JOINT STRIKE FIGHTER
the next generation strike fighter

JSF PROGRAM UPDATE

Air Force Association

14 September 2004

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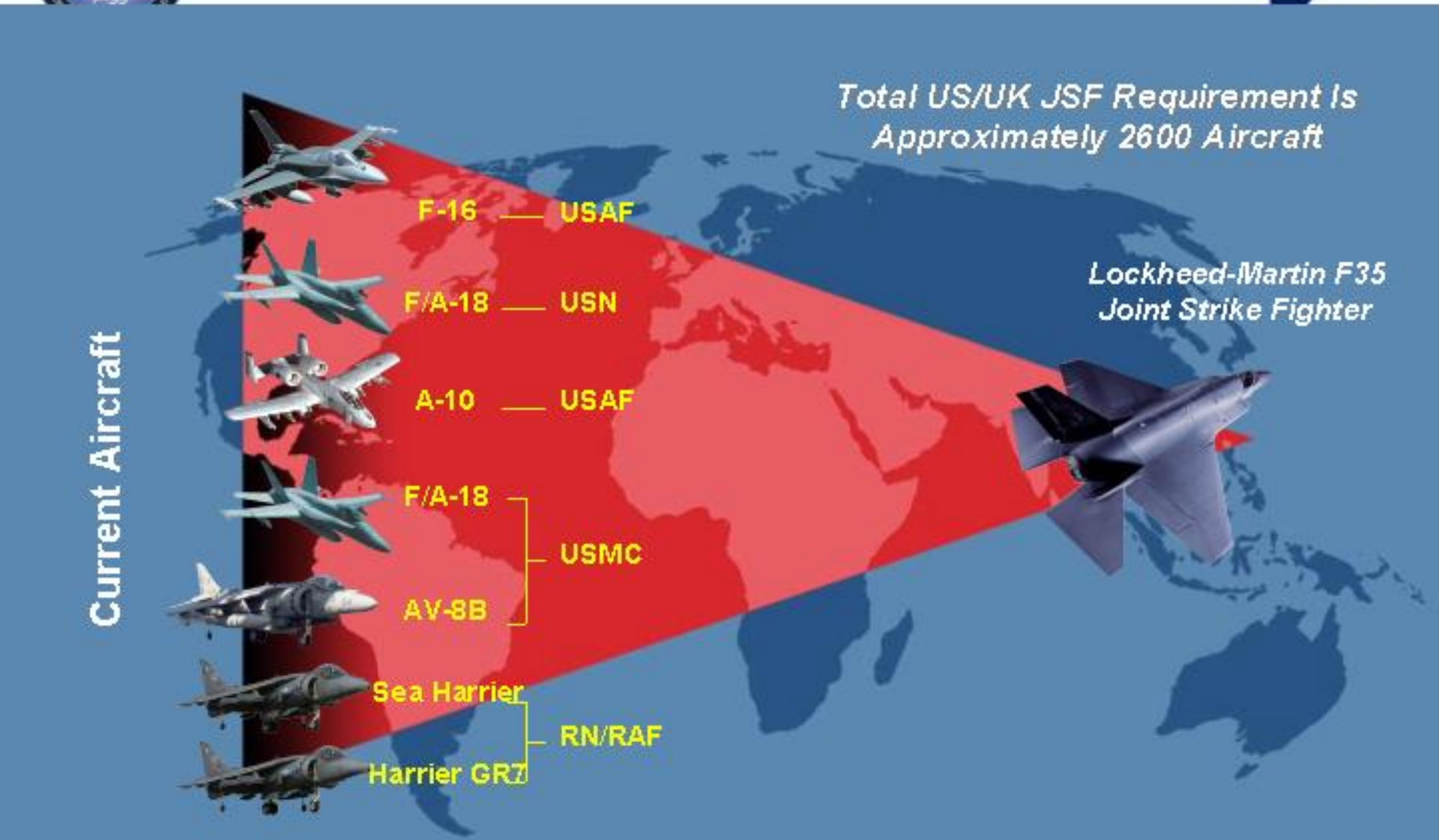
Lockheed Martin JSF Team

