

FAA & Industry Avionics Rotorcraft Forum

Aircraft Electronics Association | Lee's Summit, MO

February 1st 2012

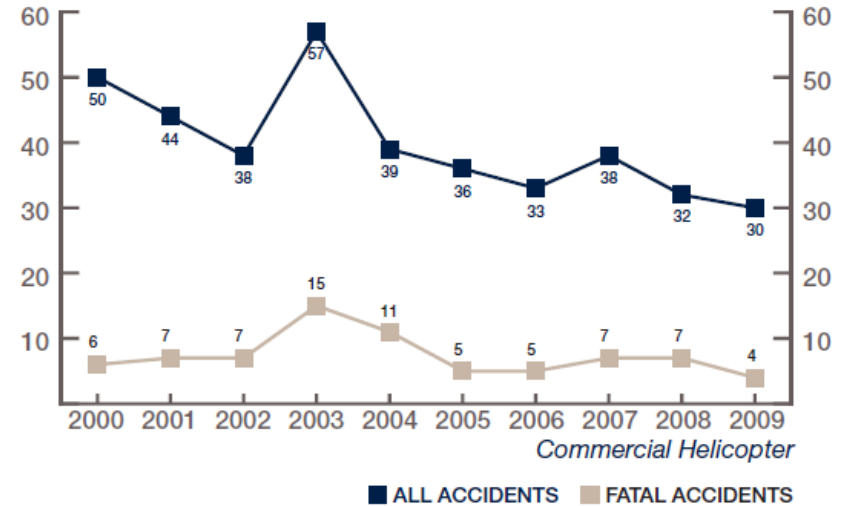
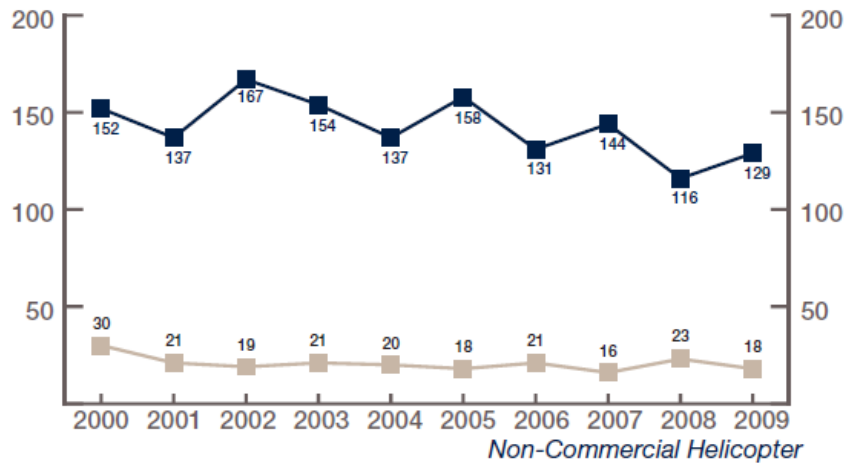


Gregory Bowles, Director Engineering & Manufacturing

ROTORCRAFT SAFETY REVIEW



Overall Rotorcraft Safety



2009 Accident Record	Non-Commercial Operations	Commercial Operations
Total Accidents	129	30
Fatal Accidents	18	4
Accident Rate	7.40	2.38
Fatal Accident Rate	1.03	0.32
Fatalities	33	16



Non-Commercial Rotorcraft Safety

(Non-Comm = 58% of Time & 81% of Accidents)

- Aircraft Class
 - SEP = 40% of Non-Comm Time & 61% of Accidents
 - SE = 95% of Non-Comm Accidents 91% of Fatalities

Aircraft Class	Accidents	Fatal Accidents	Fatalities
Single-Engine Piston	79 (61%)	9 (50%)	17(52%)
Single-Engine Turbine	43 (33%)	7 (39%)	13 (39%)
Multi-Engine Turbine	7 (5%)	2 (11%)	3 (9%)



Non-Commercial Rotorcraft Safety

(Non-Comm = 58% of Time & 81% of Accidents)

