Air Force Life Cycle Management Center
Engineering and Technical Management/Services Directorate

Providing the Warfighter's Technical Edge

AF EWISIP & MECSIP Overview

SLIDES ONLY

NO SCRIPT PROVIDED

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What is EWIS?

- **Electrical Wiring Interconnect System**

- EWIS is the components installed in any area of the aircraft for the purpose of transmitting electrical energy, signals, or data between two or more electrical end points.
  - Wire
  - Cable
  - Fiber optic link
  - Wiring/Cable/Fiber devices
  - Connectors
  - etc.

EWIS Applicability

1. Wires, harnesses, and cables
2. The termination point on electrical wires, including bus bars, external relays, switches and passive external components (resistors, diodes, capacitors), junction boxes, contactors, terminal blocks, and terminal boards
3. Circuit protection devices such as circuit breakers, fuses, and other current limiting devices
4. Connectors and connector accessories
5. Shield termination devices
6. Electrical grounding and bonding devices and their associated connections
7. Electrical splices and termination devices such as terminal lugs
8. Materials used to provide additional protection for wires, including wire insulation, wire sleeving, and conduits
9. Shields or braids
10. Clamps and other devices used to route and support the wire bundle (primary support restraint devices)
11. Secondary wiring restraint devices (cable ties, tying tape, etc.)
12. Labels or other means of identification
13. Pressure seals maintaining environmental separation between zones
14. EWIS components inside shelves, panels, racks, junction boxes, distribution panels, and back-planes of equipment racks including, but not limited to, circuit board back-planes, wire integration units, and external wiring of equipment
15. Exclusions are wiring and components inside and external components directly attached to avionic boxes and not serving as an electrical interface to the aircraft (see MIL-HDBK-454).

What is EWISIP?

- **Electrical Wiring Interconnect System Integrity Program**
- EWISIP is:
  - A systematic process to assess an aircraft EWIS for overall condition, service life extension, and continued airworthiness.
    - From system development, into sustainment.
  - It contains a framework to achieve and maintain the physical and functional integrity of the EWIS.

- Implementation of EWISIP will promote the continued operational safety, suitability, and effectiveness (OSS&E) of the EWIS systems throughout all phases of the aircraft's life.
  - Identify critical EWIS paths and degradation or damage that can then be scheduled for inspection, repair, or replacement. Reduces EWIS functional failures and EWIS electrical fires, increase safe operation of the aircraft, increase aircraft availability, and reduce overall system life cycle costs.

- EWISIP presented in MIL-HDBK-525

MIL-HDBK-525 Core Tasks

- EWIS Core Tasks (tailorable)
  - Core Process Task One – Document overall EWIS and identify critical circuit paths and functions
  - Core Process Task Two – Collect and analyze EWIS failure and maintenance data
  - Core Process Task Three – Conduct an on aircraft physical and electrical inspection and document overall condition of the aircraft EWIS
  - Core Process Task Four – Conduct a comprehensive materials/aging analysis of wiring and electrical components removed from the aircraft
  - Core Process Task Five – Analyze and provide an overall risk and life assessment of the aircraft EWIS
  - Core Process Task Six – Apply overall analysis toward an action plan
  - Core Process Task Seven – Tailor and apply Core Tasks One through Six iteratively as required

What is MECSIP?

- **Mechanical Equipment and Subsystems Integrity Program**
- Simplistically, MECSIP is:
  - Understanding of the validated capabilities of each mechanical system relative to the design service life, usage and environments
  - Monitoring of each mechanical system performance during sustainment and the implementation of corrective action when appropriate
  - Implementation of a Preventative Maintenance Program, particularly for safety critical items
- Essentially all other tasks/subtasks support these three elements

Ultimate goal:

To achieve the desired level of safety and aircraft availability at the most economic cost across the lifecycle of the weapon system.

MECSIP Systems

- Cockpit and Fuselage
- Landing Gear
- Flight Control
- Helicopter Rotor System
- Escape Capsule
- Aerial Recover System
- Vertical Or Short Takeoff and Landing Power and Control Transmission System
- Auxiliary Power Plant
- Ice and Rain Protection
- Air Conditioning, Pressurization, and Surface Ice Control
- Electrical Power Supply
- Electrical Multiplex
- Lighting System
- Hydraulic and Pneumatic Power Supply
- Fuel System
- Oxygen System
- Indicating/Recording
- Miscellaneous Utilities
- Emergency Equipment
- Personnel and Miscellaneous Equipment
- Explosive Devices and Components
- Electrical Wiring Interconnect System

MIL-STD-1798

- MECSIP requirements documented in MIL-STD-1798D
- Process to achieve and maintain the physical and functional integrity of the mechanical elements of aircraft systems.
- Tailored process to meet specific equipment, subsystem, and/or system requirements.
- Ensures the integrity (e.g., durability, safety, reliability, and supportability) of mechanical systems and equipment is achieved in development and maintained throughout the system's operational service life.

MECSIP Reviews

Review Goals

- Annual reviews are a spot check of all MECSIPs across the AF to examine selected aspects of compliance to MIL-STD-1798
- Communicate overall MECSIP health and effectiveness to senior leadership
- Identify opportunities to provide senior leadership with areas they can influence for greater future effectiveness and compliance
- 10 MECSIP Process Elements
  - Program self assessment and brief to MECSIP Technical Expert (TE)

MIL-STD-1798C - 2013

- Added detailed EWIS tasks
  - Tasked based on MIL-HDBK-525
    - Core Process Task One – Document overall EWIS and identify critical circuit paths and functions.
    - Core Process Task Two – Collect and analyze EWIS failure and maintenance data.
    - Core Process Task Three – Conduct an on aircraft physical and electrical inspection and document overall condition of the aircraft EWIS.
    - Core Process Task Four – Conduct a comprehensive materials/aging analysis of wiring and electrical components removed from the aircraft.
    - Core Process Task Five – Analyze and provide an overall risk and life assessment of the aircraft EWIS.
    - Core Process Task Six – Apply overall analysis toward an action plan.
    - Core Process Task Seven – Tailor and apply Core Tasks One through Six iteratively as required.

