

THE HUMAN EFFECTIVENESS DIRECTORATE

US Army Non - Human Factor Helicopter Mishap Findings and Recommendations

By

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Statement of Accountability



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Background



- This study describes all 207 U.S. Army Class A-B Rotary Wing Mishaps ascribed to 'Non - Human Factors' (NHF) from FY 85 to 05
- This data is based on a study of data archived in the mishap files of the USA Combat Readiness Center at Fort Rucker, Alabama
- This data is the third part of a study that will include all rotary wing aircraft in the DoD
 - The first part 'USAF Helicopter Mishap Data' was publicly released on 18 Sep 2006
 - The second part 'USA Human Factor Helicopter Mishap Data' was publicly released on 29 Mar 2007





Method



- **Obtained all U.S. Army Rotary Wing Aircraft Class A & B Mishaps ascribed to 'Non - Human Factors' from FY 85 to FY 05 inclusive from the U.S. Army Combat Readiness Center**
- **Reviewed all 207 mishap reports**
- **Created a data base for initial analysis**
- **Major injuries resulted in approximately four weeks or more of lost duty time or permanent disability**
- **Minor injuries resulted in approximately less than four weeks of lost duty time**





Definitions



Aircraft were placed in 7 groups for the analysis

AH-1 AH-1E/F/G/S
FAH-1S,
JPAH-1S

H-47 CH-47C/D
MH-47D/E

OH-58 OH-58A/C/D/DI/DR

UH-1 UH-1H/V
JUH-1H

H-60 EH-60A
MH-60A/K/L
UH-60A/L

H-6 AH-6C/G/J
MH-6B/E/H/J
OH-6A

AH-64 AH-64A/D





Overview



- **Definitions**
- **Mishap Characterization**
- **Phase of Flight Data**
- **Fatality & Injury Data**
- **Summary & Recommendations**





Definitions



Non-Human Factor Definition:

- Any mishap where the proximal cause was not due to a human factor in accordance with the Department of Defense Human Factors Analysis and Classification System
- Generally speaking: mechanical failures and weather
- Weather cases are those where severe weather was encountered but was not forecast



