Reducing accident and incidents – Communication with operators and maintenance providers

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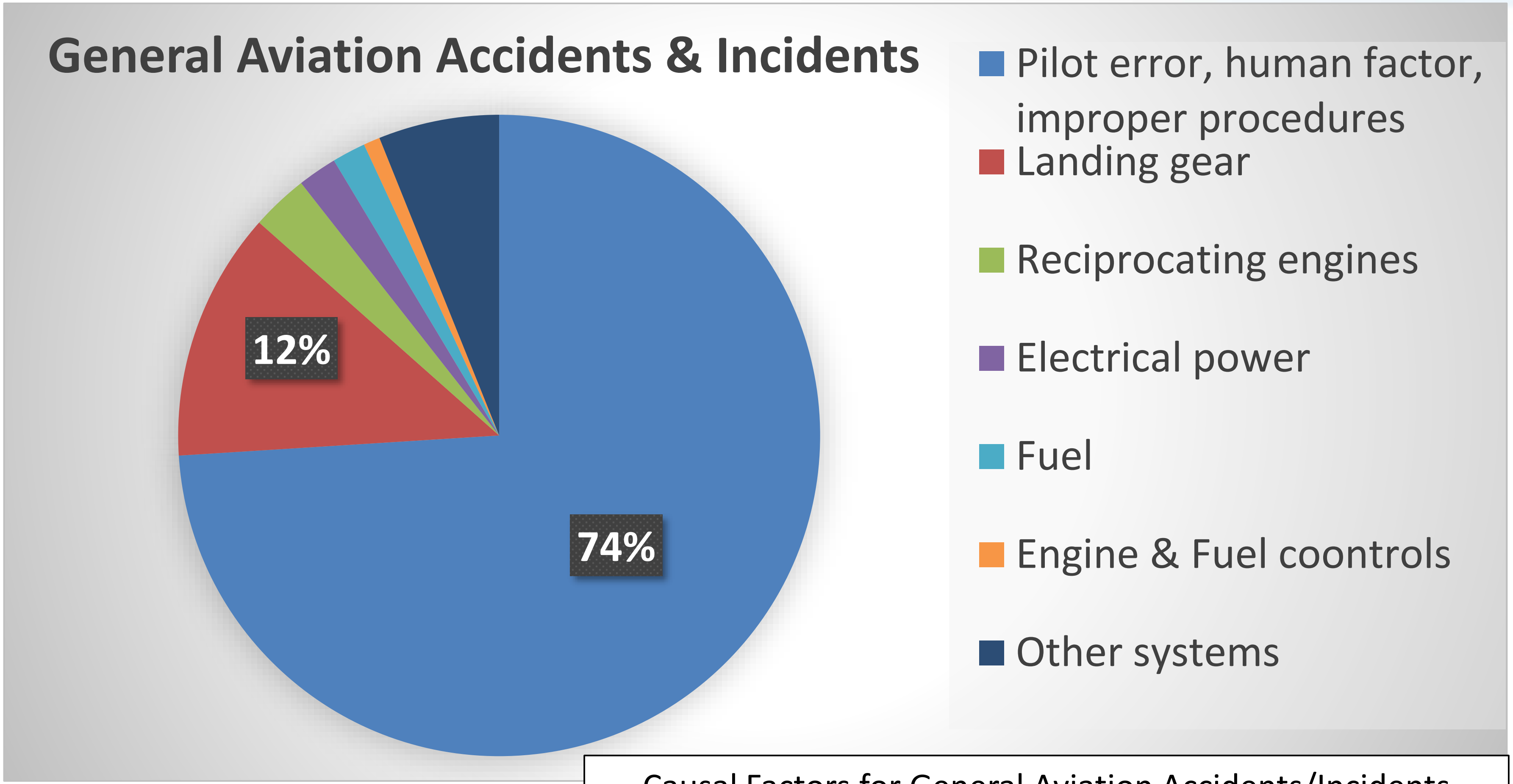
General Aviation Accidents & Incidents



Causal Factors for General Aviation Accidents/Incidents Between January 1984 and October 2004, FAA TC05-0018

