Airship Training and Simulation

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Airship Ventures
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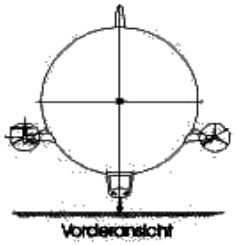
Airship Training and Simulation

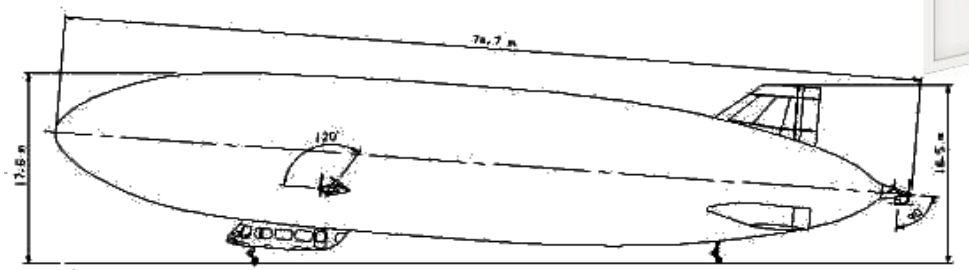
Airship Ventures

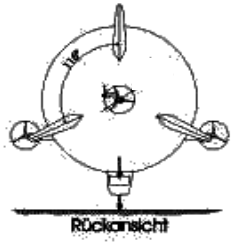
- Flying an airship
- LTA Commercial Rating
  - Ab Initio (From the Beginning)
  - Commercial Fixed or Rotary Wing
  - Transisition (Commercial LTA to Zeppelin)
- Simulator
  - Training Costs Airship vs. G-IV
  - Benifits
  - Challenges of Simulating an Airship
- Summary

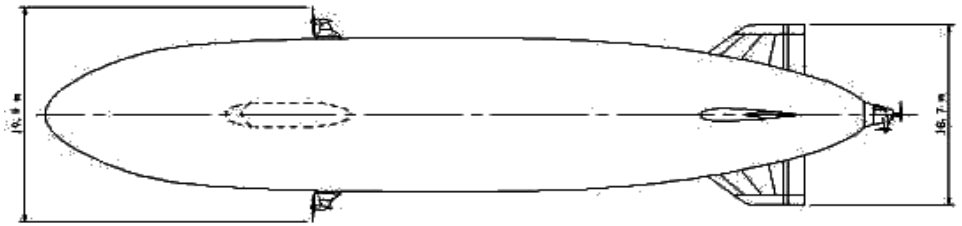
Zeppelin NT-07

Airship Ventures









DIMENSIONS

Length	75.0 m
Max. width	19.5 m
Height	17.4 m
Envelope volume	8,020 m^3
Ballonet volume	1,400 m^3
Surface area	2,630 m^2

MASS

Max. take-off weight	8,040 kg
Useful load	1,950 kg

PERFORMANCE

3 x Lycoming IO-360	200 hp
Max. level flight speed	100 km/h
Range	900 km
Ceiling	2,850 m
Max. Endurance	apx. 24 hrs

CABIN

No. of seats	2 + 12
Cabin volume	26 m^2
Cabin length	10.7 m

Zeppelin in Flight Configuration

Airship Ventures

Zeppelin NT-07

Airship Ventures

New Technology

Re-defined rigid structure – outstanding safety
aluminum / carbon fiber hybrid structure

Multi-layer composite envelope

Automatic envelope pressure system

Thrust vector flight control

Full fly-by-wire flight controls

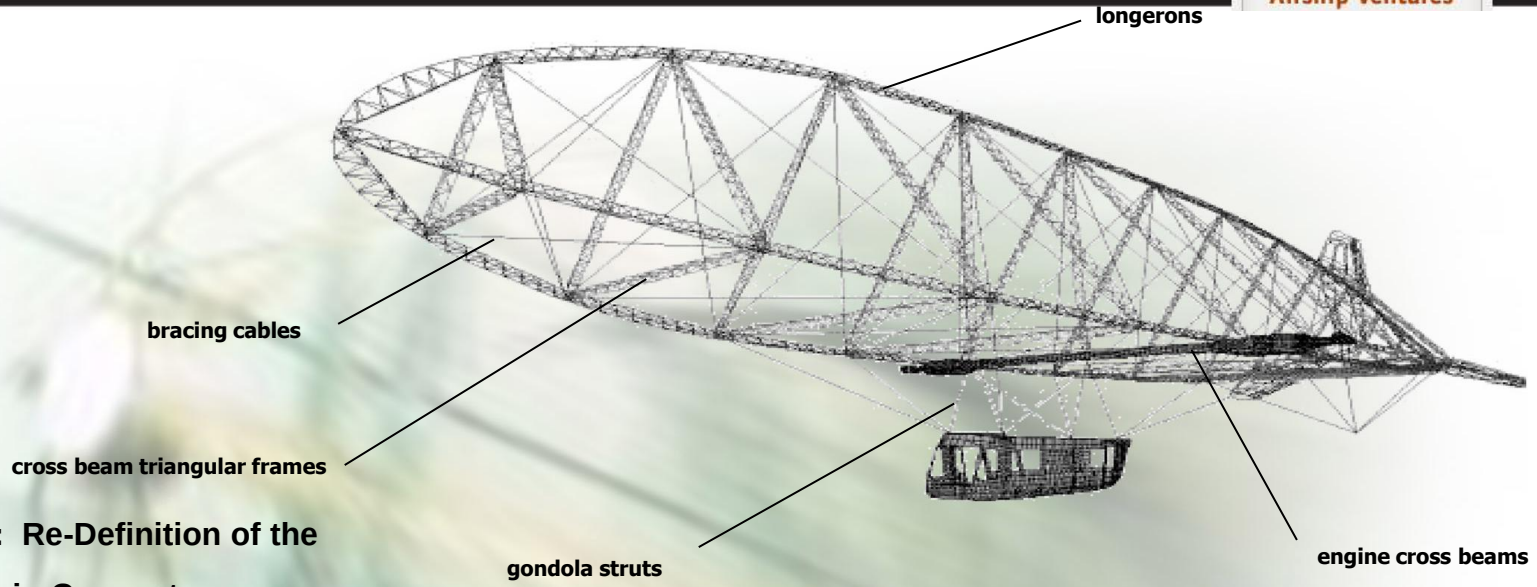
Composite empennage and cabin
state-of-the-art light weight construction