JSWAG D&I Take Action

- Fall 2019 JSWAG Working Group
  - Action Chit 2086 was created
    - Inclusion and scoring of EWIS requirements in Depot inspection events via MIL-STD-1798C (Mechanical Equipment and Subsystem Integrity Program)
  - Joint Chit with Data and Maintenance Committees
- Worked with USAF MECSIP TE to create EWIS requirements for MECSIP scorecard
  - 2 new MECSIP Process Elements created
    - Implemented for 2020 reviews
  - 2023 review streamlined to 1 EWIS Element

MECSIP Process Element 10

EWIS Integrity is part of the MECSIP execution.

Criteria:

1. The EWIS has been documented as defined in MIL-STD-1798D 5.2.17.
2. EWIS tasks (through task 6) are funded, scheduled, and being accomplished. For programs that have completed EWIS task 6, EWIS task 7 (iteration) is funded, scheduled, and being accomplished.

Scoring:

G = Both criteria

Y = 1 of 2 criteria or Partial on both criteria

R = 0 of 2 criteria

Artifact expectations:

- EWIS plans, reports, etc.

EWISIP Deep Dive

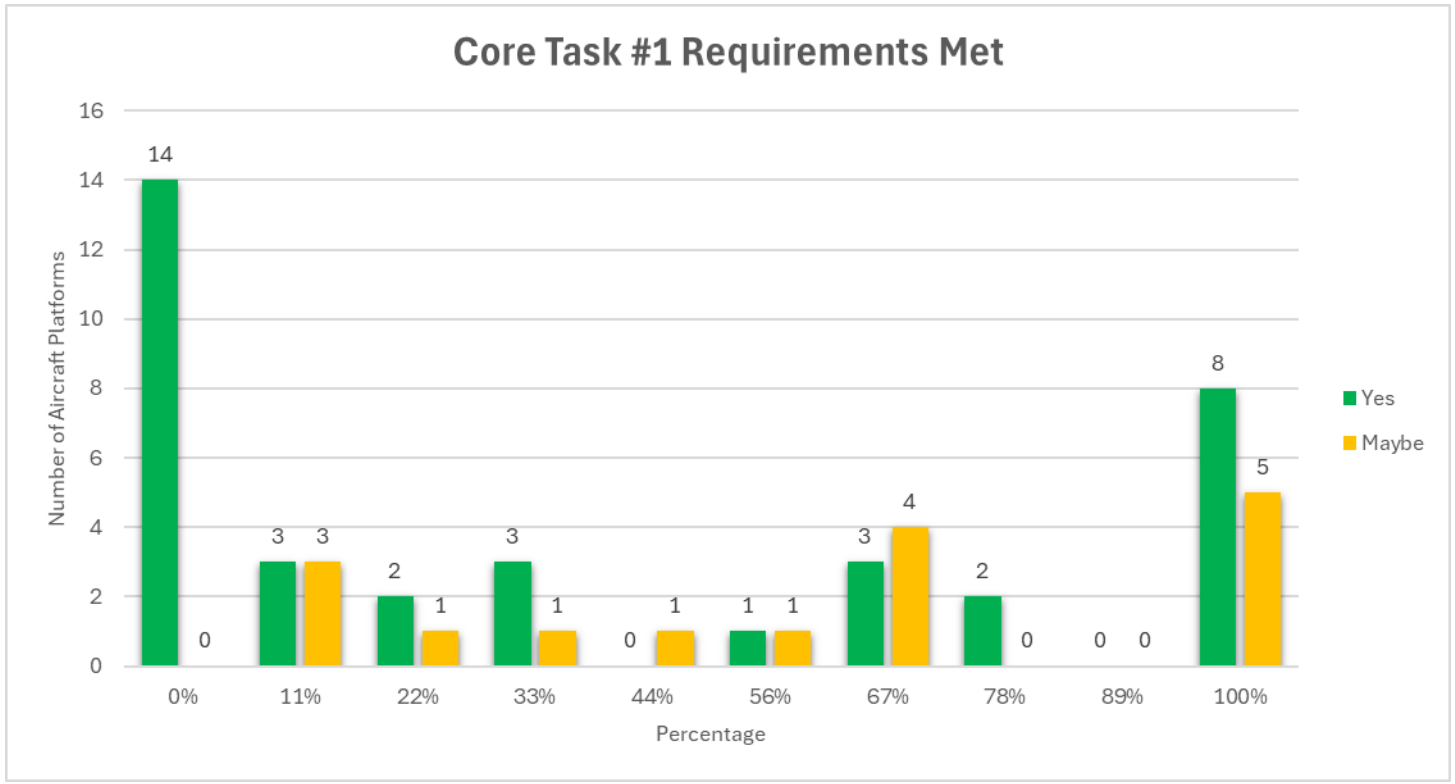
- Independent review – small team
- 36 USAF Platforms
- Used previously submitted MECSIP Review artifacts (2025*)
  - Program Office self assessed
- Commercial Derivative Aircraft – FAA Certification
- Reviewed the 7 Core Tasks of MIL-HDKB525
  - Broken down by sub-tasks
- EWIS Plan
- EWIS Gap Analysis
- Yes, No, or Maybe with rationale

EWISIP Deep Dive – Core Task #1 Subtasks

<u>Core Process Task One</u> – Document overall EWIS and identify critical circuit paths and functions.

1) Identify EWIS components and materials and all power and signal paths.
2) Document wiring configuration and circuit schematics and functions.
3) Document physical wire routing throughout the aircraft.
4) Conduct an aircraft functional hazard assessment consisting of a system safety and common causes assessment and EWIS failure modes, effects, and criticality analysis (FMECA) (AC 25.1701-1).
5) Document EWIS components and characteristics such as installation and separation.
6) Identify catastrophic failure modes and mechanisms in critical EWIS components.
7) Identify physical failures of the EWIS that can cause damage to co-located EWIS or surrounding systems, structural elements, or injury to personnel.
8) Develop a Critical Design Configuration Control Limitation (CDCCL) for fuel system EWIS components.
9) Examine physical separation of Fuel Quantity Indicator System (FQIS) circuits from high-power electrical circuits. This would be based on drawings.