Top 10 cause of general aviation accidents - USA

- 1 Loss of control in flight
- 2 Controlled flight into terrain
- 3 System component failure powerplant
  - Cylinders, mags, valves, camshaft, crankshaft, valves, pump
- 4 Low altitude operations
  - Crop dusting, EMS, fire fighting, powerline inspection
- 5 Unknown or undetermined
- 6 Instrument approach, Situation awareness
- 7 Fuel related
  - Bad gauges, poor planning, fuel management
- 8 System component failure non powerplant
  - Electrical failure, cabin fire/smoke, vacuum pump failure, carbon monoxide
- 9 Mid-air collisions
- 10 Windshear or thunderstorm

FAA presentation Sun N Fun
March 2012

Who will save us?

- As a passenger on an aircraft who do you most want to be good at their job?

No. 1 Pilots

No. 2 Maintenance Provider

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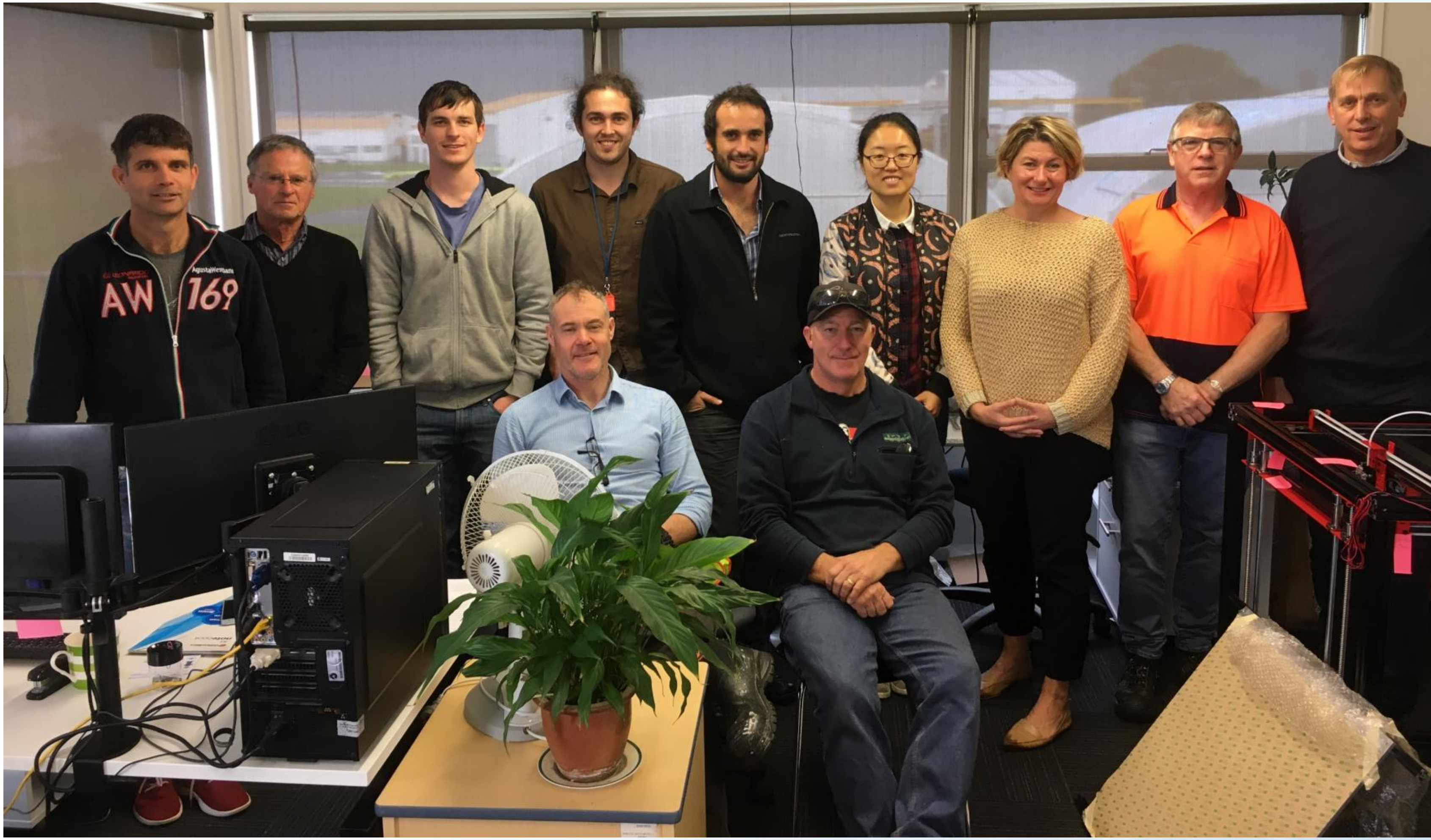
No. 3 Designers & Airworthiness Engineers