Broad Technology and Experience Base

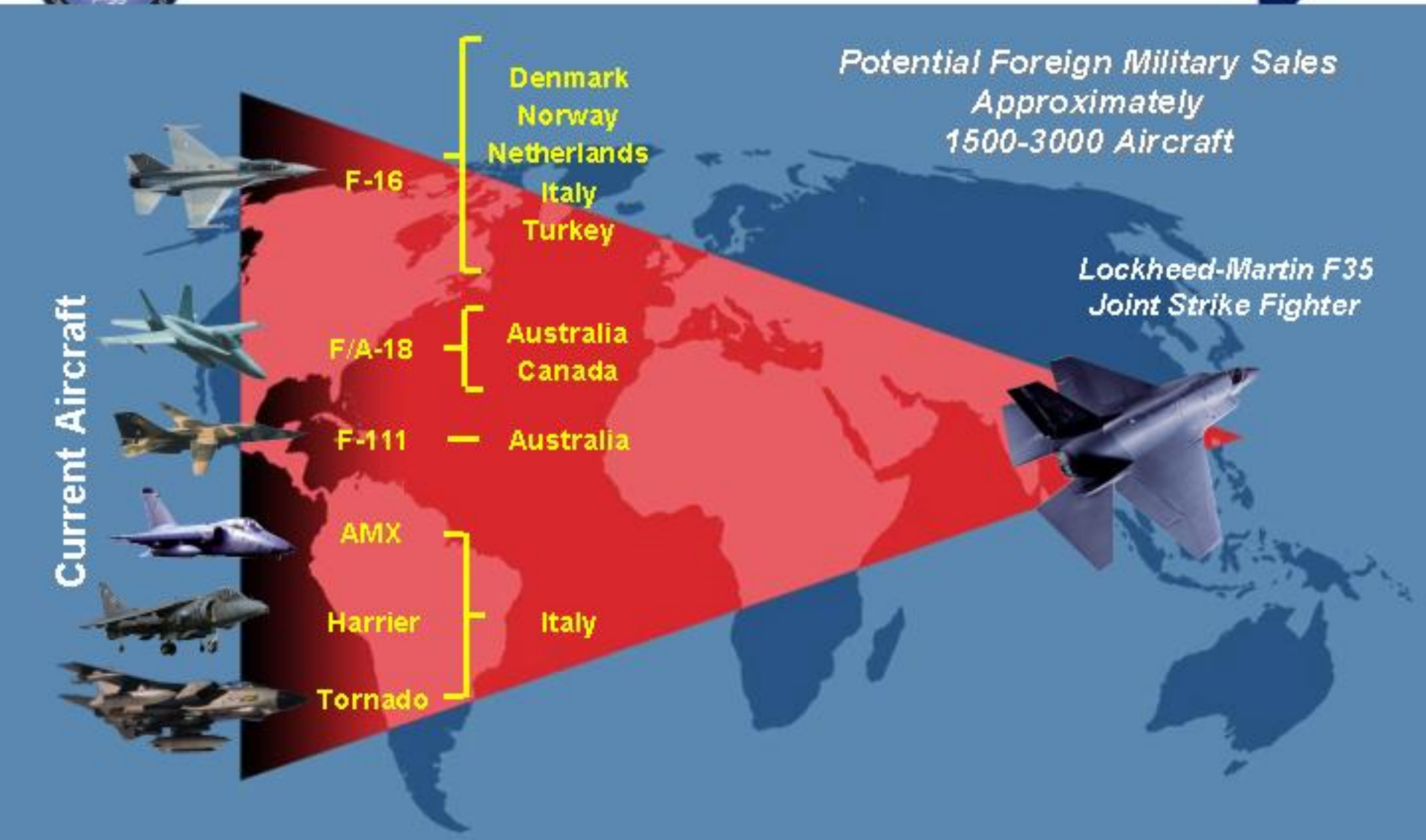
JSF Is a Multi-Service, Global Program

F-35A	F-35B	F-35C
		
Conventional Takeoff and Landing (CTOL)	*Short Takeoff/Vertical Landing (STOVL)*	*Carrier Variant (CV)*