- Type of Operation

- Personal Ops = 7% of Non-Comm Time & 33% of Accidents

Type of Operation	Accidents	Fatal Accidents	Fatalities
Personal	42 (33%)	5 (28%)	9 (27%)
Instructional	40 (31%)	3 (17%)	4 (12%)
Public Use	13 (10%)	2 (11%)	3 (9%)
Positioning	15 (12%)	3 (17%)	7 (21%)
Aerial Observation	2 (2%)	0 (0%)	0 (0%)
Business	3 (2%)	1 (6%)	4 (12%)
Other working use	10 (8%)	2 (11%)	2 (6%)
Other	4 (3%)	2 (11%)	4 (12%)



Non-Commercial Rotorcraft Safety

(Non-Comm = 58% of Time & 81% of Accidents)

- Flight Conditions
 - Day VMC = 77% of All Hours & 86% of Non-Commercial Accidents
 - IMC = 1% of All Hours & 3% of All Accidents But 17% of Fatal Accidents

Conditions	Accidents	Fatal Accidents	Fatalities
Day VMC	111 (86%)	12 (67%)	16 (48%)
Night VMC	14 (11%)	3 (17%)	10 (30%)
Day IMC	1 (1%)	0 (0%)	0 (0%)
Night IMC	3 (2%)	3 (17%)	7 (21%)



Non-Commercial Rotorcraft Safety

(Non-Comm = 58% of Time & 81% of Accidents)

- Pilot Certificates
 - 76% of Non-Comm Ops. Accidents Involve Commercial or ATP Rated Pilots (66% CFI)

Certificate Level	Accidents	Fatal Accidents	Fatalities
ATP	17 (13%)	3 (17%)	3 (9%)
Commercial	81 (63%)	9 (50%)	20 (61%)
Private	28 (22%)	4 (22%)	6 (18%)
None or not reported	3 (2%)	2 (11%)	4 (12%)
CFI on board	66 (51%)	9 (50%)	17 (52%)



Commercial Rotorcraft Safety

(Commercial Ops. = 42% of Time & 19% of Accidents)

- 4 Fatal Commercial Ops. Accidents in 2009
 - 2 External Load Operations
 - 2 Part 135 Operations
 - Oil Platform Transport
 - Hudson River Collision



Rotorcraft Safety – Accident Occurrence

- Loss of Control - (41%)
 - Performance Management (15%)
 - Dynamic Rollover (6%)
 - Exceeding Operational Limits (5%)
- Autorotation – (32%)
- System/Component Failure – (28%)
- Rotorstrike – (16%)

Source: August 2011 IHST U.S. Joint Helicopter Safety Analysis Team

General Aviation Manufacturers Association (GAMA)



Rotorcraft Safety – Problem Statement

- Problem Identified in Percentage of Accidents:
 - Pilot Judgment & Actions (84%)
 - Safety Management (43%)
 - Ground Duties (37%)
 - Pilot Situational Awareness (31%)
 - System Component Failure (28%)
 - Maintenance (20%)
 - Mission Risk (19%)
 - Post Crash Survival (13%)

Source: August 2011 IHST U.S. Joint Helicopter Safety Analysis Team

General Aviation Manufacturers Association (GAMA)



Summary of Rotorcraft Safety

- Most Rotorcraft Accidents Occur During Non-Commercial Operations (81% of All Accidents)
- Most Rotorcraft Involved in Accidents Are Single Engine Aircraft (93% of All Accidents & 81% of All Hours)
- Personal Flying Results in Disproportionate Number of Accidents
 - 4% of Flight Hours & 25% of All Accidents
- 99% of Flight Activity is VMC
 - 97% of Accidents Occur in VMC



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PAST EXPERIENCE W/NEW TECHNOLOGIES



