US Navy Helicopter Mishap Findings & Recommendations

Birthplace, Home and Future of Aerospace Medicine

U.S. AIR FORCE

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Statement of Accountability

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- **This brief represents the position of the researchers. It does not represent the position of any other organization including the United States Air Force or the Department of Defense**
- **This study is the fourth part of a study of all U.S. DoD rotary wing mishaps**

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Background

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- 393 US Navy and USMC Class A and B mishaps from safety center database, divided into 2 deciles
- Fiscal year 1985-1994 (10 years) compared to FY 1995-2005 (11 years)
- Categorized by researcher, based on mishap review, as human factors (HF) or non-HF mishap
  - HF mishaps involve errors made by aircrew only, not ATC, maintenance or supervisors
- Airframe types combined (UH1 = UH1J + UH1N)
- Excel & Epi Info™ used for analysis

Overview

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- Force & Mishap Characterization
- Overview By Type of Platform
- Mishap Rates by Type and Decile
- Fatality Rates Embarked and Ashore
- The Risk at Night
- The Risk By Phase of Flight, Mishap Cause & Brownout
- Human Factors & Velocity
- Conclusions & Recommendations

Force & Mishap Characterization

Average Annual Inventory Size FY 85 – 05

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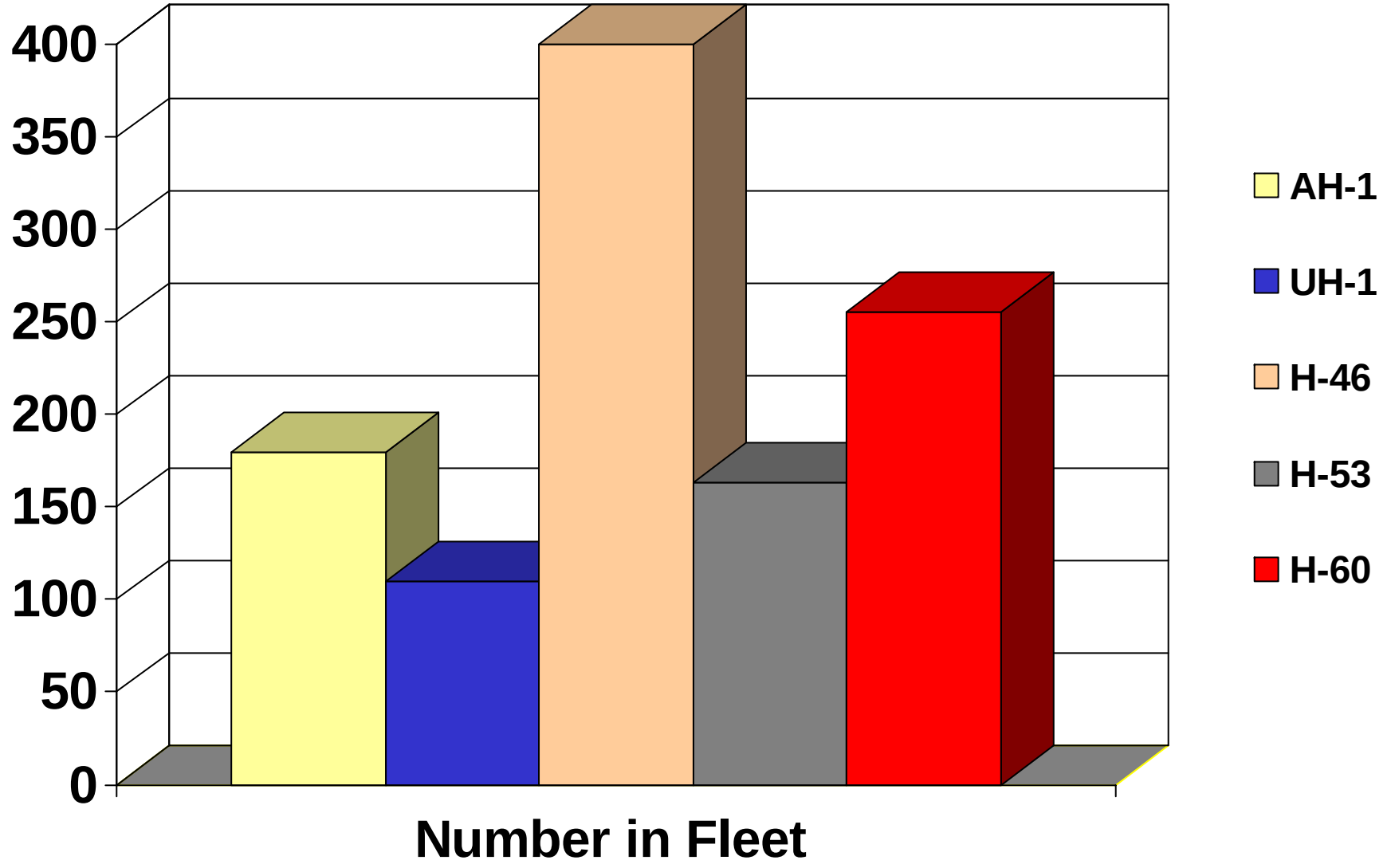
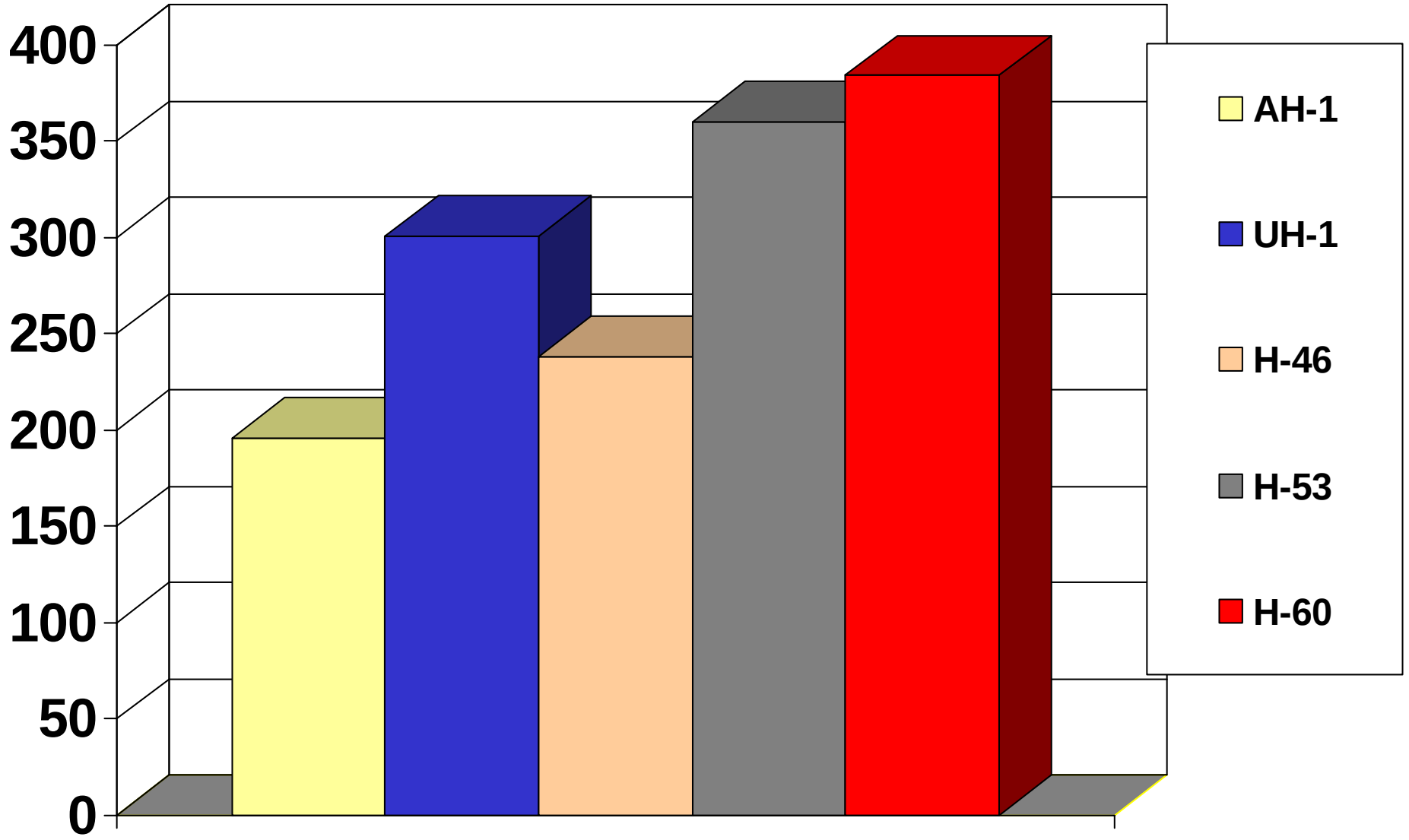


