FAAM Facility for Airborne Atmospheric Measurements

FAAM Engineering

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Met Office

NATURAL ENVIRONMENT RESEARCH COUNCIL

Introduction

- FAAM functions to provide an airborne research facility for the UK's atmospheric research community.
- The aircraft is owned by BAE Systems, and operated by BAE Systems sub-contractors.
- As well as owning the aircraft, BAE Systems are both manufacturer and the design authority.

The Structure of FAAM

- FAAM's infrastructure costs are shared by NERC and The Met Office.
- Both NERC and The Met Office also provide the conduits to resource approximately 250 flight hours each per annum.
- Met Office flight hours essentially support continued research to improve Met Office numerical weather prediction.
- NERC flight hours are applied for by the UK University community, covering a broad range of atmospheric research.

Infrastructure Resources

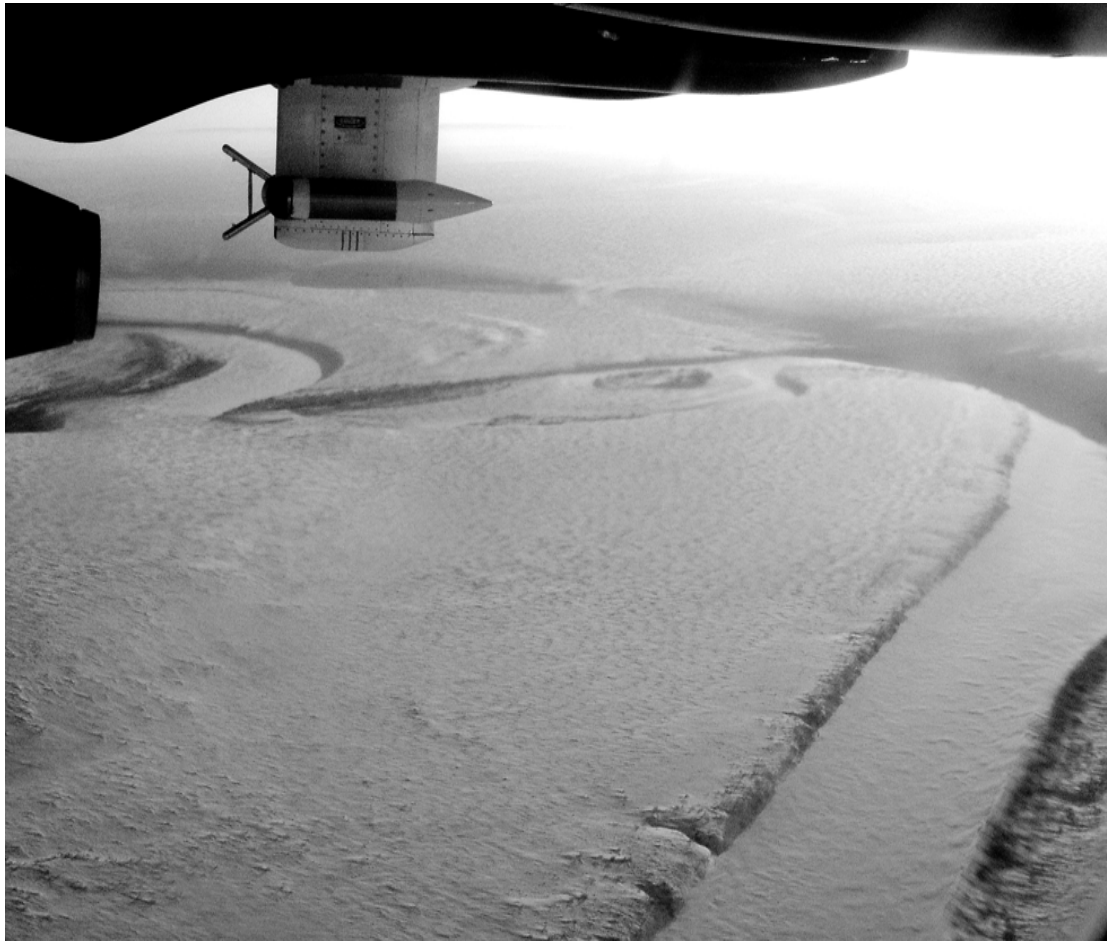
- Staff costs
- Development of the core instrumentation
- Development of data processing equipment
- Development of the aircraft platform
- Developing the processes by which we manage the aircraft's payload