Fuel Exhaustion

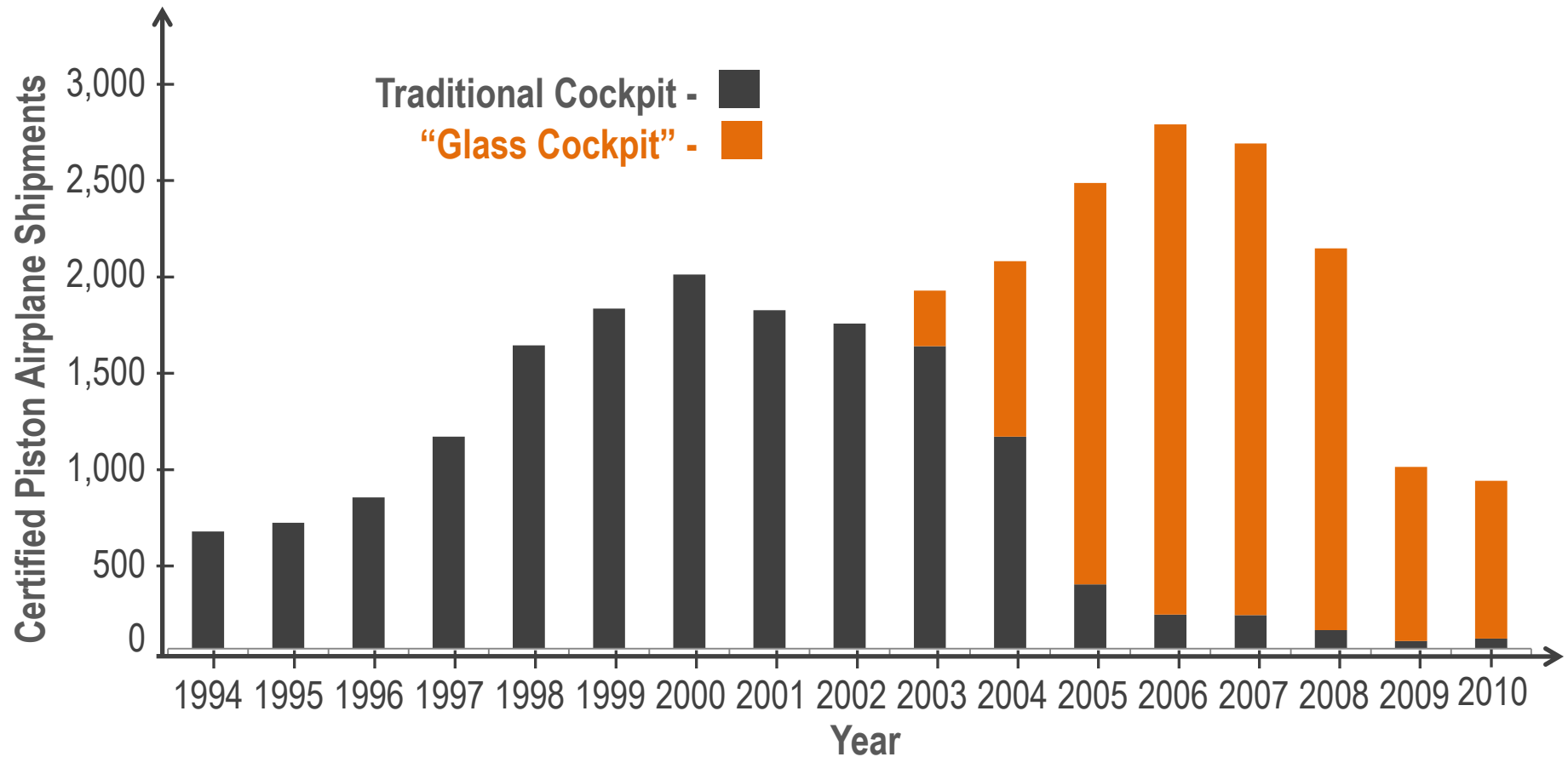
- Historically 10% of All Fixed Wing Accidents Due to Fuel Exhaustion
- Integrated Cockpits 0% of Accidents Related to Fuel Exhaustion