Utilization Rates, Hours per Aircraft-Year, FY 85 – 05



% of Inventory, FY 85 – 05, Involved in Class A or B HF Mishaps

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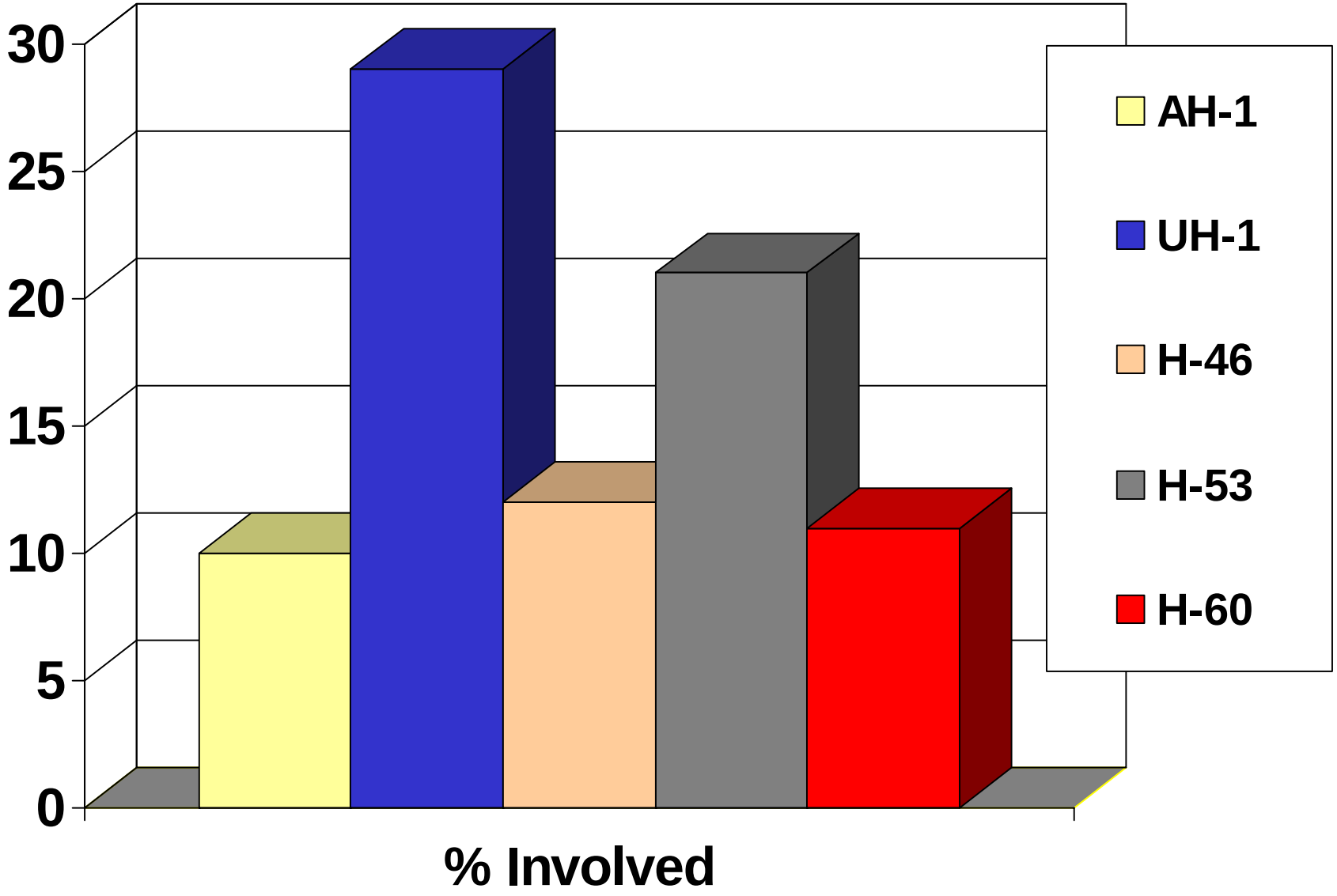

% of Inventory, FY 85 – 05, Involved in Class A or B NHF Mishaps

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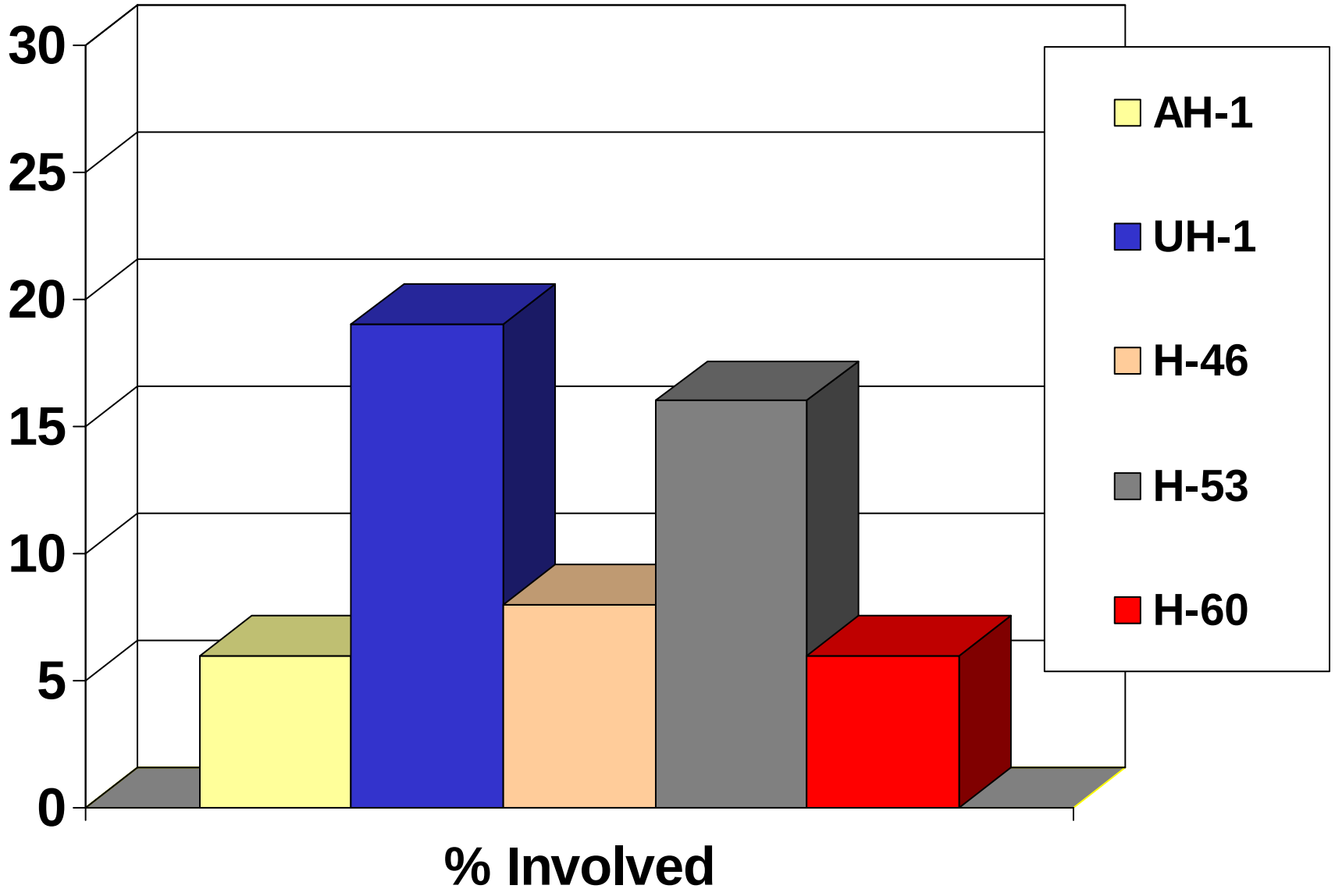

Overview by Type of Platform

AH-1, Cobra

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- Models AH-1J, T, W
- First flew in 1967
- Fleet size
  - 207 (1990)
  - 154 (2000)
- Class A mishaps
  - 14 (1985-1994)
  - 12 (1995-2005)
- Fatalities
  - 20 (1985-1994)
  - 10 (1995-2005)
- Injured
  - 14 (1985-1994)
  - 13 (1995-2005)

UH-1, Iroquois (Huey)

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- Models: UH-1D, E, J, K, N
- First flew in 1967
- Fleet size
  - 79 (1990)
  - 142 (2000)
- Class A mishaps
  - 25 (1985-1994)
  - 15 (1995-2005)
- Fatalities
  - 63 (1985-1994)
  - 24 (1995-2005)
- Injured
  - 54 (1985-1994)
  - 56 (1995-2005)

