Avionics Upgrades RNLAF (K)DC-10

Royal Netherlands Air Force

Ltcol Hielke Bosma
h.bosma@mindef.nl

Introduction

- Ltcol Hielke Bosma
- Senior Certification Specialist MAA

- Flight Test Engineer (fixed wing)

- Technical specialist (K)DC-10 CUP Program

Content

- Background
- Cockpit Upgrade Program (K)DC-10
  - Drivers
  - Program Schedule
  - Program Management
  - Certification
- Systems overview
- Successes & Technical issues & Lesson Learnt
- Questions

Facts and figures

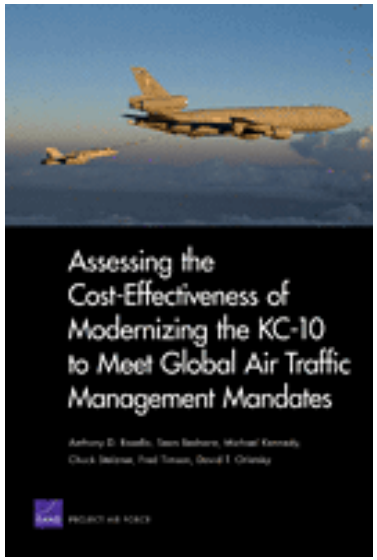
- Since 1995 the RNLAF operates two KDC-10 (tanker) aircraft
- Originally Boeing DC-10-30CF, modified to tanker (AAR)
- Combi configuration (cargo & pax)
- Utilization: 1000 FH per year
- In 2005 RNLAF procured one DC-10-30CF (cargo configuration)

Top Level Objectives Plan

- Operational until 2025
- Strategic (NATO) operations
- Comply with civil regulations (as far as practical)
- Comply with military operational standards
- Standardization with other military (NATO) operators

Drivers for a Cockpit Upgrade

- Comply with New Civil Rulemaking (or growth)
  - Communications: VDL mode 2 (-3, FANS-1, CPDLC)
  - Navigation: PRNAV
  - Surveillance: Enhanced Mode S, ADS-B
- Maintainability
  - Obsolescence avionics components
  - Maintainability electromechanical instruments
  - Decreasing amount of DC10 operators
- Military Operational Requirements
  - Link16
  - Secure Voice
  - Military GPS
  - IFF Mode 4 (with growth to 5)



Program Schedule

- 2004, SOW,RFQ, 2 proposals
- 2005, signed contract with Fokker
- 2007, start installation on first Aircraft
- 2008, first flight
- 2010, last test flight
- 2011, certification and OT&E
- 2012, first operational mission, delivery of 2nd aircraft
- 2013, delivery of 3rd aircraft

Program Management

- Main Contractor: Fokker Services (FS), NL
  - Program Management
  - Installation
  - Certification
- FS Sub-Contractor: Boeing IDS
  - Design
  - Engineering
  - Main supplier

Certification

- Used FAR 25 as the certification basis
- RNLAF/DMO applies for Military Type Certificate
- Fokker issued a Certification Plan (CP) including Means of Compliance
- Boeing IDS is responsible for the compliance plans/reports and substantiation data (SME approved data)
- Fokker Services is responsible for the verification (CVE approved data)
- Military Certification by the NL Military Airworthiness Authority (NL-MAA)

NEDERLAND
The Netherlands

MINISTERIE VAN DEFENSIE
Ministry of Defence

MILITAIRE LUCHTVAART AUTORITEIT
Military Aviation Authority Netherlands

MILITAIR TYPE CERTIFICAAT
Military Type Certificate **No.** 10

Ref.: Regeling kenmerken, registratie en luchtwaardigheid militaire vliegtuigen, regeling van 8 oktober 2001, artikel 11
Regulation markings, registration and airworthiness military aircraft. Regulation of 8 October 2001, article 11

Militair Type Certificaat houder *Military Type Certificate holder*	Ministerie van Defensie Defensie Materieel Organisatie Souschef Ressort Luchtsystemen
Fabrikant *Manufacturer*	Fokker Services B.V. Nieuw Vennep
Type en model van luchtvaartuig *Type and model of aircraft*	Fokker 60 MPA
Uitgifte op grond van onderzoeksrapport nr. *Issue based on investigation report no.*	MLA2005026720 d.d. *dated* 15 oktober 2005 *15 October 2005*

Hierbij wordt verklaard dat het type ontwerp van het luchtvaartuig genoemd in dit Certificaat met de operationele beperkingen en voorwaarden zoals omschreven in het Military Type Certificate Data Sheet voldoet aan de van toepassing zijnde luchtwaardigheidseisen van het Ministerie van Defensie.