JSF Enables True Joint, Coalition Operations



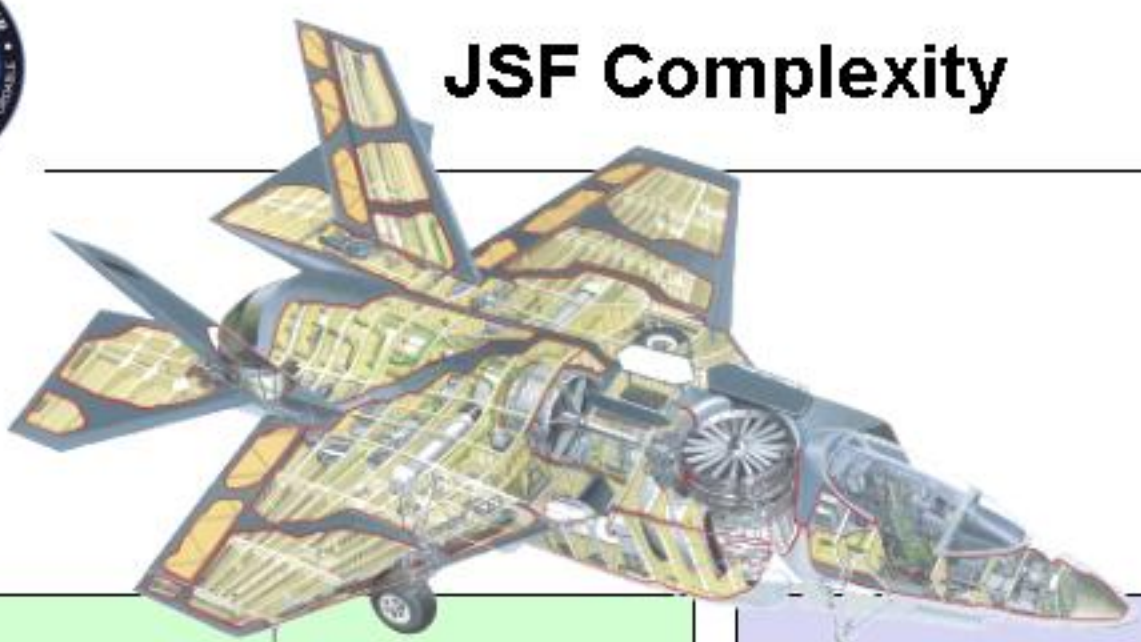
JSF Enables True Joint, Coalition Operations



Year in Review

- Air System Preliminary Design Review
- Air System Design Integration Maturity Review
- Weight Issue on STOVL
- STOVL Weight Attack Team Formed to Solve Weight Issue
  - *To Date Approx 2700 lbs Removed*
- F135 CTOL/CV First Engine to Test
- F135 STOVL First Engine to Test
- 1st Article to Assembly
  - *Lockheed Martin – Fore Fuselage and Wing*
  - *NGC – Center Fuselage*
  - *BAE SYSTEMS – Aft Fuselage*
- F136 CTOL/CV First Engine to Test

JSF Complexity



Legacy

External:

- Fuel
- Weapons
- Electro-Optical Targeting System
- Countermeasures
- Electronic Countermeasures Electronics
- Tailhook

Structural Arrangement First

Systems Installation Limited and Last

F-35

All Internal Plus •••••

- More Difficult Environmentals
- Supportable Low Observables
- Unprecedented Maintainability
  - Service Life
  - Remove and Replace Times
- Rapid Manufacturing
  - Lower Cost Materials

System Definition and Arrangement First

Structural Arrangement Last

SWAT Performance Improvement Effort

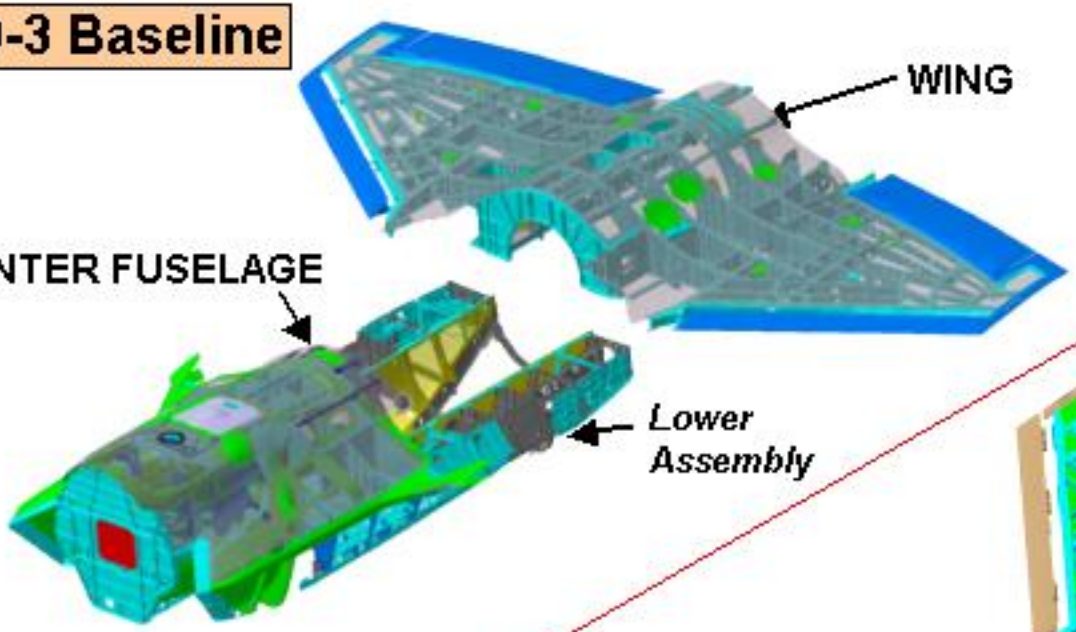
- **SWAT Studied All Facets of Performance Improvement**
  - ***Removed approximately 2700 lbs of Weight From Air System***
  - ***Removed approximately 600 lbs Equivalent Weight From Installed Propulsion Effects***
  - ***Performed Wind Tunnel Tests to Remove Drag***
  - ***Worked With JPO to:***
    - Optimize Ground Rules and Assumptions
    - Adjusted Requirements Where Appropriate
- **Results:**
  - ***All Variants Are Projected to Meet All KPPs***
  - ***Warfighter Attributes Retained***
  - ***Aircraft Aerodynamic Performance is Less of an Issue***