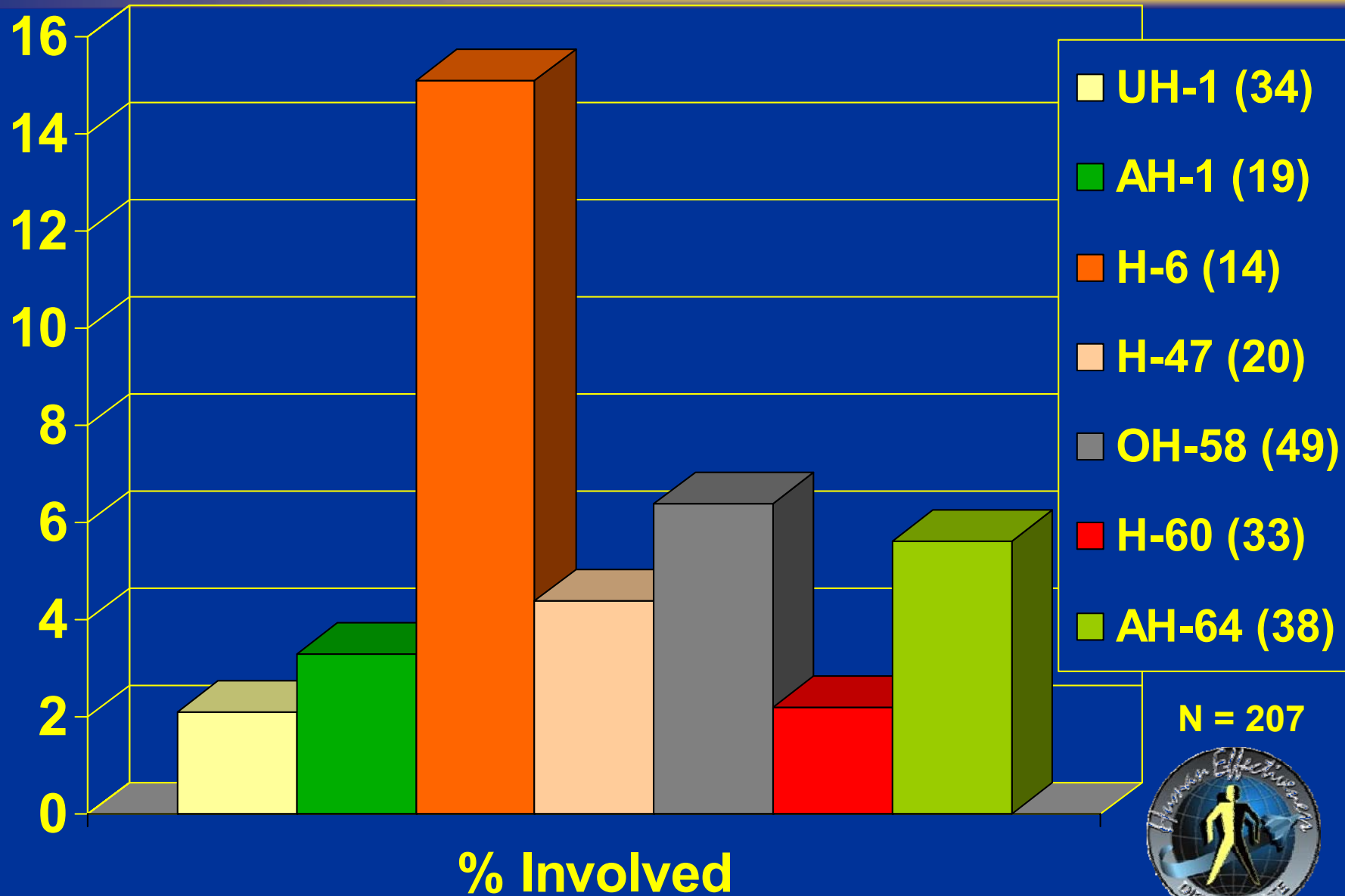


Non-Human Factor Mishap Character





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

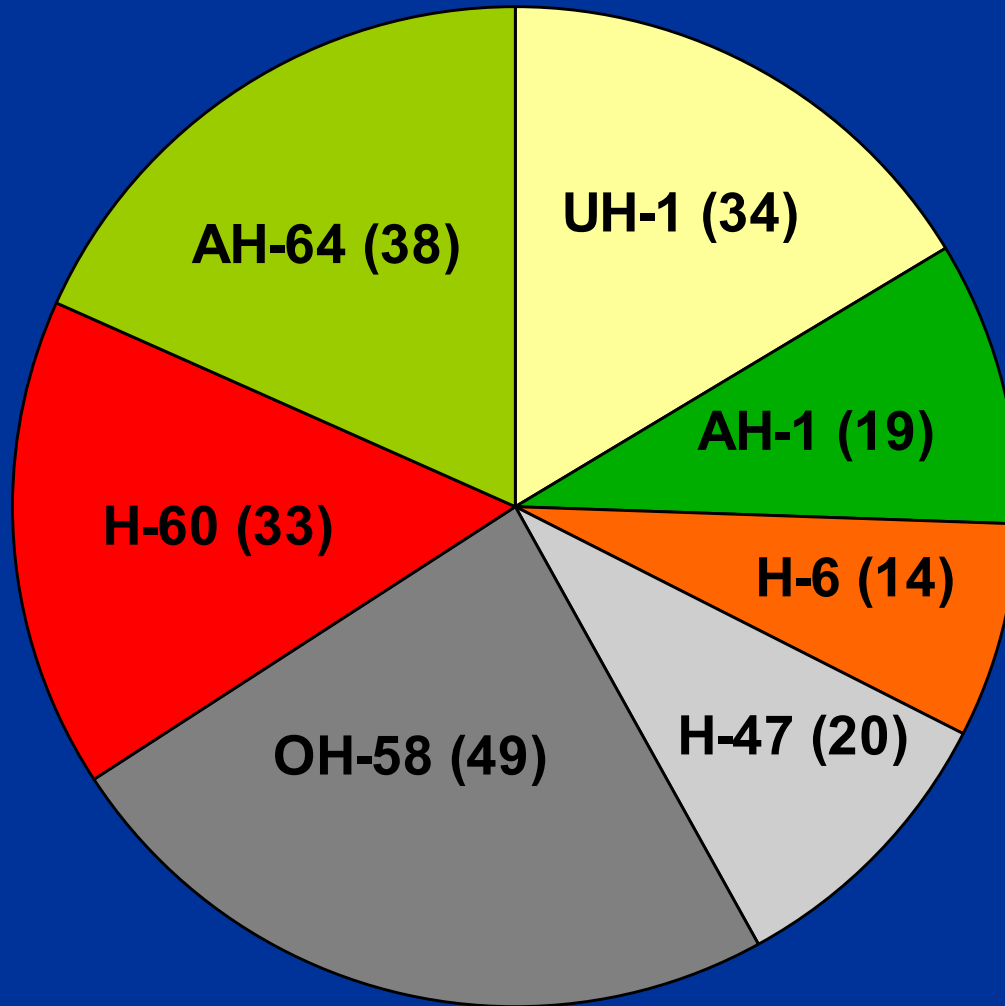


N = 207





NHF Mishaps by MDS

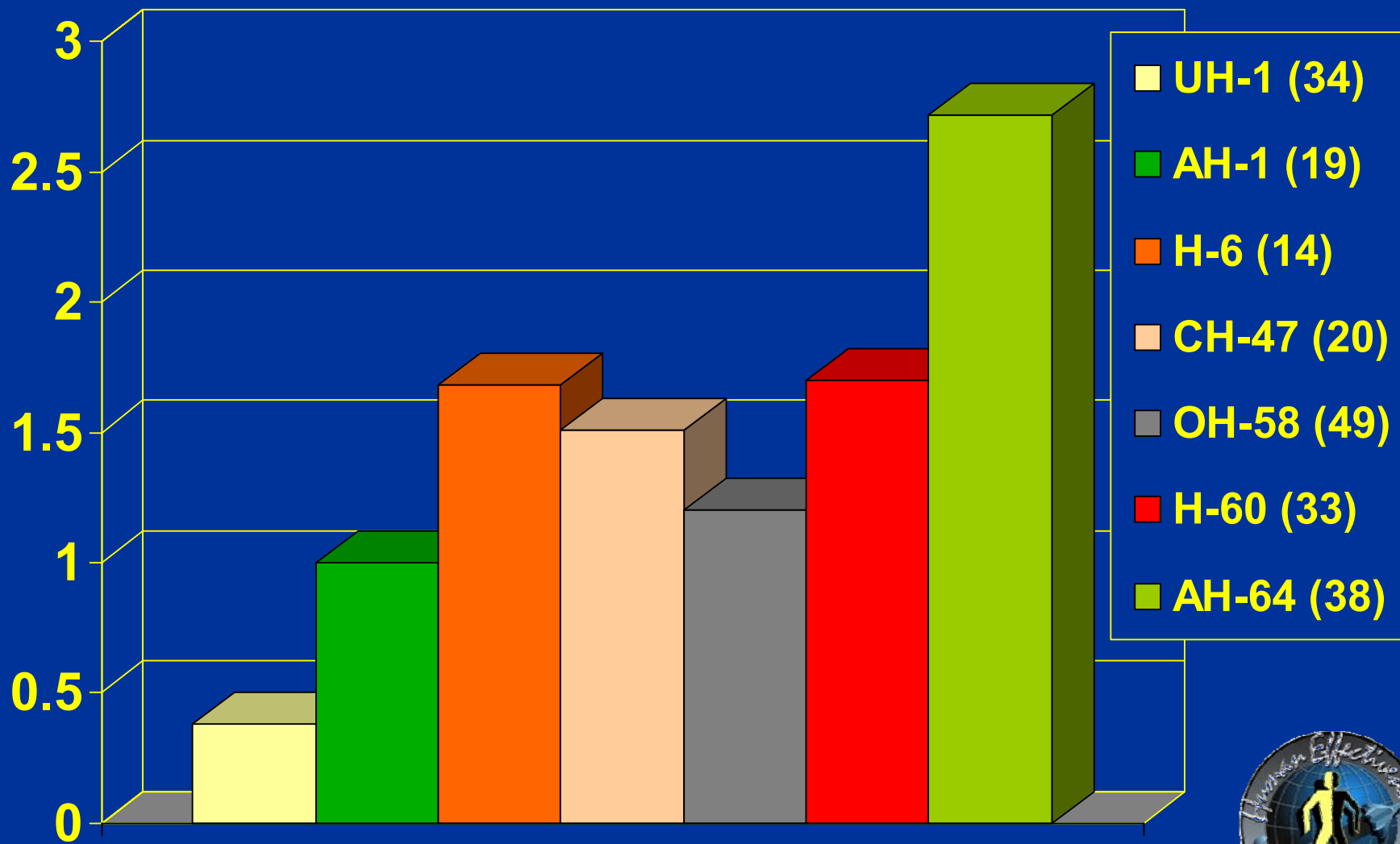


N = 207





NHF Mishap Rates/100KHrs by MDS



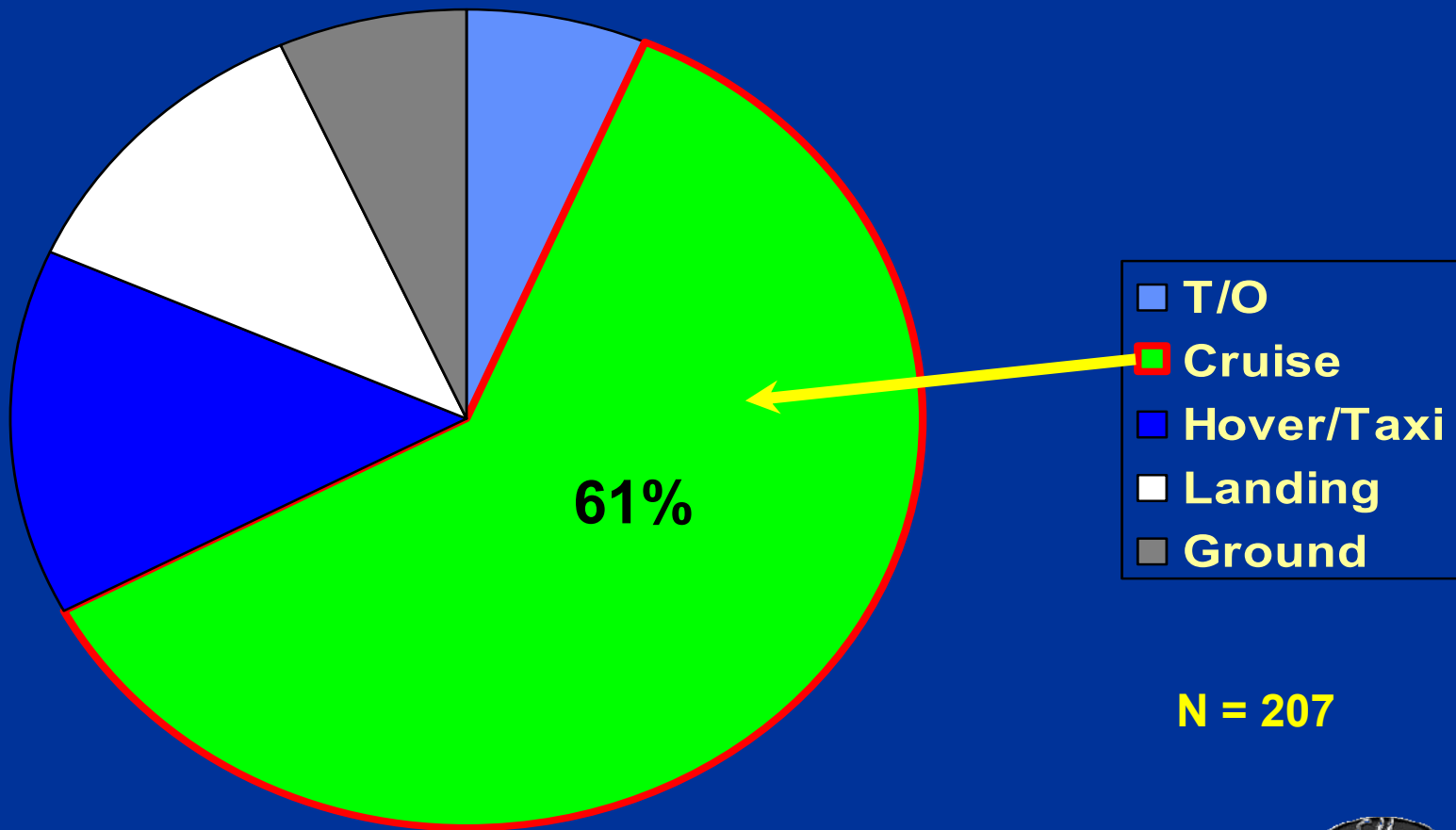


Non-Human Factor Mishap Character Phase of Flight





NHF Mishap by Phase of Flight FY 85-05

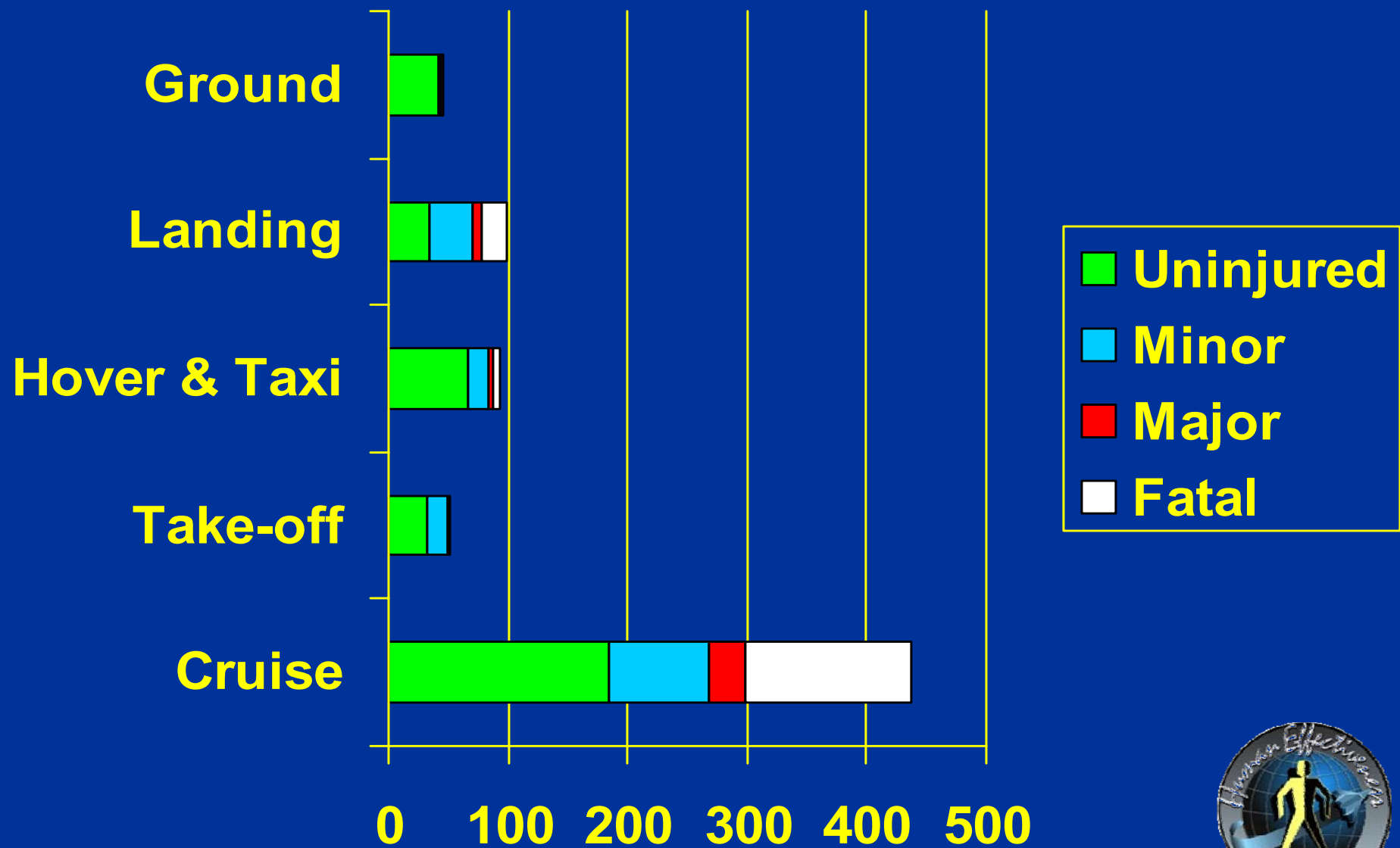


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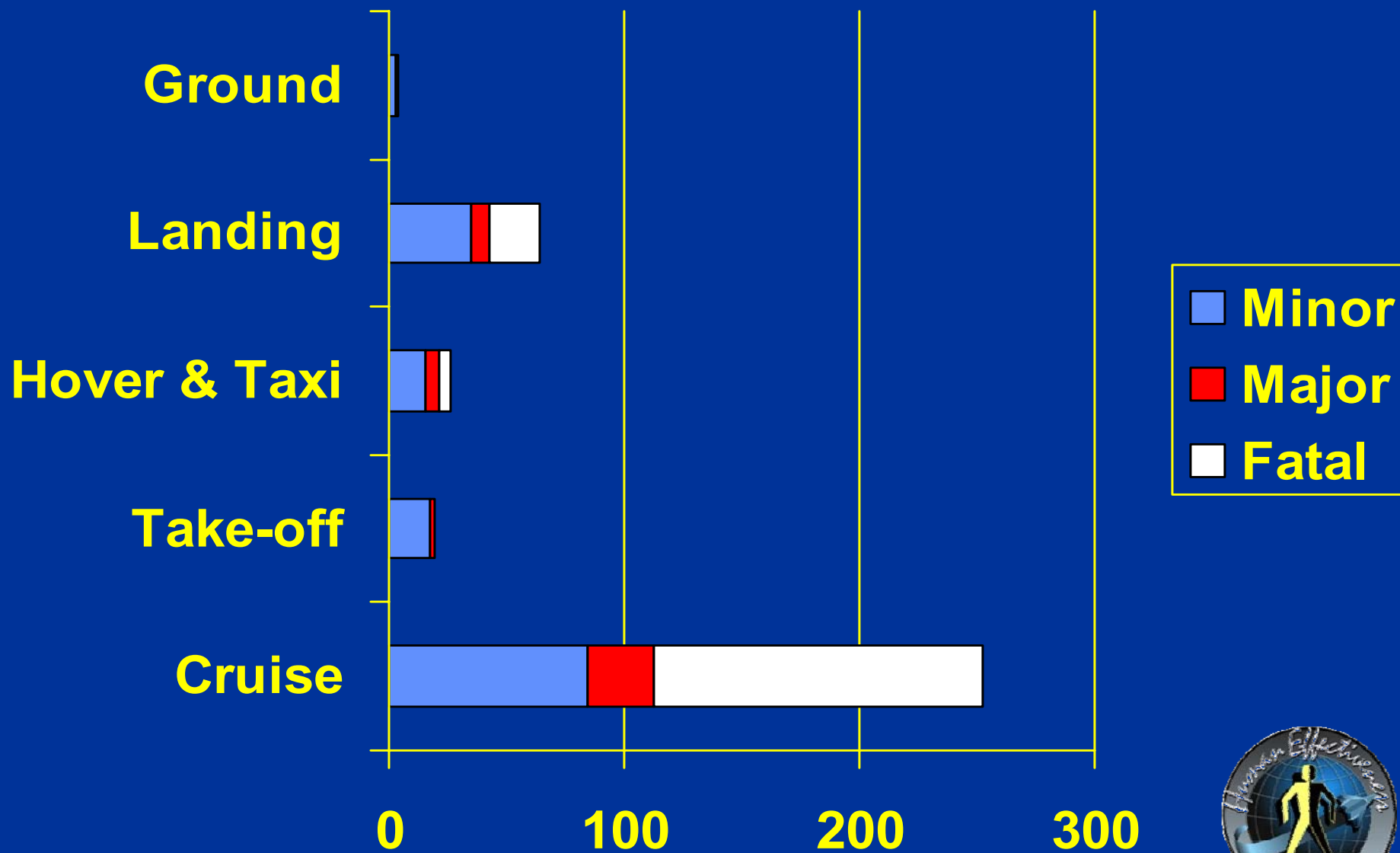