plus ca change…

The more that things change…

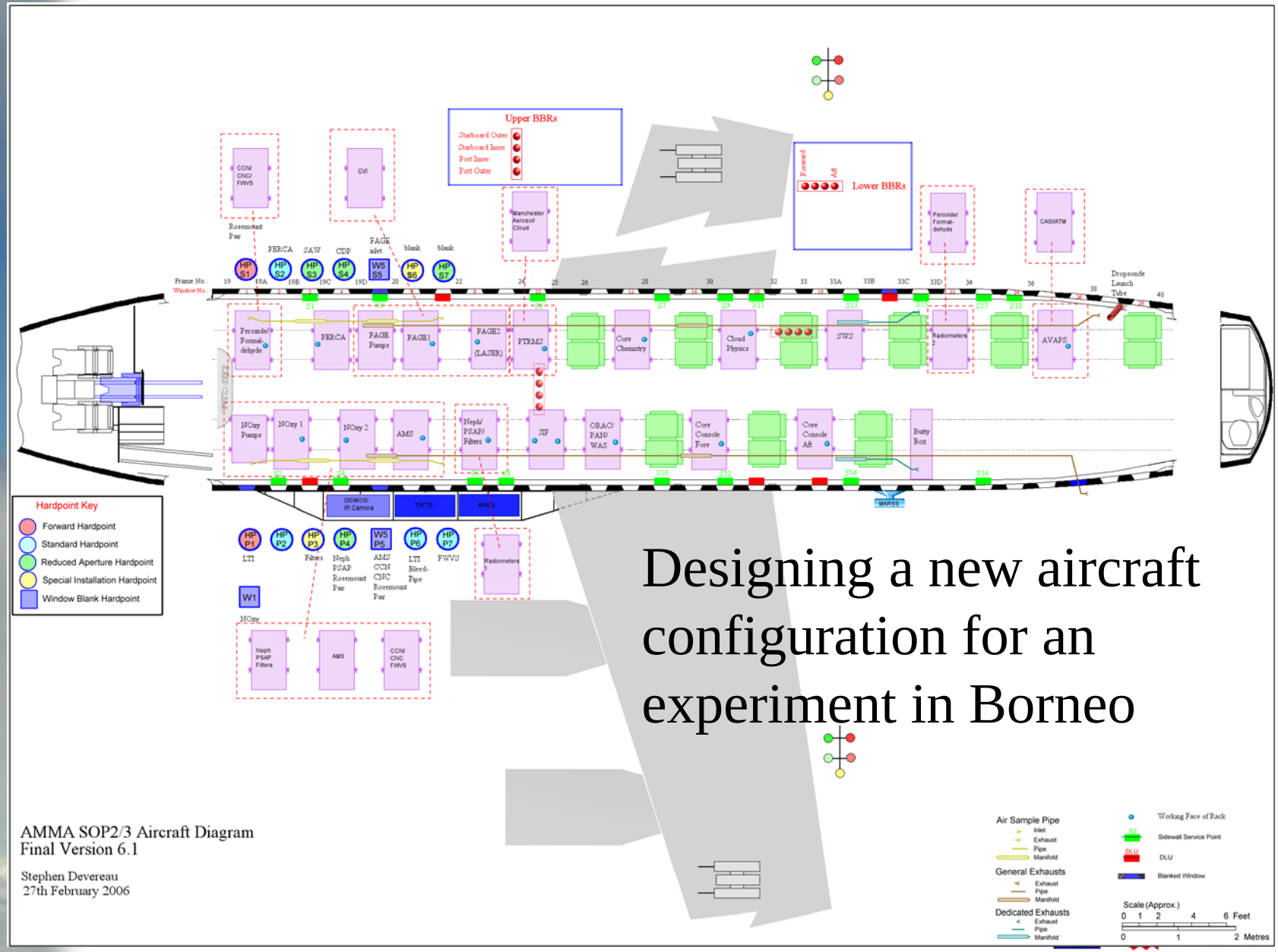
…the more they stay the same

To stand this aphorism on its head, to stay the same the more we have to change!



