F-15 MECHANICAL EQUIPMENT AND SUBSYSTEMS INTEGRITY PROGRAM (MECSIP)

The Best Fighter, Anytime, Anywhere

F-15 MECSIP Reliability Center Maintenance Program

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F-15 Approach

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• MECSIP plan
• Determine what maintenance practices will optimize system reliability
• RCM determined to be best tool
• RCM drives other analytical tools when the reliability issues are identified during the analysis (e.g. process, quality, efficiency, or safety related)
• Detailed data analysis

Reliability-Centered Maintenance, F. Stanley Nowlan, et. al., 1978, p5
Program Purpose and Benefits

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- Purpose
  - Utilize Reliability Centered Maintenance (RCM) for in-service aircraft and systems analysis
  - Improve overall aircraft/system reliability
  - Identify deficiencies in design, maintenance practices, training, support equipment and/or other logistics issues
  - Implement most cost effective function preservation strategy without safety or environmental consequences
  - Review/rewrite of Schedule Maintenance Inspection T.O. based on analysis results
  - Justify and document decisions/recommendations to provide an audit trail
  - Identify significant return on investment opportunities
## System Priority
### “Weighting Factors”

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<table>
<thead>
<tr>
<th>F15A-D by WUC</th>
<th>Weighted Score</th>
<th>Schedule Man Hrs</th>
<th>Unscheduled Man Hrs</th>
<th>Aborts</th>
<th>MTBF</th>
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F-15A-E Combined System Priority

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Advancing the Legacy

A-E Combined System Priority

Score

WUC
F-15 FSIP/MECSIP Status

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• 17 Systems Complete (Results on Next Slides)
• Four Systems In Work
  – Structures
    • Center Fuselage
    • Ramps
  – Avionics
  – Weapons
## In-work Analysis Review

**The Best Fighter, Anytime, Anywhere**

### FSIP RCM Analyses Complete to Date

<table>
<thead>
<tr>
<th>FSIP System</th>
<th>WUC</th>
<th>Status</th>
<th>% Complete</th>
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<tr>
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<td>Fuels</td>
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<td>Complete</td>
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<td>41</td>
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<td>14</td>
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<tr>
<td>Canopy</td>
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<td>Escape System</td>
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<td>Cockpit Furnishings</td>
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<tr>
<td>Lighting</td>
<td>44</td>
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<tr>
<td>Hydraulics</td>
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<td>Electrical Power</td>
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<tr>
<td>Miscellaneous Utilities</td>
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## In-work Analysis Review Cont.

### The Best Fighter, Anytime, Anywhere

### FSIP RCM In-Work Analyses Status

<table>
<thead>
<tr>
<th>FSIP System</th>
<th>WUC</th>
<th>Status</th>
<th>% Complete</th>
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<tbody>
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<td>Center</td>
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<td>In Work</td>
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<td>Aft</td>
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<td>Complete</td>
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<td>Wings</td>
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<tr>
<td>Power Plant (-6 only)</td>
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<td>100%</td>
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<tr>
<td>Avionics</td>
<td>Multiple</td>
<td>In Work</td>
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<tr>
<td>Weapons</td>
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F-15 Analysis Benefits

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• At Completion of all Systems
  – 40% Reduction in Phase Maintenance
  – 5 - 8% Increase in Aircraft Availability
  – 10% Reduction in Un-Scheduled Maintenance
  – ~$70M+ Plus in Cost Avoidance & Savings
  – ~50K+ in Man Hour Savings
  – Increase In Component and System Reliability
Objective:
• Apply Reliability Centered Maintenance Analysis to F-15A/B/C/D/E 200 and 400 Hour Phase Inspections

Goals:
• Shift 200 HR HPO requirements into 400 HR HPO
• Eliminate 3 Phase Inspections in a 1200 Periodic Cycle
• Expected increase in aircraft availability by ~15 aircraft

Measures of Success:
• RCM Analysis Performed
• Improved Single Aircraft Availability Rate 21 days in a PE Cycle
• Implementation Goals
  • F-15E Complete
  • F-15A-D Implementation Fall 2008