Zeppelin NT in Landing Configuration

Airship Ventures

Zeppelin NT-07



The Zeppelin NT: Re-Definition of the Semi-Rigid Airship Concept

Zeppelin NT internal rigid structure:

Comprises 3 longerons

Connected via 12 triangular frames

Engines, passenger gondola and empennage attached to rigid structure.

Envelope attached to the structure

Increased total stability through helium inflated envelope

In case of loss of helium pressure structure ensures flight controllability – **no envelope collapse**

Airship Flight

Airship Ventures

Our airship flies with the combination of three forces:

Static Lift – the buoyancy provided by the lifting gas ~7200 m^3 – constant from sea level to pressure ceiling

Dynamic lift – the aerodynamic lift provided by the air moving over the envelope – dependant on airspeed

Vectored Thrust – the power provided by the static thrust of the propellers angled upwards – dependant on throttle setting

Aerostatics

Airship Ventures

Super Heat – helium becomes warmer than the outside air temperature – less dense, more lift

- This occurs daily
  - After sunrise and prior to flight the superheat value measured in 1 degree C increments can reach up to 10 degrees C for a light colored ship
  - After takeoff, this value will decrease due to air flow over the envelope and within the ballonet
  - Superheat value will increase at zero airspeed
  - Superheat value will change in flight
    - Day to Night or Night to Day flight
    - IFR to VFR or vice versa
  - 3 degrees of superheat in the NT-07 equals approximately 100 kg of additional static lift
- Temperature Inversion
  - cooler air trapped near the ground – causes sudden increase in lift during approach

Zeppelin
TRAINING

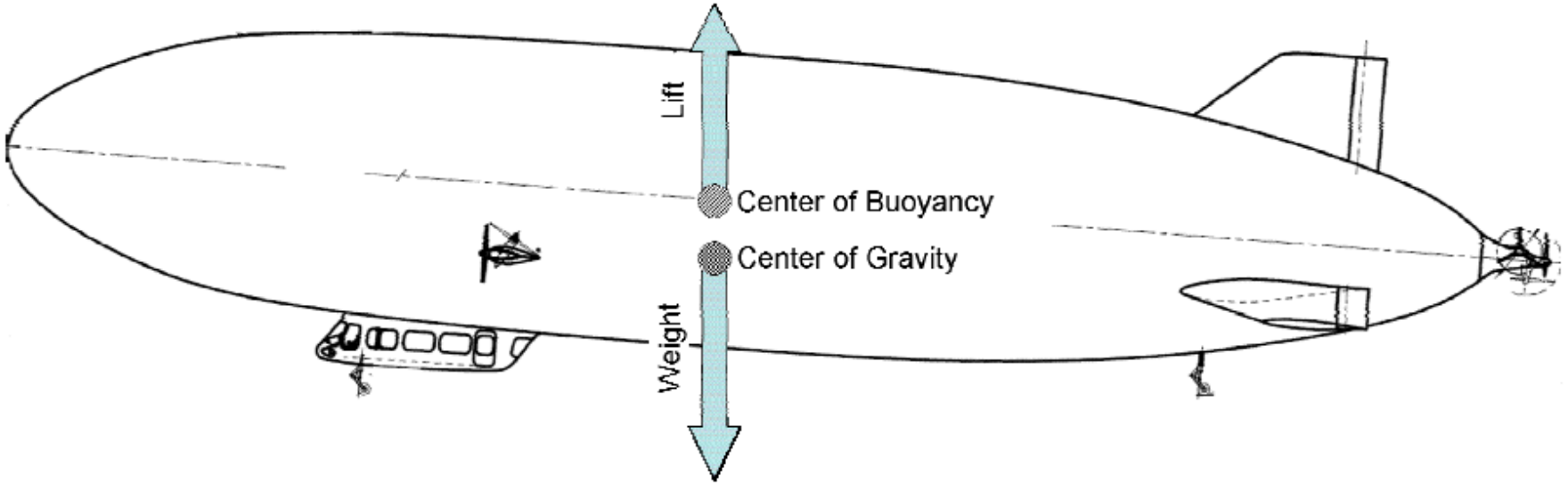
1. Weight and Balance Basics

1.1 Airship Weight and Balance – Weight (Heaviness)

The **lift** of an airship comes from the weight difference between helium and air. For better understanding of weight and balance of an airship, the lift can be merged to one point. This point is called **Center of Buoyancy.**

The **weights** of an airship can be merged to one point too. This point is called **Center of Gravity**.