It is herewith certified that the type design of the aircraft mentioned in this Certificate together with the operating limitations and conditions as described in the Military Type Certificate Data Sheet meets the applicable airworthiness requirements of the Ministry of Defence.

De Staatssecretaris van Defensie,
voor deze,
De Directeur Militaire Luchtvaart Autoriteit,
For the State Secretary for Defence,
The Director Military Aviation Authority Netherlands,

P.M.A. Vorderman
Generaal-Majoor KLu b.d.
Major General RNLAF ret.

Plaats en datum van afgifte
Place and date of issue
Den Haag, 15 oktober 2005
The Hague, 15 October 2005

Specimen

MAA-NLD Form 37 Military Type Certificate (version 1) Page 1 of 1

Classic Cockpit KDC-10

CUP Cockpit DC-10

CUP Systems (1)

Communication

- UHF/VHF Communication (ARC-210)
- Secure Voice System
- Civil SATCOM (MCS-4000)
- ACARS (VDR – RTA-50D)
- Military UHF SATCOM
- Link-16
- Interphone System

CUP Systems (2)

Navigation

- Flight Management System (CMA-900)
- Scanning DME (DME-442)
- Military Global Positioning System (TA-12S)

Surveillance

- Enhanced TCAS (ACAS II ch 7)
- ATC IFF/Mode S Transponder (APX-119)

CUP Systems (3)

Displays and Instruments

- TFT Primary Flight Displays
- Engine Instrument Display System (EIDS)
- Standby Instruments
- Flight Control Indicators

EFIS

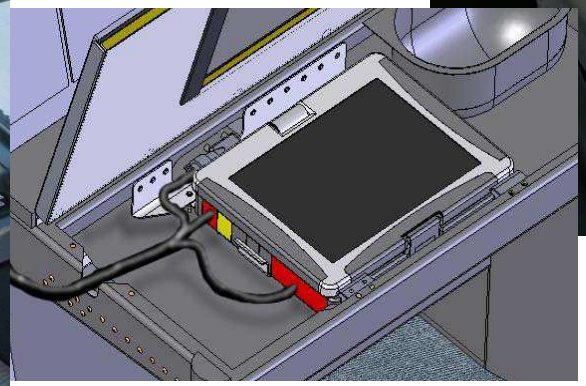

ENG FAIL
T255
CH-DG
HDG HLD
ALT HOLD
FD
POPUP
TERR
TA ONLY
VOR 1
VOR 2

Digital Instruments

Aft Pedestal

Link 16 integration

- Based on Panasonic CF-18 ruggedized laptop
- Carry-on carry-off equipment
- Special handling for operational security (OPSEC)



Successes

- Operational
  - FMS
  - SATCOM/ ACARS
  - PBN capability

- Reliability/maintainability
- Short Aircrew Conversion
- Operational Test & Evaluation

Technical issues

- Amber Band
- Mag/True
- FMS Database
- SATCOM

Amber Band

- Fast Slow Indicator
  - V2 (+ 10)
  - Awareness
- Amber Band
  - Initially not related to V2
  - During TO based on Alpha speed
  - Signal from AT/SC
  - Flashing speed indication
  - Complex algorithm (TO and GA)
  - Awareness
  - Checklist item