Payload

- In an average year, we change the instrument configuration about 40 times
- We will also make at least one major change to the aircraft configuration per year, often at the same time as the annual C-check
- All this is achieved using procedures developed between BAE Systems and FAAM


Upper BBRs
Starboard Outer
Starboard Inner
Port Inner
Port Outer
Lower BBRs
Forward
Aft
Hardpoint Key
Forward Hardpoint
Standard Hardpoint
Reduced Aperture Hardpoint
Special Installation Hardpoint
Window Blank Hardpoint
Designing a new aircraft configuration for an experiment in Borneo
AMMA SOP2/3 Aircraft Diagram
Final Version 6.1
Stephen Devereau
27th February 2006
Air Sample Pipe
General Exhausts
Dedicated Exhausts
Working Face of Rack
Sidewall Service Point
DLU
Blanked Window
Scale (Approx.)
6 Feet
2 Metres

Payload (2)

Rapid payload change is essential to the way we operate the aircraft:

- Maximises the time we can fly
- The payload can be tailored to the science requirements e.g. to maximise the flight duration

Developing the Platform

- Power for the science equipment
- Flexibility of payload – to get the maximum science from our flights
- Better communications to allow us to send real-time data from the aircraft
- Improved refuelling time to keep us airborne
- Improved intercom
- Integration of pilot displays with the data from our instruments

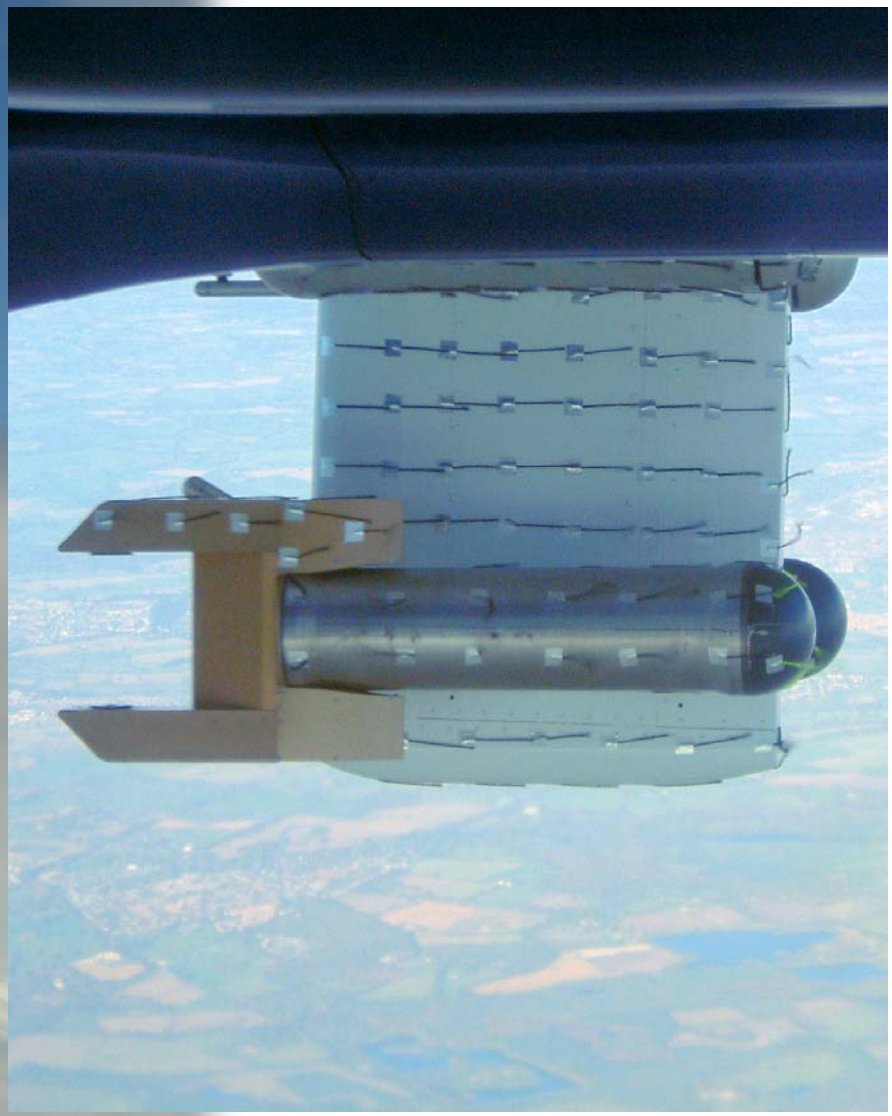
Instruments

Core Instruments

- Supplied on every flight
- Maintained and developed by FAAM
- Paid for using FAAM's infrastructure budget
- Installation of new instruments managed by FAAM.