NHF Fatalities & Injuries by Phase of Flight



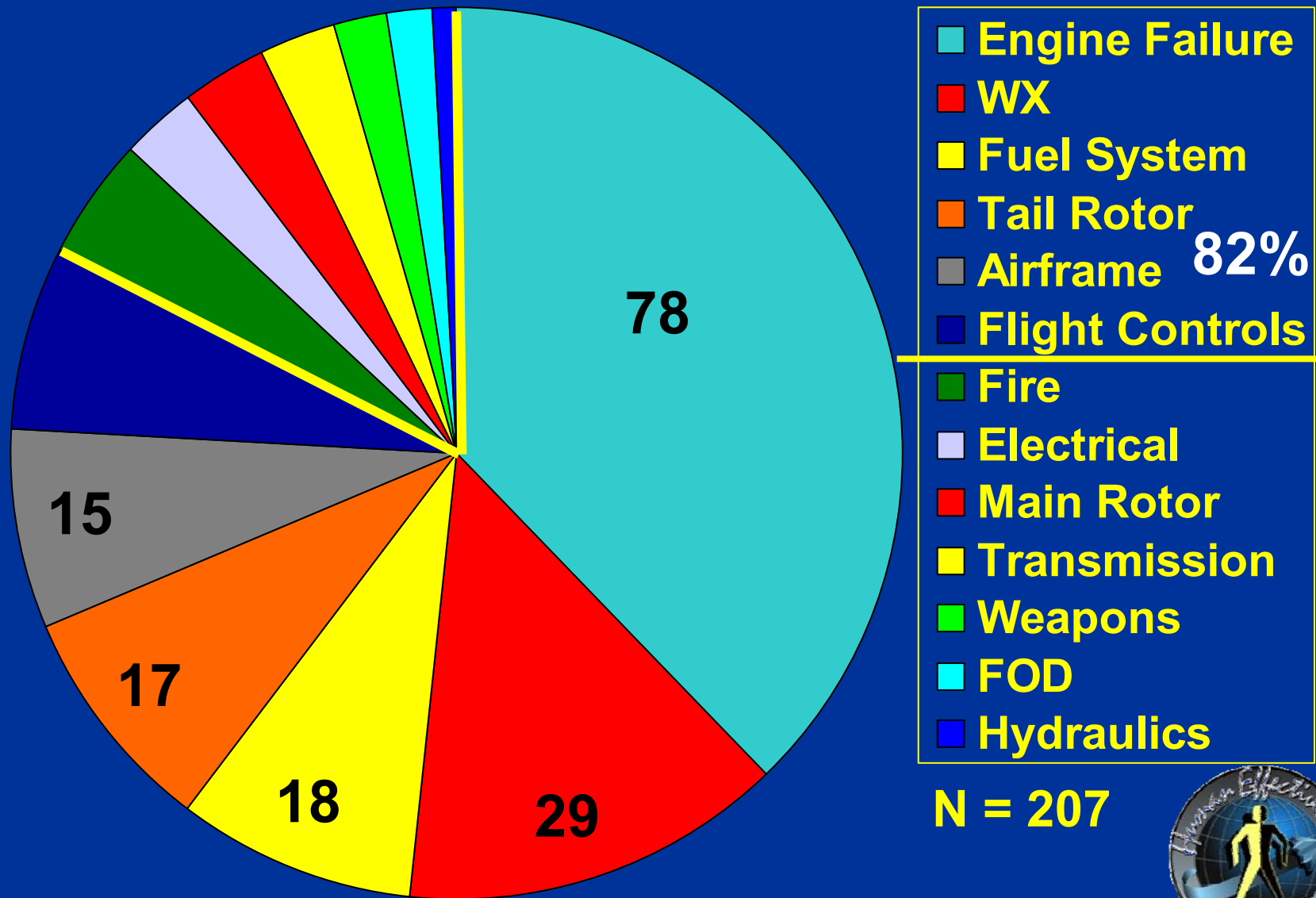


NHF Fatalities & Injuries by Phase of Flight - Overview





All NHF Mishaps Malfunction Categories

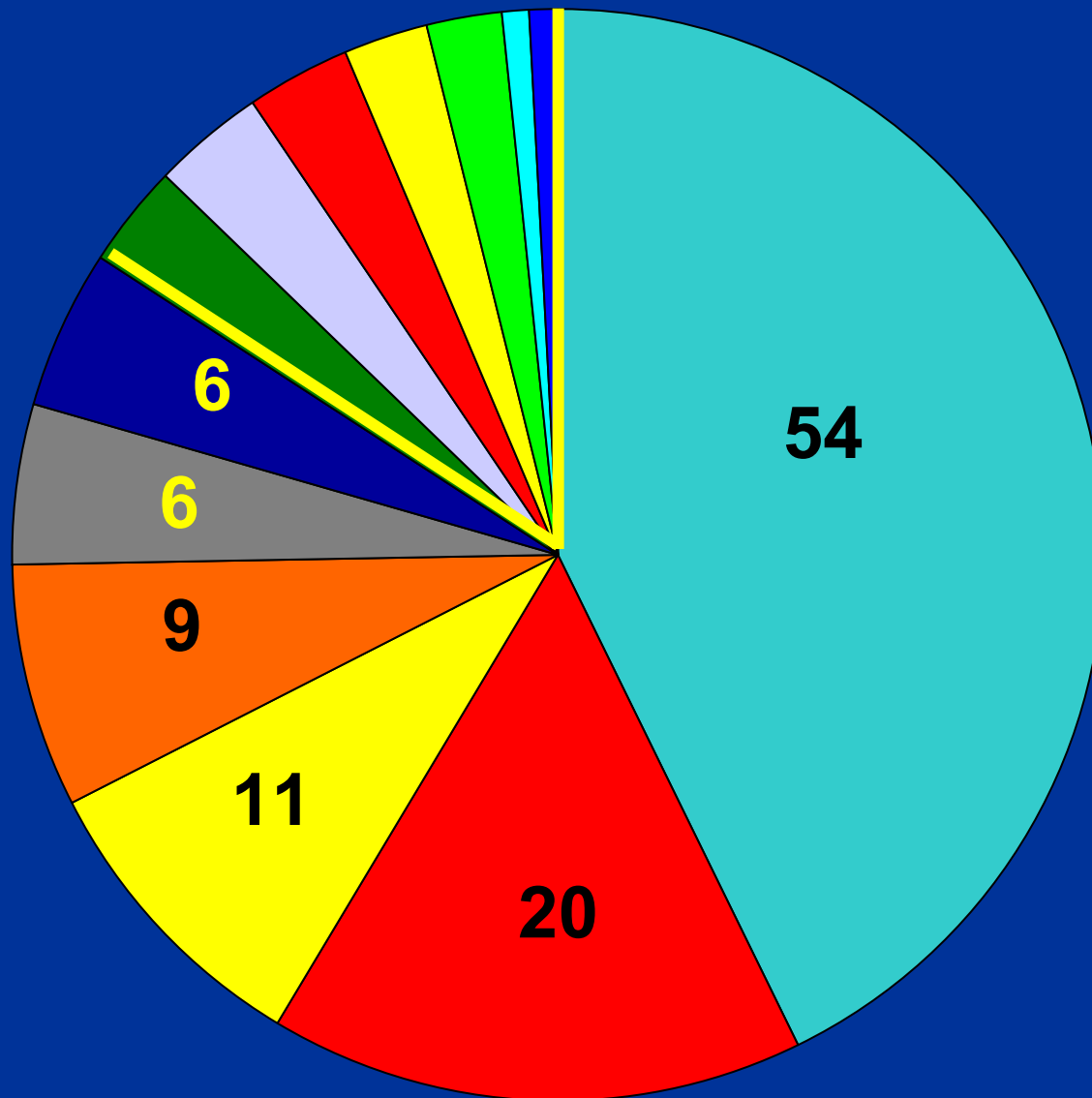


N = 207





NHF Cruise Mishaps Malfunction Categories



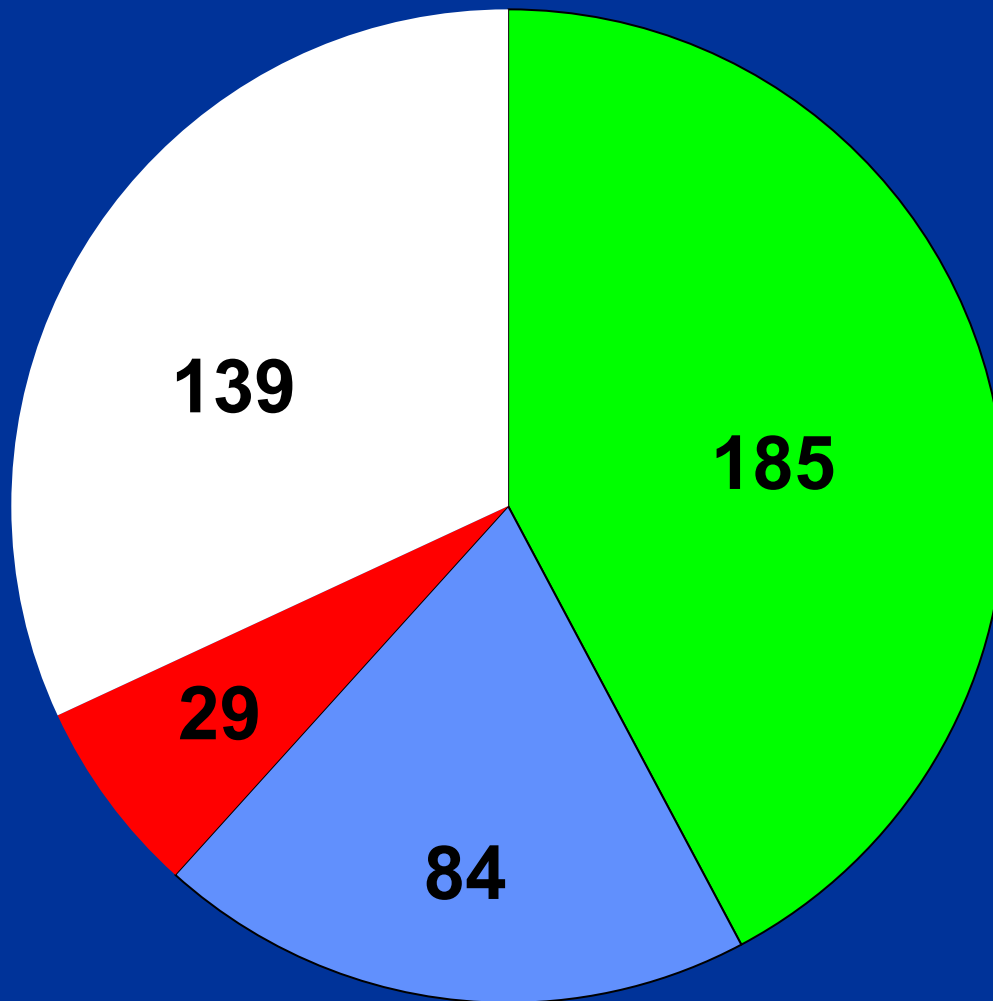
- Engine Failure
- WX
- Fuel Systems
- Tail Rotor **84%**
- Flight Controls
- Fire
- Electrical
- Transmission
- Airframe
- Main Rotor
- Weapons
- Hydraulics
- FOD