H-46, Sea Knight

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- Models C/HH-46A, D, E
- First flew in 1962
- Fleet size
  - 481 (1990)
  - 319 (2000)
- Class A mishaps
  - 44 (1985-1994)
  - 20 (1995-2005)
- Fatalities
  - 89 (1985-1994)
  - 53 (1995-2005)
- Injured
  - 225 (1985-1994)
  - 41 (1995-2005)

H-53, Super Stallion

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- Models: CH-53A, D, E
- First flew in 1964
- Fleet size
  - 141 (1990)
  - 185 (2000)
- Class A mishaps
  - 26 (1985-1994)
  - 15 (1995-2005)
- Fatalities
  - 99 (1985-1994)
  - 48 (1995-2005)
- Injured
  - 138 (1985-1994)
  - 43 (1995-2005)

H-60, SeaHawk

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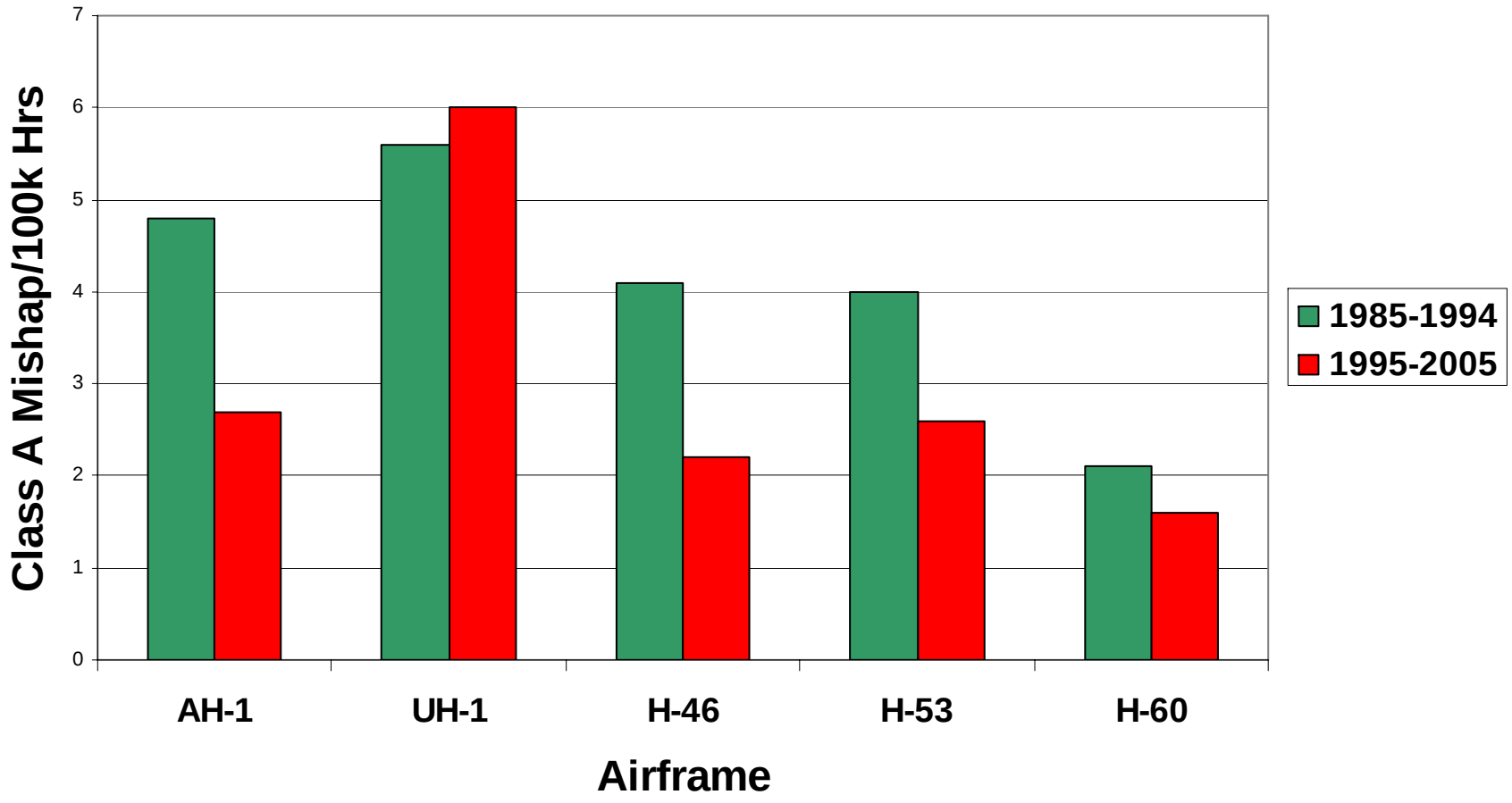
- SH-60B/F, UH-60L, VH-60N, HH-60H, others
- First flew in 1974
- Fleet size
  - 237 (1990)
  - 276 (2000)
- Class A mishaps
  - 15 (1985-1994)
  - 21 (1995-2005)
- Fatalities
  - 12 (1985-1994)
  - 24 (1995-2005)
- Injured
  - 21 (1985-1994)
  - 59 (1995-2005)

Mishap Rates by Type and Decile

U.S. Navy Helicopter Class A Mishap Rates



Class A Mishap Rate by Decile (1st Decile compared to 2nd)

	RR	95% CI	P
AH1	1.79	0.76 – 4.28	0.148
UH1	0.85	0.42 – 1.70	0.616
H-46	1.78	1.01 – 3.14	0.032*
H-53	1.51	0.77 - 3.00	0.197
H-60	1.34	0.66 - 2.71	0.385

U.S Navy Helicopter Mishap Fatality Rates

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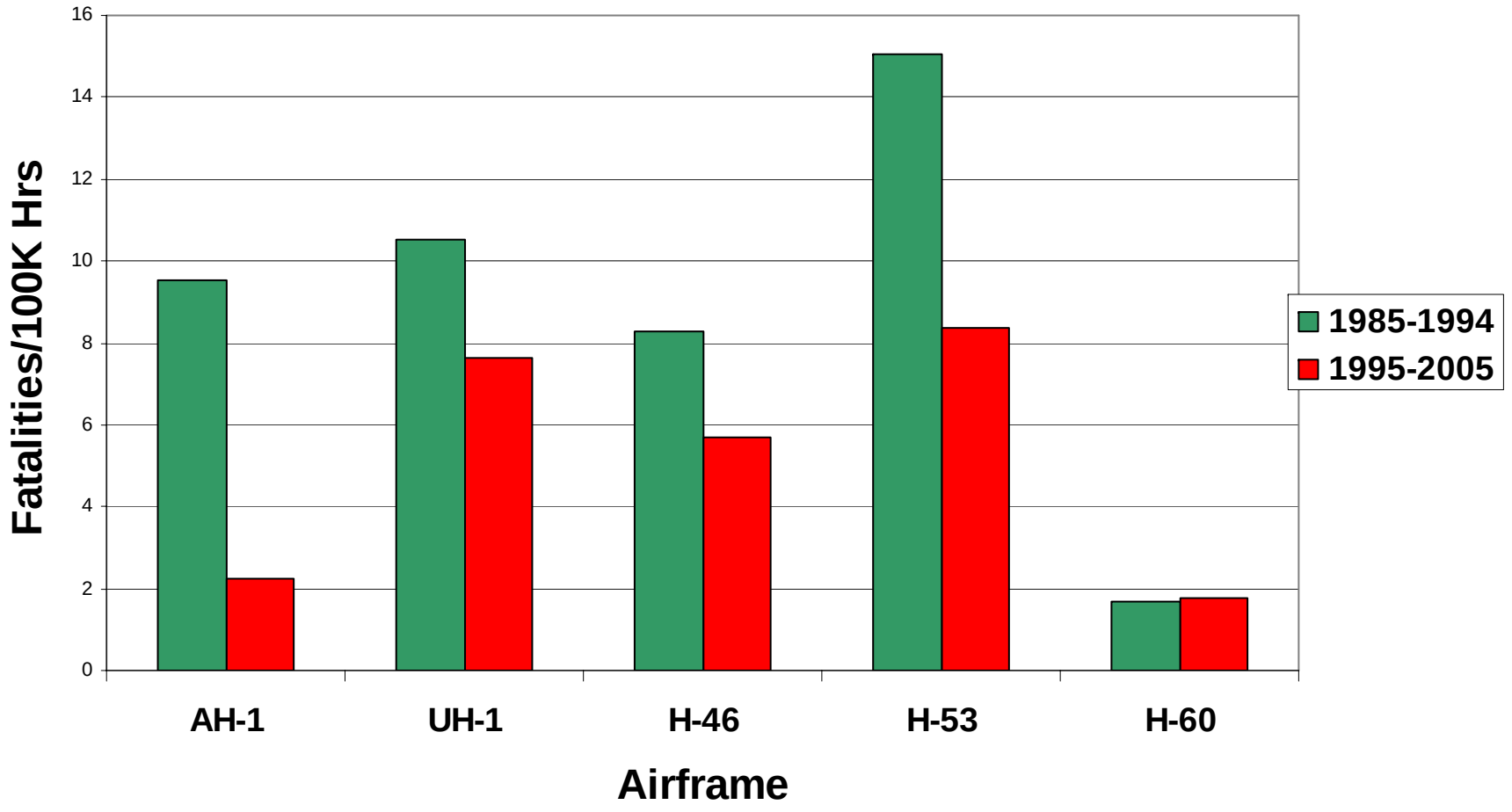