Non-Core Instruments

- Specialist instruments from the Universities and the Met Office
- Maintained and developed by the originating research group
- Paid for by the originating research group
- Installation of new instruments managed by FAAM.



Engineering Support

- Mostly, but not exclusively, supplied by BAE Systems
- Installation of new instruments or upgrading existing instruments
- Role changes - changes to the layout of the instruments, both in the cabin and externally
- An aircraft infrastructure efficiently tailored to the requirements of the science
- All this against a backdrop of working with a passenger carrying aircraft!

Instrument Considerations

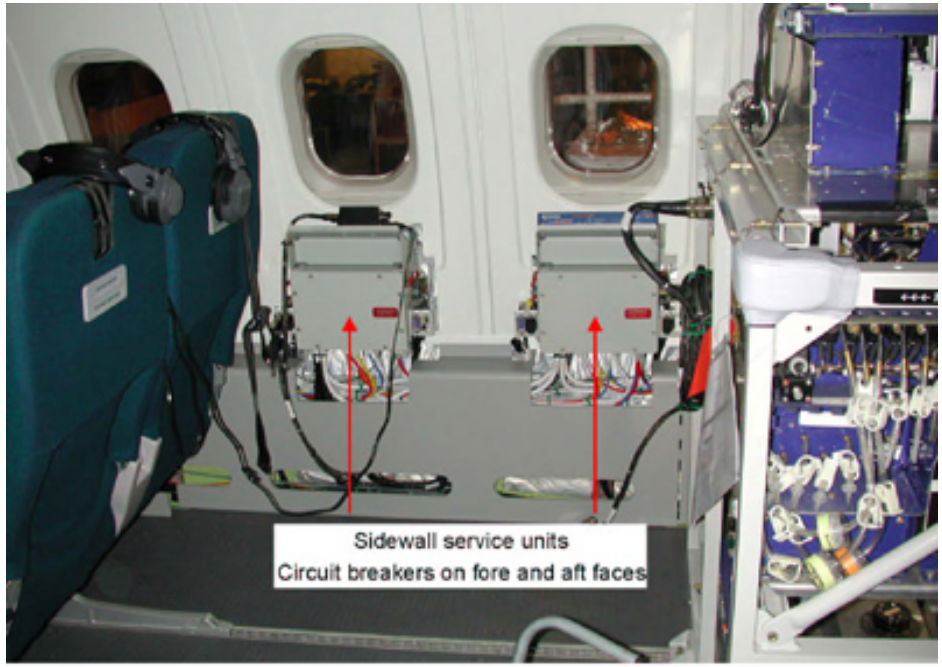
- Power – what is required?
- Space
- Weight
- Aerodynamics
- Safety
- Interface

Power

- The aircraft supplies power from generators on the engines.
- Three flavours – 230V ac, 3-phase 115V ac, 28V dc
- 50 kVA available

Power (2)

- Available via Sidewall Service Points



3 on one face and four on the other

Space

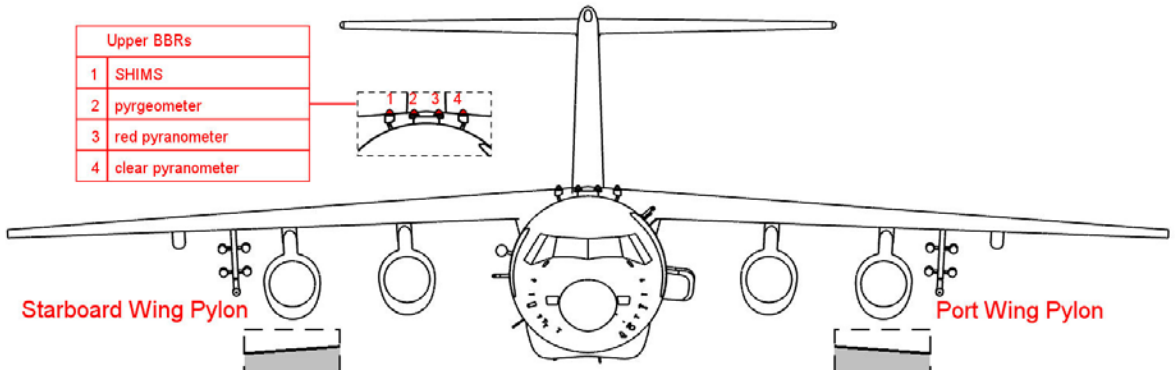
- FAAM has access to more instruments than it can fit at one time
- Instruments in the cabin must fit within a FAAM supplied rack or racks

Space (2)

- Instrument racks are supplied with the aircraft.
- The basic rack structure is aluminium alloy tube and channel section arranged to give three shelf mounting positions and two columns of 19" rails. The 19" rails are provided on both forward and aft faces of the rack. The racks are approximately 126cm wide, 120cm high and 72 cm deep. The total weight of a rack and the equipment mounted on it is limited to 220 kg.
  The centre of gravity must be no higher than 78cm above the floor.