N = 126





NHF Cruise Mishaps Fatalities & Injuries



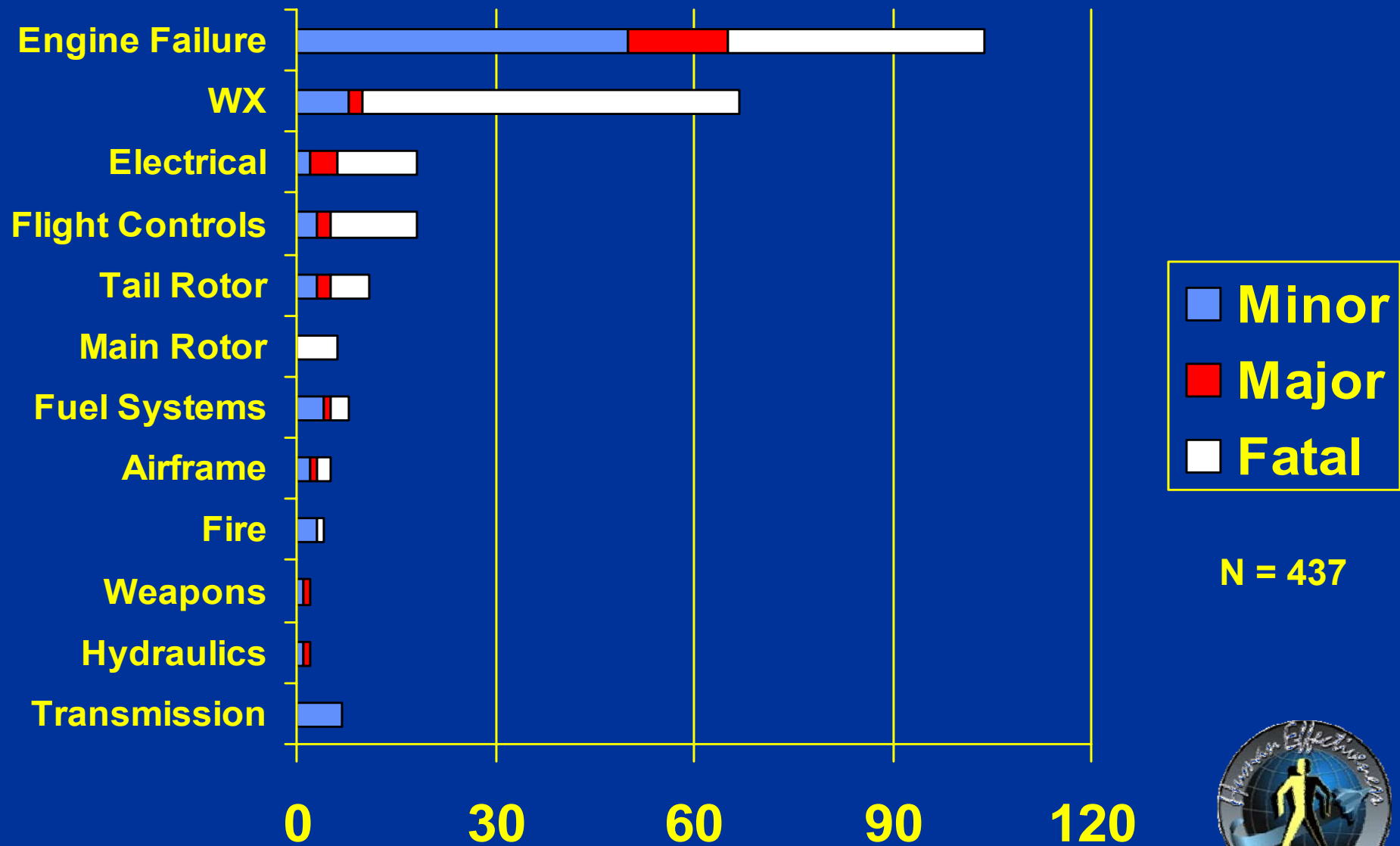
- Uninjured
- Minor
- Major
- Fatal

N = 437





NHF Cruise Fatalities & Injuries by Malfunction Category

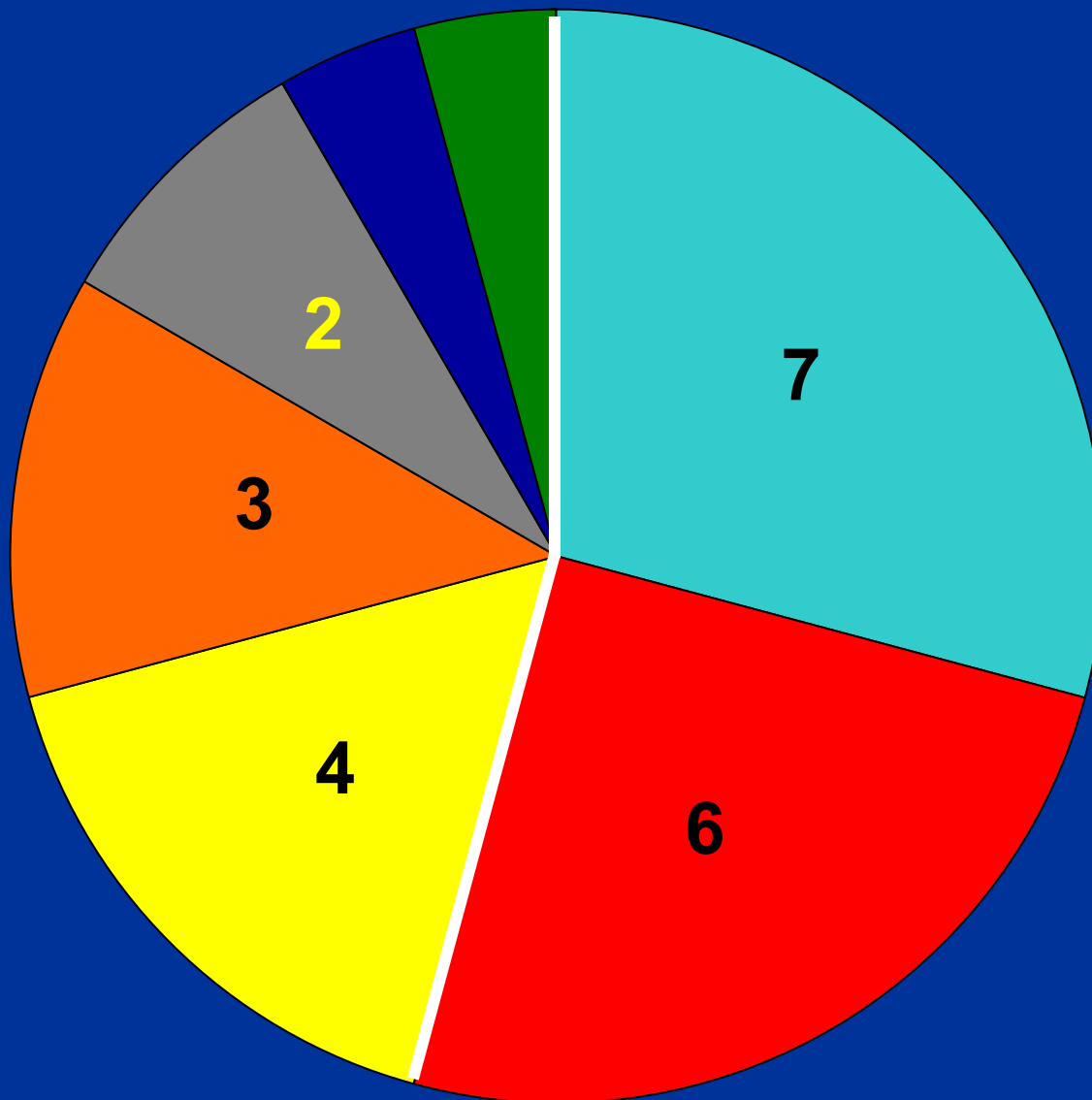


N = 437





NHF Landing Mishaps Malfunction Categories



■ Engine Failure

■ WX 54%

■ Tail Rotor

■ Fuel Systems / Starvation

■ Main Rotor

■ Flight Controls

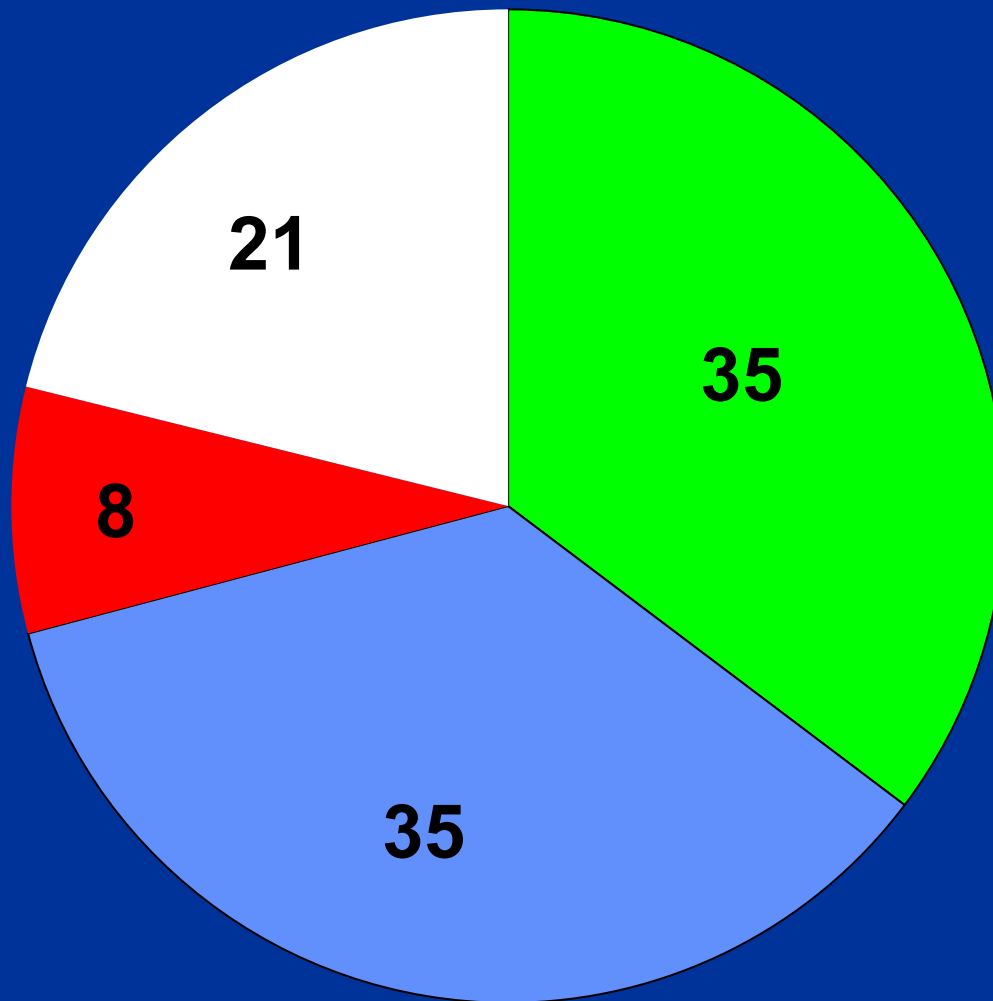
■ FOD

N = 24





NHF Landing Mishaps Fatalities & Injuries



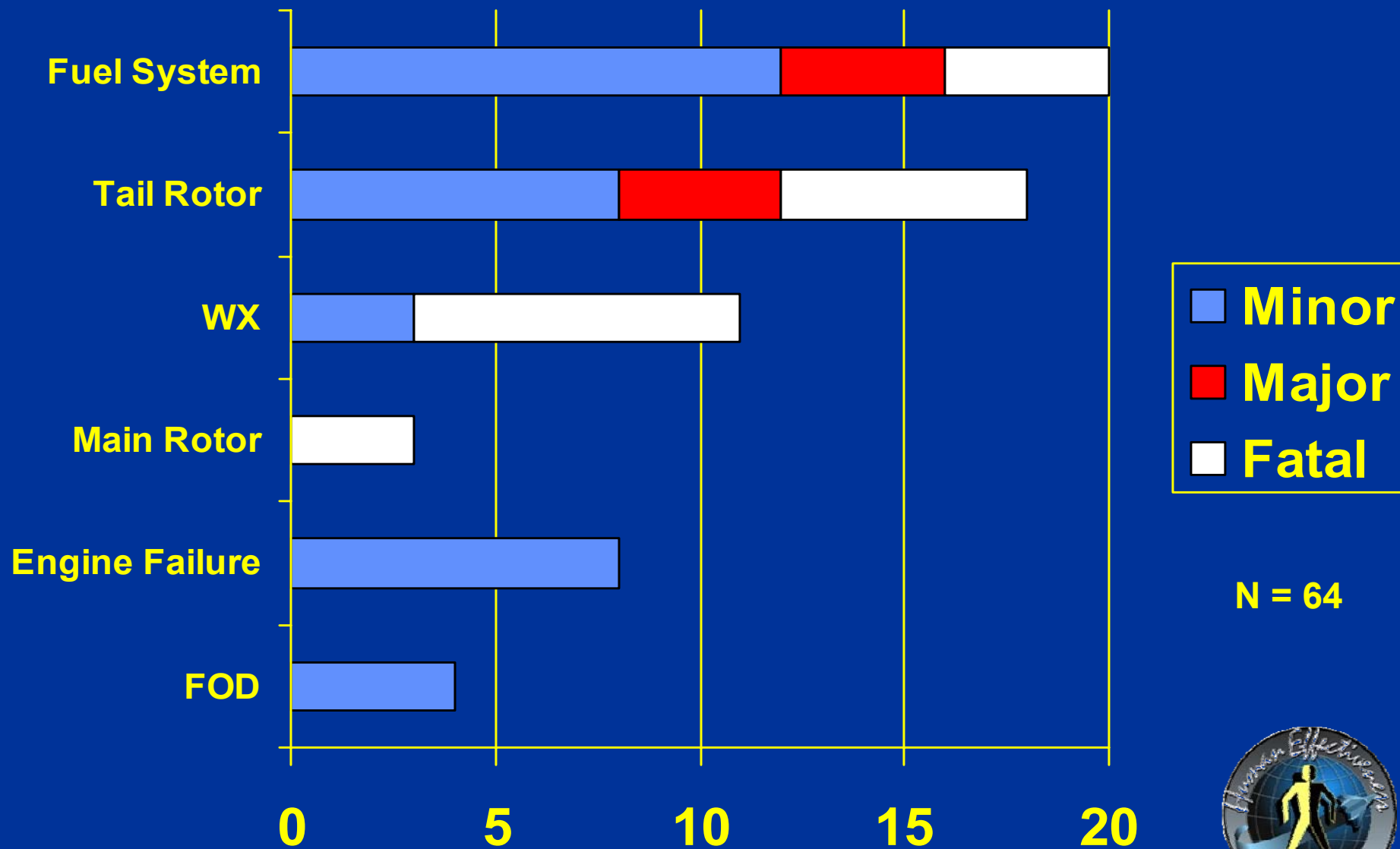