Fatality Rate by Decile (1st Decile compared to 2nd)

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	RR	95% CI	P
AH1	3.03	1.35 – 6.94	0.0026*
UH1	1.45	0.89 - 2.39	0.12
H-46	1.46	1.02 – 2.07	0.029*
H-53	1.80	1.26 - 2.58	0.00068*
H-60	0.94	0.44 - 1.96	0.86

Injury Rate by Decile (1st Decile compared to 2nd)

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	RR	95% CI	P
AH1	1.63	0.73 – 3.69	0.198
UH1	0.96	0.65 – 1.42	0.825
H-46	4.76	3.37 – 6.73	0.000*
H-53	2.80	1.97 - 4.01	0.000*
H-60	0.67	0.39 - 1.12	0.110

Fatality Rates Embarked & Ashore

Embarked

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U.S. Navy Helicopter Mishap Fatality Rate 1985 -1994

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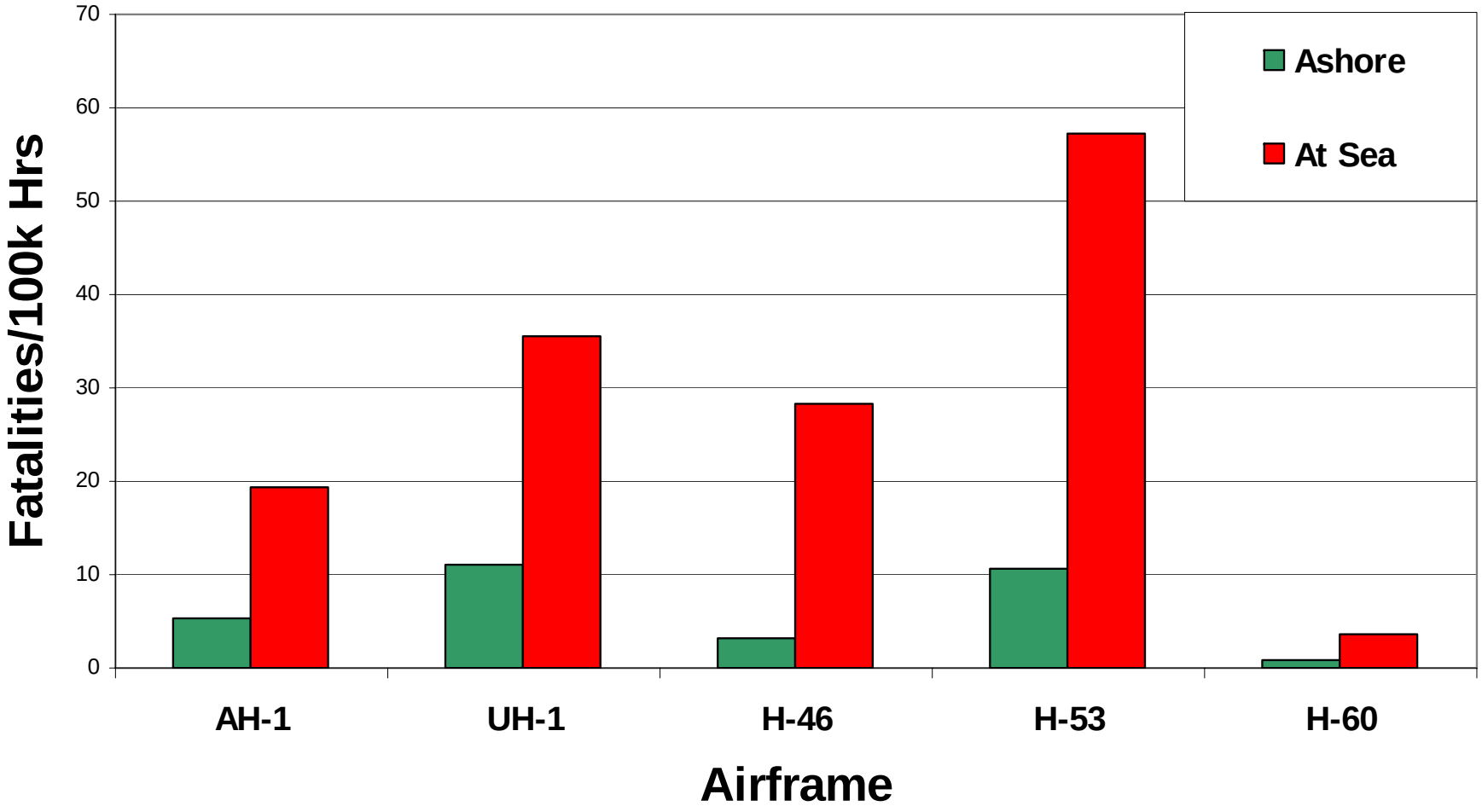

U.S. Navy Helicopter Mishap Fatality Rate 1995-2005

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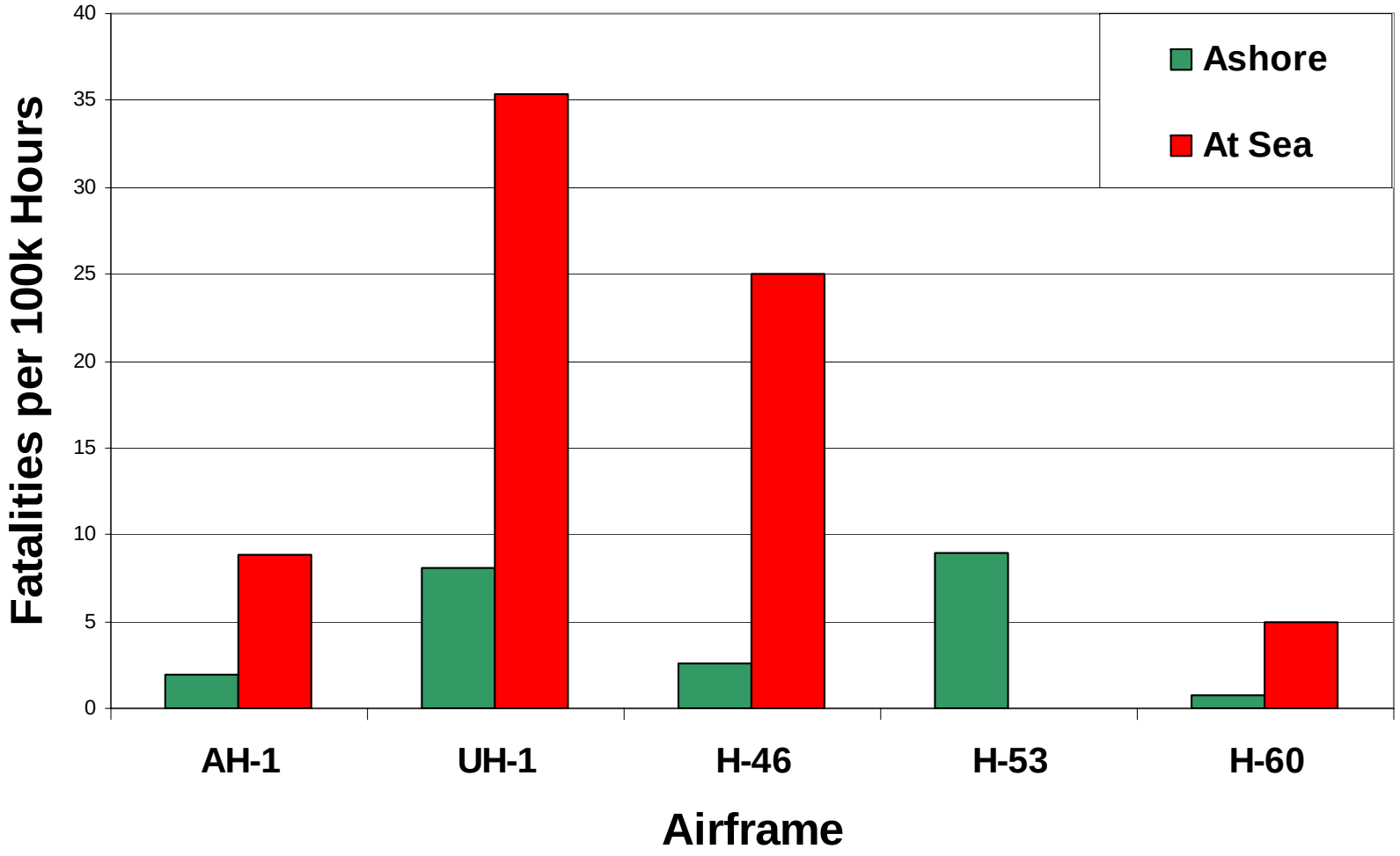


