Corrosion Evaluation of F-35 Lightning II and F-22 Raptor

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November15, 2010

2010 Congressional Requirement (H.R. 2647)

- Concern that lessons learned on corrosion for the F-22 have not been fully applied to the F-35
- Directs the Director, Corrosion Policy and Oversight to conduct a corrosion evaluation of the F-35 and F-22
- Include but not limited to floor inspections, program documentation, manufacturing and engineering processes
- Compare with F-22 and provide implications to other systems
- Provide a report in 180 days – subsequently to be reviewed by GAO (60 days for GAO to review)

Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Program in-brief		Fact Finding		Outbrief USD(AT&L)	Draft Report		DoD Cmnts →	GAO Review

F-35 Corrosion Evaluation Team Composition

Mr. Dan Dunmire, Director, OSD CPO, Team Leader
Dr. Deb Peeler, USAF, Deputy Team Leader
Dr. Dave Robertson, Team Executive Secretary

Mr. Craig Matzdorf, NAVAIR
Mr. Dave Pearson, DAU
Dr. Scott Fawaz, USAFA
Mr. Bill McMullen, DCMA

<u>CPO Support Team</u>
Mr. Richard Kinzie, Technical Consultant
Mr. Michael Carpenter, Program Management Consultant
Mr. F.D. Kisor, Manufacturing Consultant
Dr. Dave Robertson, Structures and Program Consultant
Mr. Greg Stonelake, Field Maintenance Consultant

Evaluation Areas

Program Management

- Requirements & System Engineering Process
- Emphasis on sustainment
- Operational Test & Eval
- Personnel and Training

Structures

- Management Philosophy
- Structural Risk Assessment
- Service life
- T&E, ECPs, Repairs

Materials & Processes

- M &P Selection
- Finish Specs, Flow Down Plans, Trade Studies
- Qualification Testing

Manufacturing Processes

- M, P and Finish Specifications
- Process Control, Repair Guides
- Risk Assessment and Analysis
- Qualification, Exceptions, ECPs