There was Hesitation to Embrace “Glass Cockpits” in Fixed Wing GA



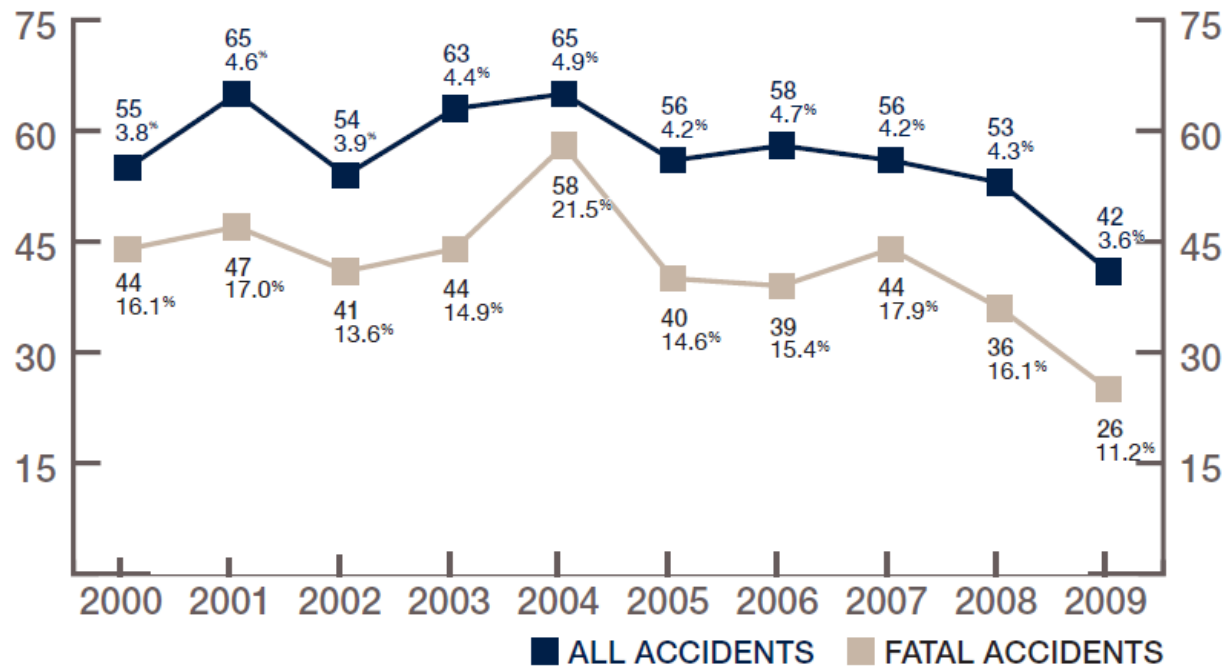
Integrated Cockpits Represent 97% of New Airplane Deliveries Today



Weather Related (18% to 11% of Fatal Accidents)