Fatality Rate, Embarked compared to Ashore

	RR	95% CI	P
AH1	4.62	1.90 – 10.90	0.00004*
UH1	3.58	2.19 – 5.81	0.0000*
H-46	9.55	6.64 – 13.75	0.0000*
H-53	3.76	2.53 - 5.55	0.0000*
H-60	5.68	2.72 - 12.03	0.0000*

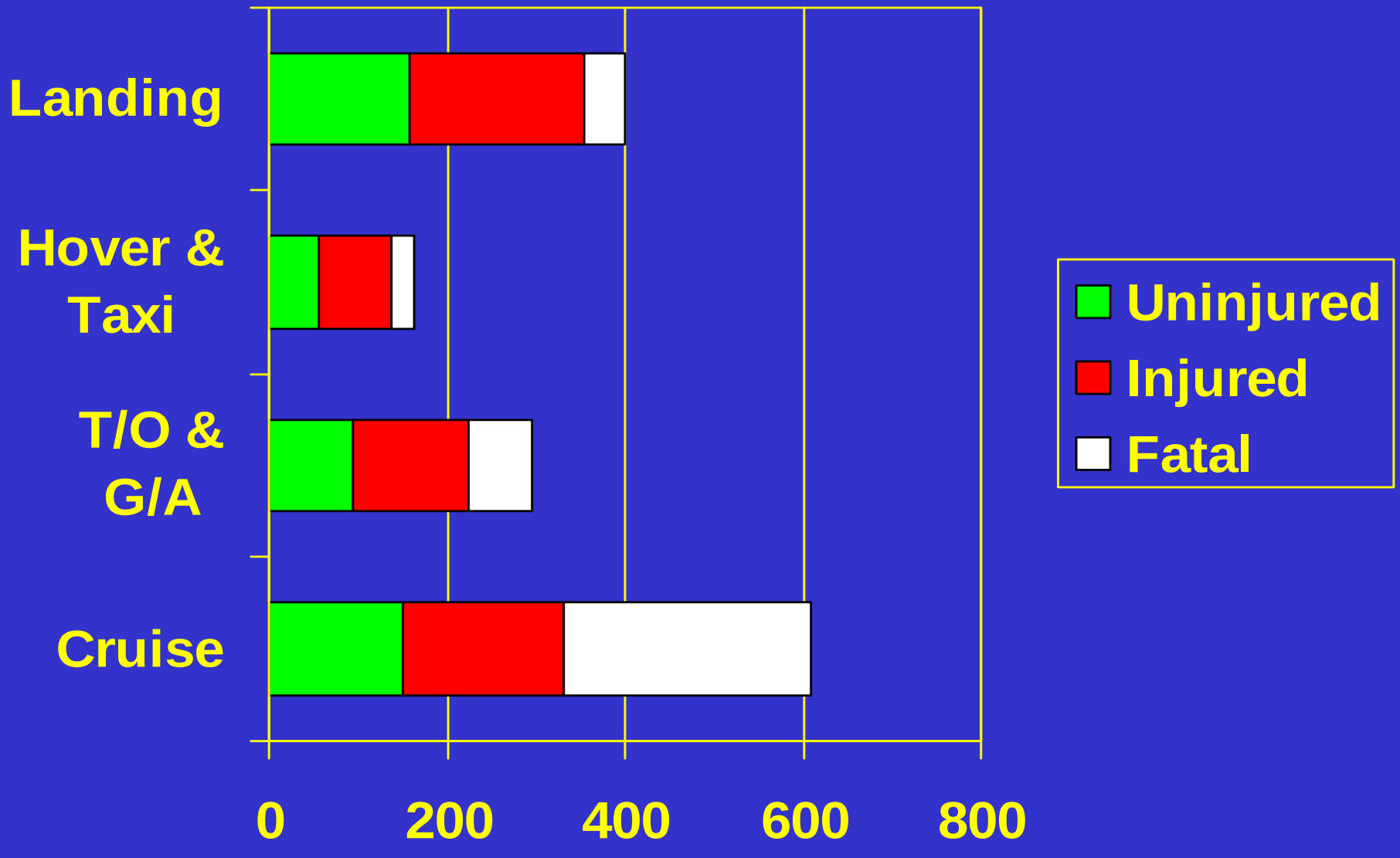
The Risk at Night

The Risk at Night

- **Mishaps were compared for additive risk of night operations and no increased risk was identified with the exception of UH-1 operations in the first decile**
  - **UH-1 first decile night operations showed 2.51 times the relative risk of day operations for a mishap 95% CI (1.1-5.71) p = .024**
  - **Second decile UH-1 night operations had no increased risk**

