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

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F-15 MECSIP Reliability Center Maintenance Program

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F-15 Approach

- 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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F15A-D by WUC				
Weighted Score	Schedule Man Hrs	Unscheduled Man Hrs	Aborts	MTBF
10	11	4	45	11
9	23	23	14	74
8	74	11	46	13
7	76	46	42	14
6	46	24	13	71
5	13	13	41	51
4	24	74	12	63
3	75	14	49	41
2	14	76	44	42
1	45	41	47	12

F15E by WUC				
Weighted Score	Schedule Man Hrs	Unscheduled Man Hrs	Aborts	MTBF
10	23	23	45	74
9	74	4	41	11
8	11	46	46	13
7	46	74	42	14
6	75	11	14	41
5	13	75	13	46
4	14	14	49	42
3	76	13	44	63
2	24	12	47	57
1	12	76	12	51

F-15A-E Combined System Priority

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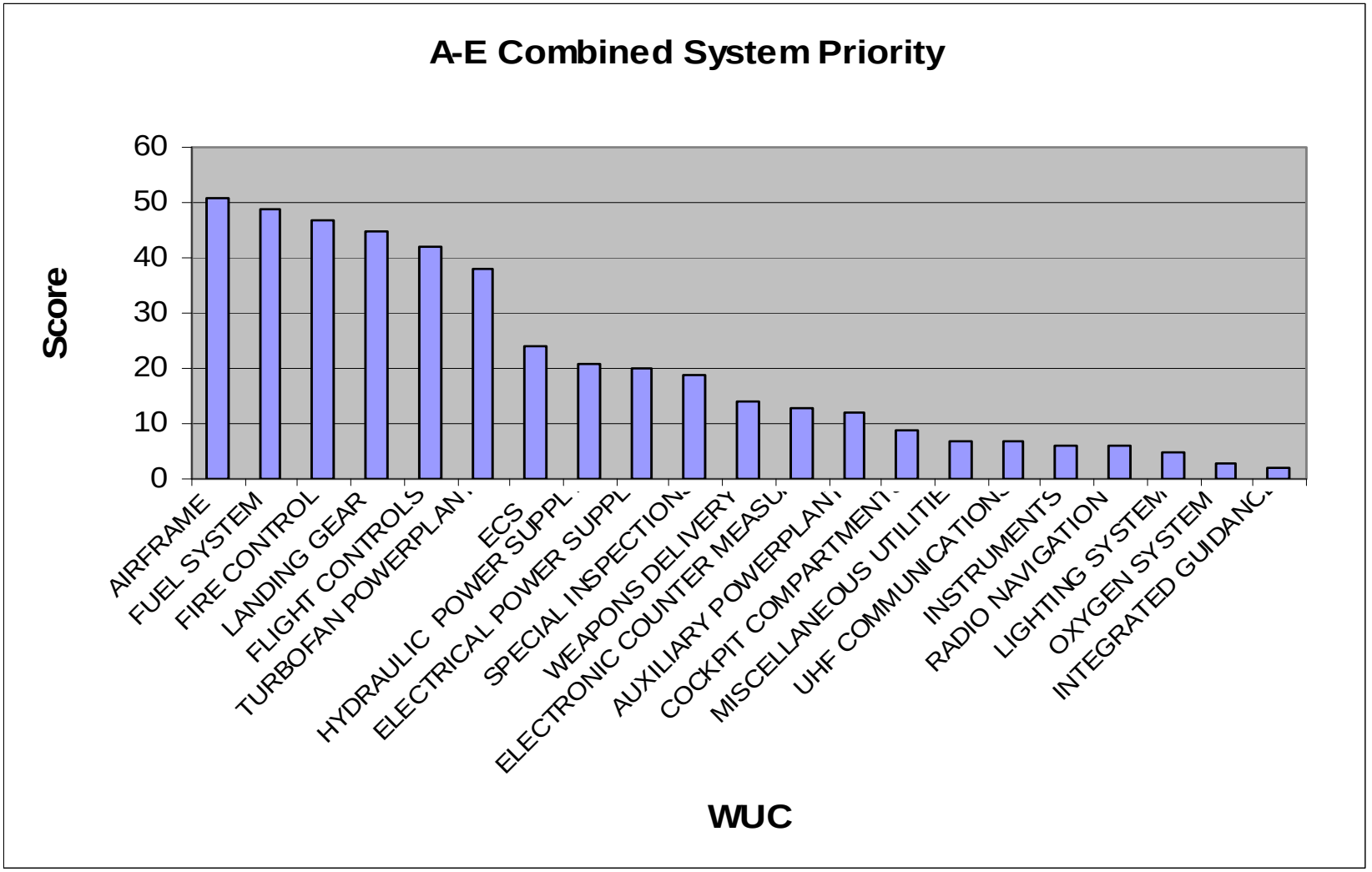

Advancing the Legacy

F-15 FSIP/MECSIP Status

- 17 Systems Complete (Results on Next Slides)
- Four Systems In Work
  - Structures
    - Center Fuselage
    - Ramps
  - Avionics
  - Weapons

In-work Analysis Review

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FSIP RCM Analyses Complete to Date			
FSIP System	*WUC*	*Status*	*% Complete*
Landing Gear	13	Complete	100%
Fuels	46	Complete	100%
ECS	41	Complete	100%
Aircraft Wiring CBA	All	Complete	100%
Flight Controls	14	Complete	100%
Cockpit/Canopy	12000/97000/91000	Complete	100%
Throttles	"	Complete	100%
Canopy	"	Complete	100%
Escape System	"	Complete	100%
Cockpit Furnishings	"	Complete	100%
Oxygen	47	Complete	100%
Lighting	44	Complete	100%
Hydraulics	45	Complete	100%
Electrical Power	42	Complete	100%
Miscellaneous Utilities	49	Complete	100%

In-work Analysis Review Cont.

FSIP RCM In-Work Analyses Status			
FSIP System	*WUC*	*Status*	*% Complete*
Structures			90%
Forward	11	Complete	100%
Center	11	In Work	69%
Aft	11	Complete	100%
Wings	11	Complete	100%
Secondary Power	24	Complete	100%
Power Plant (-6 only)	23	Complete	100%
Avionics	Multiple	In Work	38%
Weapons	75	In Work	49%

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

Scheduled Maintenance Inspection HPO Phase Interval Extension

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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

RCM Analysis Performed	30 July 2007
830 ACSG Review	3 Aug 2007
830 ACSG/CC Approval	7 Sep 2007
Interim TO Publication	1 Jan 2008
Implemented F-15E	29 Feb 2008

VRCM - A Better Way

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Traditional Maintenance	VRCM
Focuses on preserving the operation of the component	Focuses on preserving the function of the system
Considers only scheduled maintenance on component or fix-when-failed	Considers many options Fix-when-failed only when cost effective
Scheduled maintenance, if any, based on manufacturers' or vendors' recommendation	Scheduled maintenance based on the failure characteristics of the component in its operating context
More corrective maintenance	Less corrective maintenance
Very reactive approach	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

- 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

- 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

- 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

- 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

- 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