The heaviness of the airship is defined by: **Heaviness = Weight – Lift**



Ballonets

Airship Ventures

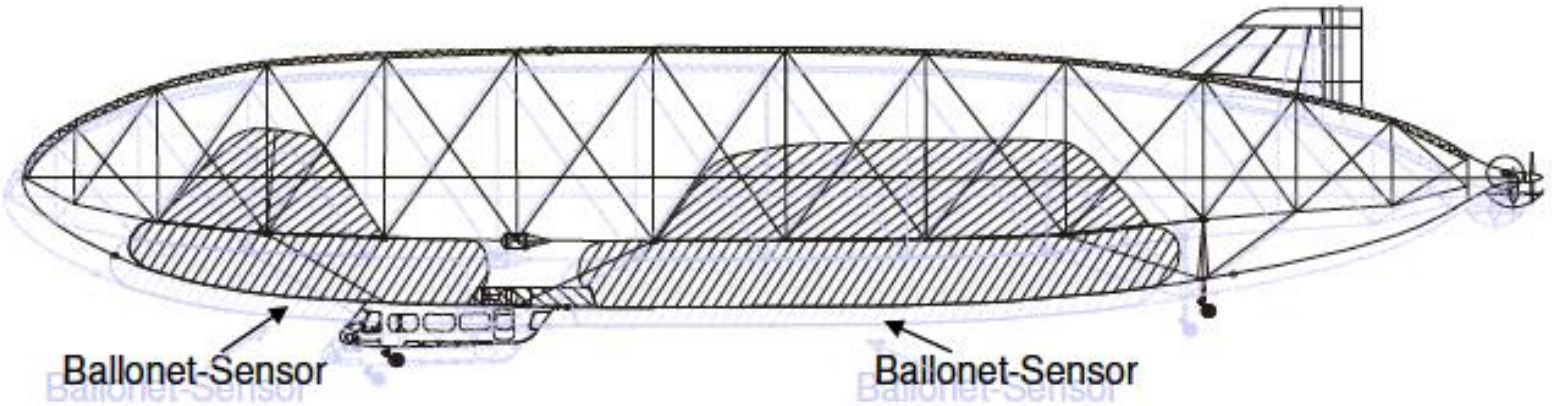
Ballonets are inflatable bags located inside the airship that can be filled with air

The Ballonets perform two functions:

- Maintain a constant pressure on the envelope by compensating for the expansion and contraction of the helium as the temperature or altitude of the airship changes
- Maintaining the trim of the airship fore and aft

As the airship rises in the atmosphere, the helium expands due to lowered external air pressure – air is forced from the ballonets through relief valves

When the ballonets are empty, the airship is at its pressure ceiling – and cannot rise further without risking damage to the envelope or venting (expensive) helium



Flight Factors

Airship Ventures

Helium Volume

- "Shoot" helium (add helium to the envelope)
- Or release helium via the valves
- We lose some amount of helium each day from osmosis and leaks

Helium Purity

- Attach aircraft to helium purification plant (about every 6 weeks)
- Air and humidity get into the envelope