The Risk by Phase of Flight, Mishap Cause & Brownout

USN Helicopter Fatalities & Injuries by Phase Of Flight



Mishap Causes 1985 - 1994

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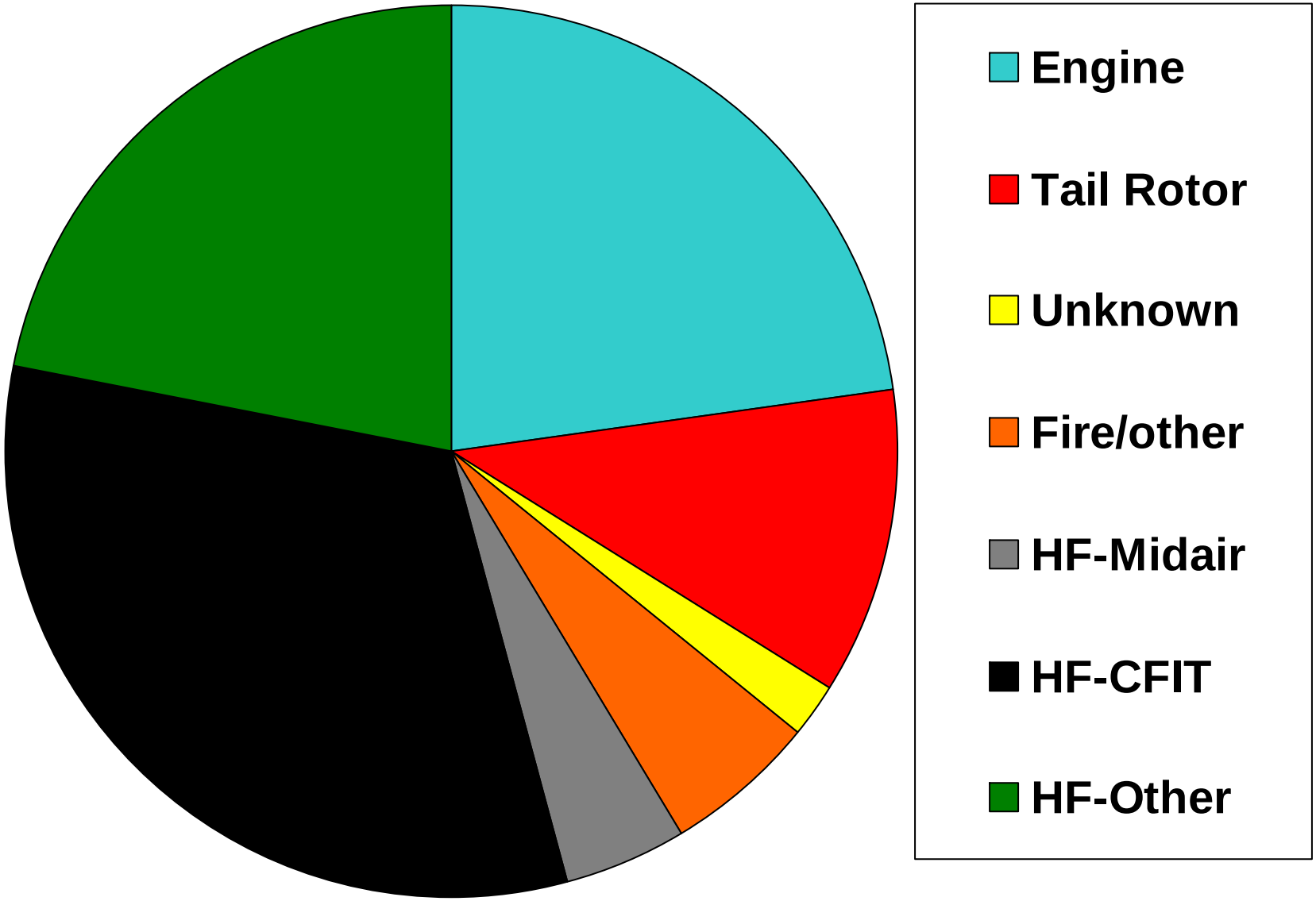
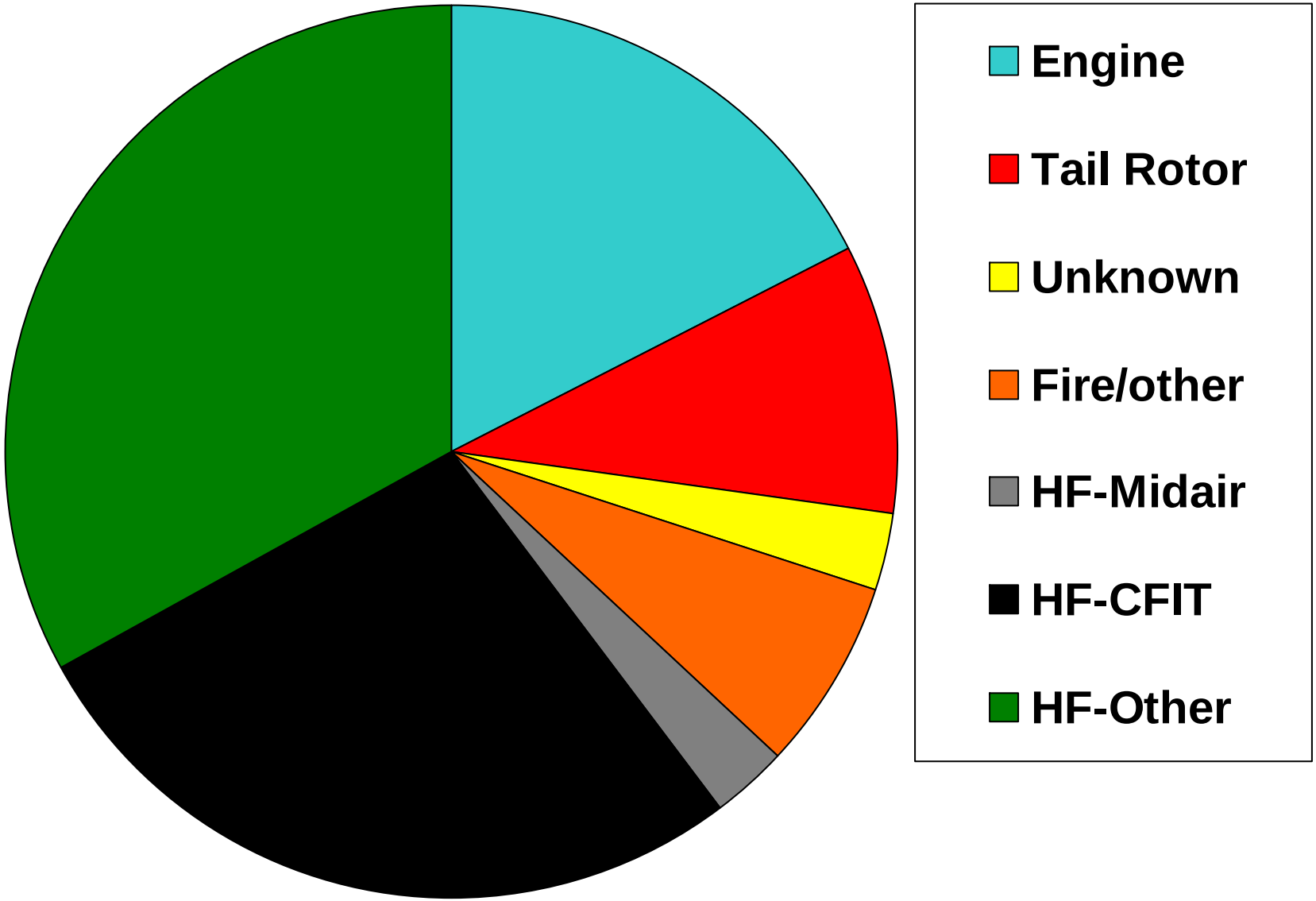


Mishap Causes 1995 - 2005



Brownout Rates (/100K Hours)

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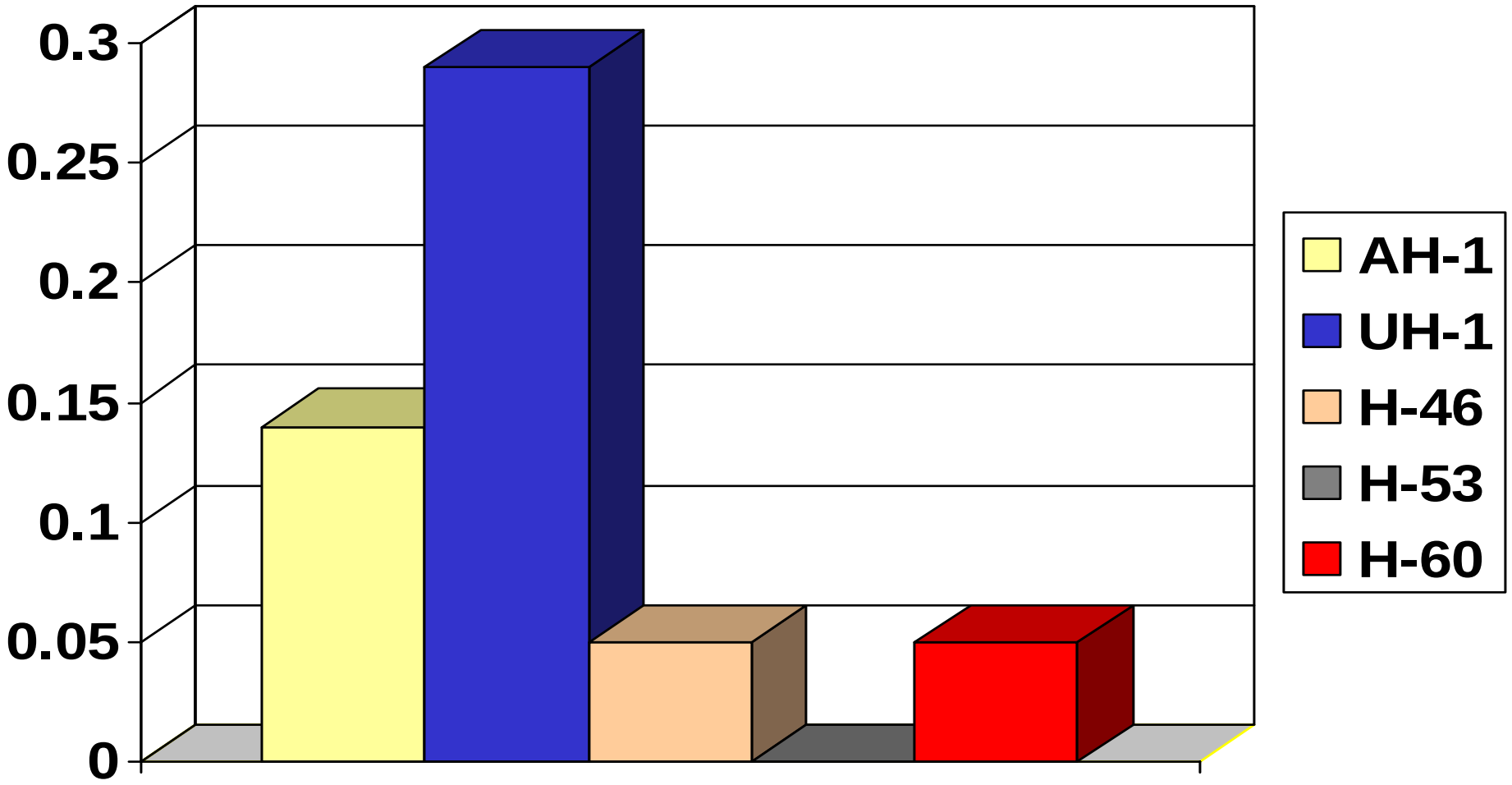
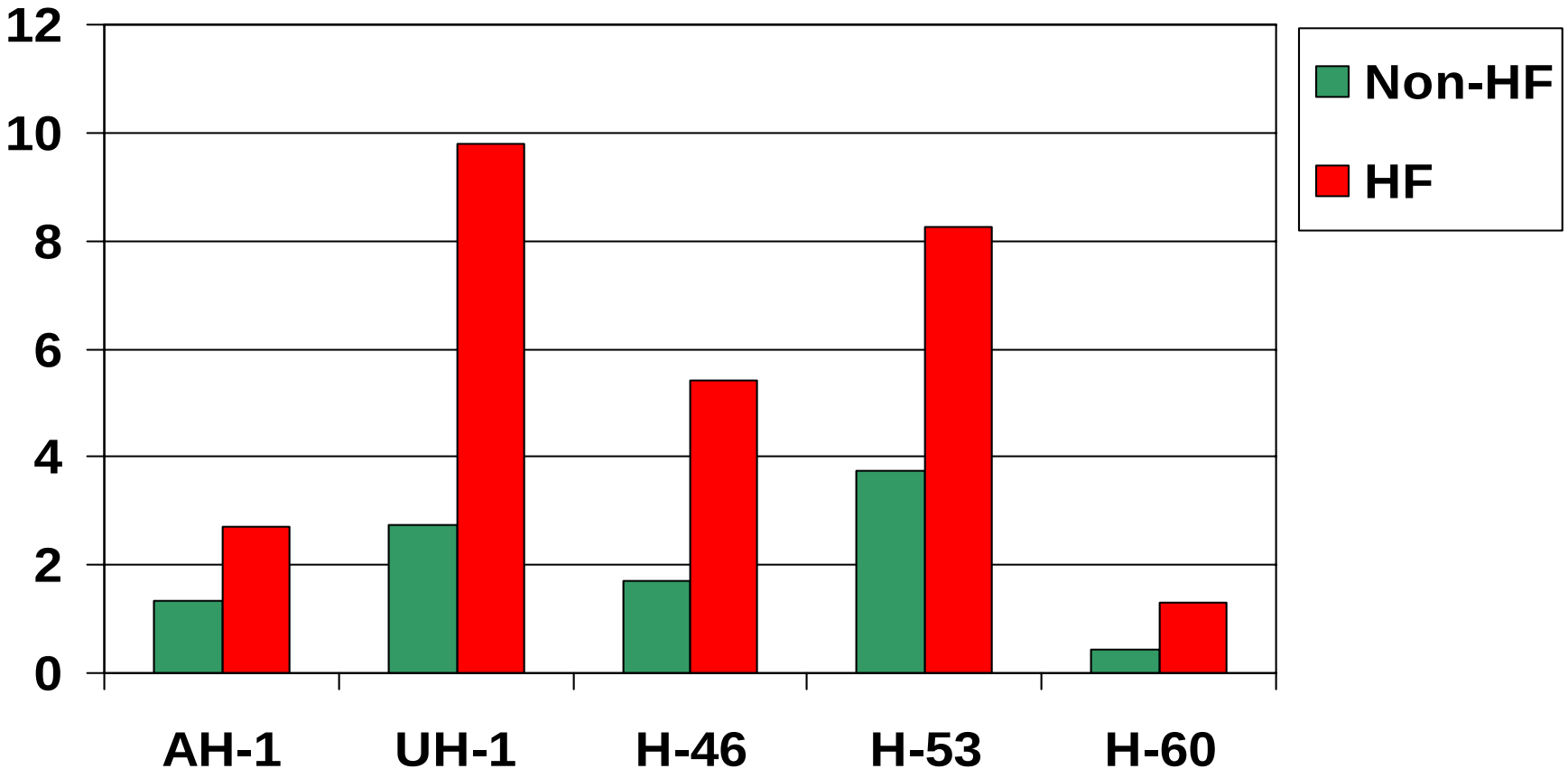