- Uninjured
- Minor
- Major
- Fatal

N = 99





NHF Landing Fatalities & Injuries by Malfunction Category

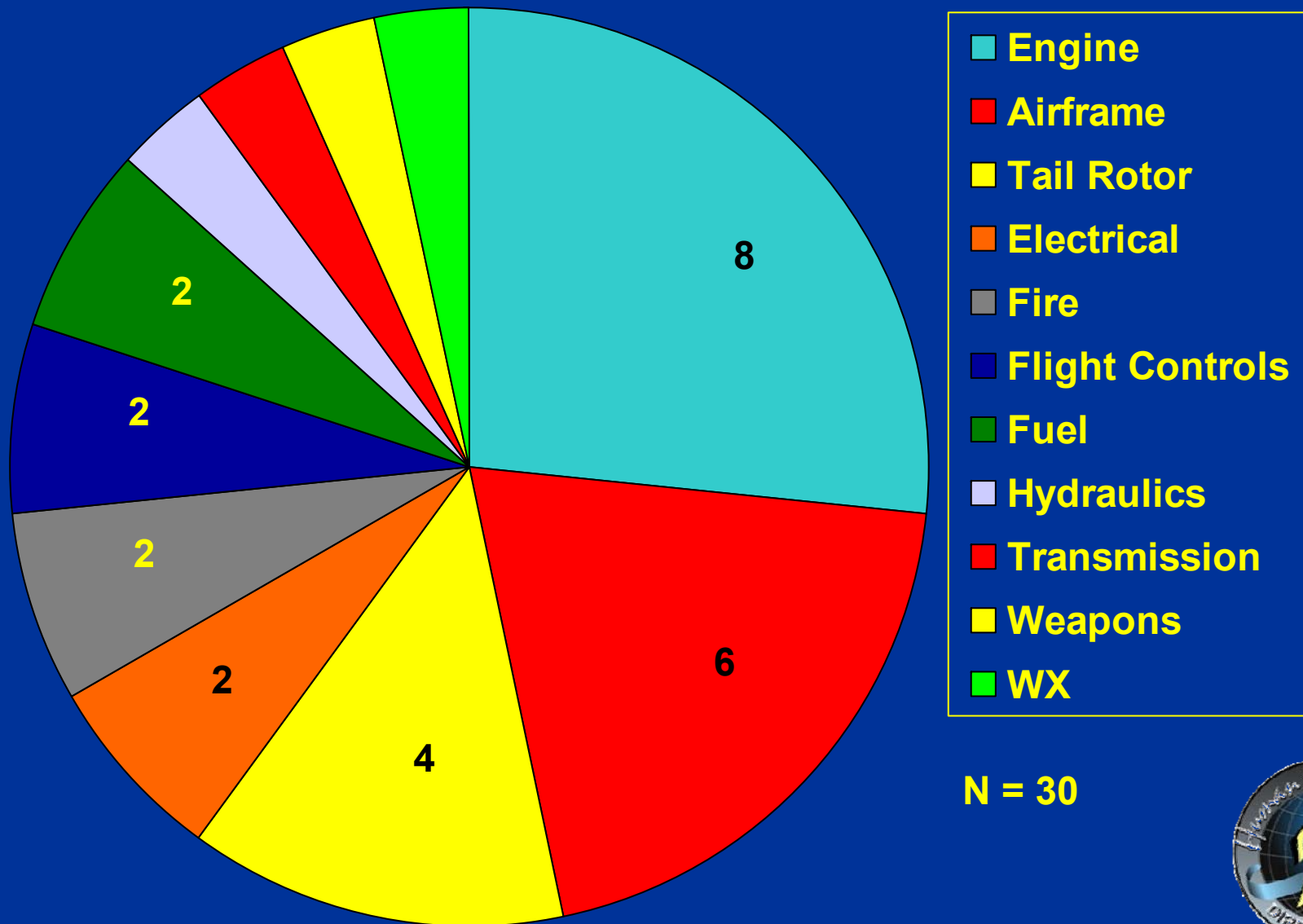


N = 64



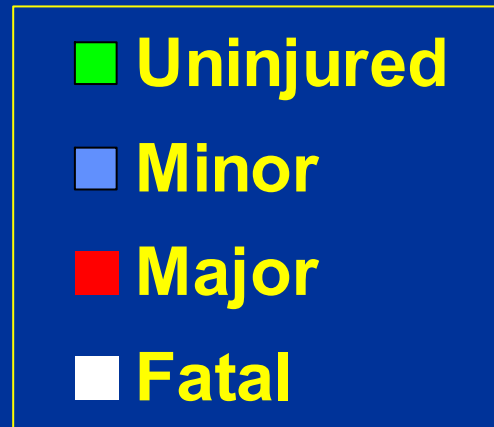
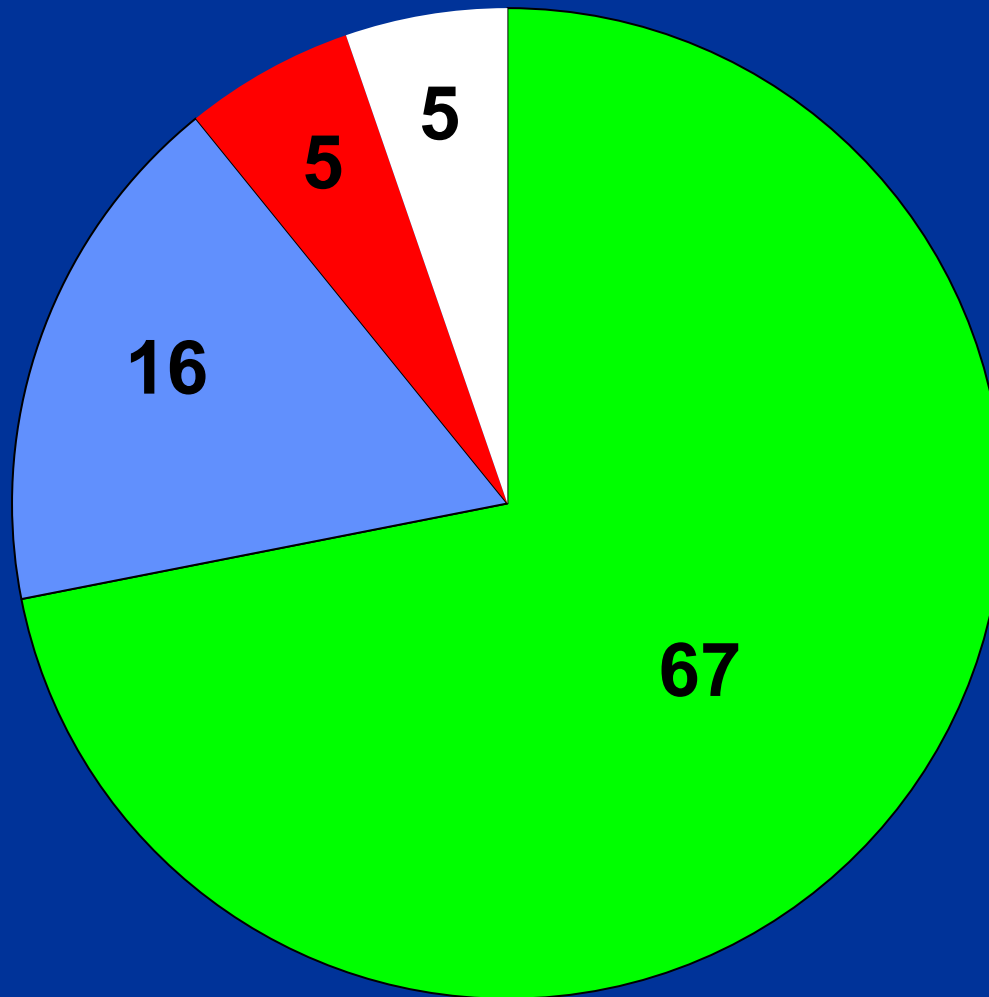


NHF Hover/Taxi Mishaps Malfunction Categories





NHF Hover/Taxi Mishaps Fatalities & Injuries

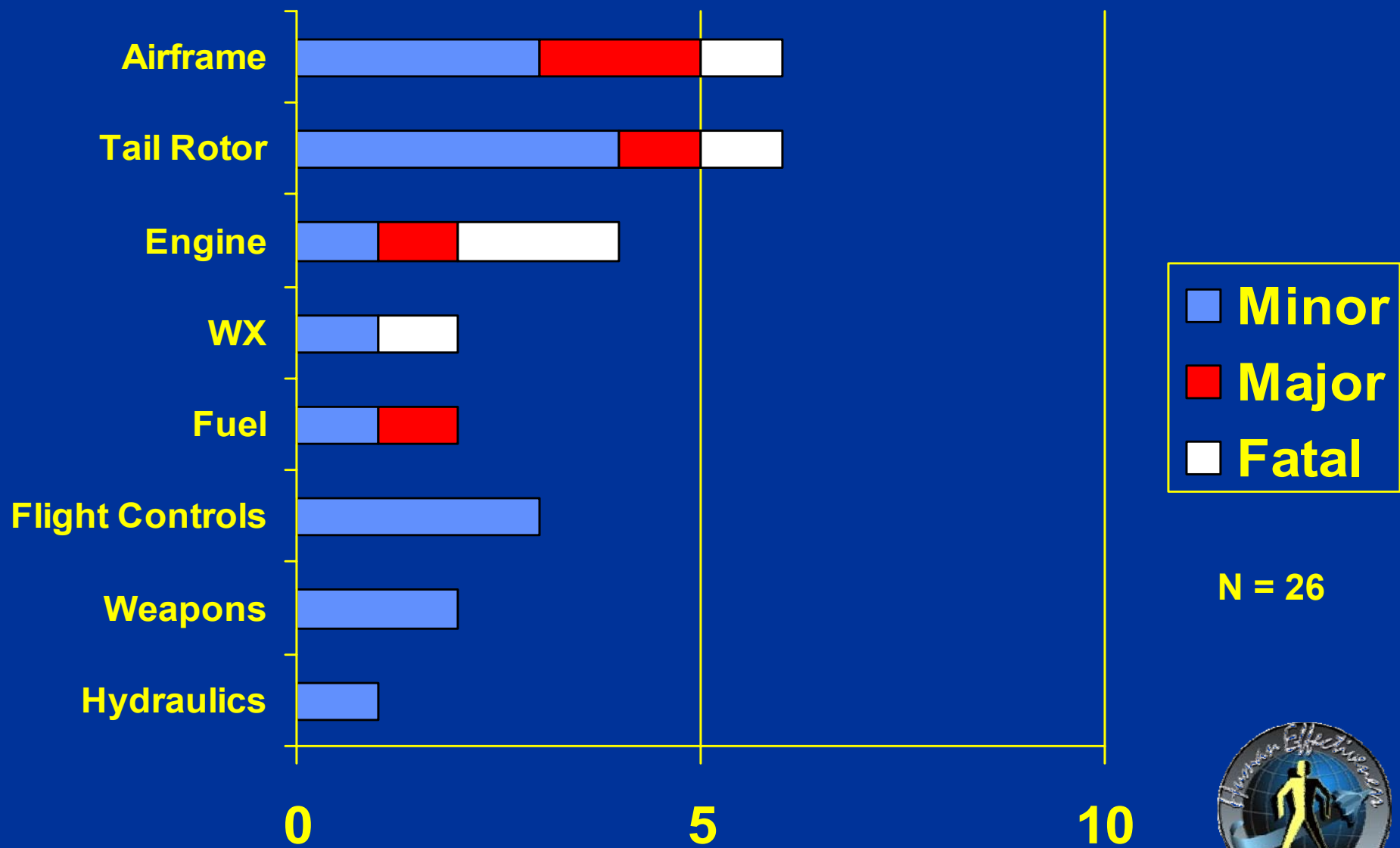


N = 93





NHF Hover/Taxi Fatalities & Injuries by Malfunction Category

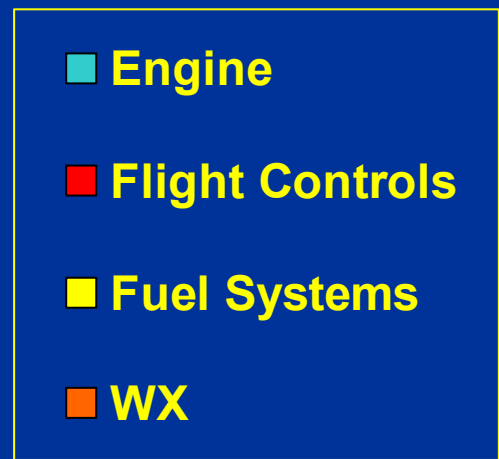
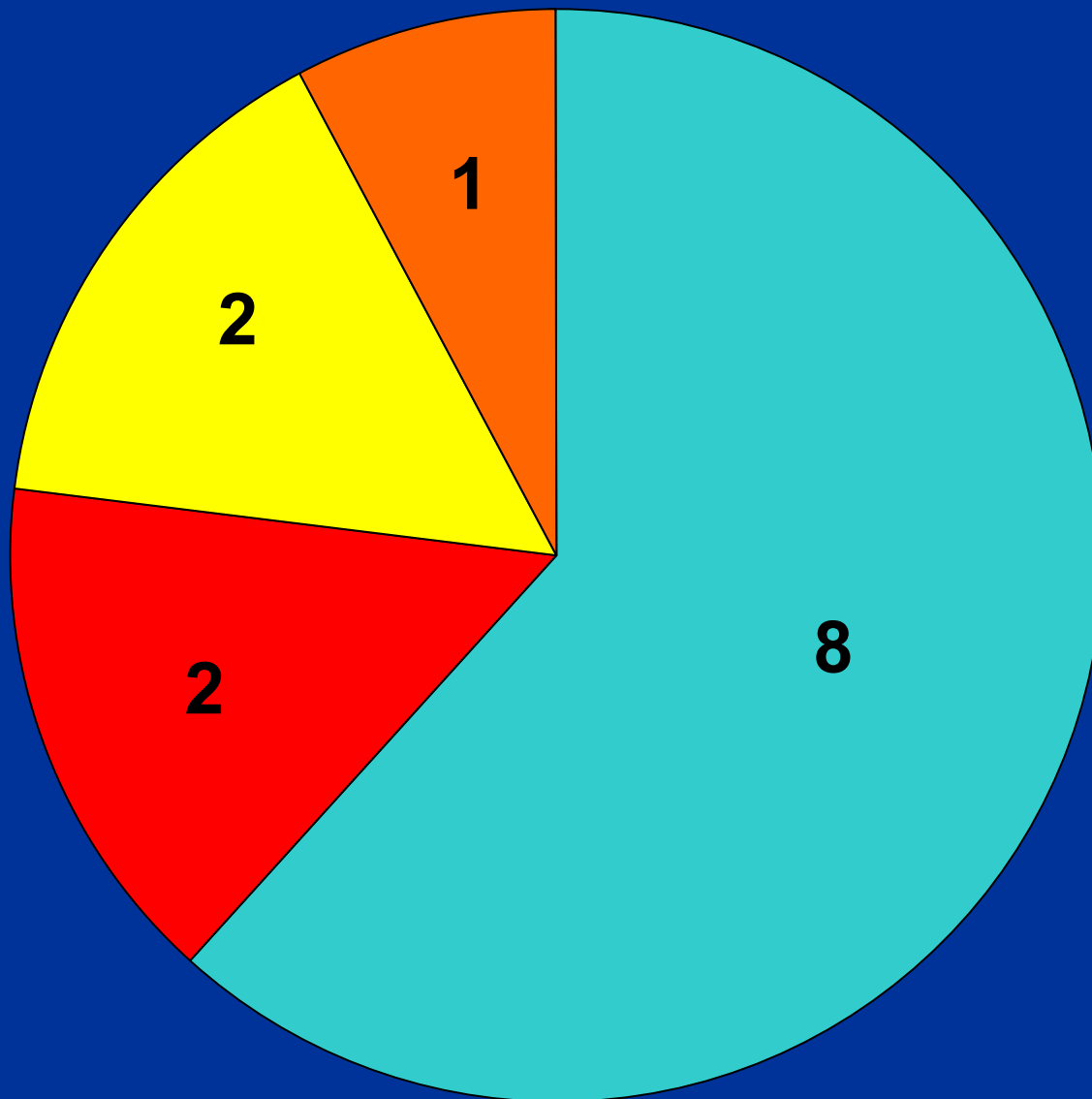