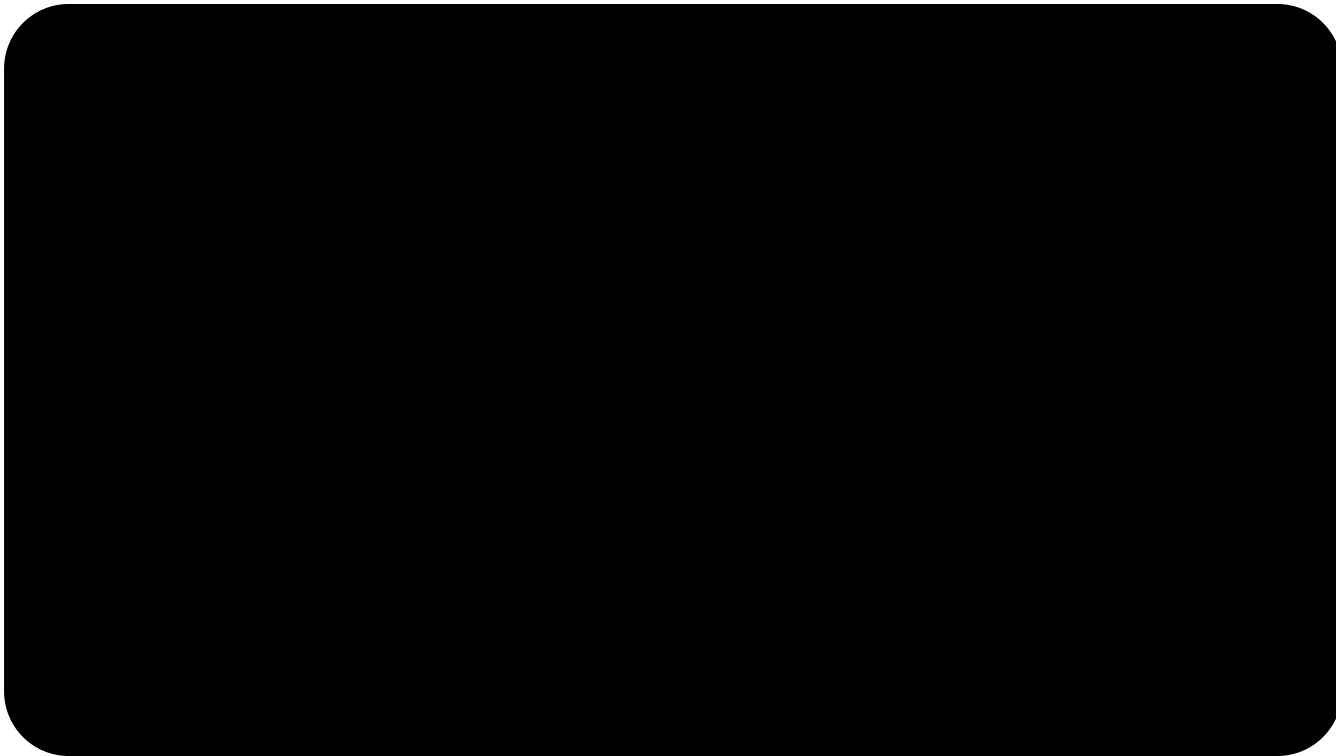
- As Glass Technology Begins to Permeate P23, Weather Related Accidents Drop Dramatically

FIGURE 18 : WEATHER ACCIDENT TREND



Loss of Control

- The Majority of Fixed Wing Fatal Accidents Involve Stall/Spin in the Pattern ($\approx 67\%$)



What's Next?