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Question

- But what can airworthiness engineers and designers do that will be most effective in reducing the number of accidents and incidents in the future bearing in mind that it appears, based on evidence provided, that pilot’s decision making and maintenance provider’s diligence will make the most difference?

Hypothesis No. 1

- For (FSL) designers and airworthiness engineers:
  - **Improving** communication with operators and maintenance providers is an effective means to reduce accidents and incidents

Question

- Are all incidents bad?
- Which comes first?
  - Fix, or
  - (avoid) Blame

Incident example

CAA CIVIL AVIATION AUTHORITY OF NEW ZEALAND

Incident Review

- Eurocopter AS 350 B3, En-route: While in the cruise a slight unusual shudder was felt, immediately the left rear passenger advised the external cargo pod had departed the aircraft. CAA safety investigation in progress. (17/153)

4. The installation instructions are in the format of an engineering drawing, implying that it is suitable for assessing conformity installation and may not be appropriate for pilot-installers to use as a set of installation and removal instructions.

5. Failure to install the locking pin, or loss of the locking pin in flight, may have been the final cause leading to the event. Investigation into a design change to include a second locking pin may be required to prevent a single point failure of the ski pod installation.

Investigation

- Review of design data
  - No single point failure in design
    - Installation drawing shows two locking pins installed at front and rear attachment
    - AFM supplement states check security of lock pins
  - AFM states that installation is only by personnel authorised by maintenance organisation
- Communication with the operator

AFM Supplement

4.0 NORMAL PROCEDURES

4.1 Installation and Removal of Cargo pod
The cargo pod may only be installed and removed by those personnel authorised by the rotorcraft's maintenance organisation.

4.2 Pre-Flight Inspections
Add the following checklist to daily pre-flight inspections.

a) Ski Pod	Inspect for de-lamination or other damage Check security of fasteners and locking pins
b) Rotorcraft Hardpoints	Inspect attachment structure for cracks Inspect locking pin attachment holes for elongation
c) Ski Pod Contents	Check contents evenly distributed Check security of latches

5.0 PERFORMANCE
The basic climb performance of the rotorcraft is reduced by approximately 200 ft/min (sea level, ISA conditions) when

Communication with the operator

- Operator had conducted internal investigation
- Had been common practice for the front locking pin not to be fitted
- Operator going to update procedures

Lesson Learned

- Communication with the operator reduces likelihood of a recurrence of a similar incident
- In future:
  - Presentation in AFM supplements
    - More pictures, more bold type

Incident No. 2 - From TAIC Report

- While spraying gorse near Waikaia on 23 January 2015, the pilot of a Robinson R44 helicopter felt an unusual and significant vibration. He landed immediately and discovered a large crack in the lower skin of one of the main rotor blades.

  The crack's origin contained features characteristic of metal fatigue. The crack had started in a radius in the blade trailing edge, known as the 'chord length transition'. Flight testing by the manufacturer found that the stress in this area was higher than had been thought.

TAIC Report AO-2015-003

Incident No. 2 – From TAIC Report

- As a result of this incident, the manufacturer developed a modification for main rotor blades in service, and made design changes to new main rotor blades for R44 (and R66) helicopters.

  The helicopter had been operated primarily for agricultural flying, usually at or over the maximum power settings. The use of a 'flick turn' while operating the helicopter close to the maximum all up weight very likely subjected the main rotor blades to additional high stresses not envisaged by the manufacturer.

  The helicopter was not designed specifically for agricultural flying. The manufacturer had therefore not been required to consider the increased loads and cycles of agricultural flying when calculating the service life of the rotor blades.