SWAT Evolution

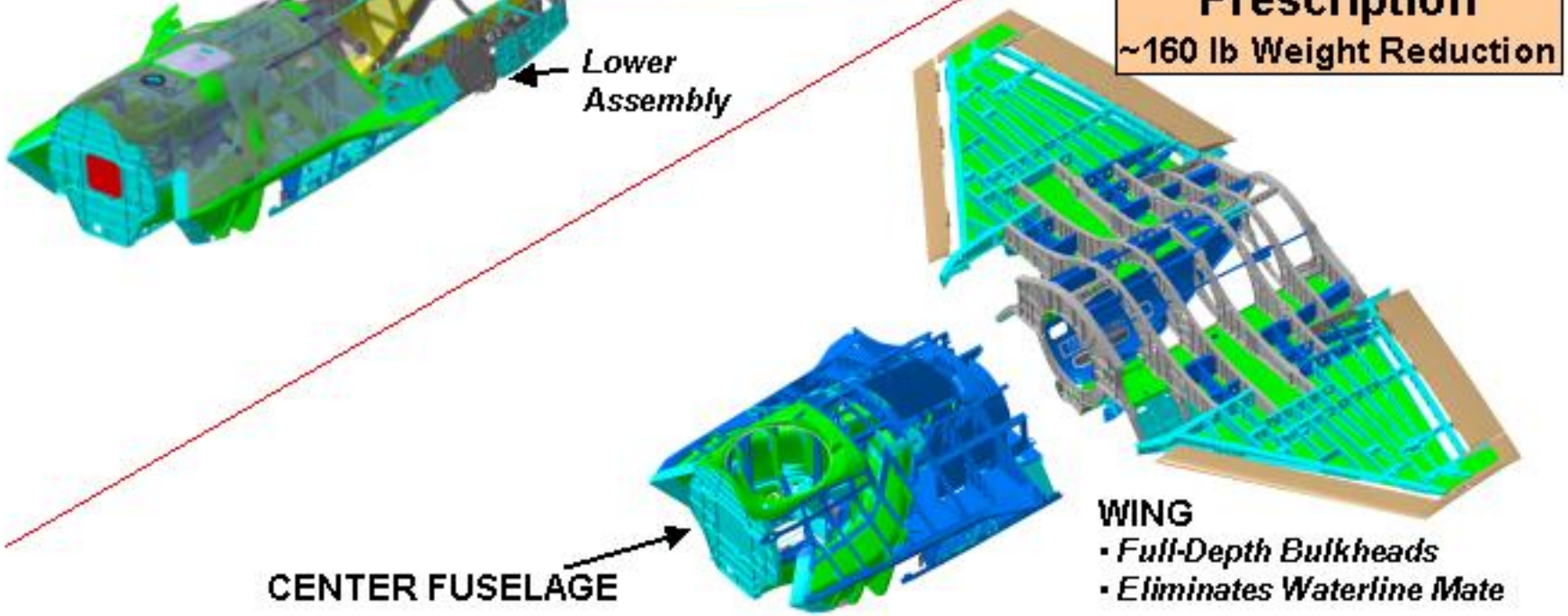
STOVL Weight Attack Team

Airframe Optimization: Mate Joint

240-3 Baseline



Proposed Prescription
~160 lb Weight Reduction



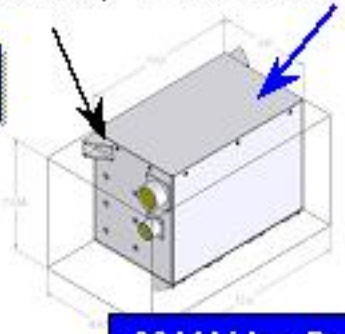
Systems Optimization: Electrical System

- Li-Ion 28-V Battery -25.8 lbs
- Al Bus Bars for ICCs & Pwr Panels -22.3 lbs
- Starter/Generator Capacity -16.0 lbs
  - *From 160 kW to 140 kW*
- Deleted EDU 3 -11.7 lbs
- Delete Power Panel #4 -23.3 lbs
- Wound-Field Starter/Generator -102.3 lbs
- Single Inverter -16.0 lbs
- Miscellaneous EPS Savings -4.5 lbs
- *TOTAL Aircraft Savings* -222.0 lbs