Tentative Schedule

<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
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<tbody>
<tr>
<td>RCM Analysis Performed</td>
<td>30 July 2007</td>
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<tr>
<td>830 ACSG Review</td>
<td>3 Aug 2007</td>
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<td>830 ACSG/CC Approval</td>
<td>7 Sep 2007</td>
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<tr>
<td>Interim TO Publication</td>
<td>1 Jan 2008</td>
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<td>Implemented F-15E</td>
<td>29 Feb 2008</td>
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VRCM - A Better Way

Traditional Maintenance

Focuses on preserving the operation of the component

Considers only scheduled maintenance on component or fix-when-failed

Scheduled maintenance, if any, based on manufacturers' or vendors' recommendation

More corrective maintenance

Very reactive approach

VRCM

Focuses on preserving the function of the system

Considers many options

Fix-when-failed only when cost effective

Scheduled maintenance based on the failure characteristics of the component in its operating context

Less corrective maintenance

Proactive approach
Additional Tasks

• Component Analysis
  – RSA
    • Return Rate Tables to the field
    • Return on Investment is 5 months
    • ~23M savings in first five years after implementation
  – Stab Act reliability decreasing
    • WR-ALC, OC-ALC & Parker working 16 action items to increase reliability
      – Review of piston and dynamic sleeve seals
      – Evaluate LVDT failures
      – Evaluate pilot valve contamination causes
      – Evaluate solenoid valve failures
Additional Tasks

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• Nose to Tail Tune-up for Manual Flight Control System
  – Identified need for standardized procedure
    • Procedure developed and tested
    • Several T.O. deficiencies noted
  – Incorporate into FY 08 PDM on A-D and selected E models

• Standardize Flight Control Impoundment Procedures
  – FY03 Commanders’ Conference action item
    • Procedure developed with field input
  – Implementation in work
    • Technical procedures in F-15 tech order
    • Maintenance management procedures to be in new 21-101 supplement
Additional Tasks

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• Combine Three Thru-Flight job guides into One
  – PACAF and HQ ACC requested task
  – Draft procedure developed and distributed to MAJCOMS and ANG for review
  – Meeting with ACC A8 and OC/ALC engineering on 22 Aug 06
  – Combine Thru-Flight Job Guide Implemented in 2007

• F15 Hydraulic Fluid Contamination
  – Contamination prevalent in Aircraft and Ground Support Equipment
  – Private sector research indicates 70 - 80% of component failures attributed to contamination.
  – Contamination clean-up will increase component Mean Time Between Failures (MTBF)
    – Purification of Hydraulic System test in-work;
      • Procurement of 50 Purifiers, AF to take delivery in late Summer 2008
    – Qualify new hydraulic filters (5 micron). Qualification testing completed, flight testing in-progress
      • Procurement of New Filters, AF to take delivery in early 2009
Other Actions

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- Hydraulic System
  - Engineering investigation/re-evaluation of damage limits on hydraulic tubing and hydraulic system leak limits
  - PCI & PCII Establish Go-no-go wear limits for the hydraulic pump external shaft
- Electrical Power System
  - Engineering investigation for:
    - Overhaul processes for the IDG, CSD and GCU
    - Possible re-design of the CSD Input Shaft Carbon Seal.
    - Improvement of the F-15A-D CSD to the F-15E CSD solder ring carriage to eliminate need to change FOHE.
    - GCU -- Investigate sources of moisture associated malfunctions.
- Flap-up stop
  - Engineering Investigation into the construction and installation procedures for the flap-up stop and the flap bathtub fitting
- Secondary Power
  - Research new Secondary Power System Test Set and CBA/ROI analysis
- PRCA
  - F-15A-D and F-15E PRCA Tester Redesign
Results

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- Preventative Maintenance program that optimizes the reliability and availability of the aircraft.
- Appropriate maintenance intervals that match failure modes.
- Identifies other actions to improve reliability and maintainability.
- At Completion of Analysis Transition into Sustainment Phase.
  - On-going analysis (living program)
Summary

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• Application of RCM methodology for F-15’s lifecycle is a must
• Reliability Improvements increase A/C Availability
• On-going analysis (living program)
• Increase in Component and System Reliability
• Upon Completion of F-15 RCM Expected Results
  – 40% Reduction in Phase Maintenance
  – 5-8% Increase in Aircraft Availability
  – 10% Reduction in Unscheduled maintenance
  – ~$70M+ cost avoidance & savings
  – ~50K+ Man hour savings
Questions