RW Mishaps in DVE- Latest Statistics

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Disclaimer

The words and figures come from open sources including the recent publication and slide presentation by William Greer and Joshua Schwartz of the IDA - Institute for Defense Analyses (United States) entitled:


In addition some of the Rotary Wing Mishap data come from a presentation by Pete Mapes entitled **DoD Helicopter Mishaps FY85-05: Findings and Recommendations** (2012)

And from the NATO RTO Task Group HFM-162 Technical Report entitled **Rotary-Wing Brownout Mitigation: Technologies and Training** (Jan 2012)
“Like all novices we began with the helicopter but soon saw it had no future and dropped it. The helicopter does, with great labor only, what the balloon does without labor, and is no more fitted than the balloon for rapid horizontal flight. If its engine stops it must fall with deathly violence, for it can neither float like a balloon, nor glide like an airplane. The helicopter is much easier to design than the airplane, but it is worthless when done.”
Brownout (BO) Mishap Overview

- Near ground, downwash from rotor causes dust or sand to circulate, causing a degraded visual environment (DVE)*
- Helicopter flight crew can experience spatial disorientation and loss of situational awareness from DVE
- DVE from BO can lead to helicopter mishaps during landing, takeoff, or hover near ground
- BO widely perceived as notable mishap cause at study start

Brownout (BO) Mishap Overview
Historical BO mishap perspective: All-service rotorcraft with BO
- US Army 2002-2016
- US Navy and USMC 2000-2016

- 39 DVE mishaps
- 6 DVE mishaps
- 3 DVE mishaps

- 2 DVE mishaps
- 76 DVE mishaps
- 5 DVE mishaps
- 1 DVE mishap
- 2 DVE mishaps
- 3 DVE mishaps

Typically 1 out of 4 Class A RW Mishaps are attributed to DVE
- The USAF attributed no deaths due to DVE mishaps but 5 injuries 2005-16
- The US Army reports 46% of the RW total fatalities occurred in DVE 2002-16
- The US Navy reports 11 Class A RW DVE mishaps with 2 fatalities and 3 injuries 2000-16
### Classes indicate level of seriousness of mishap; Class-A is focus here

<table>
<thead>
<tr>
<th>Mishap Class</th>
<th>Total Property Damage Cost</th>
<th>or</th>
<th>Fatality/Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong></td>
<td>&gt;$2,000,000 and/or aircraft destroyed</td>
<td></td>
<td>Fatality or permanent total disability</td>
</tr>
<tr>
<td><strong>B</strong></td>
<td>$500,000 - $2,000,000</td>
<td>or</td>
<td>Permanent partial disability or 3 or more persons hospitalized as inpatients</td>
</tr>
<tr>
<td><strong>C</strong></td>
<td>$50,000 - $500,000</td>
<td>or</td>
<td>Nonfatal injury resulting in loss of time from work beyond day/shift when injury occurred</td>
</tr>
<tr>
<td><strong>D</strong></td>
<td>$20,000 - $50,000</td>
<td></td>
<td>Recordable injury or illness not otherwise classified as Class-A, B, or C</td>
</tr>
</tbody>
</table>

Source: DoD Instruction 6055.07, 6 June 2011

Note: Addition of Class D Mishap and $2M value for Class-A Mishap (previously $1M) is a relatively recent change (since 2009)
Class-A BO Summary: All Services By Year

Overwhelming majority of Class-A BO (destroyed and other) occurred in OIF/OEF (with notable spike in 2003) vice ROW
Vast majority of BO Class-A (destroyed and other) mishaps occurred in OIF/OEF vice ROW, with Army aircraft (particularly the H-60 and H-47) the primary ones.