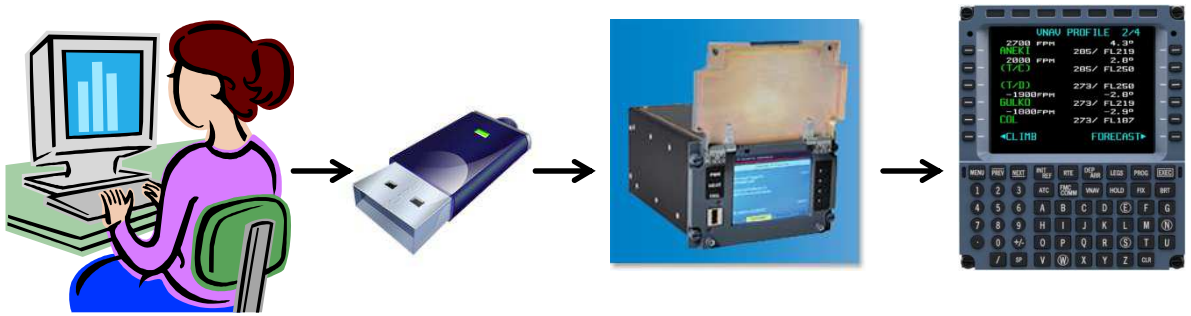
Mag/Tru

- Simple DC-10 design
- Complicated integration
  - FMS switches automatically above N73/S60
  - ILS/VOR provides just bearing signal
  - System corrects variation twice
- Approach Thule, Greenland
- Procedural solution
- Understanding system

FMS Database

- Jeppesen based
- Entire world – 10 pieces
- FMS memory size (only 4 Mb!)
- CMC – RNLAF – KDC-10 Dataloader – FMS
- Database integrity
- Database content

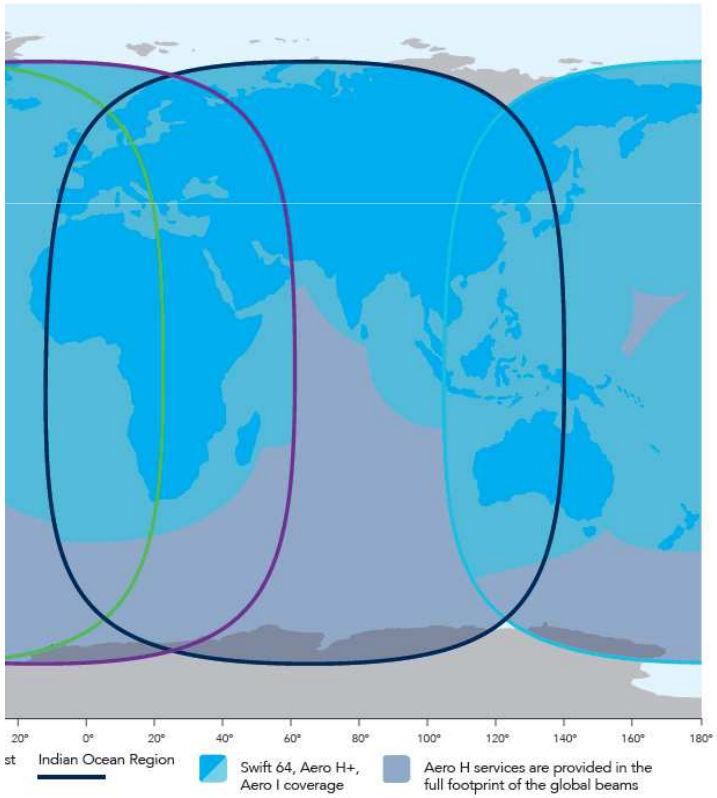
- Manpower
- Procedures
- Contract



SATCOM

- Backup for HF
- Geostationary satellites
- Automatic handover
- Trip from Middle-East to Australia

- Settings
- Configuration
- Service provider



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Lessons Learnt

- Program Management
  - Fokker contractor - Boeing subcontractor
  - RNLAF team size
- Complexity of design, level of integration
  - Underestimating flight test effort
  - Software design of DCU complicated
- Certification – contract
  - Acceptance – certification
  - Civil - Military
- Processes behind new systems
  - Database management
  - Organizational issues

'DAD. WHY ARE THERE ALWAYS TWO PILOTS?'
'ONE HAS TO PREVENT THE OTHER FROM DOING STUPID THINGS'
'WHICH ONE IS DOING THE STUPID THINGS?'

Questions?