Baseline Battery Envelope (55.8 lbs)

Li-Ion Battery Envelope (30.0 lbs)

Inverter/Converter/ Controller (ICC)



28-V Li-Ion Battery

Engine Starter/Generator

AC Inverter – Proposed Prescription Deletion

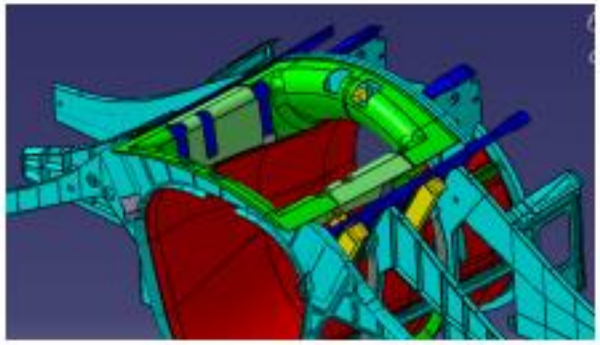
Power Panel 4 Deleted

EDU #3 - Deleted

Proposed Prescription
~ 220 lb Weight Reduction

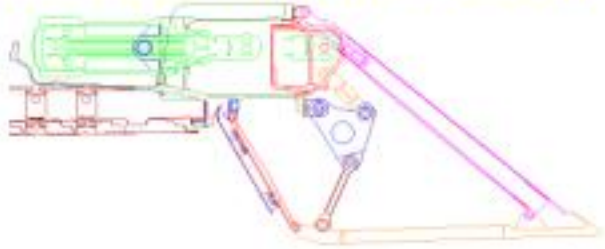
Propulsion Optimization Summary

Aux Inlet Optimization



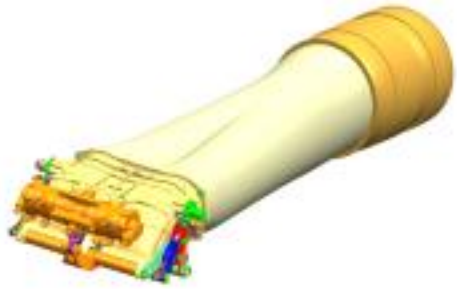
Improving Inlet Pressure Recovery

STOVL Exhaust System



2.1" Radius Reduction & Lower Weight
Reduced Aircraft Drag

Roll Post Modulation



During STO Deck Roll

Projected Performance Benefits:

- ~600 lbm VLBB Increase
- ~100 Ft Reduction in Flat Deck STO Distance
- ~25 nm Mission Radius Improvement

Key Performance Parameters

USMC ★ USN ★ Joint ★

KPP	USMC	USAF	USN
Radio Frequency Signature	Low Observable		
Combat Radius	450 nm USMC Profile	590 nm USAF Profile	600 nm USN Profile
Sortie Generation	4 Surg / 3 Sust	3 Surg / 2 Sust	3 Surg / 2 Sust
Logistics Footprint	< 8 C-17 equivalent loads (20 PAA)	< 8 C-17 equivalent loads (24 PAA)	< 46,000 cu ft 243 ST
Mission Reliability	95%	93%	95%
Interoperability	Meet 100% of critical, top-level Information Exchange Requirements Secure Voice and Data		
STOVL Mission Performance		N/A	N/A
Short Take-Off Distance	550'		
Vertical Lift Bring Back	2 x 1K JDAM, 2 x AIM-120 With Reserve Fuel		
Maximum Approach Speed	N/A	N/A	145 knots

Projected to meet or exceed KPPs

F-35 Program Requirements Drive Advanced Manufacturing System

This Program is Different…..