TAIC Report AO-2015-003

Incident No. 2 – From TAIC Report

Had the aircraft design organisation assessed the loads and cycles that the modified helicopter would be subjected to in the agricultural role, and been able to compare these with the original data from the manufacturer, the increased stresses would likely have been identified.

However, Robinson submitted that manufacturers would be reluctant to release proprietary data like that to other parties, primarily for legal considerations.

In any event, in this case Robinson calculated that the increased stresses did not warrant a reduction in the main rotor blade life.

TAIC Report AO-2015-003

Incident No. 2 TAIC Report

- The Commission recommended that the Director of Civil Aviation:
  - consult the original equipment manufacturer when considering a modification or supplemental type certificate, which, if approved, could result in any aircraft being used in a way that is significantly different from that which the manufacturer originally modelled and used as the basis for determining component fatigue lives and the aircraft maintenance programme.

TAIC Report AO-2015-003

Communication with the Operator

- The manufacturer and national airworthiness authorities had issued a number of safety notices, gazette articles and Airworthiness Bulletins to highlight the dangers of overloading and overstressing helicopter dynamic components, particularly during agricultural flying.

- In December 2001, Robinson issued Safety Notice SN-37 – Exceeding Approved Limitations Can Be Fatal. A copy of this safety notice is included in the aircraft flight manual carried in each helicopter.

- In May 2006, the Civil Aviation Safety Authority of Australia issued Airworthiness Bulletin AWB 02-015 Helicopter – Effects of Fatigue on Life Limited Components.

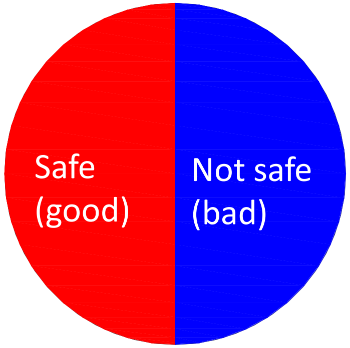
TAIC Report AO-2015-003

Lesson Learned

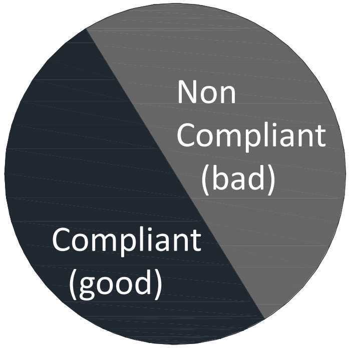
- AG operators and OEM need to communicate
- Equipment designers should communicate with Ag operators and maintenance providers and OEM
- In future:
  - Emphasise operating limitations in AFM supplement
  - Contact OEM

Hypothesis No. 2

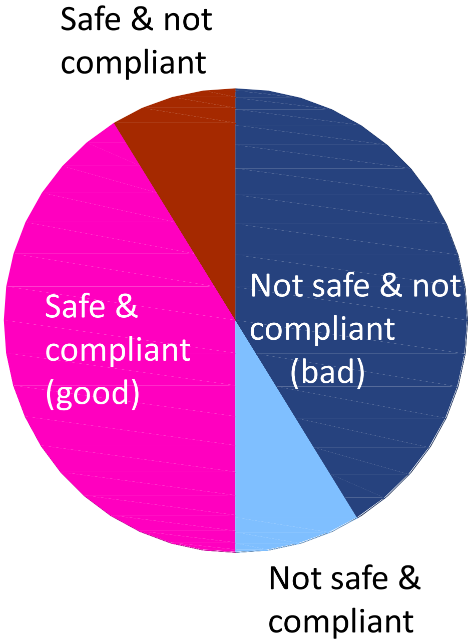
– Safety is not (quite) the same as compliance



Safety World



Compliance World



Certified Aircraft
Operating World

Question

- Which comes first?
  - Safety, or
  - Compliance

NOn-Required Safety Enhancing Equipment (NORSEE)

- **What is NORSEE?**
  - Applies to equipment not required by airworthiness rules (parts 27/29) or operational rules (e.g. parts 91, 135)
  - Subset of Non-Required Equipment that can be shown to improve overall safety in rotorcraft
    - Considers the *risk* side of the safety equation (as with any system)
    - Also considers the overall *safety benefits* of that system

