights

- Original Enhancement Action: Training: FAA and industry to provide recommended practices to instructors for pre-flight risk assessment of student flights.
- Results:
 - Recommended Practice: (https://ushst.org/wp-content/uploads/2023/02/USHST_H-SE-125_Preflight_Final.pdf)
 - FAA Safety Aviation Learning Center Course, ALC-683, Conducting Preflight Self-Briefings for Student and VFR Pilots:
(https://www.faasafety.gov/gslac/ALC/course_content.aspx?clD=683&slD=1341&searchresults=true&preview=true)
- Notes: Output #4 "If an AC is developed, then promote the contents of the AC to flight instruction organizations." To prevent indefinite delays, the USHST Steering Committee voted to reduce the scope of this H-SE in 2022 and not pursue Output #4. This was consistent with a broader decision to limit the outputs on any open H-SEs to only those that could be managed solely within the USHST membership.

H-SE 127a, Training for Recognition/Recovery of Spatial Disorientation

- Original Enhancement Action: Industry develop training for recognition of spatial disorientation and recovery to controlled flight. The training developed should emphasize the use of all available resources installed on the aircraft (to include automation, such as increased use of autopilot).
- Results:
 - Recommended Practice, Spatial Disorientation Induced by a Degraded Visual Environment, Training and Decision-Making Solutions: (<https://ushst.org/wp-content/uploads/2021/02/Rec-Prac-HSE-127-Spatial-Disorientation-3-1.pdf>)

H-SE 130, Education and Simulation on Hazards of Over-The-Counter Medication

- Original Enhancement Action: FAA and industry to emphasize the hazards of pilots flying impaired by sedating over-the-counter (OTC) medications—particularly antihistamines—including through renewed education/awareness initiatives and the exploration of the use of simulation during initial and recurrent simulator training.
- Results:
 - FAA document What Over-the-Counter (OTC) medications can I take and still be safe to fly?
(https://www.faa.gov/sites/faa.gov/files/licenses_certificates/medical_certification/medications/OTCMedicationsforPilots.pdf)
 - Safety Bulletin: Is it safe to fly after taking nonprescription medications?
(https://vast.aero/archives/Safety_Bulletins/medication.pdf).
- Notes: Output #s 2 and 3 concerned research into the feasibility of the development of virtual reality (VR) and augmented reality impairment simulation (#2) conduct formal (VR) validation. The team determined that the simulation portion of this H-SE was not feasible.