N = 26





NHF Take-Off Mishaps Malfunction Categories



N = 13

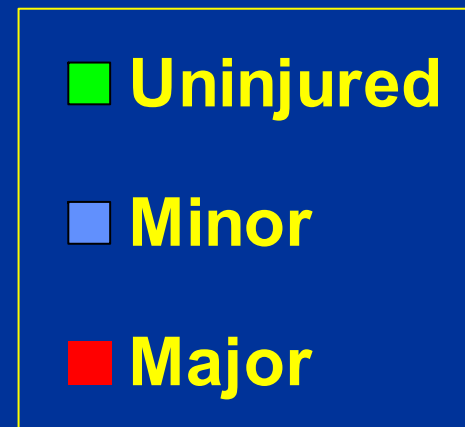
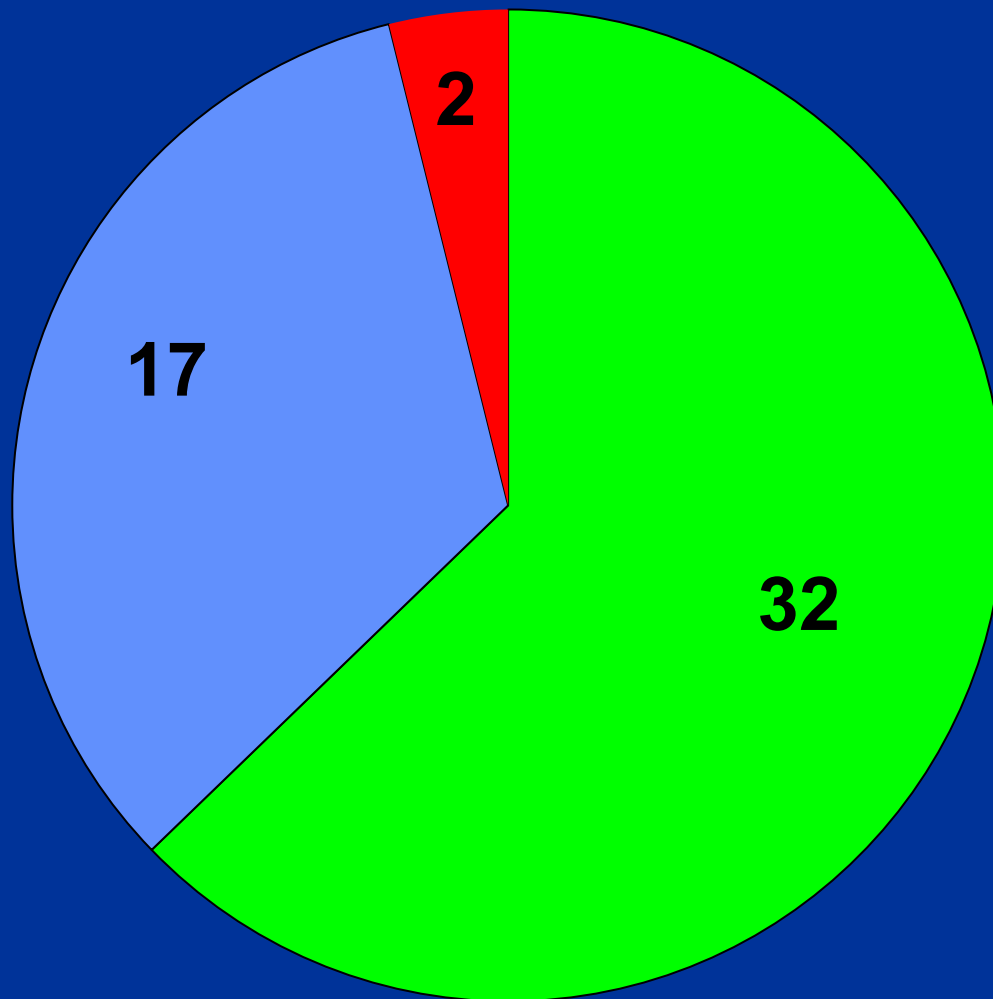




NHF Take-Off Mishaps Injuries



No Fatalities

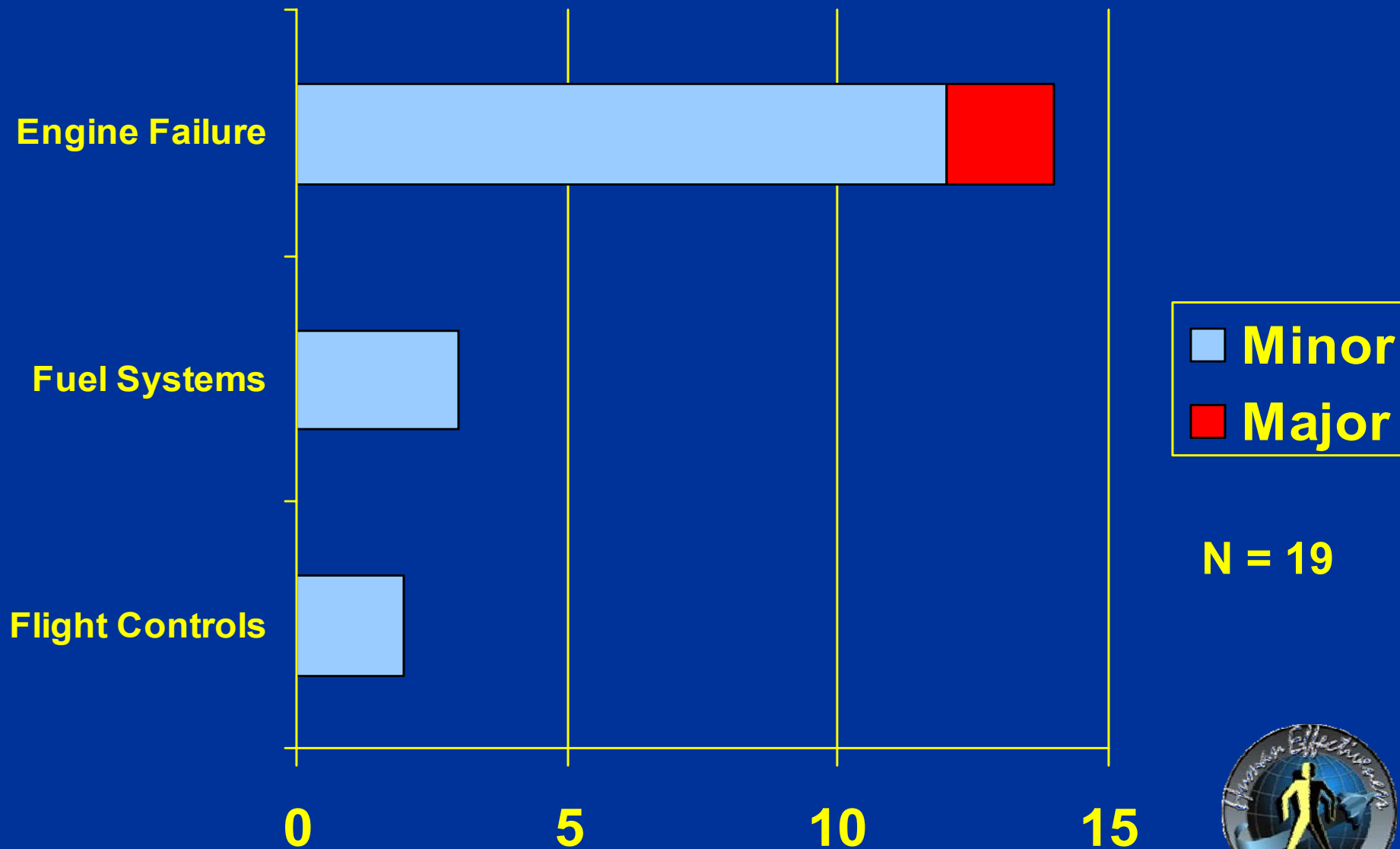


N = 51



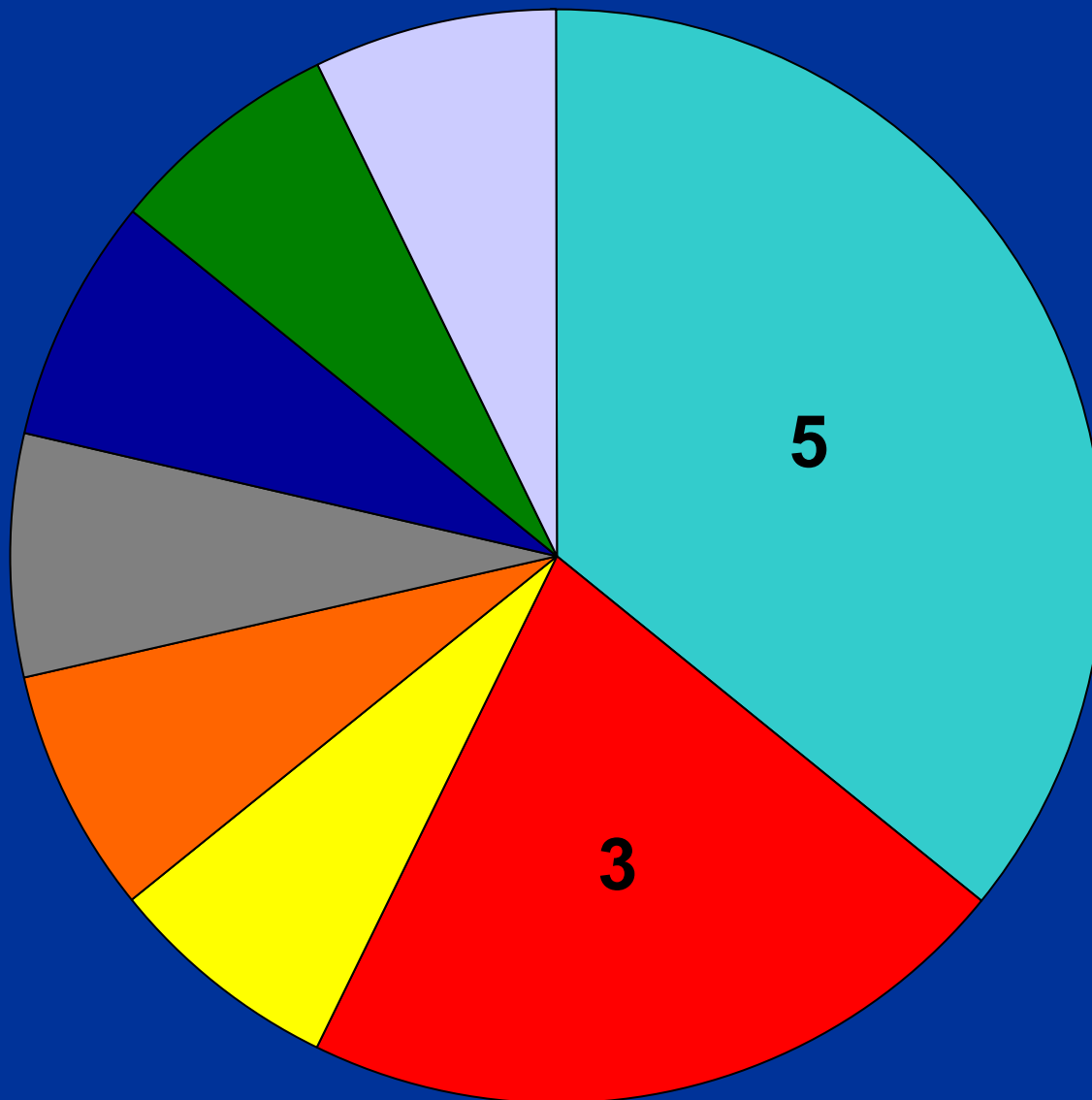


NHF Take-Off Fatalities & Injuries by Malfunction Category





NHF Ground Mishaps Malfunction Categories



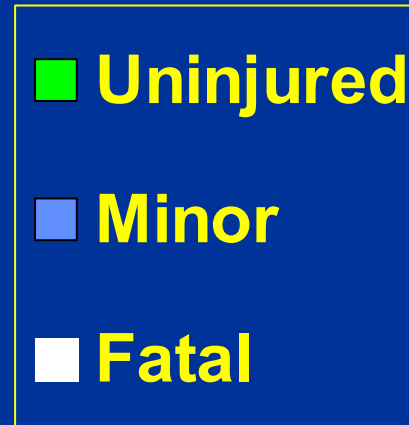
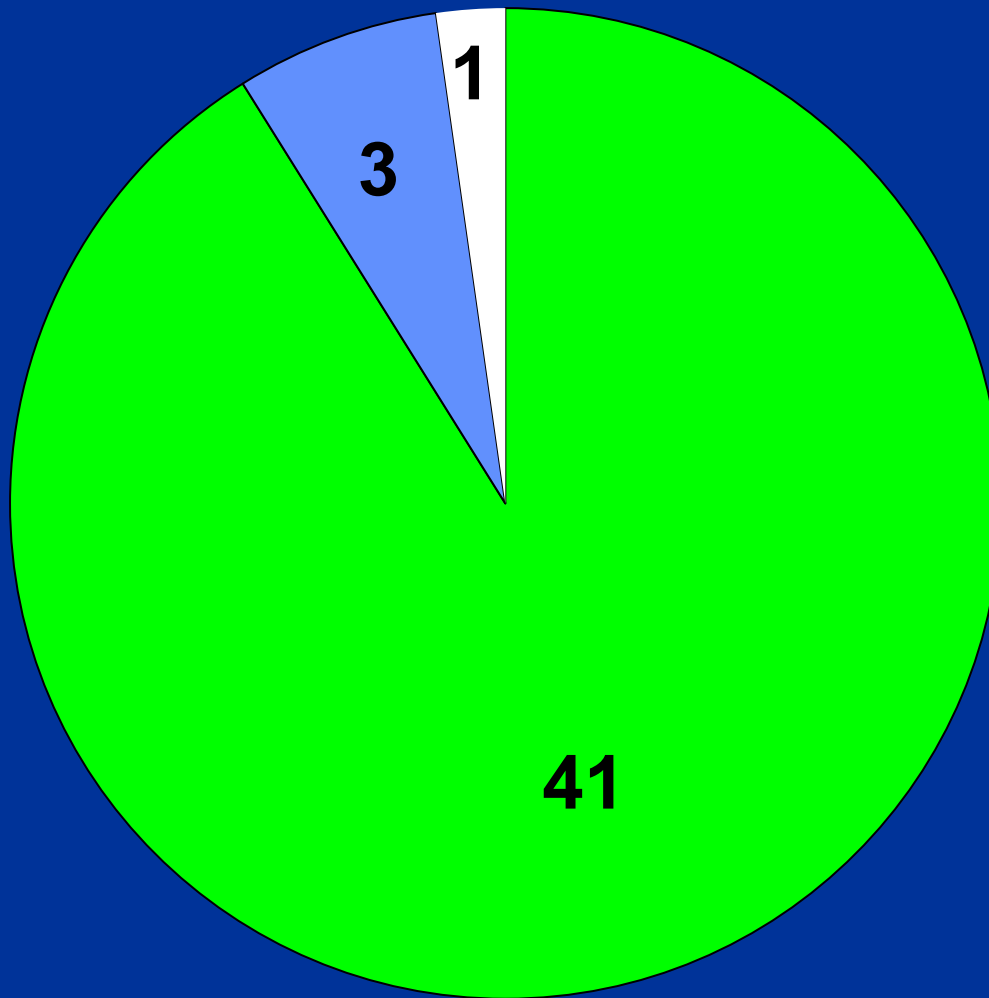
- Airframe
- Flight Controls
- Fire
- Engine Failure
- FOD
- Main Rotor
- Transmission
- WX