Space (3)

Upper BBRs	
1	SHIMS
2	pyrgeometer
3	red pyranometer
4	clear pyranometer

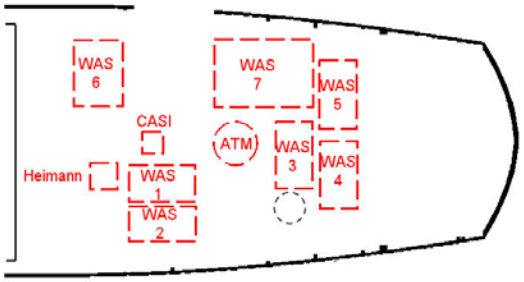


2D-2P	outer up	inner up	SID-1	PCASP	inner up	outer up	FFSSP
2D-2C	outer down	inner down	dummy	2D-S	inner down	outer down	dummy

base
CPI

base
no fit

Rear Cargo Hold			
WAS 1	not fitted	WAS 2	not fitted
WAS 3	not fitted	WAS 4	not fitted
WAS 5	not fitted	WAS 6	not fitted
WAS 7	not fitted	CASI	not fitted
ATM	not fitted	Heimann	fitted



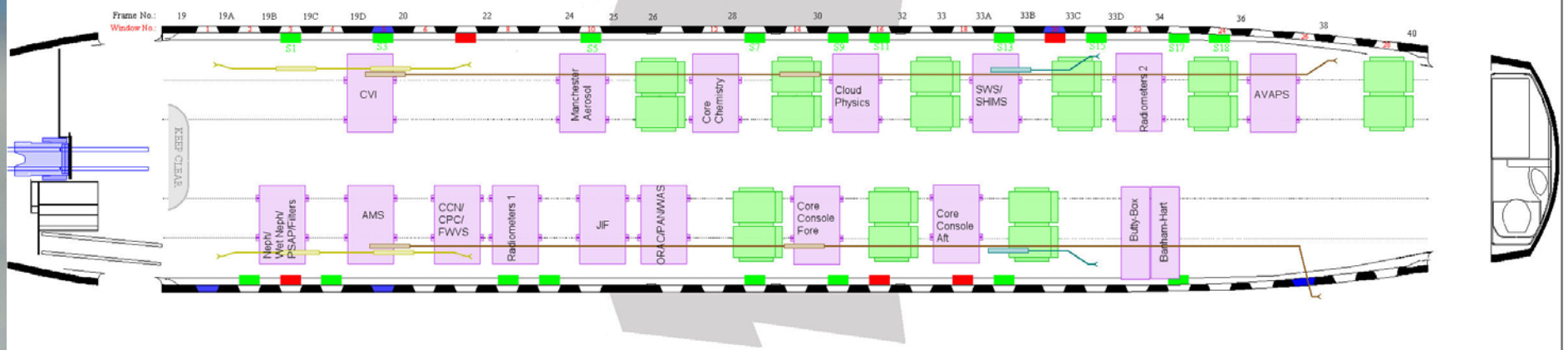


Diagram 1 of 2: Interior & Forward View
Title: MCCM Config 5 Var 19v1 ADIENT TOFAMS
Filename: MCCM Config 5 Var 19v1 ADIENT TOFAMS Diagram 1 of 2
Date: 08/01/08 Author: S Devereau

Flight No.	Date	Author

Air Sample Pipe
Inlet
Exhaust
Pipe
Manifold
General Exhausts
Exhaust
Pipe
Manifold
Dedicated Exhausts
Exhaust
Pipe
Manifold