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Blunt Force Trauma (BFT)

- **Compared 2014 data to similar 2003 study**
  - 5-years of data for each study
  - Same injury categories were used -
    - Bony Injuries
    - Organ/Visceral Injuries
    - Many subcategories of each

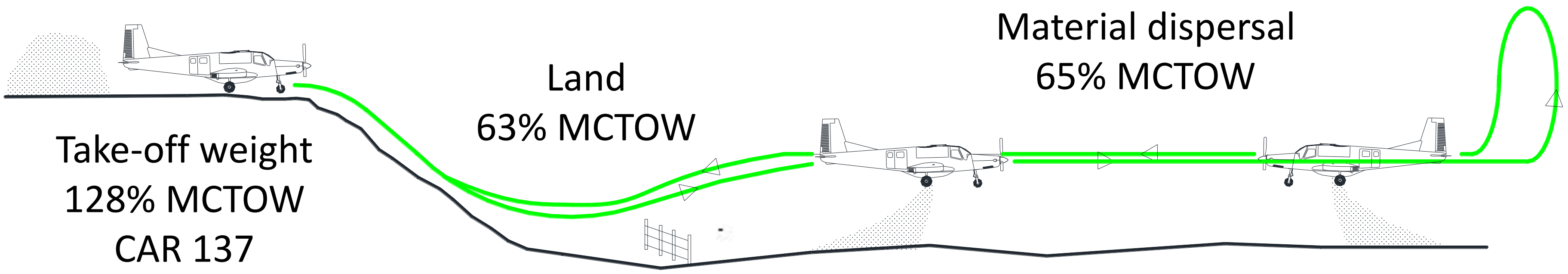
- **10 years after the 2003 study, no statistically significant difference for most documented bony injuries and organ/visceral injuries in fatal U.S. rotorcraft accidents.**