N = 14





NHF Ground Mishap Fatalities & Injuries



N = 45



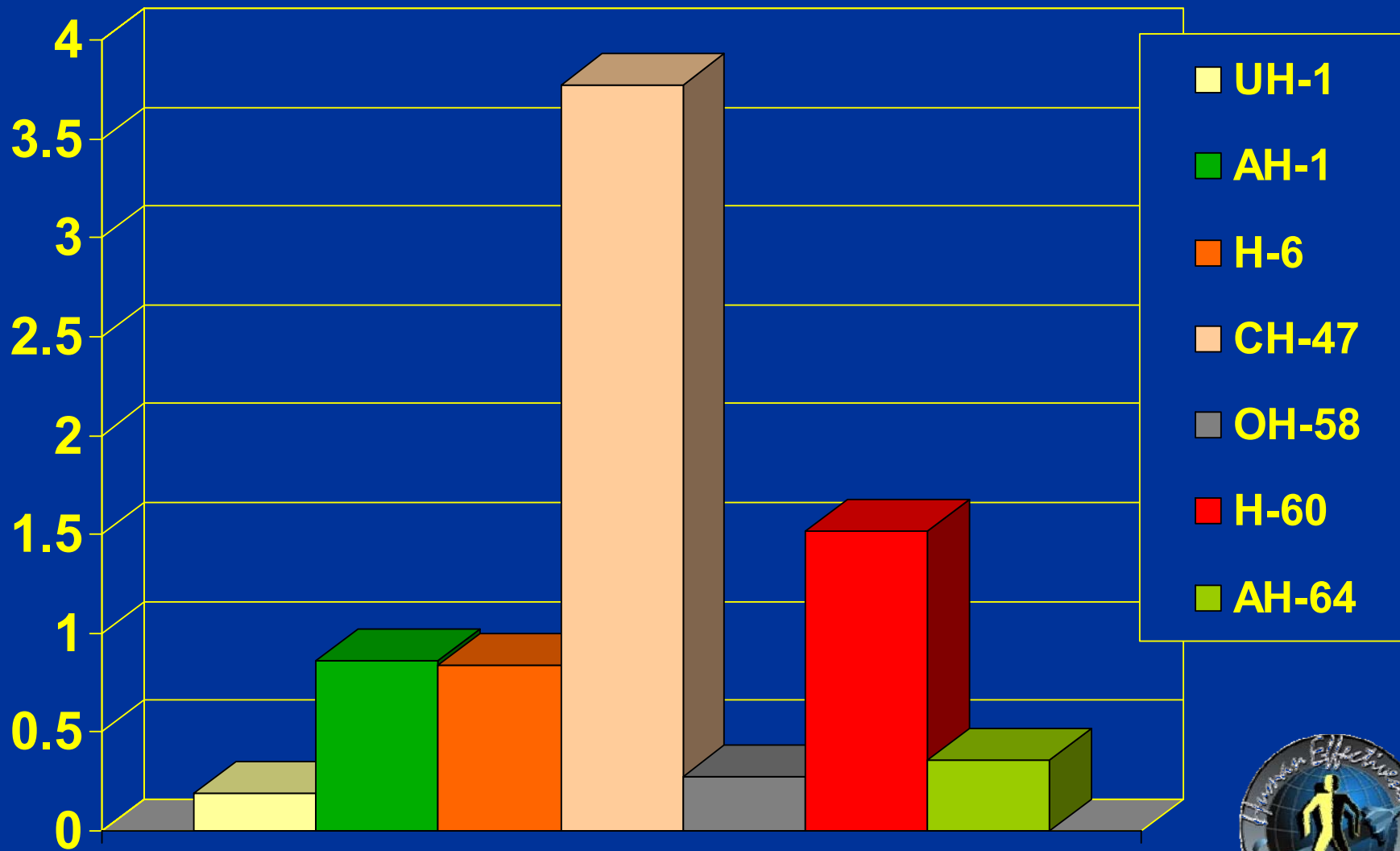


Non-Human Factor Deaths & Injuries



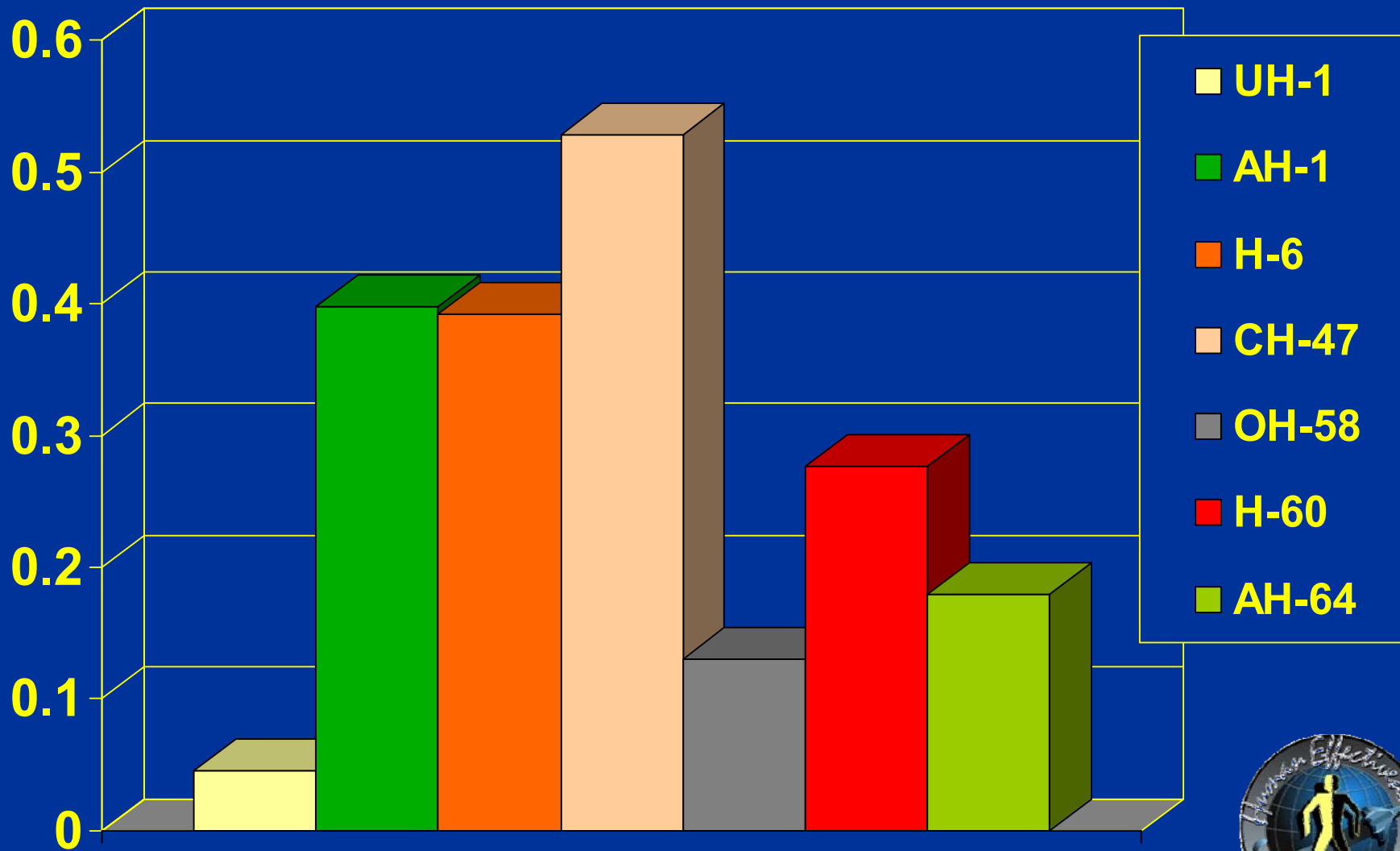


NHF Fatality Rates/100KHrs by MDS



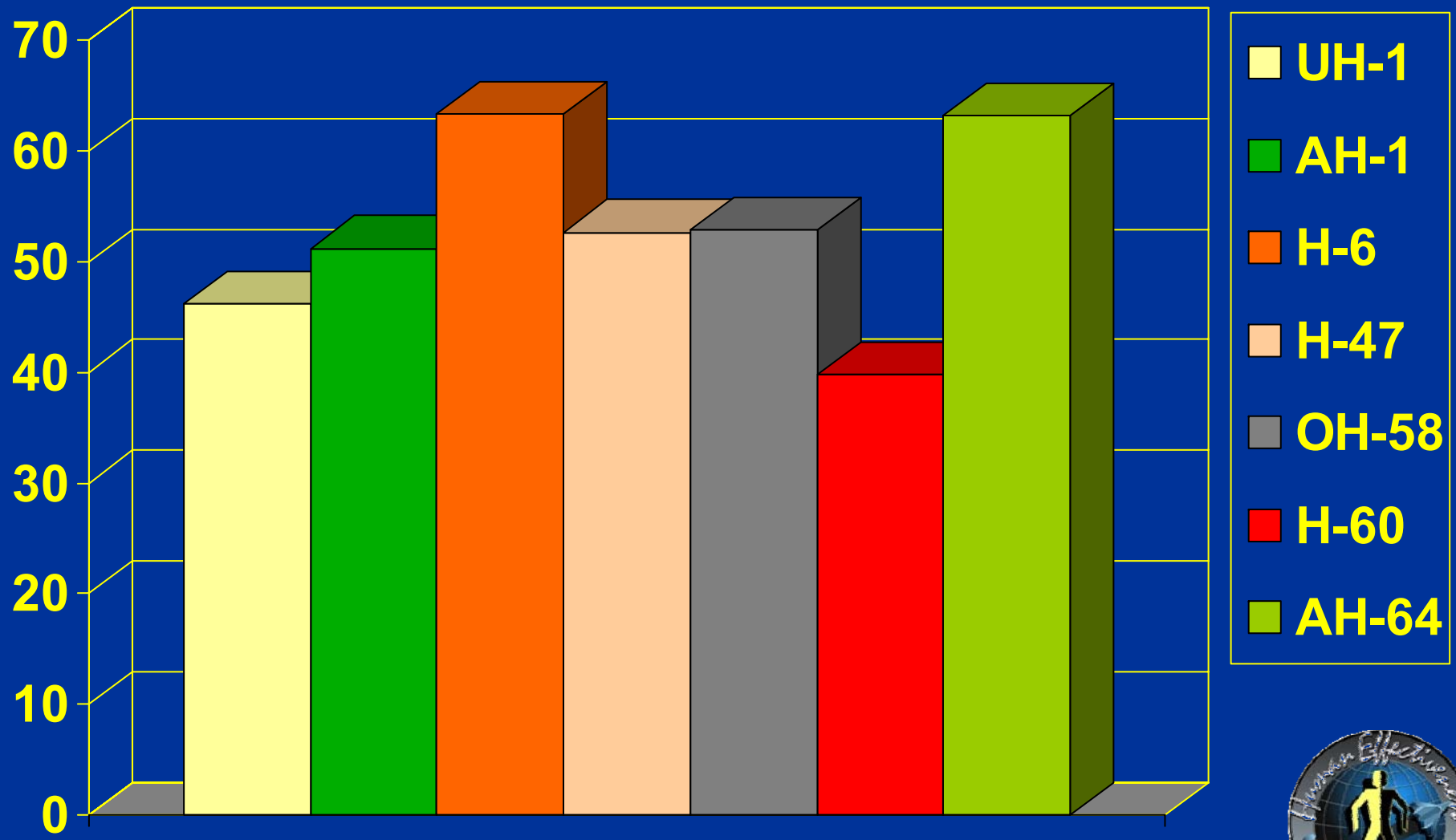


NHF Fatality Rates/100K Hours Adjusted for average personnel on board



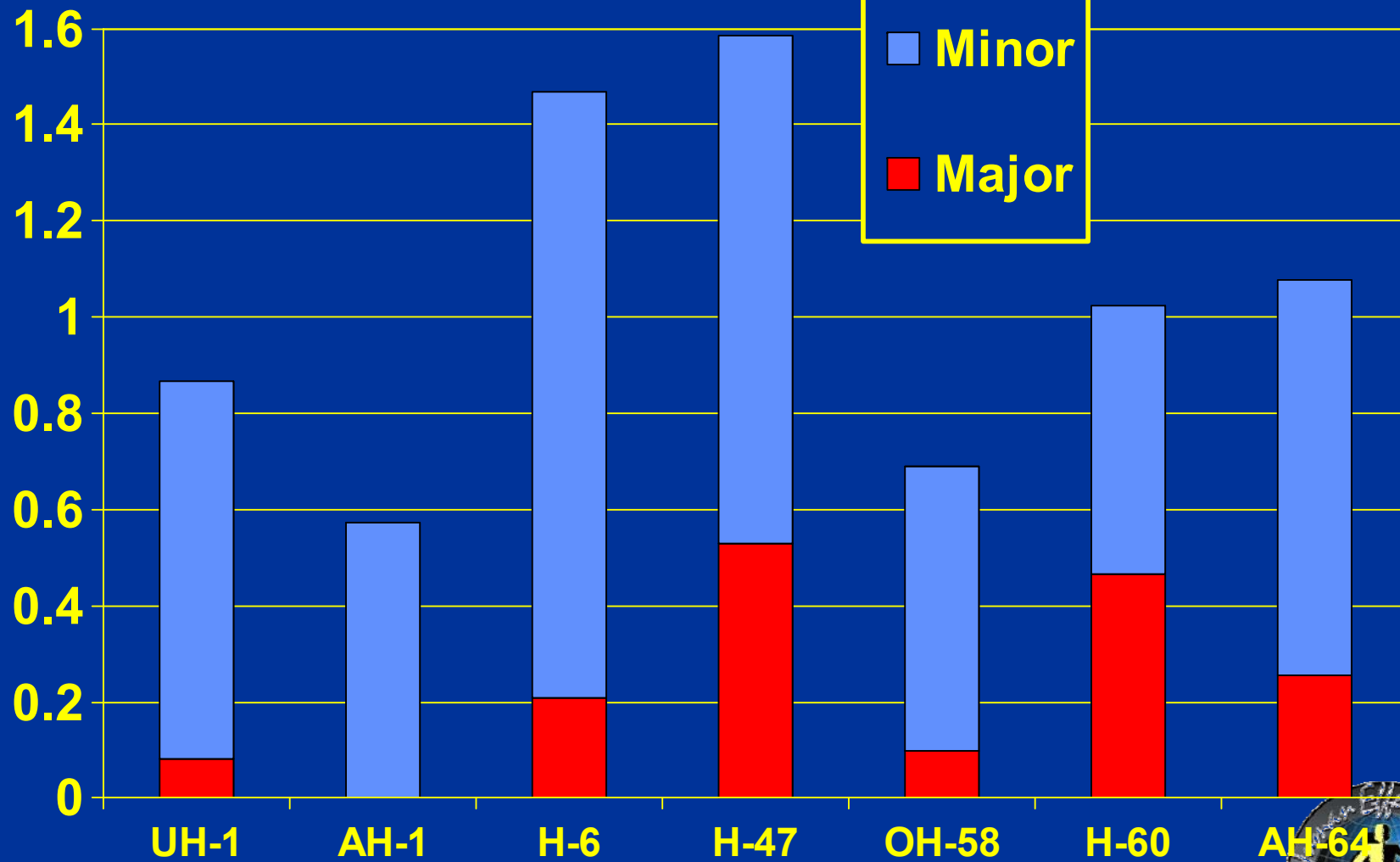


NHF Mishap Protection Factor



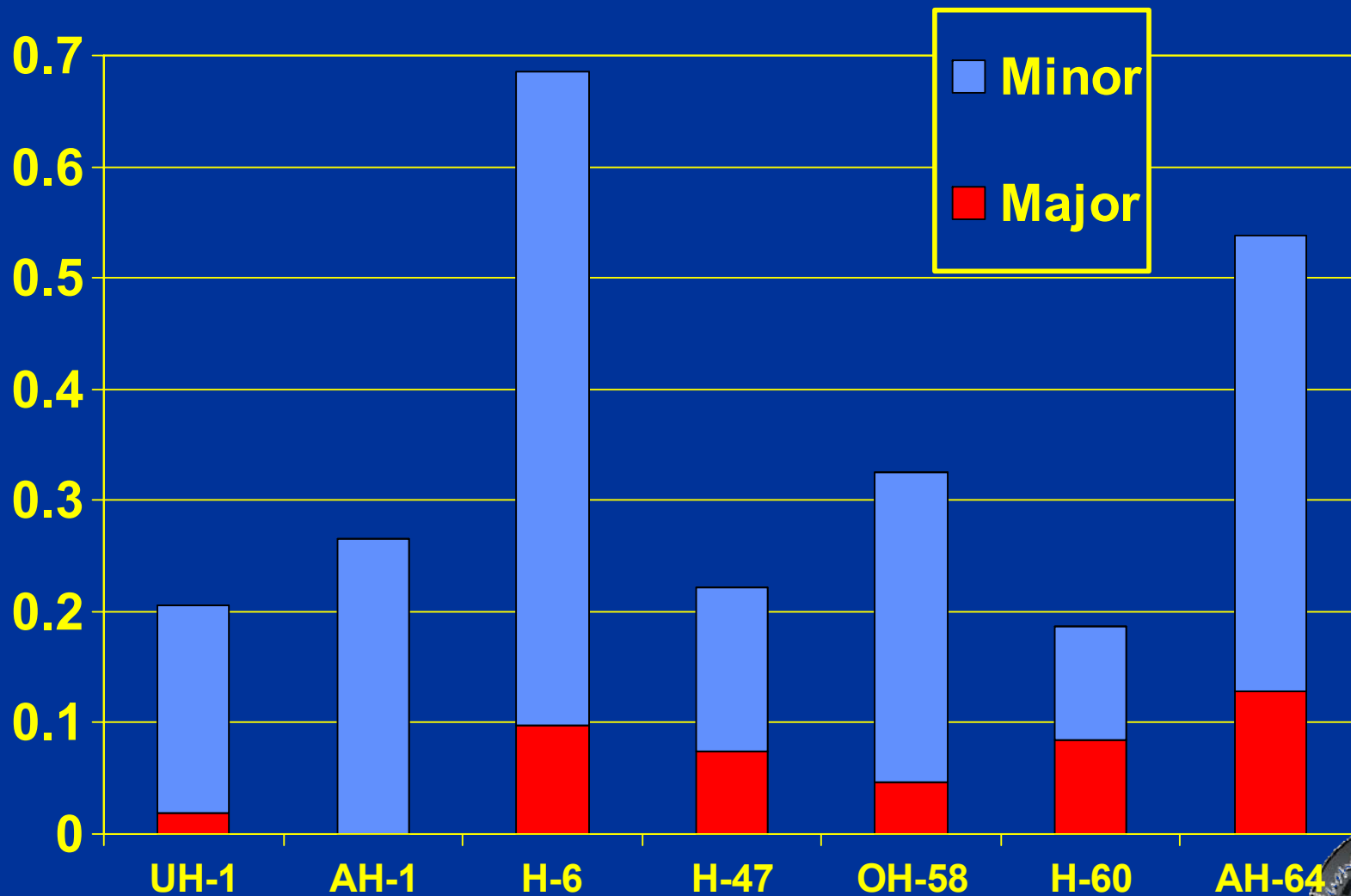


NHF Injury Rates/100K Hours by MDS



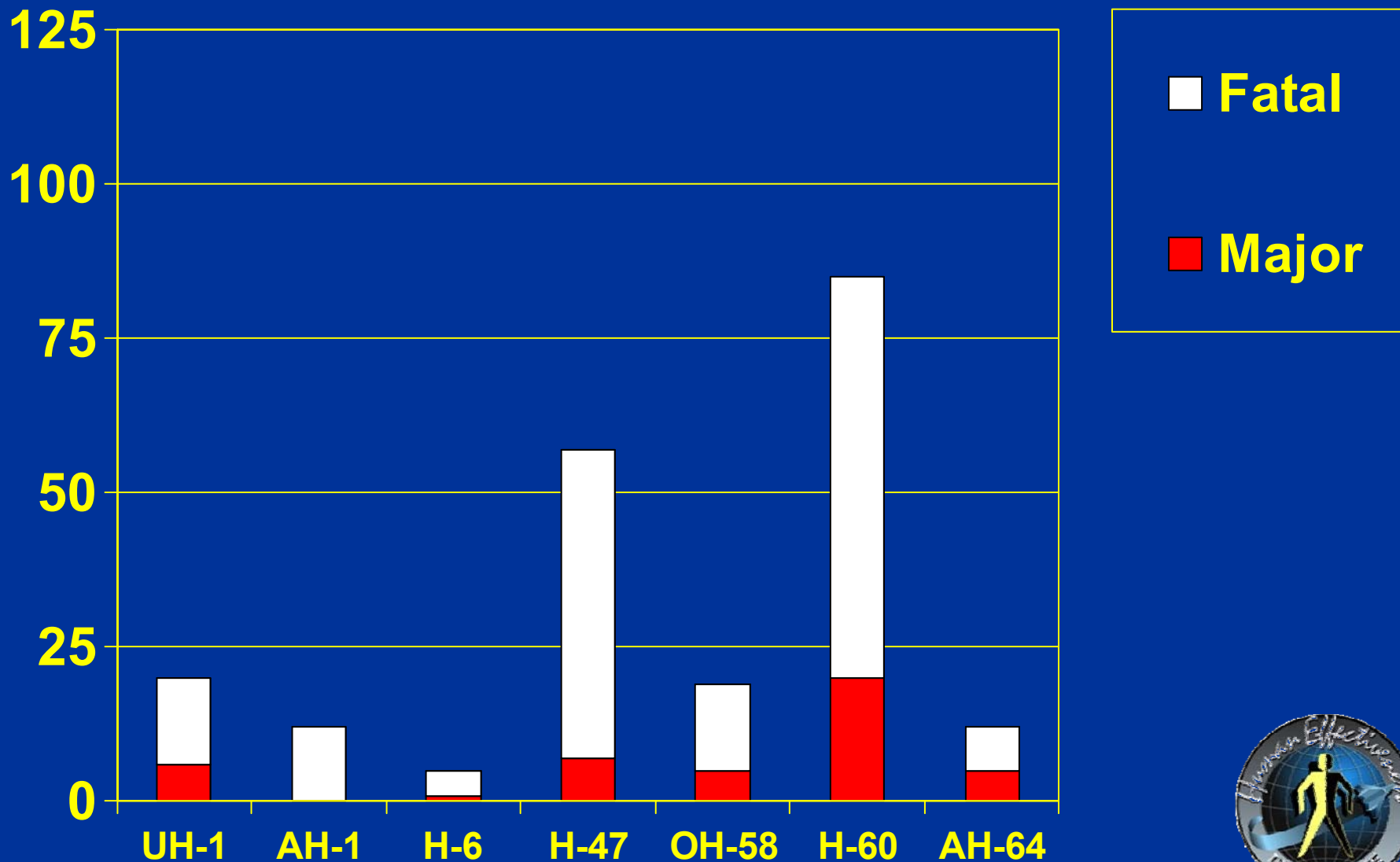


NHF Injury Rates/100K Hours Adjusted for average personnel on board



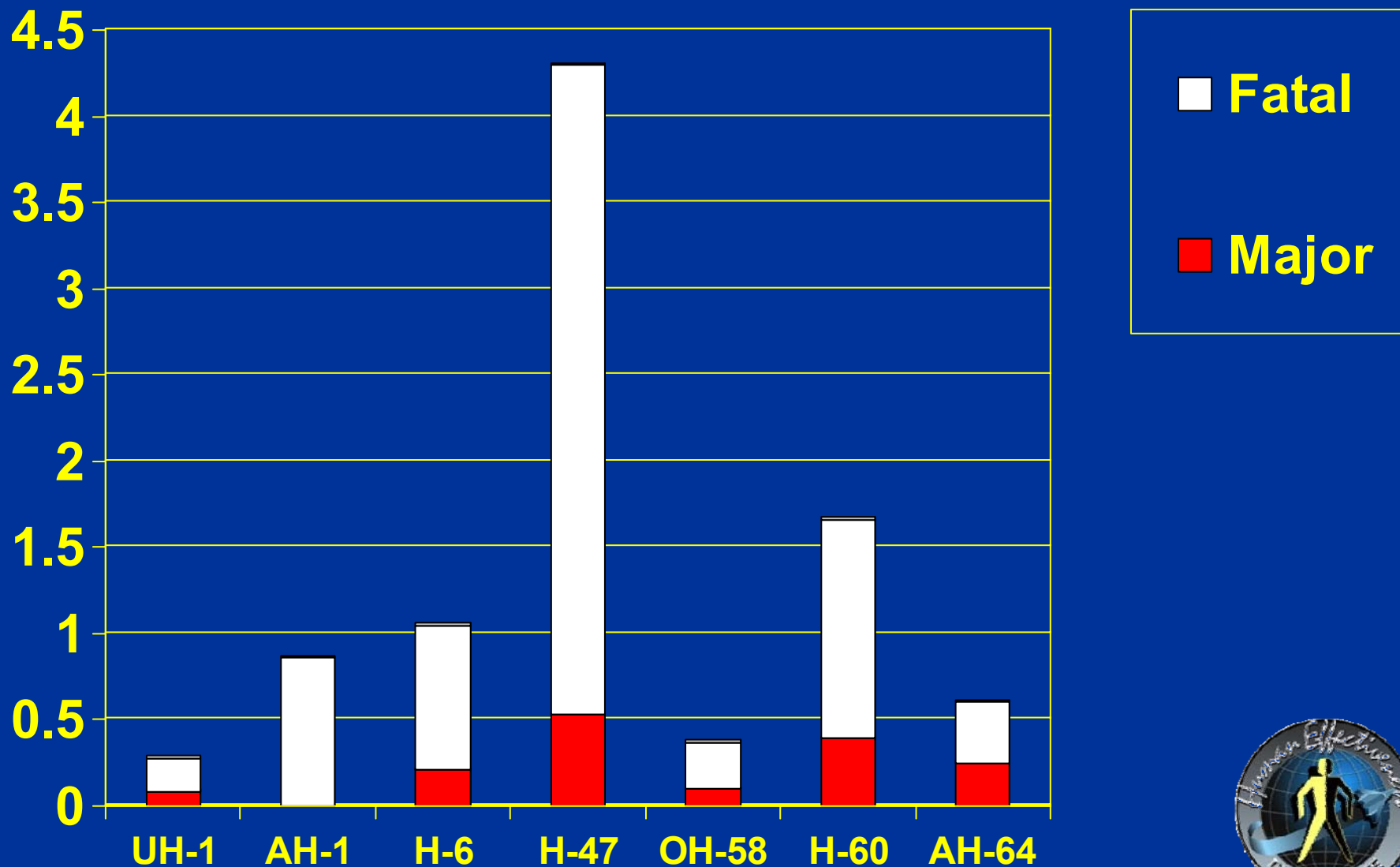


NHF Fatalities & Major Injuries by MDS



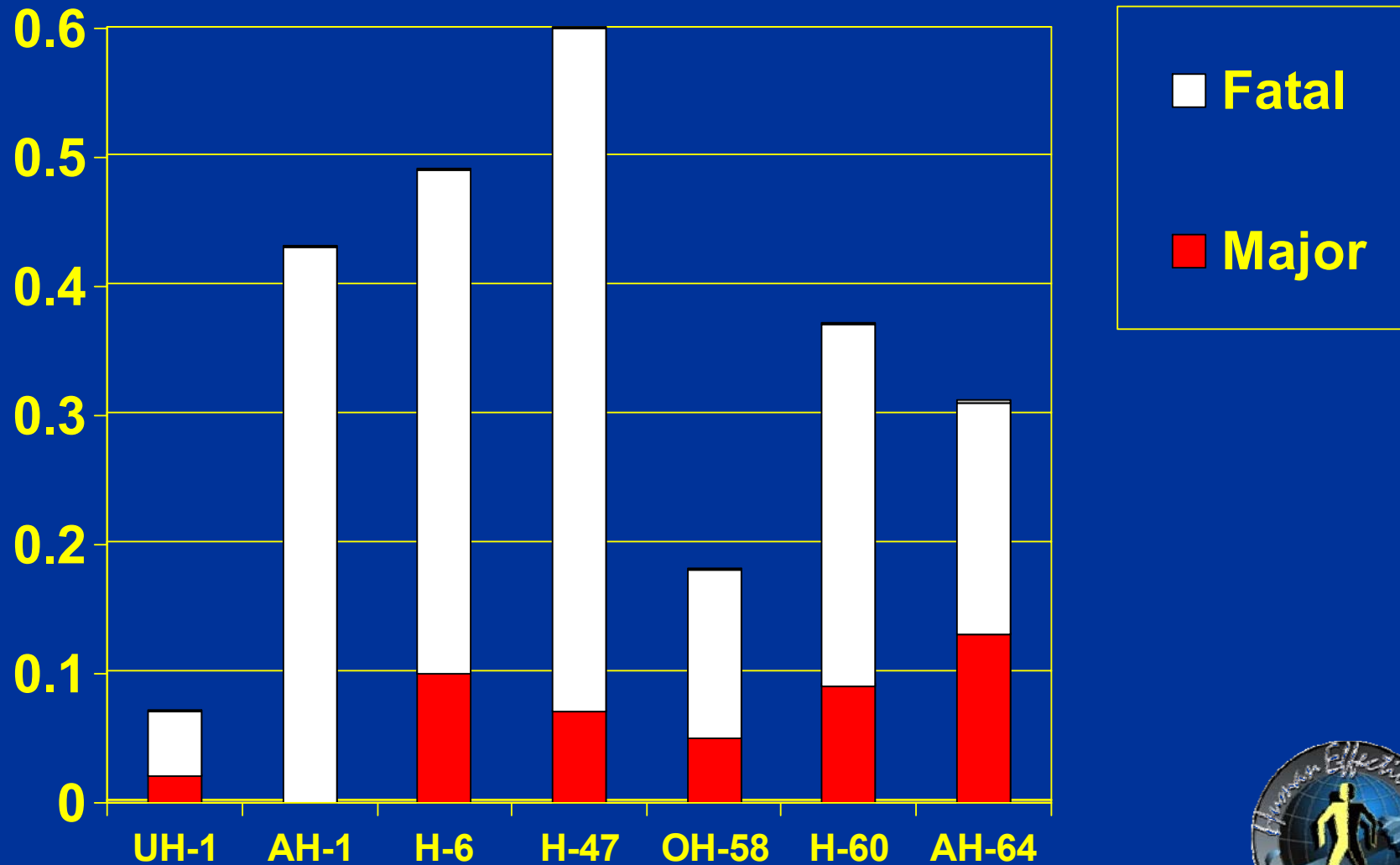


NHF Fatality & Injury Rates by MDS/100K Hours



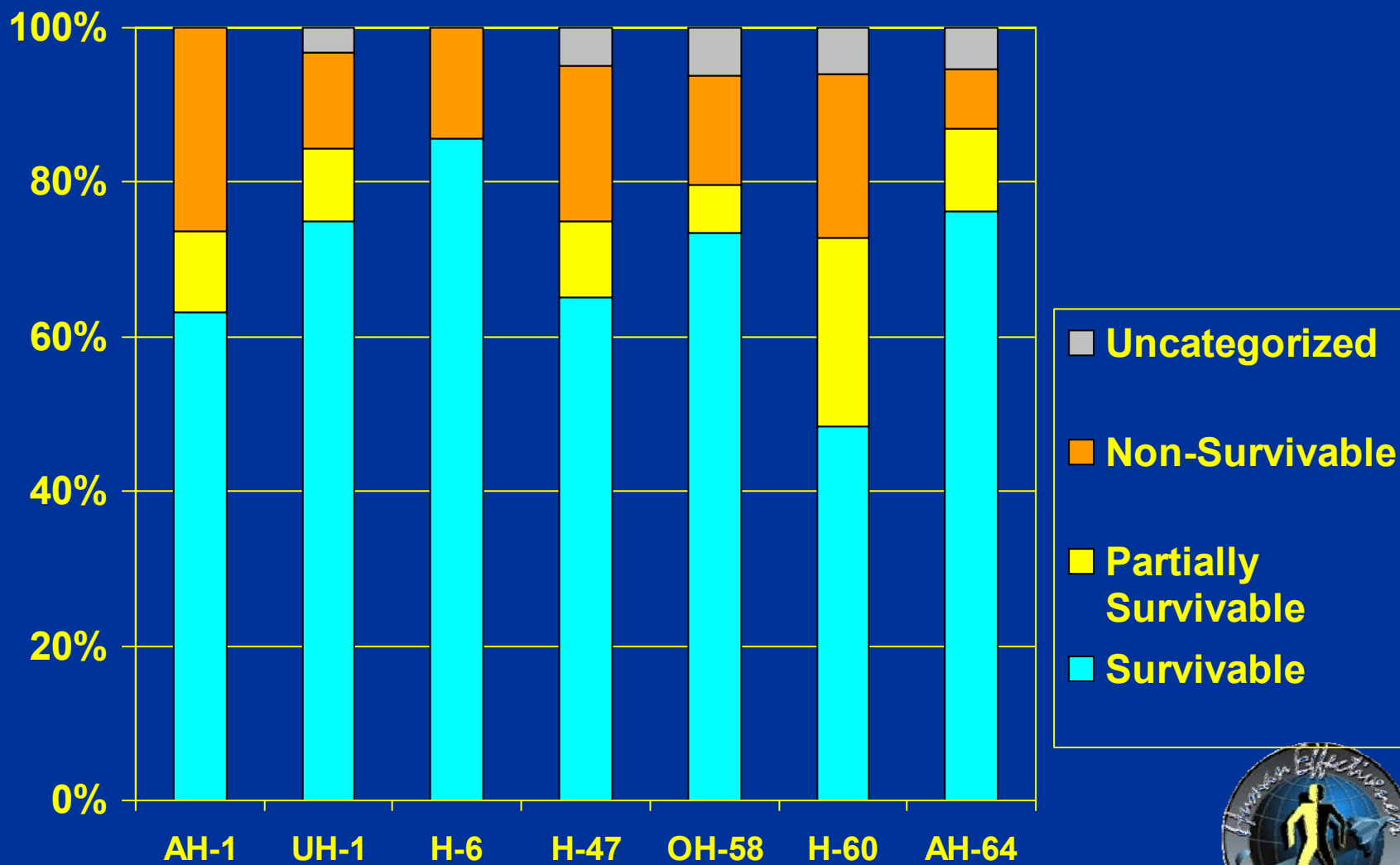


NHF Fatality & Injury Rates by MDS/100K Hours - Adjusted



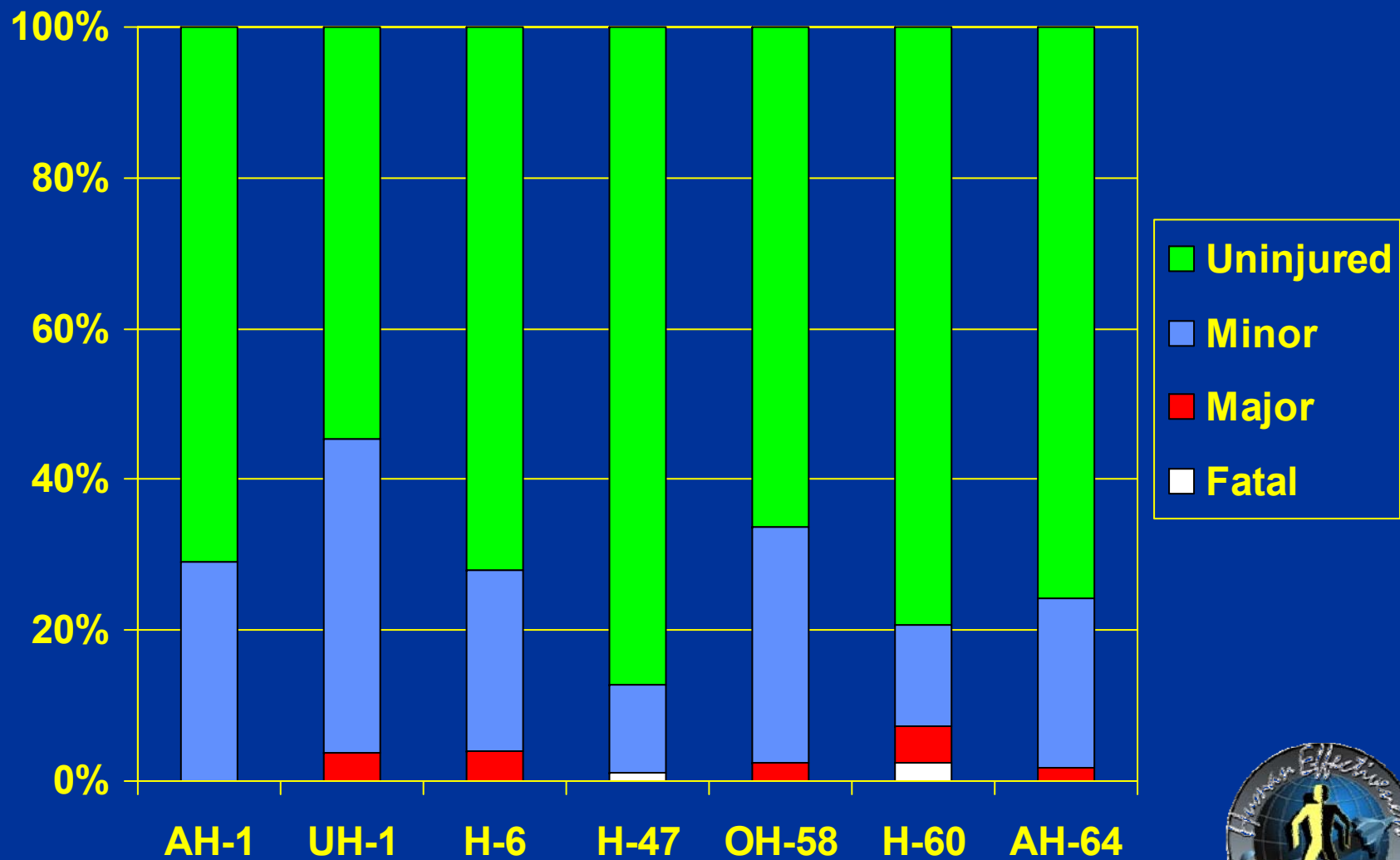


Percent Survivable Mishaps



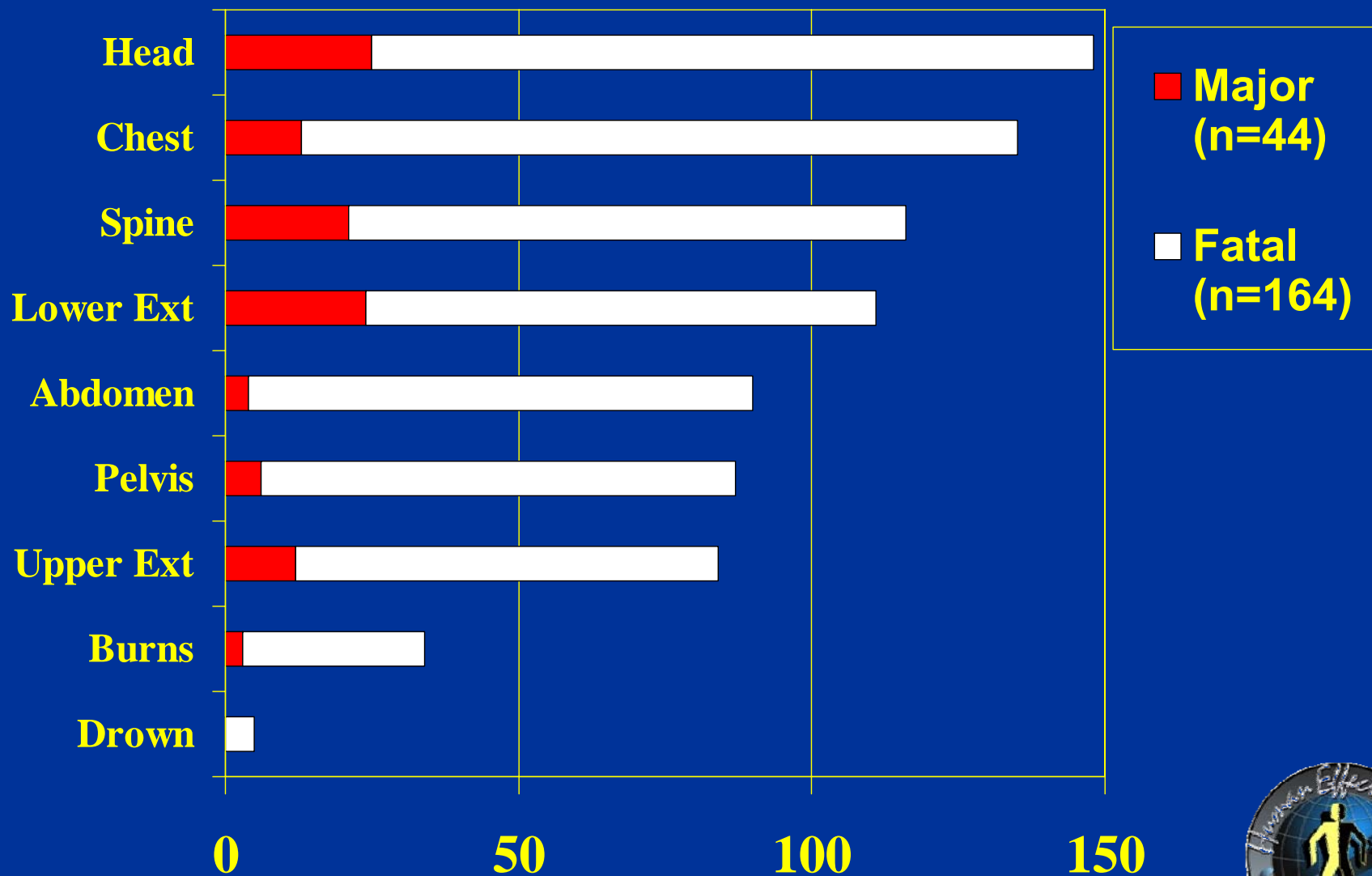


Percent Injuries in Survivable Mishaps





Army Rotary Wing Non-Human Factor Mishap Fatalities & Injuries





Pilot Fatality and Injury Location



PILOT Injuries n=409	Fatal	Major	Minor	Total
Head	60	14	39	113 (27.6%)
Chest	60	5	13	78 (19.1%)
Abdomen	43	2	3	48 (11.7%)
Pelvis	36	1	5	42 (10.3%)
Upper Ext	35	8	23	66 (16.1%)
Lower Ext	41	14	47	102 (24.9%)
Spine	45	17	35	97 (23.7%)

Pilot injuries were most often to the head, lower extremity, and spine in NHF mishaps





Pilot Fatality and Injury Location



PILOTS (N = 409)	Fatal (N=69)	Non-Fatal (N=340)	Percent Fatal
Head	60 (87.0%)	53	53.1%
Chest	60 (87.0%)	18	76.9%
Abdomen	43 (62.3%)	5	89.6%
Pelvis	36 (52.2%)	6	85.7%
Upper Ext.	35 (50.7%)	31	53.0%
Lower Ext.	41 (59.4%)	61	40.2%
Spine	45 (65.2%)	52	46.4%

Percent of pilots with a given injury location who died





Non-Pilot Injury Location



Non-PILOT Injuries n=315	Fatal	Major	Minor	Total
Head	63	11	17	91 (28.9%)
Chest	62	8	5	75 (23.8%)
Abdomen	43	2	0	45 (14.3%)
Pelvis	45	5	5	55 (17.5%)
Upper Ext	37	4	13	54 (17.1%)
Lower Ext	46	10	20	76 (24.1%)
Spine	50	4	19	73 (23.2%)

Non-Pilot injuries were most often to the head, lower extremity, chest, and spine in NHF mishaps