EWISIP Deep Dive – Core Task #1 Results



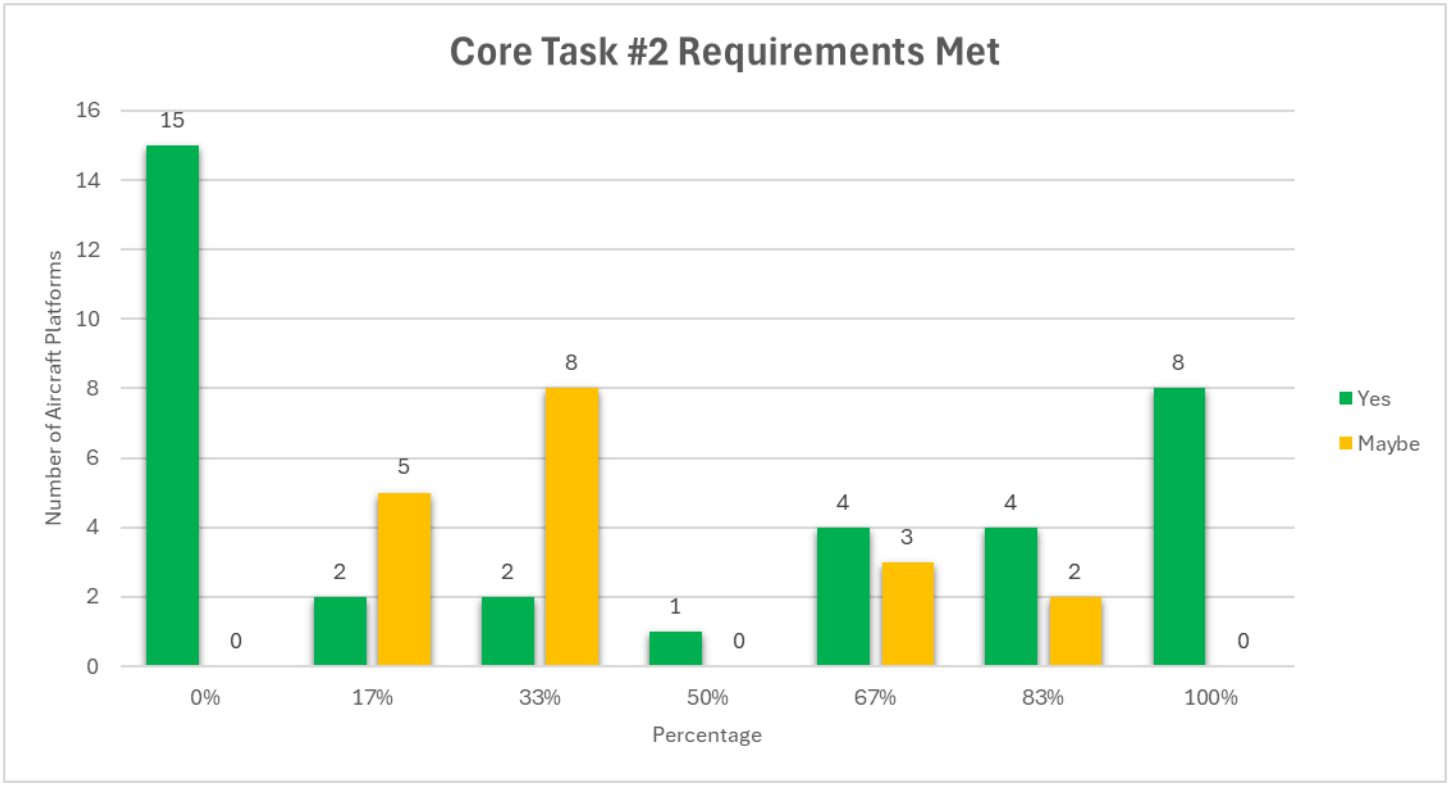
- EWIS documented in TOs, routing and installation drawings, and legacy process specifications
- FHA includes EWIS FMECA and is incorporated into physical failure assessment
- Analysis failure modes and mechanisms are identified as stated in MMP and EWIS reports.

EWISIP Deep Dive – Core Task #2 Subtasks

Core Process Task Two – Collect and analyze EWIS failure and maintenance data.

1) Document how the aircraft EWIS failure and maintenance data is collected and analyzed.
2) Review and assess mishap and maintenance databases and applicable Airworthiness Directives.
3) Interview maintenance and engineering support staff.
4) Use data mining approaches to examine maintenance and failure data for failure types that include wiring chafing, broken wires, arcing, burned wiring, electrical fires, electrical insulation dielectric failure, and corrosion. Problems related to electrical bonding, fiber optics, connectors, relays, switches, circuit breakers, distribution panels, and other EWIS components that may be included in the data system should also be reviewed...
5) Review findings, maintenance actions, discrepancies, and repairs accomplished as part of mandatory or voluntary inspections.
6) Organize data by zone/station, probability, and criticality of failure.