Fuel

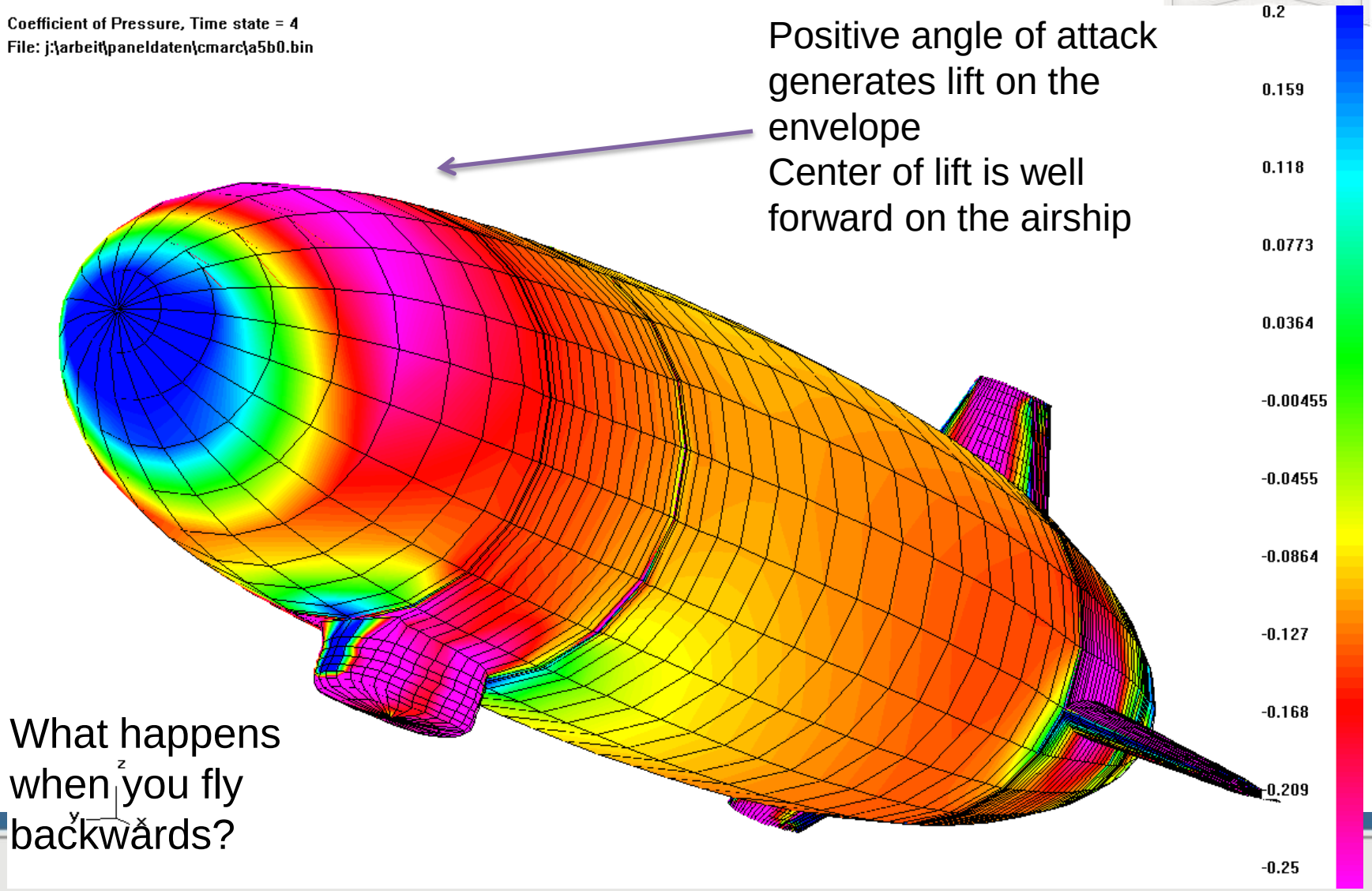
Ballast

- Ballast is our safety net in case we have an emergency, a strong descent, or have to vent helium

Service Load (passengers and payloads)

Aerodynamic Lift

Airship Ventures

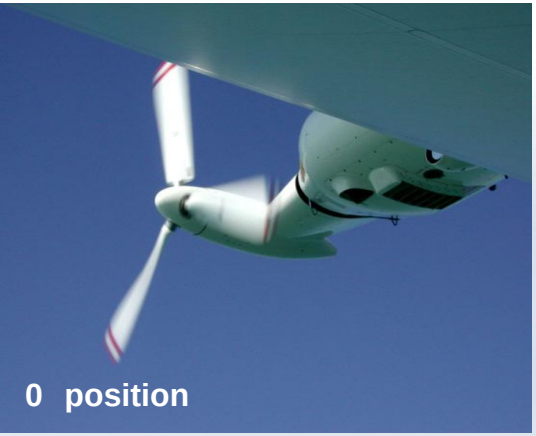


Positive angle of attack generates lift on the envelope
Center of lift is well forward on the airship

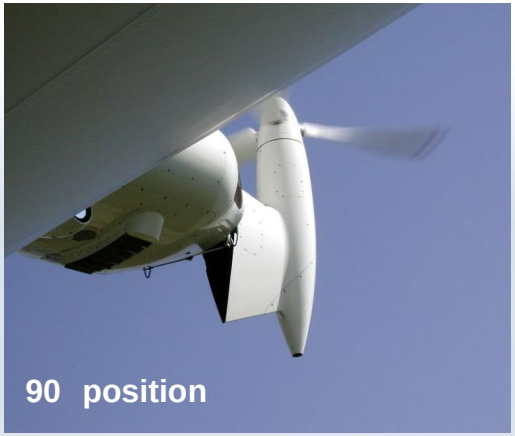
What happens when you fly backwards?

Zeppelin NT-07 Thrust Vector Control

Lateral Power Plants



0 position



90 position

Aft Power Plant

The Zeppelin NT: Thrust Vector Control – Propulsion System

Two lateral power plants, with a 0 to 120 propeller swivel range and adjustable pitch propeller blades for precise thrust and direction adjustability

One additional dual propeller (one swivel) aft power plant for simultaneous lateral and vertical thrust