Aggressive Quadrotor Part II

Daniel Mellinger and Vijay Kumar
GRASP Lab, University of Pennsylvania

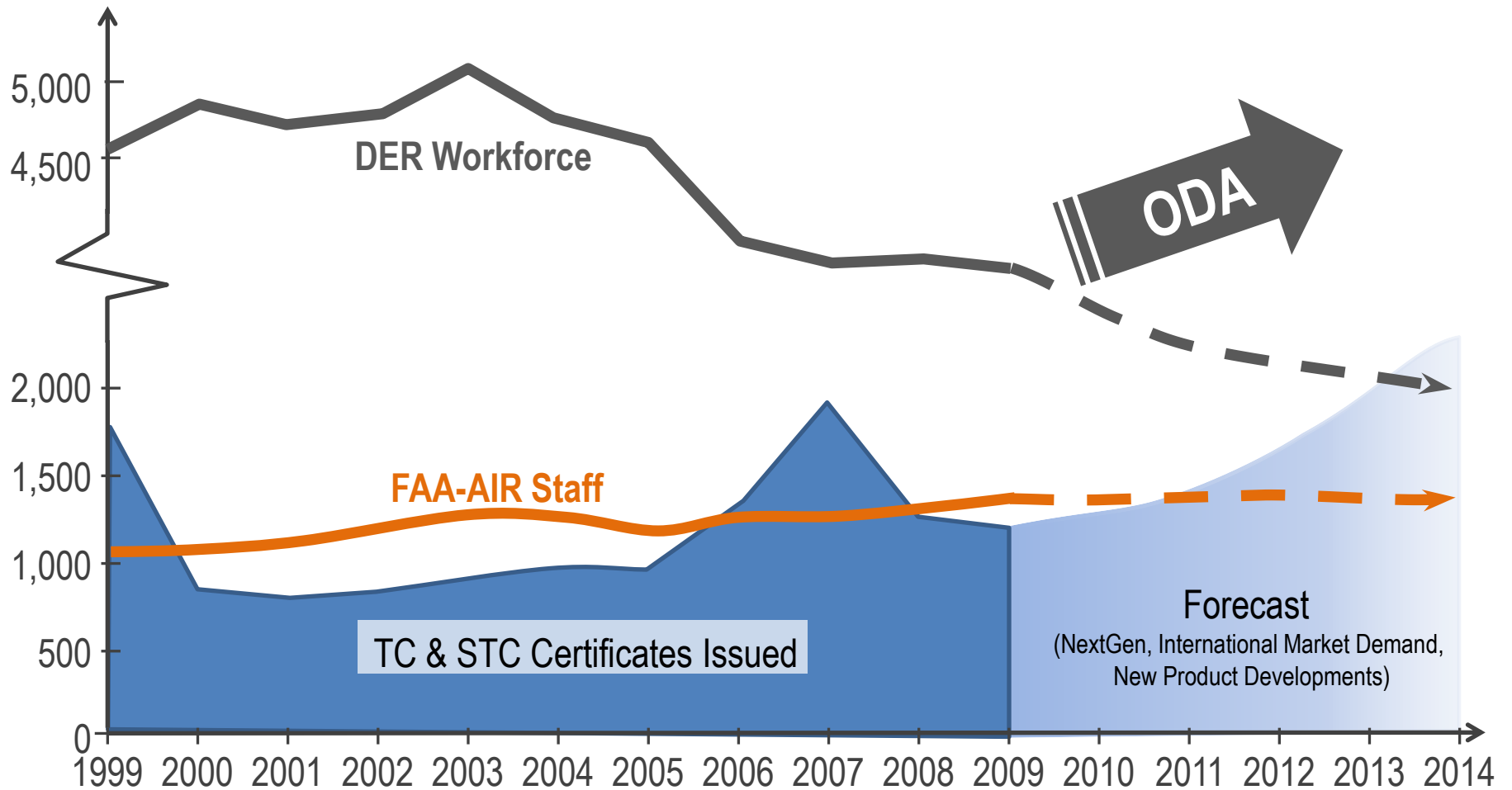


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ENABLING ROTORCRAFT TECHNOLOGY



FAA Certification Demand & Resources



Clear & Predictable Path to Certification

- Investment in Rotorcraft Industry
 - Risk from Questionable Certification Process Makes Business Case Difficult to Justify
- Current Experience Includes
 - Undocumented Technical Concerns
 - Reluctance to Rely on FAA Data (TSO for Example)
 - Changing Expectations & Technical Arguments
 - Inconsistent Regulatory Interpretation



Consistency of Regulatory Interpretation

- Inconsistency of Regulatory Interpretation is Major Industry Concern
 - Experiences Perceived as “Rulemaking by Policy”
 - Invalidating Past Methods of Compliance
 - “Rule Creep” Due to Evolving Interpretation
 - Policy & Guidance Enforced as Requirement
- Highlighted as a Government Concern:
 - 2010 GAO Report on FAA Certification & Approval Processes
 - 2011 FAA Reauthorization Bill (H.R. 658)
 - FAA Order IR8100.16 (2-2d., May 2011):
 - “Policy Statements Must Not Invalidate a Method of Compliance the FAA Previously Agreed to...”



Regulation Sets Requirements

- Regulation Sets the Requirement
- All Requirements Must Come from Regulation or Regulatory Intent
 - Requirement or “Intent” of regulation does not change once established
 - Intent can only be changed through formal rulemaking once established (regulation can not have changing intent per EO 12866 & APA)

Establishing Intent of Regulations

- Intent of Regulation Can Be Established in a Number of Ways
 1. Plain English reading of rule language
 2. NPRM/Final rule preamble
 - Detail in rulemaking background materials of NPRM and final rule
 - Disposition of comments to NPRM in final rule
 - Issues reviewed in Regulatory Flexibility Analysis
 - $\frac{3}{4}$. Issuance of FAA policy & guidance
 - $\frac{3}{4}$. Custom and practice through previous approvals and accepted MOC
 - Common methods resulting in findings of compliance*

Issuance of Policy & Guidance

- If Regulatory Intent is Not Clear Through Plain Language & Preamble Material:
 - Policy &/or Guidance Can be Used to Establish Intent
 - Previous Acceptable Methods of Compliance Can Establish Intent
- Once Intent Has Been Established, New Policy Can Not Change Intent Unless Past Policy Was In Error
 - Nothing but rule change can modify intent of a regulation once properly established

Language of the Rule

- Sec. 27.1309

Equipment, systems, and installations.