EWISIP Deep Dive – Core Task #2 Results



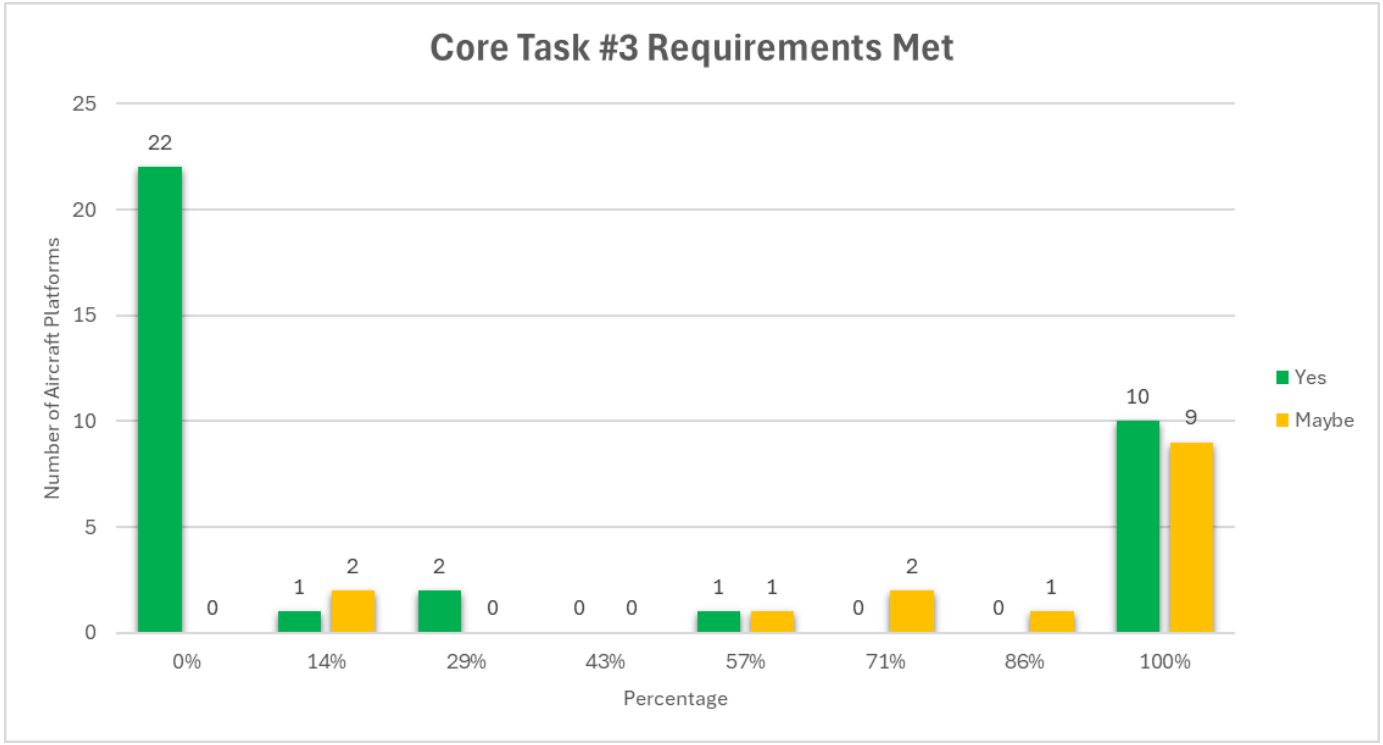
- The EWIS failure data is captured in database and available for review
- EWIS failure and maintenance data has been used to institute several depot replacements and design improvements
- High drivers for EPS failures/related aborts are documented and shared in a semi-annual meeting.

EWISIP Deep Dive – Core Task #3 Subtasks

<u>Core Process Task Three</u> – Conduct an on aircraft physical and electrical inspection and document overall condition of the aircraft EWIS.

1) Use findings from Tasks One and Two based on the failure criticality to select zones for inspection. Use available wiring design and installation documents SAE AS50881 or applicable platform-specific contractual design/installation documents for additional guidance.
2) Develop inspection checklist for the selected zones.
3) Conduct a physical inspection and document overall condition of aircraft electrical system using guidelines established in MIL-HDBK-522.
4) Specifically examine wiring for exposed conductors, cracked or deteriorated insulation, loss of insulation mechanical properties, excessive splices, presence of contamination/corrosion, or insulation discoloration due to overheating conditions.
5) Examine circuit breakers, distribution panels, and other conductive path components for corrosion, thermal damage, and electrical degradation.
6) Large or complex areas should be divided into manageable size. Emphasize Severe Wind and Moisture Prone (SWAMP) and high-maintenance areas.
7) Prepare and document with photos findings from the physical inspection. Discrepancies that may affect aircraft safety should be identified for immediate action.

EWISIP Deep Dive – Core Task #3 Results



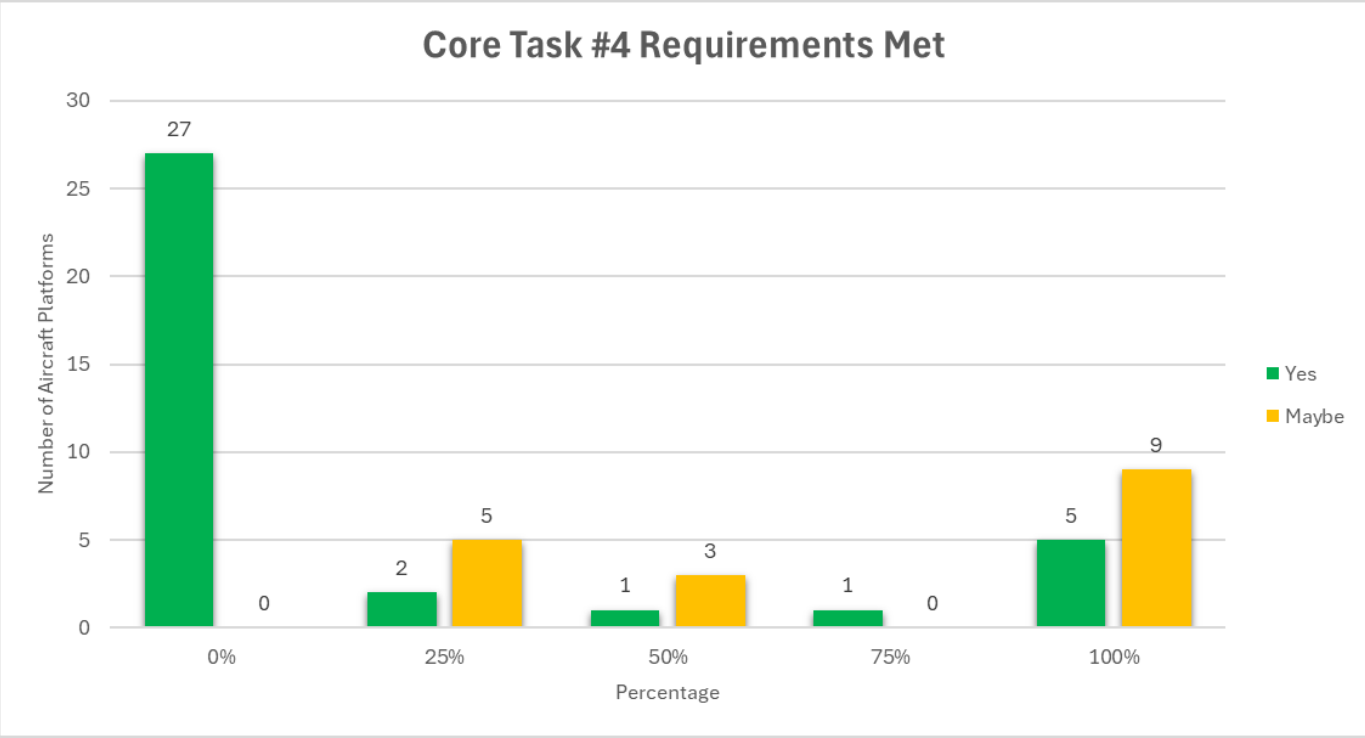
- EWIS Physical Audit TIM brief identified Flight Controls System as a high failure rate using a database
- Boeing/MECSIP Team further reviewed EWIS inspection/maintenance procedures and added inspection items to the EWIS Zonal Analysis
- EWIS report designates zones, probability and suggestions for inspection/review following methods designated in MIL-HDBK-525