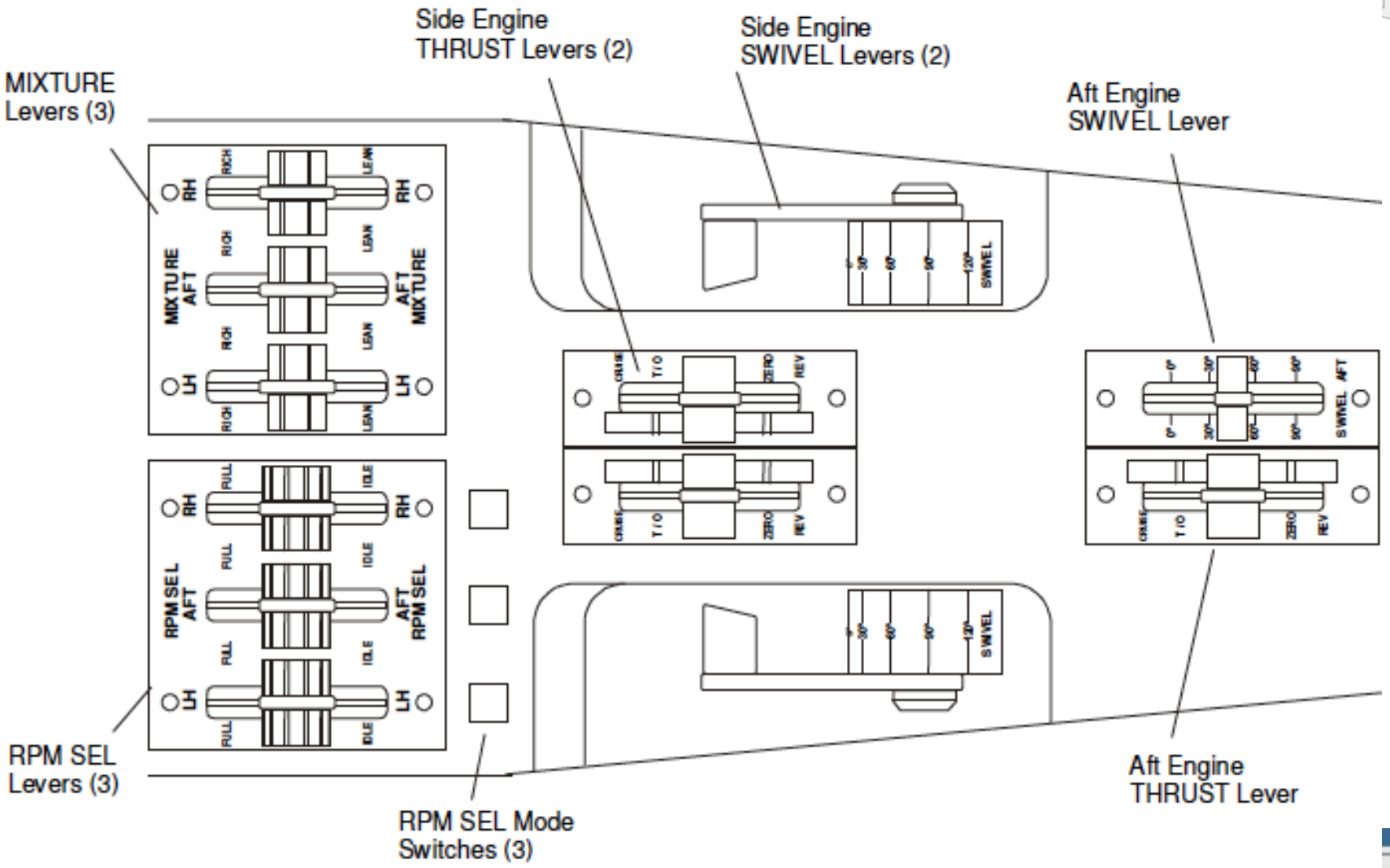
Maximum maneuverability sustained during take off and landing when aerodynamic control is ineffective

Continuous complete pilot control at all flight conditions

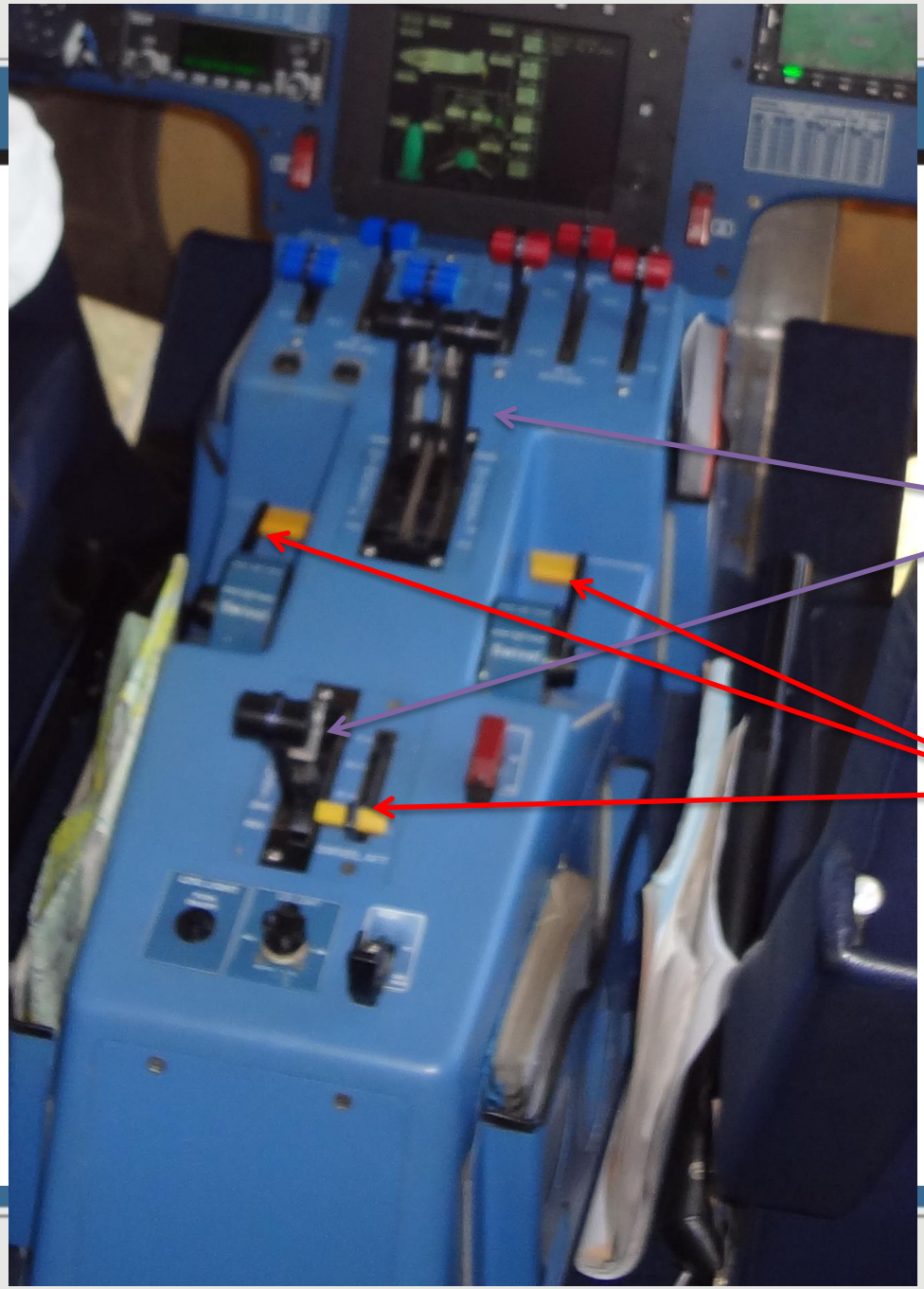
Only 3 ground crew necessary for passenger turn-around (12 passengers) in four minutes