- **No meaningful progress in occupant protection**

- **50% skull injuries, 65% brain injuries. WEAR A HELMET!!**

Example – Ag 750XL

Ag Flying – Fixed Wing

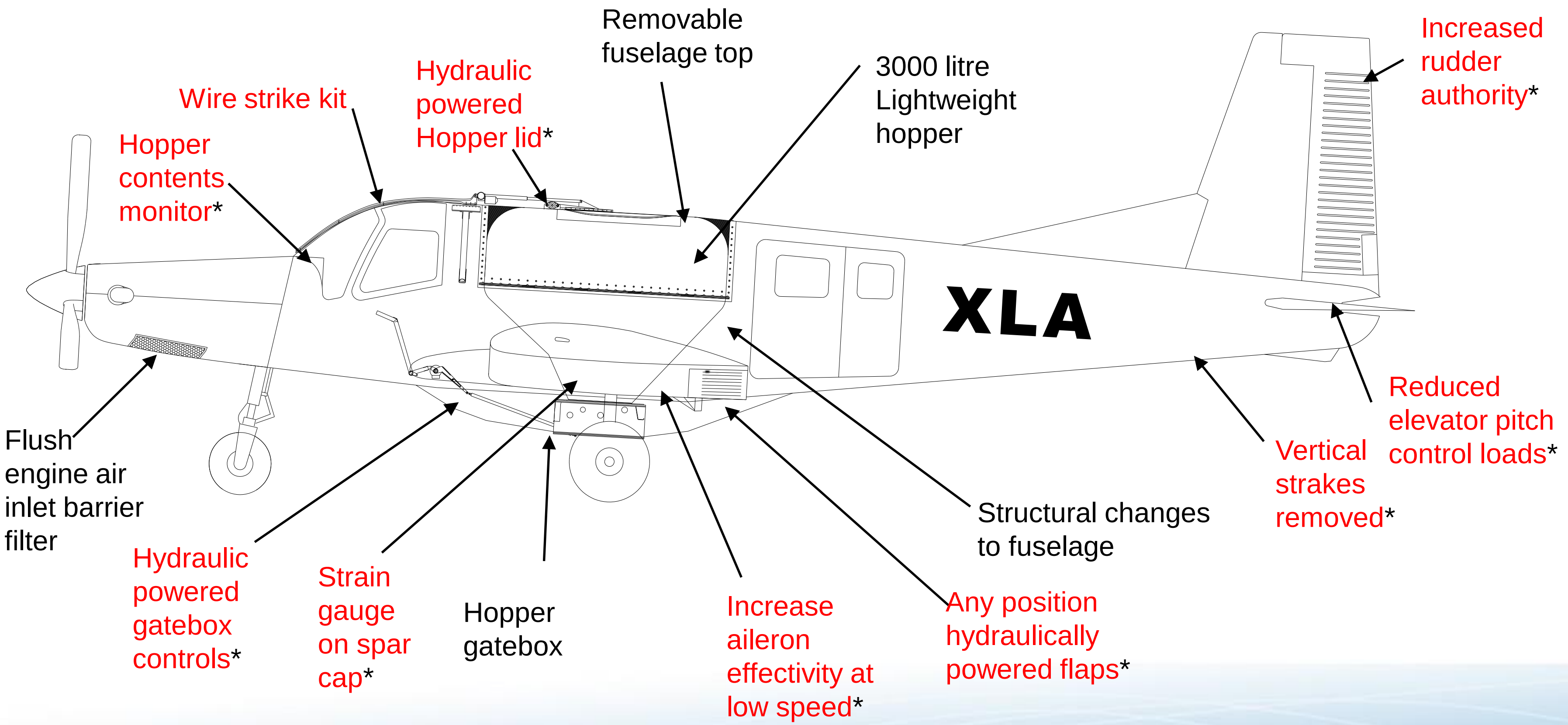


12 flights per hour

Example NoRSEES (Non Required Safety Enhancing Equipment & Systems)

- Ag operator and FSL combined to develop the AG design
- Modifications to:
  - Reduce pilot fatigue
  - Improve cross wind landing performance
  - Improve low speed roll control
  - Reduce take-off roll
  - Improve hopper contents monitoring
  - Monitor structural fatigue
- Operator suggested 8 of the 10 safety related modifications

FA 750XL Ag Conversion



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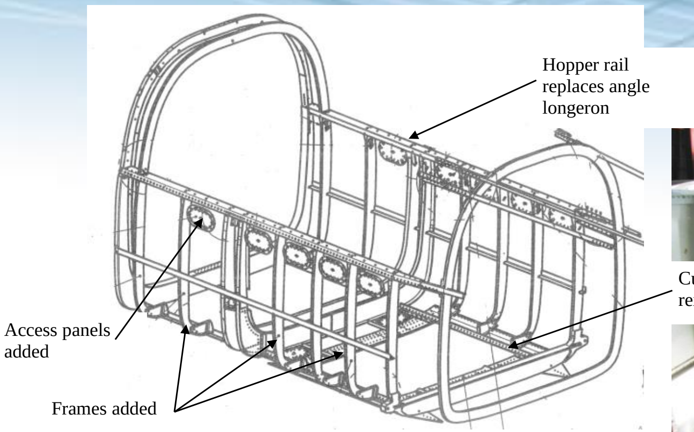
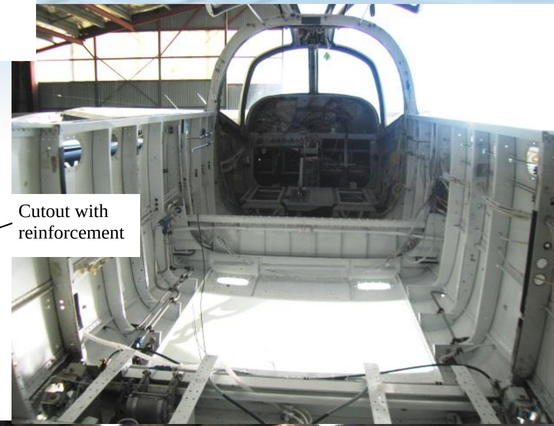

Hopper rail
replaces angle
longeron
Cutout with
reinforcement
Access panels
added
Frames added




ZK-XLA

Flight Manual

- Formal communication between designer and operator is the Aircraft Flight Manual and Flight Manual Supplements
  - Limitations
  - Emergency and Normal Procedures
  - Weight and Balance information
  - Performance information