EWISIP Deep Dive – Core Task #4 Subtasks

<u>Core Process Task Four</u> – Conduct a comprehensive materials/aging analysis of wiring and electrical components removed from the aircraft.

1) Use findings from Tasks One, Two, and Three for selection of EWIS components for removal.
2) Conduct a lab or visual inspection to document condition of components and follow with a detailed materials examination which may include electrical, mechanical, chemical, and/or destructive aging analysis of selected EWIS components.
3) Apply aging assessment techniques and aging/degradation models to determine remaining life of EWIS components, if available or established.
4) Review the results of the comprehensive analysis performed on the electrical components removed from the aircraft. Reviews should also include assessment of trends or increases in the number of NFF, CNF, RETOK, BCM, and DCR maintenance codes, which may indicate wiring system intermittency problems.

EWISIP Deep Dive – Core Task #4 Results



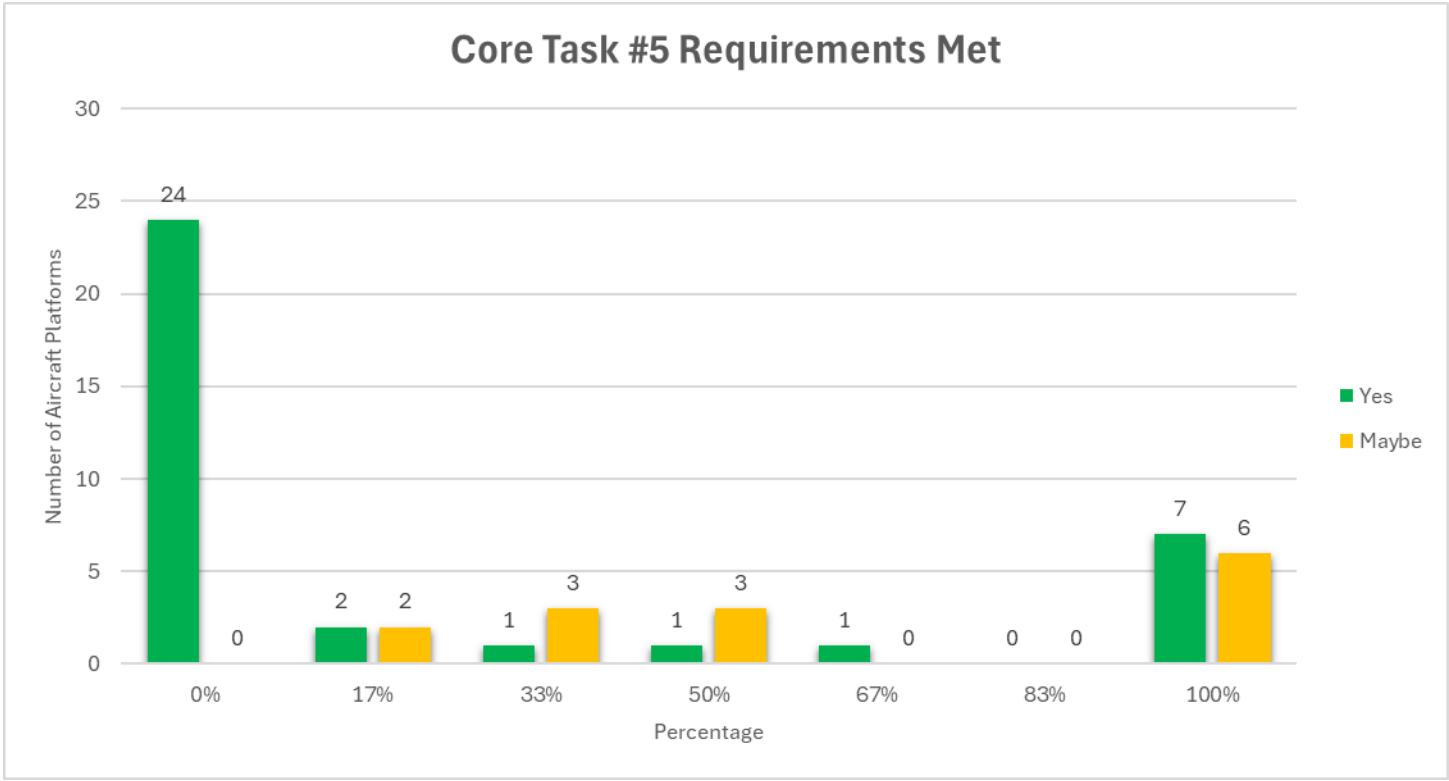
- Visual and Lab inspections performed to document condition of selected components
- MMP includes verbiage for identify, prioritize and forecast failing functional equipment that could impact aircraft safety or function
- Contractor testing of sampled EWIS remaining service life funded, test report provided

EWISIP Deep Dive – Core Task #5 Subtasks

<u>Core Process Task Five</u> – Analyze and provide an overall risk and life assessment of the aircraft EWIS.