Thrust Controls

Airship Ventures



Thrust Controls



Thrust Levers (black)

Swivel Controls (Yellow)

Thrust levers control the pitch of the propellers – including zero and reverse. Throttles are automatic

Getting your Airship Rating

LTA Commercial Rating – Ab Initio (no experience)

Airship Ventures

Standard duration of training: Approximately 20 months

Maximum duration of training: 24 months

Theoretical (ground) training: 300 hours

Practical training: Three months on a ground crew

Minimum of 50 training flight hours

Minimum of 150 supervised flight hours

Pass the Written Test, Practical Test, and Class II Medical

“Supervised” means a current, rated commercial pilot is in the other seat

LTA Rating – Commercial Fixed/Rotary Wing

Standard duration of training: Approximately 15 months

Theoretical training: Minimum of 93 hours

Practical training: Three months on a ground crew

Minimum of 40 training flight hours

Minimum of 130 supervised flight hours

Pass the Written Test, Practical Test, and Class II Medical

There is NO Airship Flight Instructor rating – any commercial Airship Pilot can act as a CFI - and therefore the CFI material (FOI) is on the Commercial Airship test

Zeppelin Transition – LTA Commercial Pilot

Airship Ventures

Standard duration of training: Approximately four months

Theoretical training: Minimum of 49 hours

Practical training: Minimum of 25 training flight hours

Minimum of 100 supervised flight hours

No additional FAA Written or practical test is required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Ground School

(a) Zeppelin Airship systems training;

(b) Airship flight manual (AFM) and all appropriate AFM supplements;

(c) Use of emergency equipment;

(d) Use of the PITEX computerized weight and balance program;

(e) Use of the FAA-Approved minimum equipment list (MEL);

(f) Pre-flight inspection procedures;

(g) Normal procedures;

(h) Abnormal and emergency procedures;

(i) Engine runups and systems checks;

(j) Ground crew coordination to include unmasting;

(k) Refueling operations;

(l) Masting and taxiing with the mast truck, and

(m) Post-flight procedures.

Flight Training (p1)

Airship Ventures

1. Flight and Crew Coordination
2. Weight and Balance and Trim
3. Pre-Flight and Checklists
4. Engine Runs and System Checks
5. Ground Maneuvering on the Mast
6. Straight and level Flight (Altitude/Heading)
7. Turns, Climbs and Descents (Alt/Pressure) Control
8. Unmasting Procedures
9. Ground Maneuvering Off the Mast
10. Takeoff with Various Static Heaviness

Flight Training (p2)

Airship Ventures

11. Takeoff with Maximum Static Heaviness
12. Transition into Flight Configuration
13. Flight to and from Pressure Height
14. In-Flight Weigh-Off
15. Manual Pressure Control
16. Trim in Flight
17. Hovering Maneuvers
18. Approaches to Landings
19. Landing with Various Static Heaviness
20. Landing with Maximum Static Heaviness

Flight Training (p3)

21. Landing Light and at Equilibrium
22. Landing with Maximum Static Lightness
23. Go-Around Procedures
24. Ground Maneuvering off the Mast
25. Masting Procedures

26-28 Flying by Instruments

29. Engine Failure and Runaways on Takeoff
30. Vector Failure and Runaways on Takeoff
31. Engine Failure and Runaways on Landing
32. Vector Failure and Runaways on Landing or during Hover
33. Engine Failure and Runaways in Flight
34. Vector Failure and Runaways in Flight
35. Engine Failure and Runaways during Hover

Flight Training (p4)

Airship Ventures

36. Free Ballooning
37. Envelope Emergencies
38. Ditching and Emergency Landings
39. Electrical System Failures
40. Aerodynamic System Control Failures
41. Fire Emergencies

… + 28 more emergencies and failures

Zeppelin Flight Training by Airship Ventures

Zeppelin Flight Experience

- 8 hours ground school
- Walkthrough of Airship Preflight
- 30 minutes of “stick time”

Airship Currency

Airship Flight Training (LTA)

Airship Flight Training (Non-LTA)

Simulators

A Simulator artificially recreates aircraft flight and the flight environment

Several types:

- Procedural – switches, knobs and dials, checklists
- Physics – flight models, aerodynamics – may be used for research, engineering (CFD, FEA, etc.)
- Desktop – PC / display + joystick
- Handling – responses, power, controls
- Full Flight Simulator – cockpit, handling, and environment
  - FAA approved for logging time

Why do we care?