American Helicopter Society International Forum 71, 5-7 May 2015
Class-A BO Summary: All Services By Environment

- **Total Combined**:  
  - Takeoff  
  - Landing  
  - Day  
  - Night

- **OIF/OEF**:  
  - Takeoff  
  - Landing  
  - Day  
  - Night

- **ROW**:  
  - Takeoff  
  - Landing  
  - Day  
  - Night

**Destroyed Aircraft (Loss)**

- **Total Combined**:  
  - Takeoff  
  - Landing  
  - Day  
  - Night

- **OIF/OEF**:  
  - Takeoff  
  - Landing  
  - Day  
  - Night

- **ROW**:  
  - Takeoff  
  - Landing  
  - Day  
  - Night

**Other Class-A**

- **Total Combined**:  
  - Takeoff  
  - Landing  
  - Day  
  - Night

- **OIF/OEF**:  
  - Takeoff  
  - Landing  
  - Day  
  - Night

- **ROW**:  
  - Takeoff  
  - Landing  
  - Day  
  - Night

**Most BO Class-A mishaps occurred during landing phase and at night**

**No Class-A BO mishaps occurred during hover or low speed mission phases**

*American Helicopter Society International Forum 71, 5-7 May 2015*
Class-A BO Summary: BO % of All Mishap Causes

- Destroyed Aircraft
- Other Class-A
- Total Class-A

Data for All Services

Notable fraction of OIF/OEF Class-A mishaps due to BO
Very small fraction of ROW Class-A mishaps due to BO

American Helicopter Society International Forum 71, 5-7 May 2015
Class-A BO Summary: Army (Only) Mishap Rates

BO rates in OIF/OEF rates generally much higher than ROW; H-47 rates notably higher than other aircraft in OIF/OEF
Size of the Active Inventory by Service FY 85 – 05

- USA (5,891)
- DON (1,109)
- USAF (202)
The US Air Force reports 6 Class A mishaps since 2005 with no fatalities and 5 injuries. 5 of the 6 mishaps were in the HH-60G PAVE LOW
USAF Findings

- Class C USAF mishaps do not foretell Class A or B
- H-60 use in CSAR produces a high fatality rate not seen on the use of the H-60 by other services
- The H-53 & H-60 experience high mortality and morbidity compared to other services and the H-1
- Cruise CFIT was the most lethal and injurious phase of flight
- The wire strike and the midair were 100% lethal
- All brownouts and all but one IMC mishap occurred at night
- IMC imposed 20 to 30 times the risk of a mishap
- Mishaps are likely with low time aircraft commanders
Army Findings

- Cruise flight (CFIT) is the most lethal and injurious
- Twin rotor aircraft & attack helicopters appear to be the most survivable
- The training pilots receive to deal with NHF mishaps improves protection factor by roughly 20%
- Cargo compartment crew are more likely to receive major injuries and die than pilots
- IMC is associated with the highest risk of mishap fatality
- Unforecast adverse weather accounts for 1/6 of NHF mishaps, engine failure is the leading NHF mishap cause
- Whiteout/brownout was the most common risk factor in mishaps below ETL
- Tail rotor strikes were common in AH & OH helicopters
US Army Class A RW mishaps

US Army:

• DVE accidents were 24.9% (103) of the 414 Class A/B flight accidents within the analysis timeframe (FY 02–27 Jan 2017)
• Fatalities: 129 (118 Military, 1 DAC & 10 Non-DoD) This represents 46.2% of the total fatalities (279)
• Total cost: $978 Million
• AH-64: 11.2% of Class A/B associated with DVE. There were 37 AH-64 fatalities with 6 (16.2%) in DVE mishaps
• OH-58D: 12.8% of Class A/B associated with DVE. There were 35 OH-58D fatalities with 2 (5.7%) in DVE mishaps
• H-60: 32.7% of Class A/B associated with DVE. There were 143 H-60 fatalities with 76 (57.3%) in DVE mishaps
• H-47: 47.4% of Class A/B associated with DVE. There were 64 H-47 fatalities with 39 (60.9%) in DVE mishaps
US Army mishaps continued

Dust/Brownout -61.1% (63 of 103)
• Low illum/low contrast/low visibility -20.4% (21 of 103)
• IIMC -14.6% (15 of 103)
• Whiteout -3.9% (4 of 103)
• 56.3% (58 of 103) occur during approach/landing
• 26.2% (27 of 103) occur during maneuvering/cruise flt
• 13.6% (14 of 103) occur on takeoff/departure
• 3.9% (4 of 103) other – hover, air taxi
• Fatalities: 118 Military, 1 Civilian (DAC IP) & 10 Non-DoD
• DVE mishaps account for 46.2% of aviation fatalities
## Comparison of USA HF Class A & B Mishaps by Threats & Type