(a) The equipment, systems, and installations whose functioning is required by this subchapter must be designed and installed to ensure that they perform their intended functions under any foreseeable operating condition.

(b) The equipment, systems, and installation of a multiengine rotorcraft must be designed to prevent hazards to the rotorcraft in the event of a probable malfunction or failure.

(c) The equipment, systems, and installations of single-engine rotorcraft must be designed to minimize hazards to the rotorcraft in the event of a probable malfunction or failure.

Amdt. 27-46, Eff. 8/8/2011



Language of the NPRM Preamble

From the NPRM for 27-21:

Sec. 27.1309 currently requires that all rotorcraft equipment, systems, and installations be designed to prevent hazards to the rotorcraft if they malfunction or fail. ***This proposal would continue the requirement that multiengine rotorcraft must prevent hazards in case of a probable malfunction or failure. Single-engine rotorcraft would have to be designed to minimize hazards in case of a probable malfunction or failure.***

A majority of Part 27 rotorcraft are single-engine rotorcraft and designs for those models are currently required to prevent hazards under probable failure conditions. ***The FAA is not aware of any justification for more stringent equipment, systems, and installation requirements for single-engine rotorcraft. It is therefore proposed to provide relief for the large majority of small rotorcraft designs consistent with the currently provided for airplanes in Sec. 23.1309.*** The proposed wording for Secs. 27.1309 (b) and (c) is consistent with Part 23.



Language of the Final Rule Preamble

From the final docket for 27-21:

A fourth commenter says he does not understand the different criteria based on the number of engines. In the present rules, the requirements in Section 27.1309(a) and (b) are identical to Section 29.1309(a) and (b), ***which is contrary to the concept of less strict requirements in Part 27, where applicable. The proposed change relieves the requirements of Part 27 by considering only probable failures and by recognizing the different operational capabilities and levels of probable safety between single-engine and multiengine rotorcraft after a probable failure.***



Language of the Guidance

AC27.1303b.(4)(ii)(B)(5)(i) [page F-6]

(i) Failure of the EFIS to perform an intended function which results in the reversion to standby instruments or requires the use of abnormal procedures should be shown to be **improbable**.

(Note that IFR rotorcraft have more stringent requirements that are implemented in Appendix B, which became rule on 3/2/83. That suggests this requirement is for VFR rotorcraft)

AC27.1309 d.(2)(ii)(B) Note (See Page F-29)

“Generally, the guidance for Failure Analysis of paragraph c is not required in its entirety for Category B, non-IFR rated rotorcraft. The **only** failure/reliability requirement is ***that no single failure can result in a hazard to the rotorcraft.***” This can usually be accomplished by a systems safety assessment that may or may not, depending on complexity and configuration, require a numerical reliability analysis.



Example

- VFR Rotorcraft
 - Attitude System Not Required
 - Similar Misleading Failure Mode



Loss of Function $\approx 10^{-2}$



Loss of Function $\approx 10^{-4}$

Operation vs. Certification

- Operational Risk Can't be Mitigated by Increasing Certification Assurance Levels...
- In Some Cases Operational Risk Can be Reduced Through the Introduction of New Technology



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PROPOSED SOLUTIONS



Rotorcraft Safety Issues Prime for Technological Solutions

- Experienced Pilots & Simple Machines
- VFR Day Accidents to Loss of Control & Lack of Situational Awareness...



FAA-Industry Team to Address Rotorcraft Avionics Certification Streamlining

- FAA & Industry Need to Work Towards Clear & Documented Understanding of Certification Policy for Avionics Technologies
- Streamlined Path for Technology Such As:
 - ADS-B “Out”/ “In” to 2020
 - Situational Awareness Information
 - Traffic Display
 - Weather Display
 - HTAWS & Terrain Information
 - Flight Protection Systems & Autopilots
 - Flight Data Management Systems