Practice emergency procedures without risk to the airship

Practice rare events (major envelope leak)

Environmental Conditions outside of normal range

Flight operations out of normal range (CG extremes, exceeding pressure ceiling)

Practice time consuming events (IFR approaches)

Cost of training pilots

Cost of a Gulfstream IV Rating

Airship Ventures

G-IV - $36M, seats 14-19, 73,000 lbs, Mach 0.88 (528mph)

21 days – $26,200 – 120 hours

Of which 100% are in the simulator

$218/hour

1 hour in the aircraft = $5500

120 hours = $660,000

Full Flight Simulators

FAA - Levels A-D

ICAO Document 9625-3 Types 1-7

Positive Transfer of Training

- Habits learned in the simulator directly correspond to habits needed to fly the actual aircraft

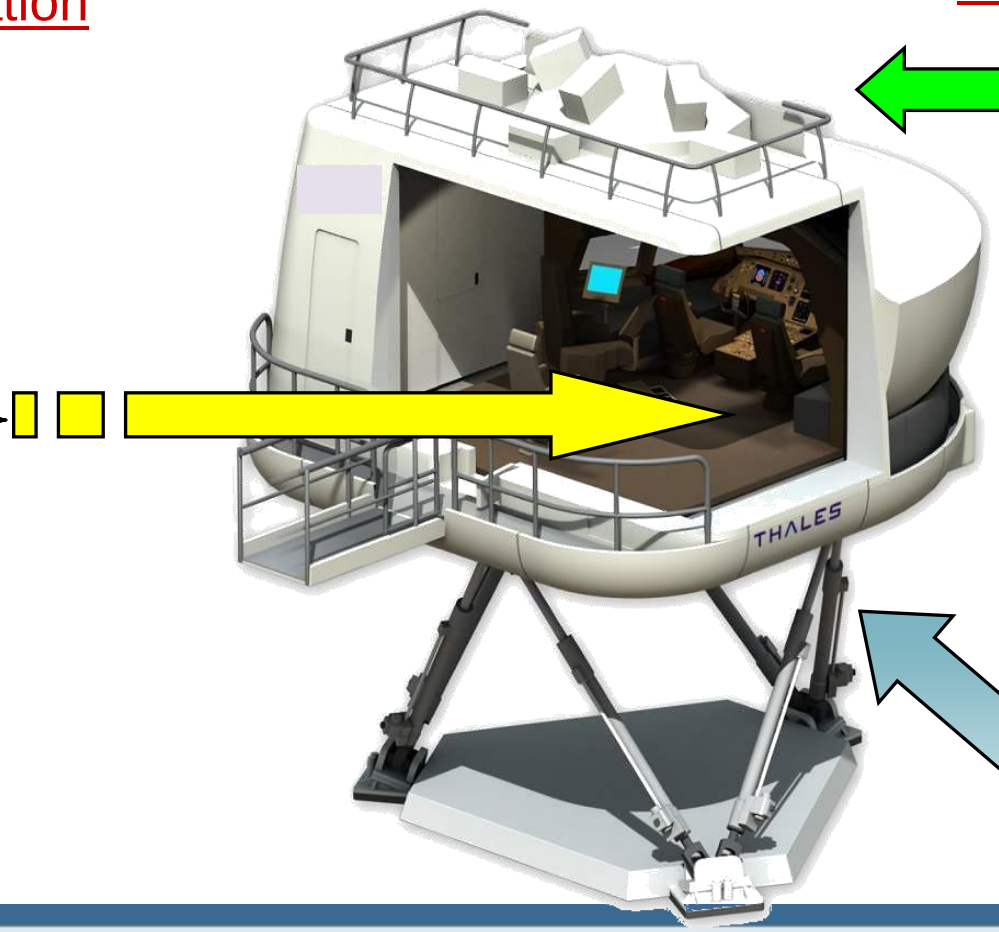
Simulation Features

Airship Ventures

- Agreed list of simulation features elements required to support any individual training task

Aircraft Simulation

- Flight Model – Aero & Engine
- Airship Systems
- Ground Handling
- Flight Controls & Forces
- Cockpit layout



Environment Simulation

- Environment ATC
- Environment Weather
- Environment Navigation
- Environment Aerodrome & Terrain

Cueing Simulation

- Sound Cue
- Visual Cue
- Motion Cue

Source: ICAO “Simulator Int. Working Group”