…VERY Different

Different in Everything We Do

- 1 Day Takt
  - 1 Airplane Delivered Every Day
- 1 Year Order to Delivery
  - 5 Month Assembly Span
- Mixed Model Moving Assembly Line
- Unprecedented Affordability Challenges
- High Rate Global Manufacturing
  - Development and Assembly Performed by Global Partners

Forward Fuselage - Lockheed Martin

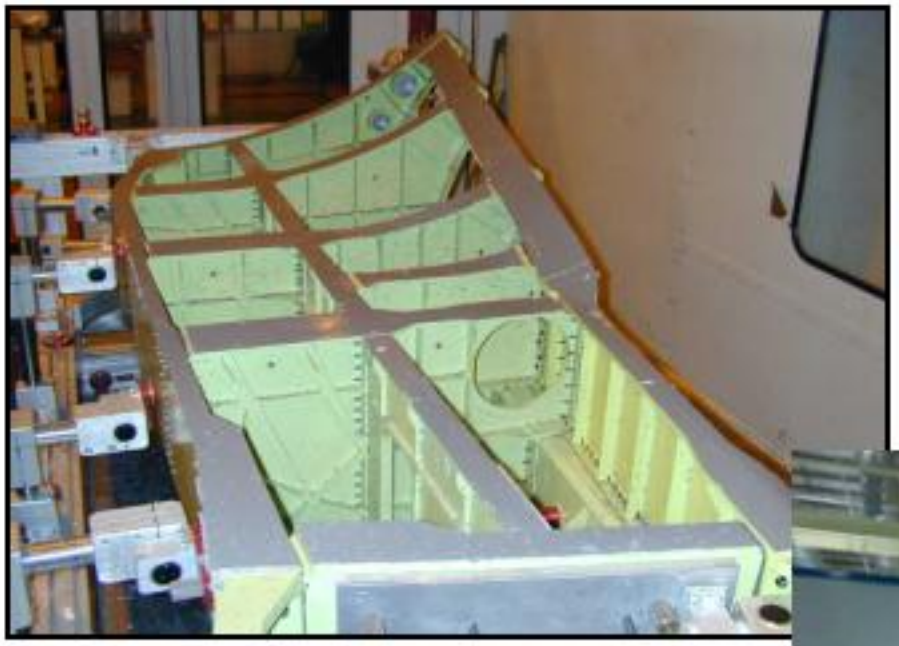
Center Fuselage - Northrop Grumman

Wing – Lockheed Martin

Upper Wing Skin

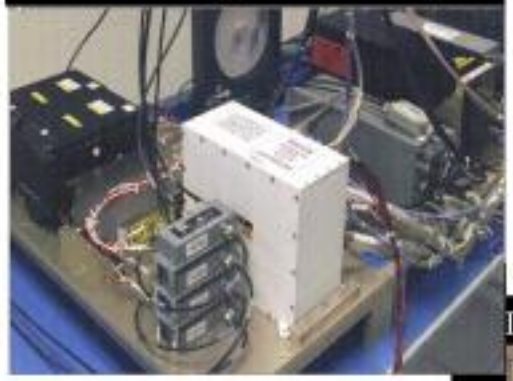
Lower Wing Skins

AFT Fuselage and Tails – BAE SYSTEMS



Mission Systems Initial Hardware Deliveries

CNI Block 0.1 Integration 98% Complete

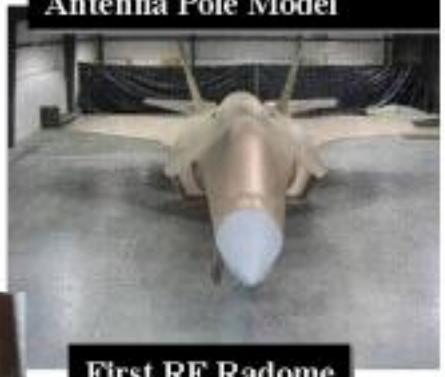