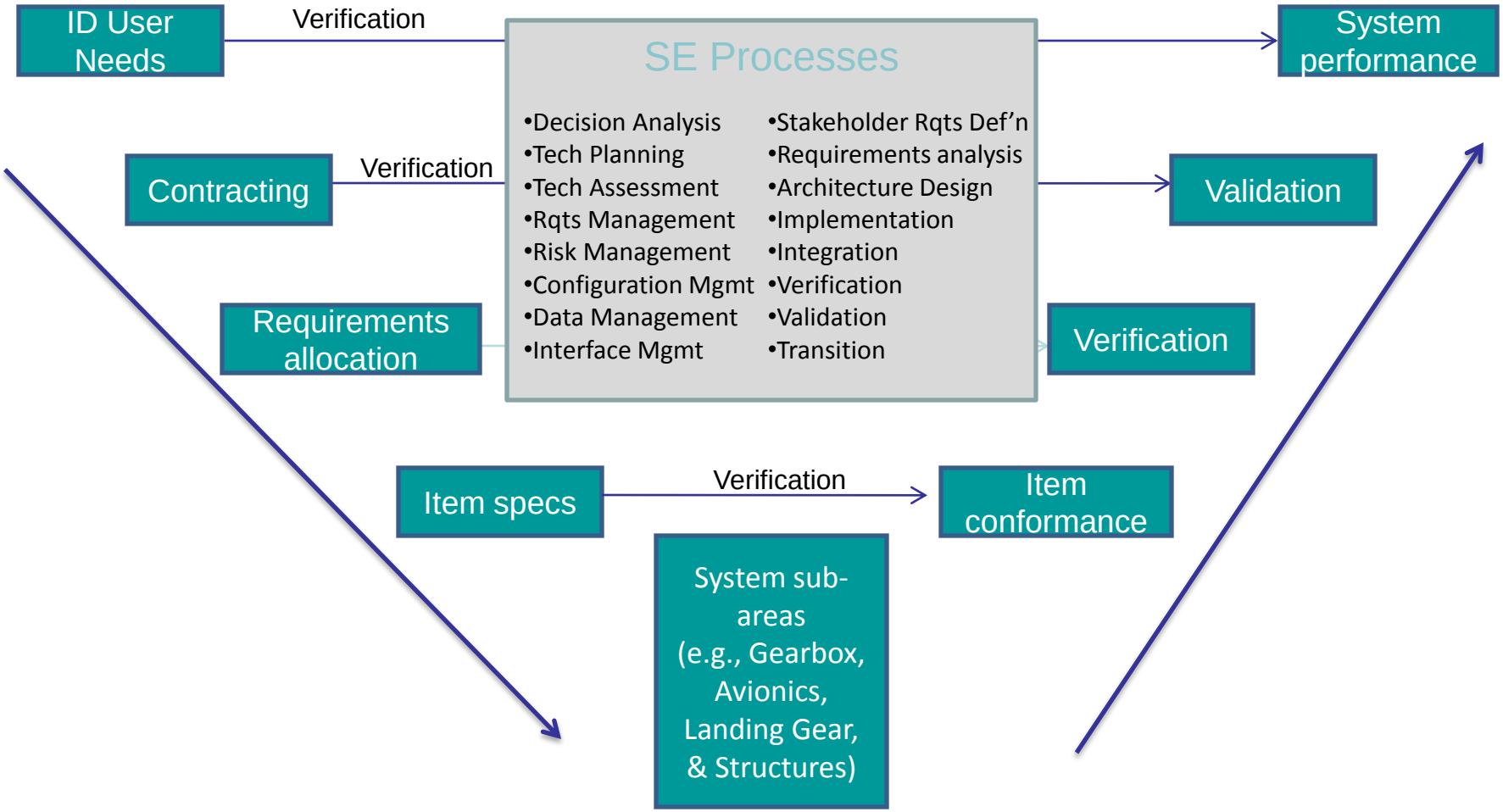
Subsystems, Components

- Verification of mfg, storage procedures,
- Quality Control, Acceptance Criteria
- Documentation, traceability

Corrosion Management and Compliance

- **CPAT**
- **CPC Plans**
- **Standards**

PM/SE Team Approach



Acquisition Policy

Common Issues

- PBA forces Gov't dependence on the Ktr; reduced organic expertise
- Limited Gov't oversight/influence beyond Performance Baseline
- OEM has design authority, Gov't pays for deficiencies

F-22

- Programmatic pressure drove premature Gov't acceptance of designs
- Lack of focus or attention on Life Cycle Cost

F-35

- Unprecedented complexity; Joint, Int'l program w/ three variants
- Immature SE processes, engineering council & risk management

Expertise

Common Issues

- Lack of corrosion focused knowledge
- Insufficient LO maintenance and corrosion NDI capability

F-22

- Limited corrosion/M&P expertise impacting design
- Stove piped disciplines of unequal authority impacting corrosion performance
- Ktr unmotivated to accept available gov't CPAB expertise and LO capability

F-35

- F22 issues increased interest/understanding of environment and M&P
  - Ktr leverage is across program offices, ktr partners have a small voice
  - Ktr more willing to accept gov't CPAT Inputs

Requirements Flowdown

Corrosion Resistant, 30 yrs, 8k Hrs

Common Issues

- No direct corrosion requirements
- Delegation of Design authority down multiple levels masks additional risk

F-22

- Unrealistic Ktr testing
- Lack of corrosion focus during design
- Class 1 Design authority erroneously delegated down by Ktr

F-35

- Prime Ktr requirements flowed down to subs inconsistently
- MMH/FH Requirement resulted in an improved focus on sustainability

Qualification

Common Issues

- Program concurrency increasing risk
- Low visibility of design baselines
- Lack of independent testing of Ktr designs/re-designs
- Reductions in climatic testing for cost and schedule
- Inadequate Ktr/Gov't Quality Assurance capability

F-22

- Assumption of "best case" scenarios
- Qualification of designs by similarity
- Inadequate system level verification of the functional baseline for corrosion

F-35

- No overall verification method currently in place
- Improved test approach reduced some risk (both coatings and components)

Design Trades

Common Issues

- Corrosion performance lost to signature, weight, & environmental
- Corrosion protection sacrificed to facilitate ktr mfg/env'l goals
- Trades drive unknown LCC w/o proper contract incentives

F-22

- Design choices/changes challenge technical understanding
- Coating trade made via "gentle" testing
- "Fixes" implemented prior to adequate testing; reactionary responses

  → Team assessment – long term high risk

F-35

- Increased corrosion risk from designs to save weight & environment

Observations

- F-22/F-35 should be best example of Lessons Learned
  - F-22 has additional lessons to learn
  - Both systems retain corrosion risk
- Additional corrosion risk for other existing and future systems
  - Non aerospace WS/Ktrs transitioning to light metals and special finishes
  - Introduction of new materials and processes
- Acquisition of new weapon systems must be a business partnership
  - Clear requirements, thorough testing, informed trades critical for success
  - Focus on Corrosion needs to start early, stay late
  - Failure to “design in” corrosion performance
    - Significant loss to the govt/taxpayer
    - Heavy MX burden; O&S Costs, capability unavailable to the warfighter

Advice for Future Systems

- Independent expert evaluation and advice
- Clear and traceable flow down of requirements
- Design Guidelines that balance competing requirements
- Adequate verification and validation via operationally representative testing
- Early operational evaluation in corrosive locations

Increased Readiness, Reduced Life Cycle Cost

Needed Future Actions

- R&D for corrosion of materials and processes
- Corrosion expertise to requirements and acquisition programs
- Appropriate MIL specs and stds addressing corrosion resistance
- Robust program CPC documentation and performance review
- Contract language, metrics and incentives for LCC/ corrosion
- Documented cost for corrosion trades
  - Informed O&S baselines
  - Improved MX planning