1) Apply algorithms or models that provide an EWIS risk assessment based on failure histories, failure modes and mechanisms, materials properties, and environmental and maintenance conditions.
2) Address criticality of the wiring system and its impact on aircraft safety, reliability, and availability.
3) Review safety assessment process in MIL-STD-882 and AC25.1701-1.
4) Consider electrical fires, reported hazards, system reliability, and availability.
5) Analyze and provide an overall EWIS risk and life assessment using collected data (Tasks One through Four).
6) Prepare a report on the aircraft EWIS risk and life assessment. Where possible, the report should identify the risk at the device, system, and aircraft level.

EWISIP Deep Dive – Core Task #5 Results



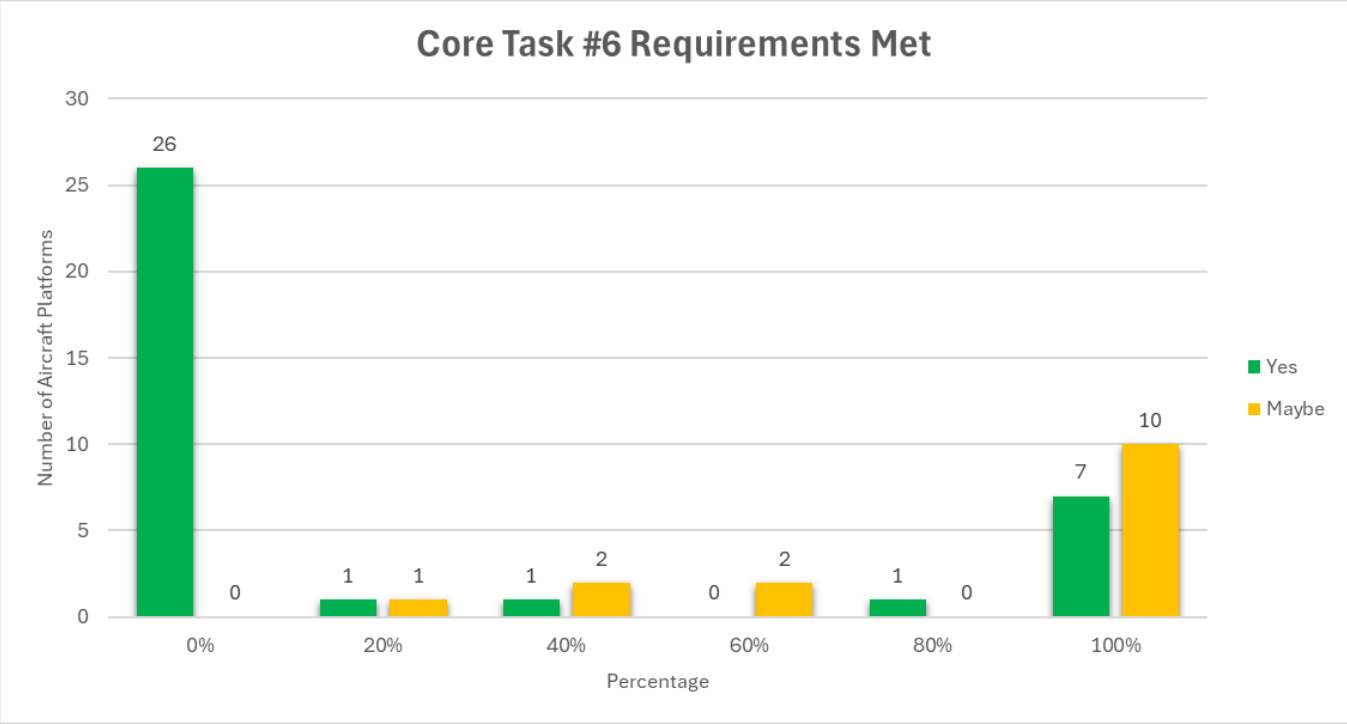
- EWIS report allows for remarks to denote removal while also showing hazard/risk assessment, EWIS items and severity
- Task is planned to support SLEP strategies and determine when additional service life testing will be required
- Life assessment is provided based on maintenance data, TO and other sources.

EWISIP Deep Dive – Core Task #6 Subtasks

Core Process Task Six – Apply overall analysis toward an action plan.

1) Use the collected data from Tasks One through Five to provide recommendations to mitigate risk through inspection, replacement, or upgrade of wiring system components, etc.
2) Recommend scheduled inspections over system life.
3) Recommend installation of new technology to improve long-term performance and reduced cost.
4) Update maintenance manuals to include the following for EWIS fuel tank system components: mandatory replacement times, inspection intervals, related inspection instruction/procedures, and Critical Design Configuration Control limitation for fuel system components.
5) Prepare a report that details the recommendations on how to mitigate identified risks. The report should include recommended updates/changes to maintenance and inspection processes.