Hypothesis 3

- Quality and method of presentation of information is significant for effective communication with operators

AG 750 XL Take-off Performance Data

- **Not prescribed by CAR 137**
- Account for:
  - Aircraft weight
  - Airstrip altitude
  - Airstrip slope
  - Outside air temperature
  - Wind speed and direction
- Use with ground load monitoring system

Power	Takeoff power set before brake release	1. Normal takeoff technique 2. Decrease distance 7% for each 5 kts headwind 3. Up to 10 kts of tailwind increase distances by 12% for each 2.5 kts Sloping runways. 4. Decrease distances by 4% per 1% down slope and increase distances by 6% per 1% of up slope
Flaps	20°	
Propeller	91.2% Np (2,006 RPM)	
Surface	Dry Grass	
Temperature expressed as deviation from ISA		

Take Off Weight	Take Off Speed		Press. Altitude	ISA - 10℃		ISA		ISA + 10℃		ISA +20℃	
	Knots IAS			Ground Roll	Total to Clear 50ft	Ground Roll	Total to Clear 50ft	Ground Roll	Total to Clear 50ft	Ground Roll	Total to Clear 50ft
(lbs)	Rotate Speed	Speed at 50ft	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
9488	69	82	SL	1788	2801	1903	2939	2080	3224	2223	3489
			2000	1979	3056	2118	3266	2282	3524	2535	4038
8500	65	78	SL	1355	2205	1440	2325	1570	2525	1672	2742
			2000	1495	2414	1596	2575	1715	2772	1896	3168
7500	61	76	SL	1032	1737	1095	1841	1160	1949	1267	2170
			2000	1136	1911	1210	2034	1296	2185	1428	2492
6500	57	76	SL	756	1354	803	1434	850	1514	926	1675
			2000	832	1485	886	1578	1043	1691	1043	1907

Provide an App

Hopper Load Calculator

Input fields coloured			
A/C Reg No.	ZK-XLA		
Max Hopper Load	2200	(kg)	(refer AFM Ag supplement Section 2)
A/C Ag Operating Weight	4305	(kg)	(refer AFM Ag supplement Section 2)
Aircraft empty weight	1650	(kg)	(refer aircraft Wt & Bal sheet with AFM)
Crew weight	75	(kg)	Includes pilot & crew
Fuel	450	(litres)	
Baggage weight	5	(kg)	
Airfield Altitude	0	(ft)	(pressure altitude)
OAT	15	(°C)	
Ground roll distance	500	(m)	(Usable airfield length for ground roll)
Distance to 50ft AGL	850	(m)	(Third party risk in takeoff area)
Airfield slope	0	(%)	(+ve is down slope during takeoff)
Wind	5	(kts)	(+ve is head wind during takeoff)
Max hopper load	**2034**	(kg)	