<table>
<thead>
<tr>
<th>MDS</th>
<th>CFIT</th>
<th>MIDAIR</th>
<th>B/O</th>
<th>TR</th>
<th>Night (Associated)</th>
<th>Cause Lost Lives</th>
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</tbody>
</table>
Navy mishaps summary

The US Navy reported 38 personnel have been injured in brownout/whiteout mishaps in their helicopter operations since 1985. The Navy reports 2 fatalities and 3 injuries due to mishaps in whiteout/brownout. CH-46 below
DoN Findings

- The risk of fatality in cruise is 2.43 times greater than in flight below effective translational lift given an accident.
- DoN has cut mishap fatalities and injuries in half since the period from FY 85 to 94.
- Mandatory cranial use yields lower head fatality/injury ratio (2.8:1) compared to the Army (4.97:1).
- Pilots are more likely to be uninjured than cargo compartment occupants.
- Twin rotor design & IP on TH-57 increased HF survivability.
- DoN has greater likelihood of over water mishap yet water fatalities have been dramatically reduced.
United Kingdom (UK) experienced 24 brownout mishaps involving material damage in the 5-year period 2005 – 2009 of which, 70% were assessed as being due to Spatial Disorientation (SD) and/or mishandling and 30% were attributed to an unseen Landing Site (LS) hazard. The UK reports RW mishaps in DVE have decreased over the recent past (Curry, Bushby 2016).

Since 1973, Bundeswehr (German Defense Forces) has recorded a significant number of mishaps (>30) in association with dust or snow.

RWB contributed to a Canadian Forces (CF) Griffon (CH146) crash in Afghanistan in 2009, during take-off, which resulted in three fatalities and three injuries. Between 1986 and 2006, there were 2 whiteout related accidents and 54 incidents in the CF.

Norway cites 13 whiteout/brownout mishaps since 1982.

France has experienced eight brownout mishaps over the past 15 years, most occurring in Africa.

In Sweden, whiteout a contributing factor in at least one fatal/one minor mishap.

The Netherlands reports a CH-47 Chinook D did not notice left drift during an approach in Afghanistan. The aircraft rolled over on the ground, caught fire and was destroyed.
Lifesaving and crashworthiness recommendations (Mapes, 2007; Wright, 2012-13)

- NATO helicopters need Helicopter Terrain Avoidance and Warning Systems (HTAWS). Commercial off the shelf (COTS) hardware is available. It is estimated an HTAWS system would prevent 54% of the fatal H-60 mishaps in the US DoD services alone.
- Bring data-link weather data into all helicopter cockpits.
- Provide COTS traffic warning technology to prevent mid-airs.
- All helicopters need wire detection technology. Wire cutters should be installed on all helicopters.
- Develop extensive simulator training for Human Factor Mishap Scenarios.
- Occupants of mishap helicopters above Effective Translational Lift (ETL) cannot be adequately protected, the only protection is mishap prevention through increased situational awareness.
The Way Ahead - Recommendations

Lifesaving and crashworthiness recommendations (Mapes, 2007; Wright 2012-13)

- Injuries and deaths in low speed mishaps can be mitigated:
  - All occupants should use the 5-point lap and shoulder restraints
  - Airbag installation should be encouraged
  - Stroking seats should be standard for all occupants
  - Head protection use should be required of all occupants
  - Continue to improve rear compartment seating
  - Crew positions should be designed to eliminate (minimize) the need for any crewmember to be out of a crashworthy seat below ETL
  - Maximize use and acquisition of twin rotor multiengine designs
  - Move pilots out in front of forward rotor head
  - Prevent occupancy beneath heavy components
Aircraft Saving Recommendations (Mapes, 2007)

All helicopters need technology permitting safe flight and the maintenance of situational awareness (SA) in DVE including brownout /whiteout conditions, particularly at night:

- Automated hover with instant availability
- Automated landing systems
- Sensor based systems
- Intuitive hover and landing graphics on cockpit displays (including tactile cues)
- Effective simulator training as well as in-flight training

- All helicopters without rearward visibility (AH & OH) should be equipped with technology to prevent tail rotor strikes:
  -- Warning systems that notify the pilot when an object is in the proximity of the tail rotor.
  -- Automated systems permitting hover over a fixed position without drift.
Future US DoD Rotorcraft

Farnborough Airshow 2016
Bell Helicopter talks about the Bell V-280 Valor programme
Questions ?