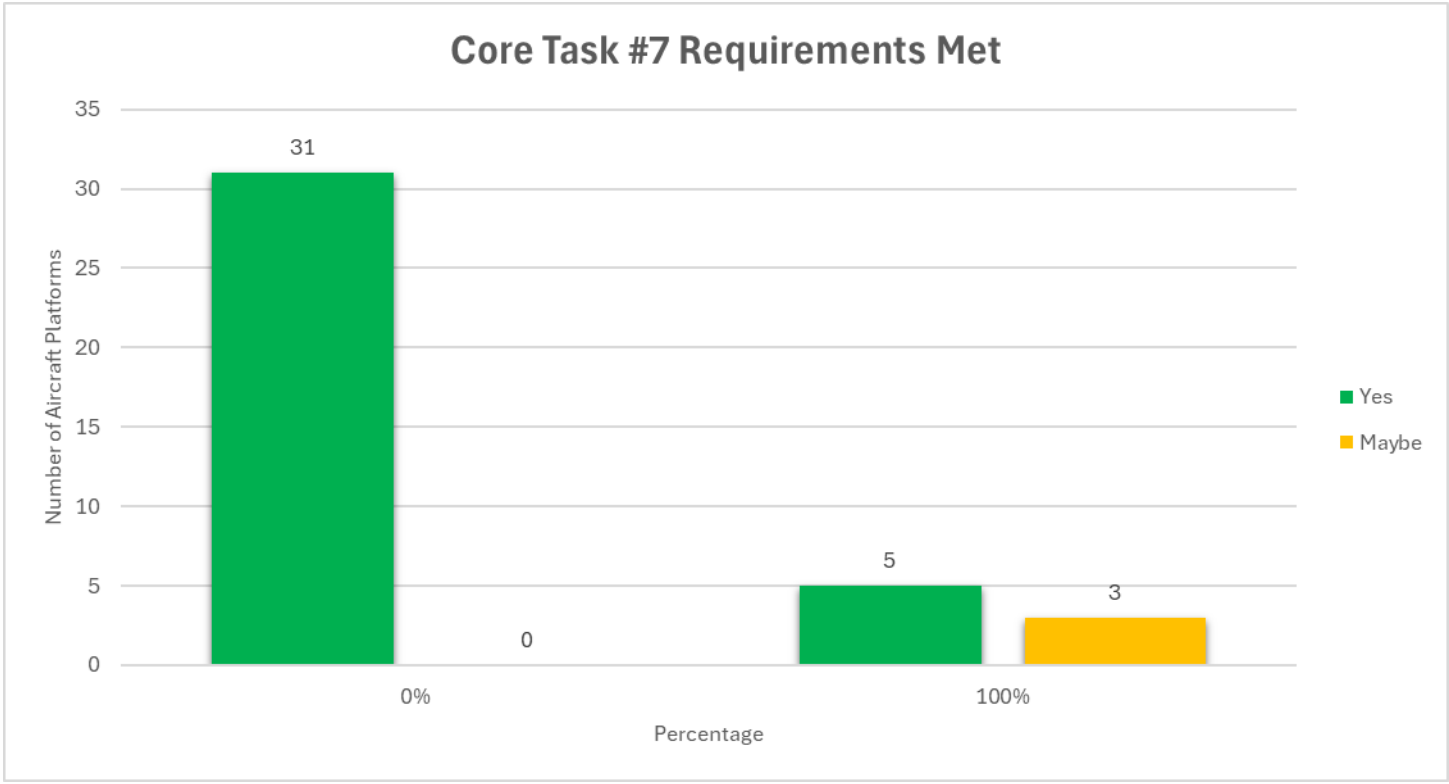
EWISIP Deep Dive – Core Task #6 Results



- SPO utilizes a chaffing awareness program/module for field maintenance to report issues, which informs modification of inspection criteria in work cards
- MIL-HDBK-525 verbiage exists withing MMP. Includes aircraft health assessment plans and details procedure to implement
- FDR/Fault log data is reviewed continuously each month. Maintenance recommendations are presented to the field on a weekly basis