S2 Sidewall Service Point
DLU DLU
Blanked Window

Scale (Approx.)
0 1 2 4 6 Feet
0 1 2 Metres

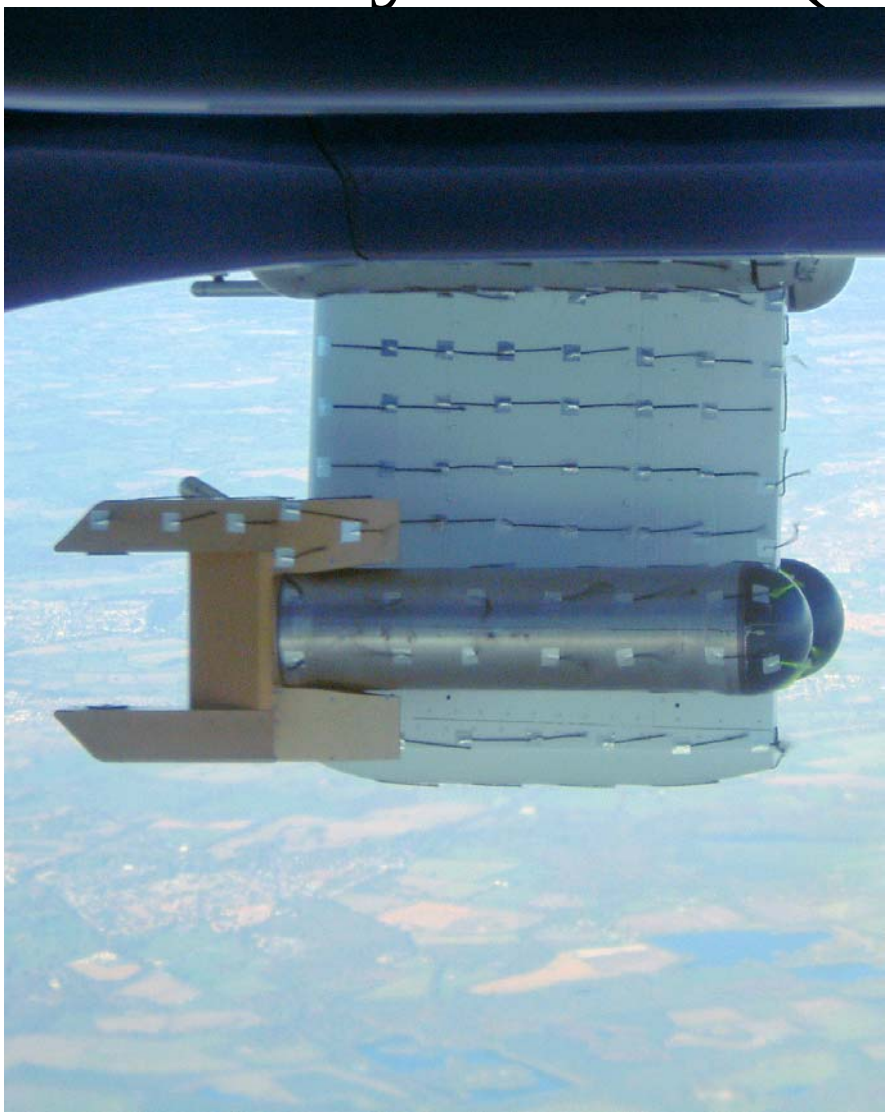
Weight

- Each rack is limited to 220kg
- The aircraft payload is approximately 4000kg, including instruments and people
- Less weight = greater duration
- Less weight = better climb performance
- Less weight = more instruments

Aerodynamics

- Drag is important to aircraft performance
- The aircraft changes pitch during flight
- External instruments are fitted to hardpoints
- The external fit can be modified to the science requirements

Aerodynamics (2)



Safety

- All equipment must go through an airworthiness process with BAE Systems
- This process ensures that there is no danger to passengers or to the aircraft
- It is possible to carry wet chemistry equipment, gases, lasers etc

Interface

- Is data recorded as part of the instrument, or does it send data to the aircraft data system?
- What are the operator requirements?
- Does the instrument require adjustment during flight?

Airworthiness Approval

- The instrument is best fitted into a rack (but this does not have to be the case).
- Weight and structure are important – the instrument must be designed for 9g forward, 3g sideways, 1.5g upwards
- Wiring and electrical integrity important
- Special consideration given to harmful gases, radiation
- Each instrument will be EMC tested.

Putting an instrument on the aircraft

- Designs discussed with FAAM
- Build the instrument (with help from FAAM)
- Document the instrument
- BAE Systems inspect the rack and documentation
- FAAM design an aircraft configuration designed to include the new instrument
- The instrument is added to the aircraft

FAAM *Facility for Airborne Atmospheric Measurements*

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