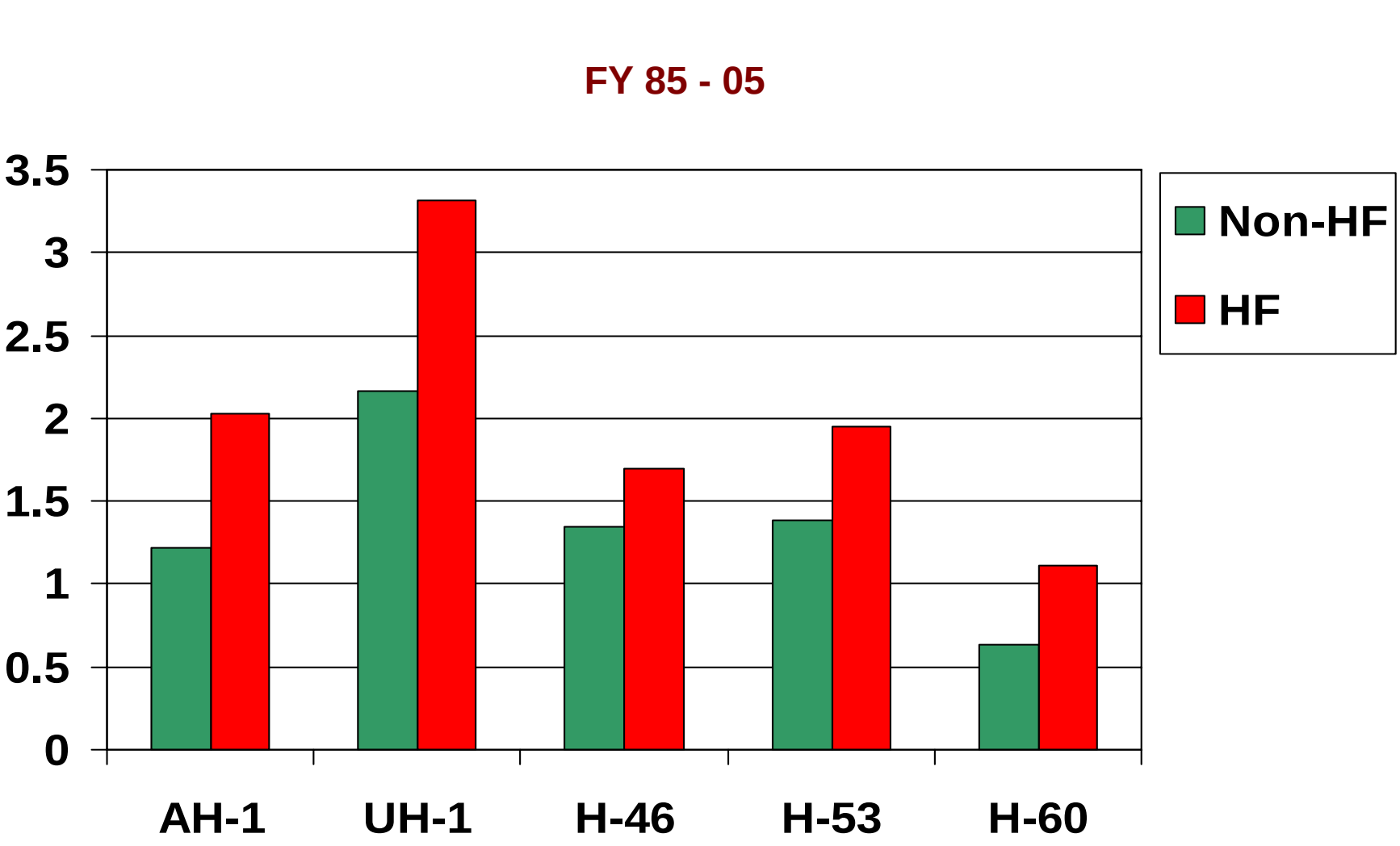
Human Factor vs. Non-Human Factor Mishaps