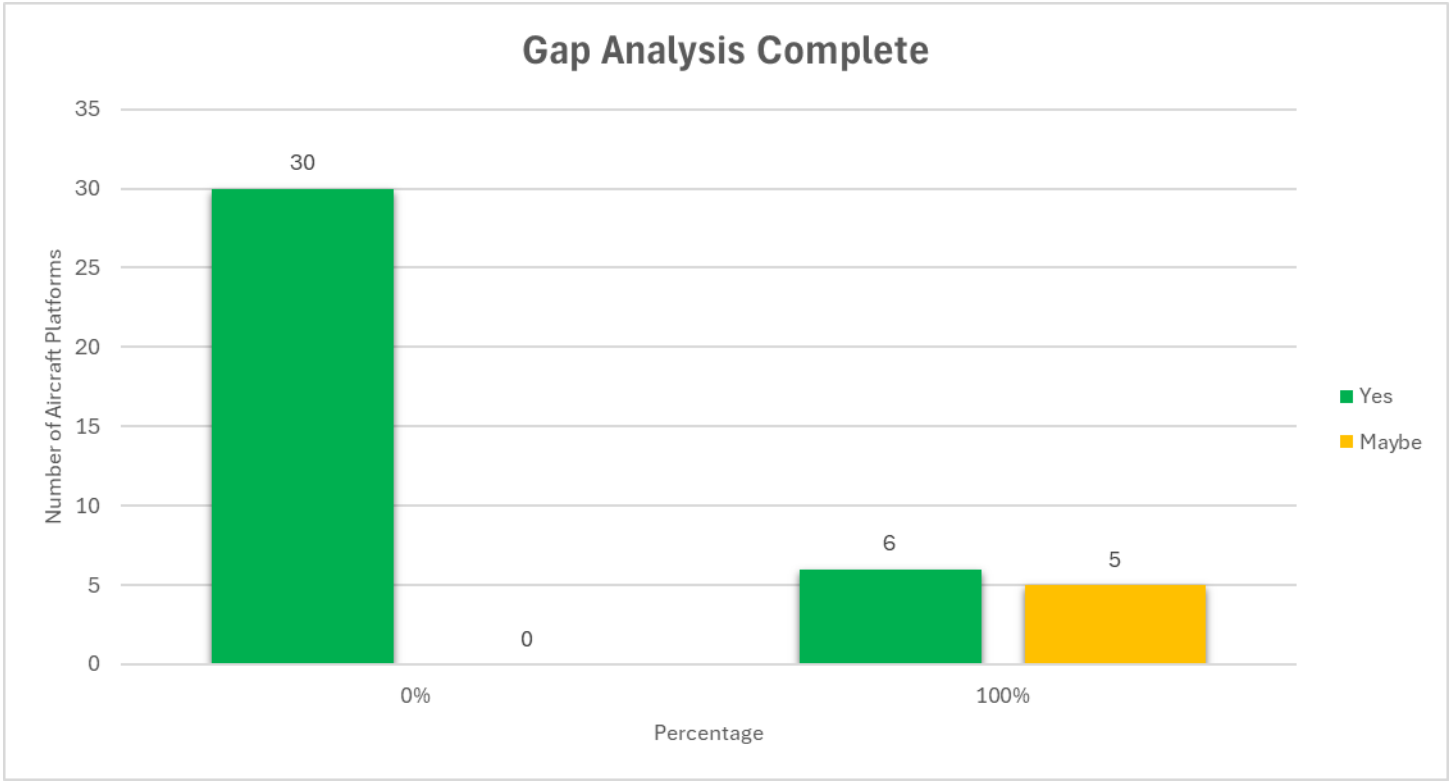
EWISIP Deep Dive – Core Task #7 Results

<u>Core Process Task Seven</u> – Tailor and apply Core Tasks One through Six iteratively as required.



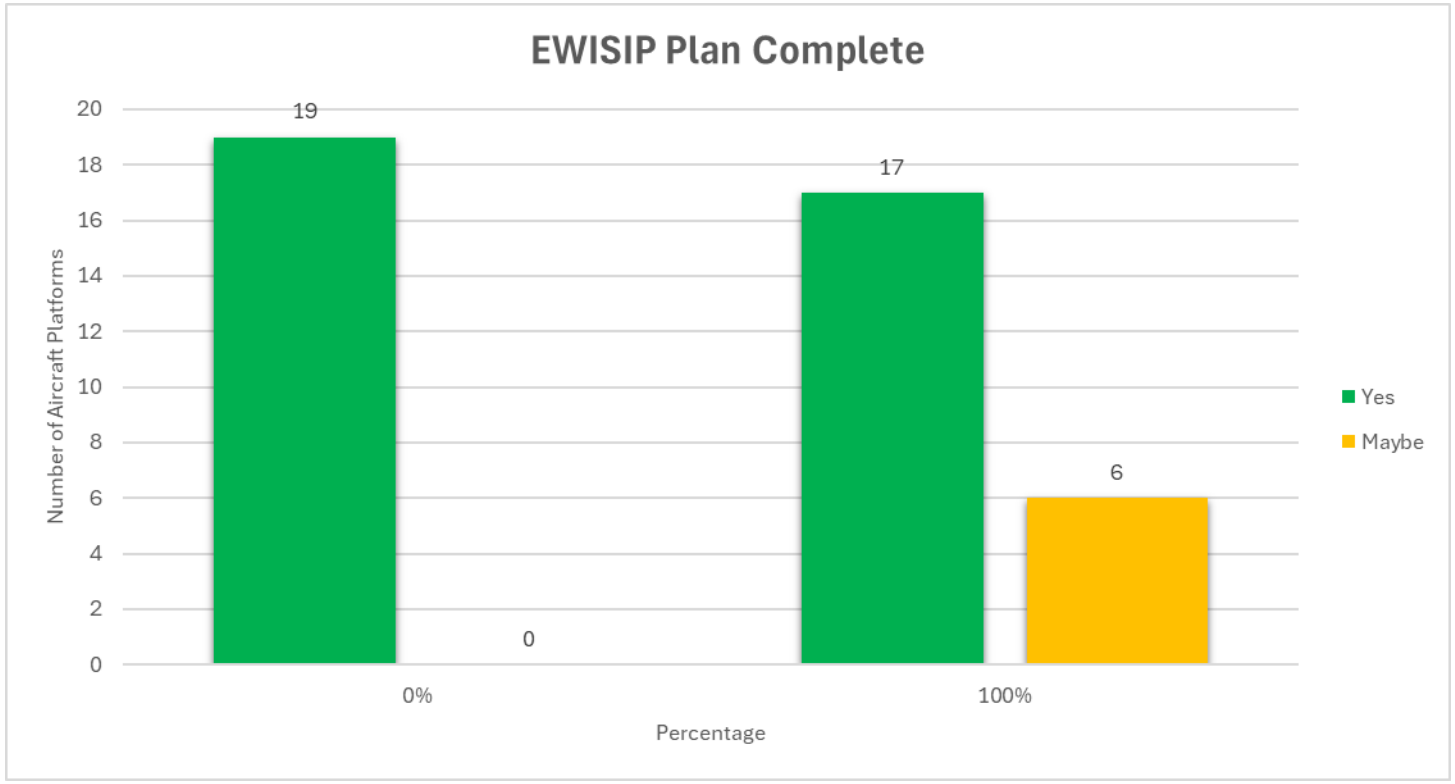
- Provided a process to perform iterative assessments
- EWIS Master Plan addresses Task 7 and describes how to perform an iterative assessment

EWISIP Deep Dive – Gap Analysis Results



- The EWIS plan covers some of the information I would consider a gap analysis of MIL-HDBK-525 and the current approach.
- Gap analysis present for Core tasks 1 & 2
- SPO is currently working on completing a gap analysis between current processes and MIL-HDBK-525

EWISIP Deep Dive – EWIS Plan Results



- EWIS Plan as a living document that will include EWIS progress achieved.
- EWIS Plan provides details on Task 2 scheduling and notional planning/scheduling for Tasks 3-6, also provides guidance on how to complete Task 1
- Extensive EWIS Plan found in MMP and documentation.

EWISIP Review Retrospect

Improvements:

- Utilizing MECSIP Managers for inputs
- Previous MECSIP assessments and artifacts
- Understanding FAA Certification
- More though review of artifacts

Future Implementation:

- Inclusion of development programs
- EWISIP expertise within the Program Offices
- EWISIP breakout

Questions?