High-Level Requirements for ICAO Standard FSTDs

Color legend	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII
Specific Represent. Generic	PPL, MPL1, CPL (All T)	IR (T)	Class Rating (T)	MPL2 (T+TP)	TR, ATPL IO, RO, RL (All T)	MPL3 (T+TP)	TR, ATPL MPL4 RE, RO, RL IO, CQ (TP)
Cockpit & Structure	Class, enclosed	Generic, Open	Class, enclosed	Class, enclosed	Aircraft replica, enclosed	Class, enclosed	Aircraft replica, enclosed
Instruments & Panels	Flat Panel & Overlay				Hi Quality Flat Panel & Overlay	High Quality Flat Panel & Overlay	+Full 3D replication
Non sim area	Open				Enclosed		Enclosed
Visual display	200 x 40 Direct	45 x 30 Flat Screen	200 x 40 Direct	45 x 30 Flat Screen	200 x 40 Direct	200 x 40 Collimated	200 x 40 Collimated
Motion	None				None	Reduced 6 DOF	Full 6 DOF
Flt & Flt Ctrl	Class rep.	Generic	Class rep.	Generic	Aircraft Specific	Class rep.	Aircraft Specific
Aircraft Systems	Aircraft Representative (Required Procedures)				Specific (All proc.)	Class rep.	Specific (All proc.)
Air Traffic Control	None	Background Chatter	None	Background Chatter	Background Chatter	+ Dynamic Automated Environment	+ Dynamic ATC Environment

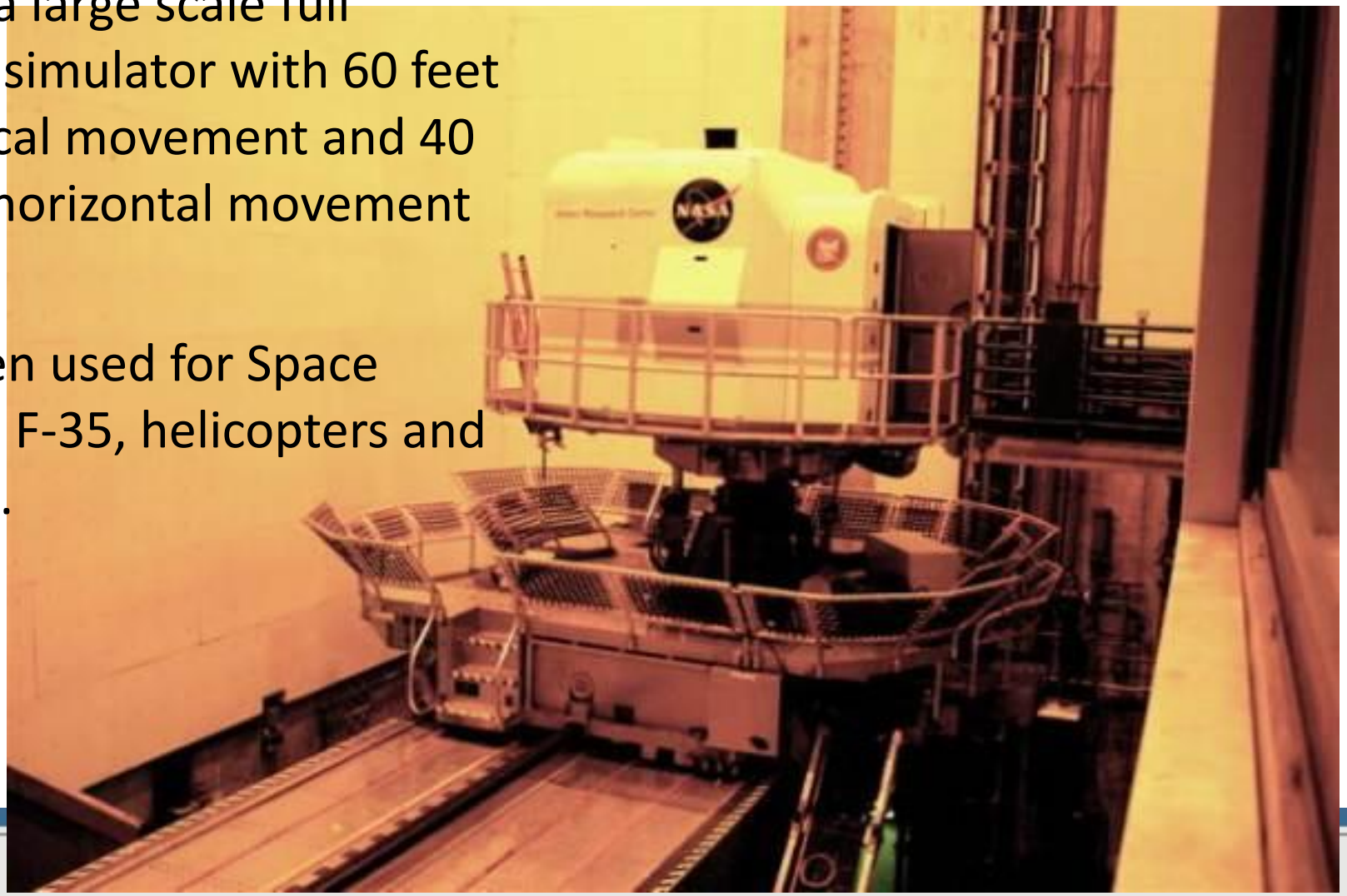
Source: ICAO “Simulator Int. Working Group”

NASA Vertical Motion Simulator

Airship Ventures

VMS is a large scale full motion simulator with 60 feet of vertical movement and 40 feet of horizontal movement

Has been used for Space Shuttle, F-35, helicopters and airships.




Questions ?
Eureka