Includes Stability test of 50 hr (100k commands) without reset

Fusion Risk Reduction Data in BAC 1-11

Display Management Computer

Antenna Pole Model



First JSF Radar Into Lab

Integrated Core Processing

Inertial Navigation System

First RF Radome

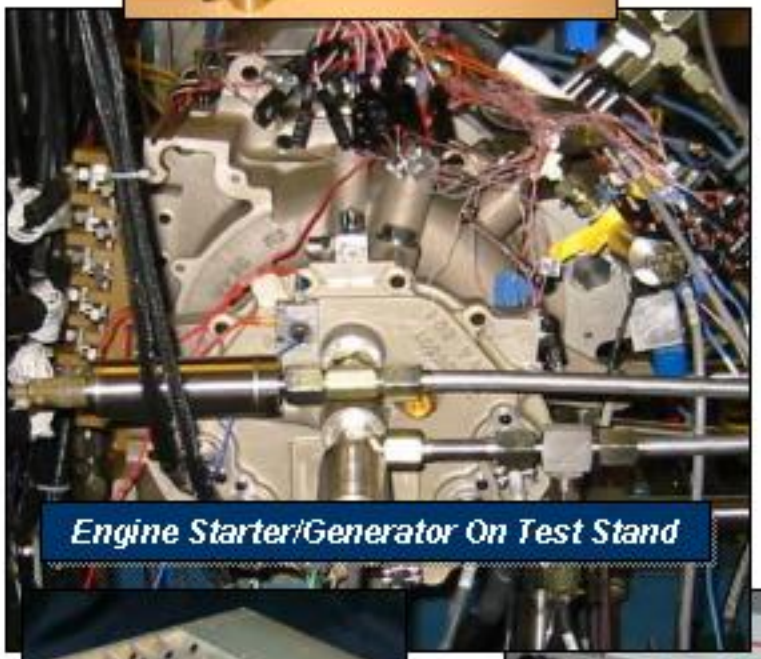
Vehicle Systems Development Progress

28-V Battery Under Test

EDU 1 & 2 – Delivered To HS SIL

ICC – 100% Power Demonstrated

115Vac Inverter – 100% Power Demonstrated



Engine Starter/Generator On Test Stand

28Vdc Converter – 100% Pwr Demonstrated

C/R – 100% Power Demonstrated

Pwr Panel Chassis

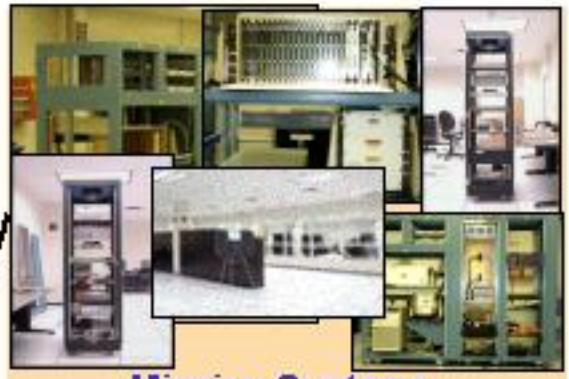
PDC - Operational

EDU Chassis

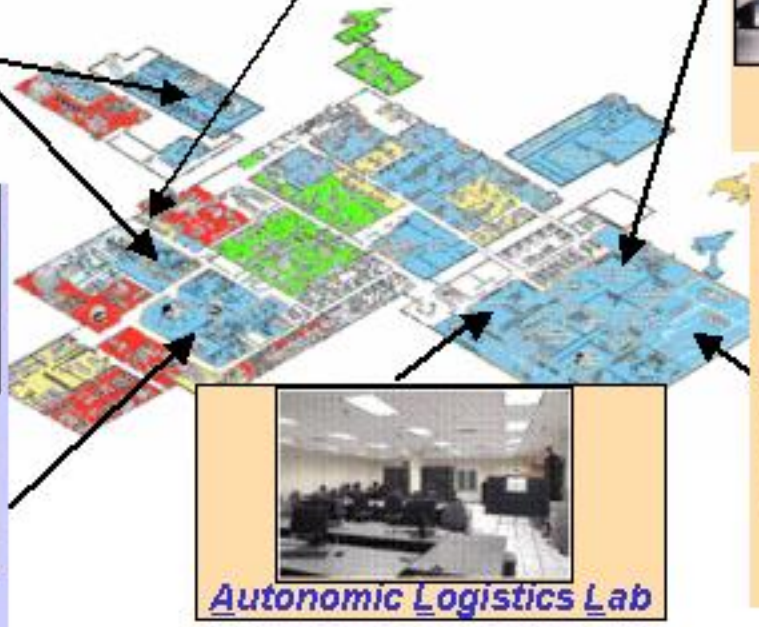
F-35 Integration/Test Laboratories Co-located