Non-pilot Fatality and Injury Patterns, by Location



Crew & PAX	Fatal (N=95)	Non-Fatal (N=220)	Percent Fatal
Head	63 (66.3%)	28	69.2%
Chest	62 (65.3%)	13	82.7%
Abdomen	43 (45.3%)	2	95.6%
Pelvis	45 (47.4%)	10	81.8%
Upper Ext.	37 (38.9%)	17	68.5%
Lower Ext.	46 (48.4%)	30	60.5%
Spine	50 (52.6%)	23	68.5%





Paired Pilot vs. Passenger & Crew

U.S. Army Rotary Wing Non-Human Factor Mishap Fatalities & Injuries



MISHAPS N = 207	PILOTS N = 409		PAX & CREW N = 315		$\Delta\%$
	#	%	#	%	
NOT INJURED	218	53.3	132	41.9	-11.4 RR = .77 (p<.0011)
MINOR INJURY	99	24.2	67	21.3	-2.9 RR = .89 (p<.388)
MAJOR INJURY	23	5.6	21	6.7	+1.04 RR = 1.2 (P<.538)
FATAL	69	16.9	95	30.2	+13.3 RR = 1.75 (P<.00006)



Emergency Locator Transmitters

U.S. Army Rotary Wing Non-Human Factor Mishaps



MISHAPS N = 207	Fatal Mishap N = 49		Non-Fatal Mishap N = 158	
	#	%	#	%
No ELT Installed or ELT not armed	8	25.6	4	3.2
ELT Installed	41	74.4	154	96.8





Summary & Recommendations





Summary



- **NHF mishaps affect all MDS approximately equally**
- **Most NHF mishaps, injuries, and fatalities occur during cruise flight (High V^2)**
- **Most NHF cruise mishaps are due to engine failure or weather**
- **Engine failure is common to all phases of flight but is uniquely NOT the greatest problem with regards to injury during landing**
- **Head injury is associated with the greatest risk of fatality**
- **Non-pilot crew members and passengers have greater frequencies of more severe injuries than pilots**
- **Lack of an installed and armed ELT is highly associated with fatal mishaps**





Safety Technology Recommendations



- **Require all personnel aboard helicopters to wear helmets at all times**
- **Provide real time, satellite datalink weather to all helicopter pilots**
- **Improve crashworthiness, flail and Gz protection of non-pilot seating to mitigate disproportionately high injury and death rates compared to pilots**
- **Improve the ability of rear compartment crew to remain in crashworthy seating below ETL**
- **Eliminate the need to use harnesses in place of crashworthy seating**
- **Emergency Locator Transmitters should be installed and armed on all aircraft**
- **Design emergency procedures to minimize V^2**