Aircraft weight limited by conditions

Maintenance Procedures

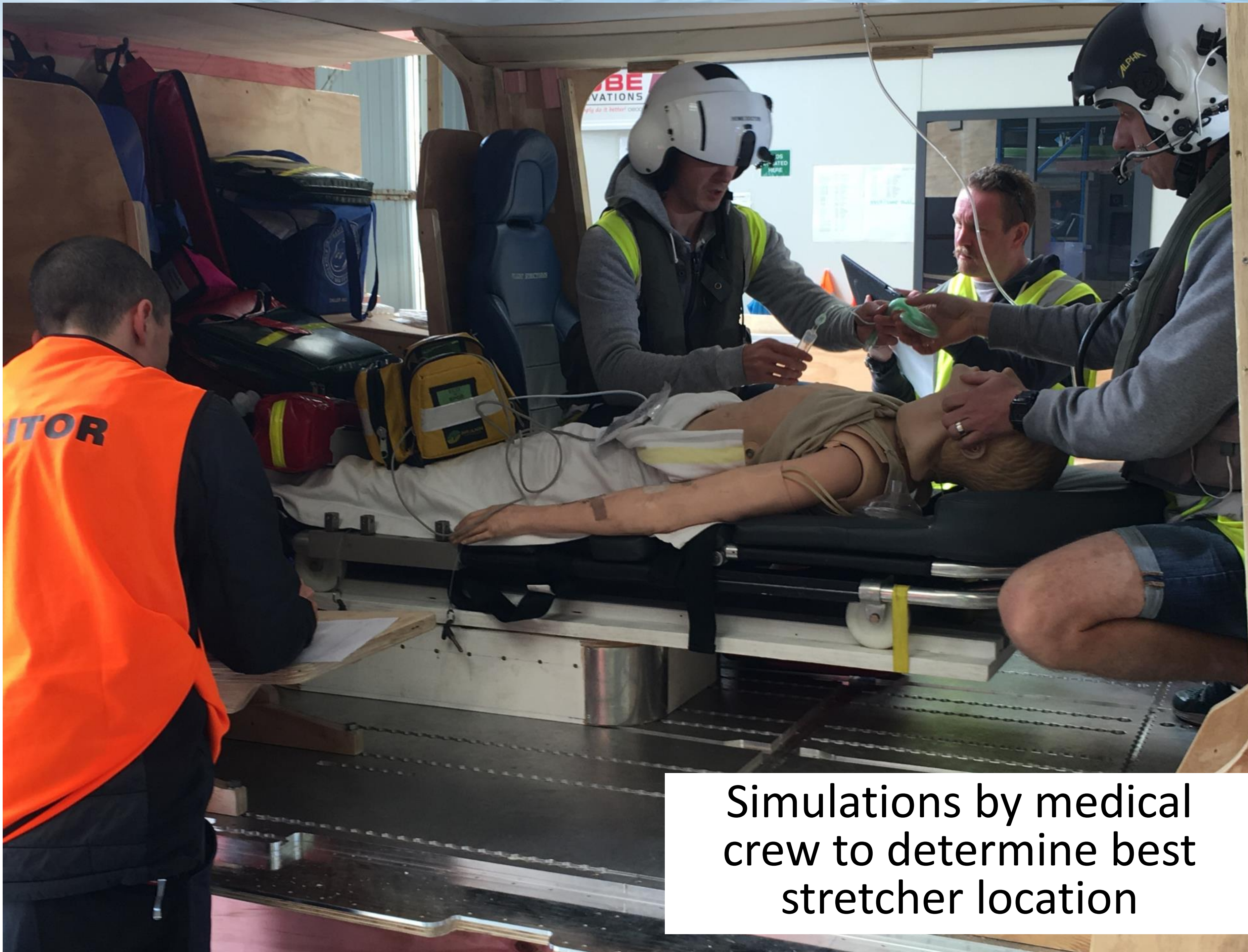
- Developed by aircraft maintenance controller
- Based on the OEM's maintenance manual for restricted category operation with amendments based on service experience with Cresco aircraft
- Reformatted to a zonal inspection system for practical application

Lesson Learned

- Many very good (actually the most and best) suggestions to improve aircraft safety come from operators and maintenance providers

NORSEES Example - Emergency Medical Services (EMS)

- Main cabin fitout
- Operator input is massive
  - Flight crew
    - Aircraft safety
    - You can never have too much fuel
  - Medical crew
    - Patient safety
    - You can never have too much medical oxygen



Simulations by medical crew to determine best stretcher location

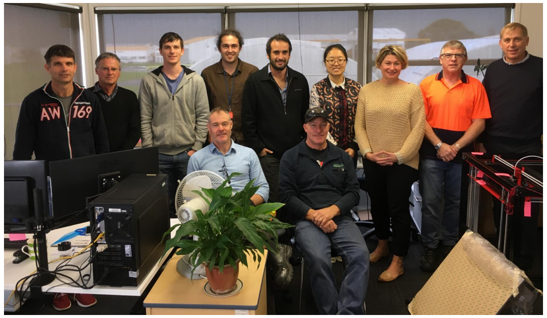
Operators: Safer to winch onto stretcher base than onto floor

Lesson Learned

- Medical crew and flight crew provide valuable input for EMS design

Take Away





- Communicate with operators and maintenance providers
- Present AFM and AMM supplements so they are easy to understand and emphasise important information
- Operators have a plethora of good ideas for safety enhancing modifications.