Fatality Rates/100K Hours
by HF and Non-HF By MDS

FY 85 - 05



Class A Mishap Rates/100K Hours by HF and Non-HF By MDS



Human Factors and Velocity

Human Factors Numerator Data

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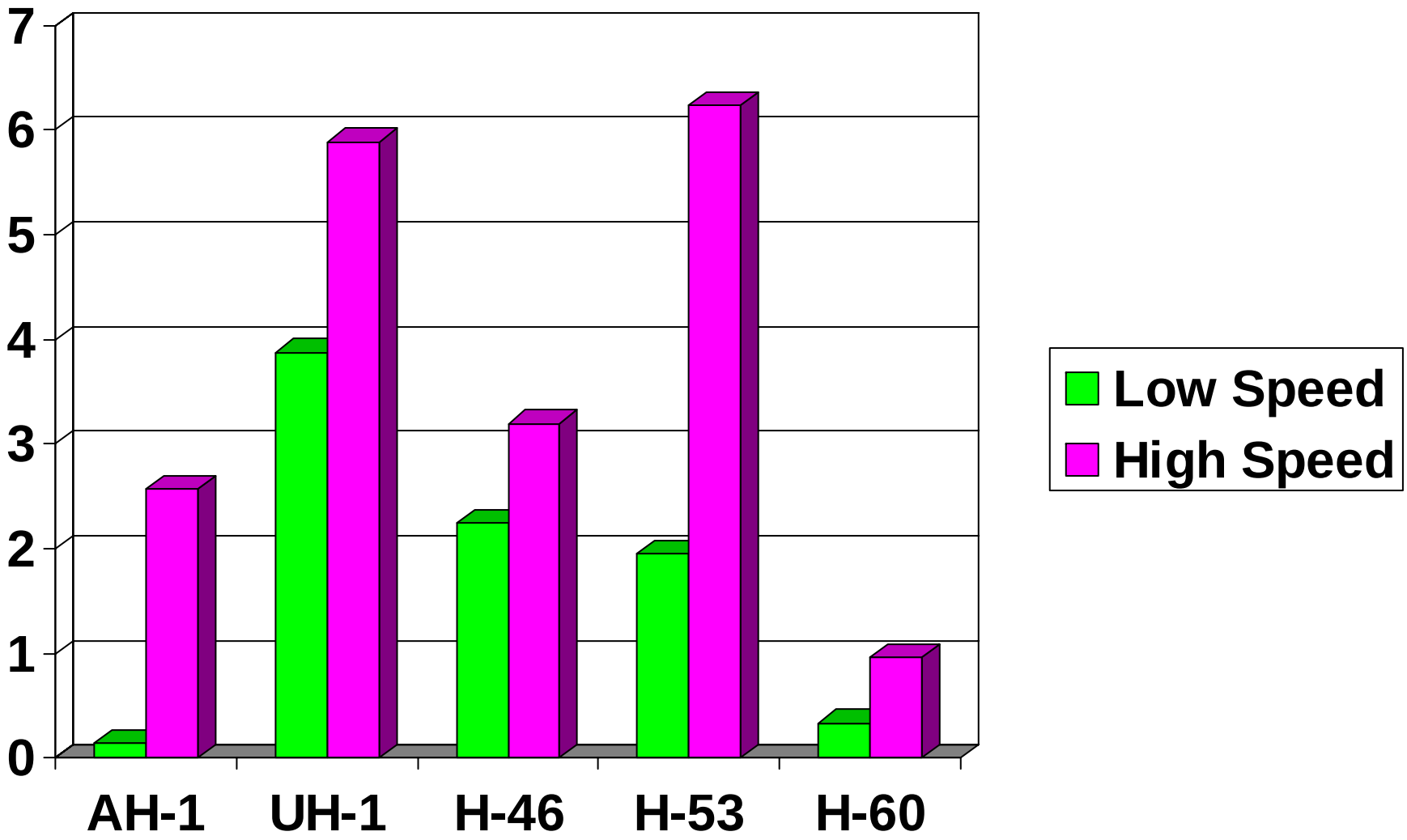
Airframe	Midair	Brownout	VMC-IMC	Spatial Disorientation	Power Line	Rotor Strike	CFIT
AH1	2 (2)	1 (0)	1 (0)	2 (0)	0 (0)	0 (0)	3 (1)
UH1	2 (0)	1 (1)	1 (0)	0 (1)	1 (1)	2 (0)	4 (3)
H-46	2 (1)	1 (0)	3 (0)	1 (1)	2 (2)	10 (1)	4 (1)
H-53	1 (0)	0 (0)	4 (1)	1 (0)	1 (0)	4 (0)	2 (1)
H-60	0 (0)	0 (1)	0 (1)	0 (1)	0 (1)	1 (2)	1 (8)
Total	7 (3)	3 (2)	9 (2)	4 (3)	4 (4)	17 (3)	14 (14)

USN Helicopter HF Mishaps
Fatality Rate/100K Hours - Low Speed vs. High Speed



USN Helicopter NHF Mishaps
Fatality Rate/100K Hours - Low Speed vs. High Speed

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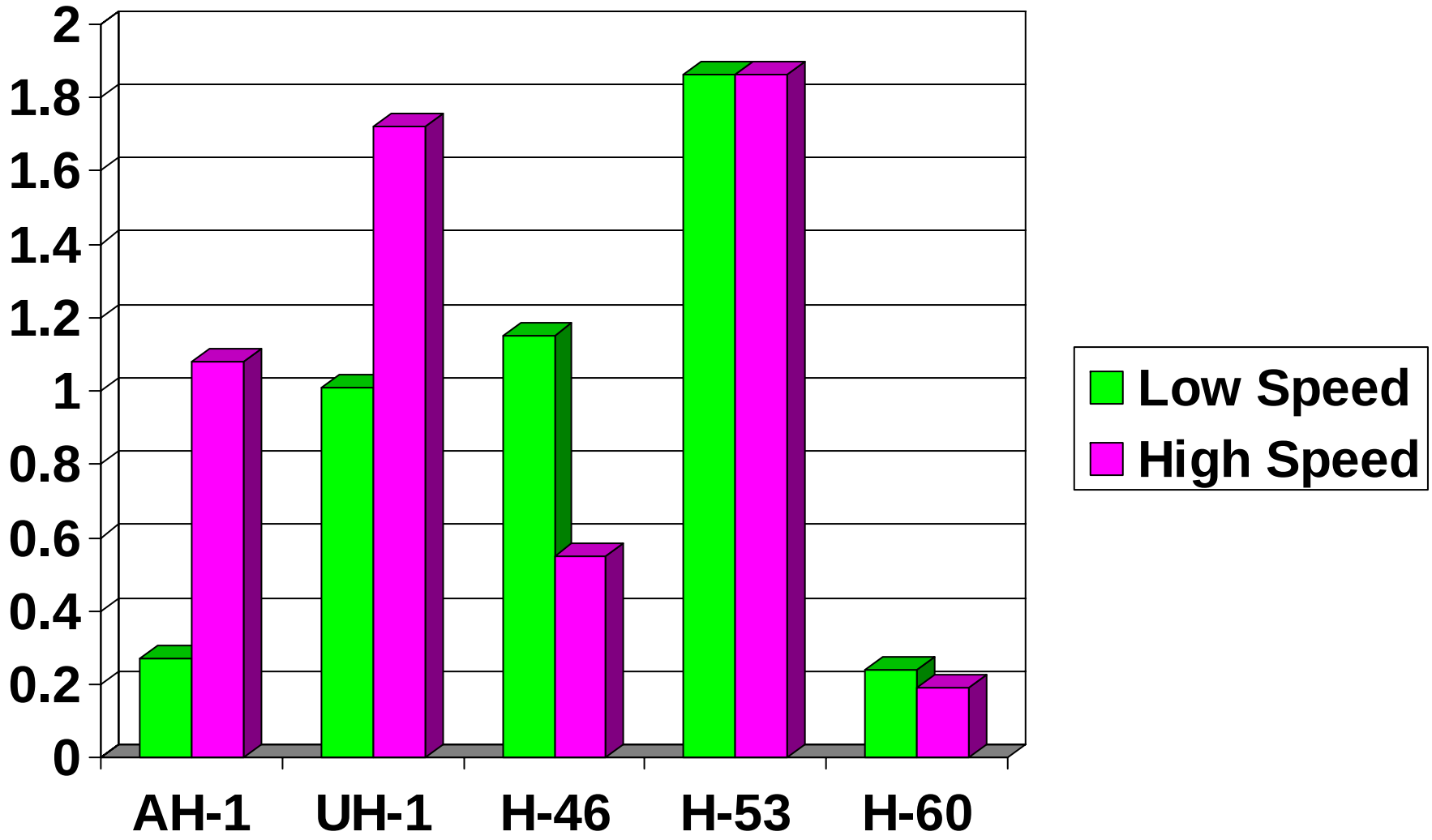

Conclusions & Recommendations

Discussion

- **Embarked operations: potential for "softer" water impact with less obstacles, but data shows statistically significant increased fatality rates than in operations ashore (Drowning)**
- **Hover and ground ops less fatal than cruise operations (matches USAF & Army Data) - Due to V^2**
- **Newer airframes look safer than older**
- **Statistically significant improvements in fatality and injury rates occurred across the AH-1, H-46 & H-53 airframes in the second decile!**
- **Only the H-46 achieved a statistically significant reduction in mishap rate in the second decile: RR 0.56 – 95%CI (.33 - .96) p = 0.0325**
- **Unlike the USAF and Army data, in the second decile, night operations impose no statistically significant increase in mishap rates compared to day operations**

Conclusions

- **Rotary Wing operations have higher mishap rates than fixed-wing operations**
- **Embarked operations have higher Class A mishap and fatality rates than shore operations**
- **The cruise phase of flight has a higher mortality than other phases of flight (V^2 Wins)**

Conclusions

- **USN database lacks data to conduct detailed analysis**
  - **Number of airframes in fleet (obtained from civil sources)**
  - **Number of night, NVG, IMC hours flown (estimated from pilot records)**
  - **Number of hours flown over land versus embarked (not recorded – could MFOQA get this data?)**
  - **Weather conditions at time/location of mishap (weather often discussed only if factor)**
- **Database not standardized with other services**
  - **HFACS may improve this situation**

Recommendations

- **Track morbidity and mortality in addition to mishap rate information**
- **Improve and standardize mishap database to capture numerator and denominator data needed for analysis**
- **Establish a DoD center for analysis to standardize data collection throughout the Services and conduct analysis of systems used by more than one service**