Manned Tactical Simulator

JSF Interoperability Lab



Mission Systems Integration Lab



Vehicle Systems Processor/Flight Control System Integration Facility

Autonomic Logistics Lab

Vehicle Systems Integration Facility

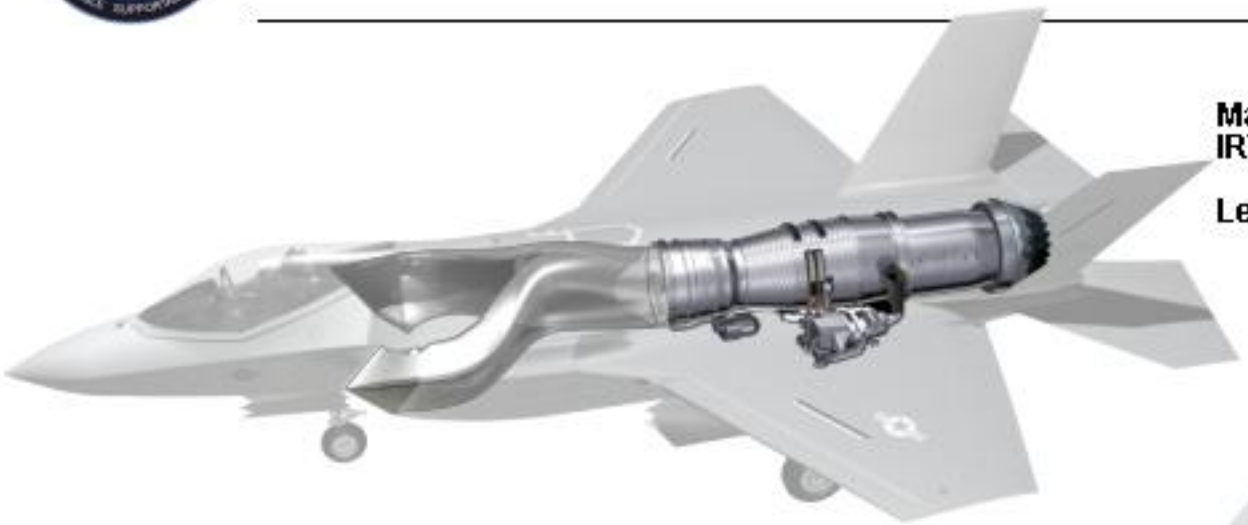
CODE: Labs Connected for Air System Integrated Facility (ASIF)

Labs Which Stimulate the Air System | Stand-Alone Labs

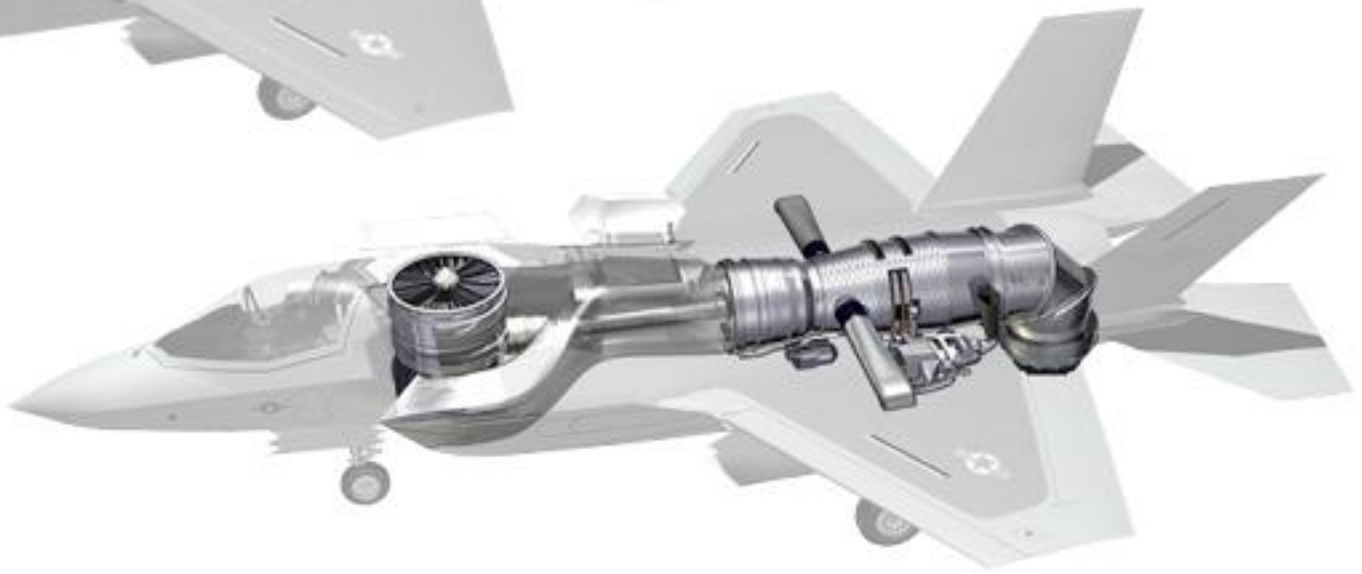
JSF Propulsion

PRATT & WHITNEY
JSF PROPULSION SYSTEM
F135
ROLLS-ROYCE HAMILTON SUNDSTRAND

F136
A STEP BEYOND



Maximum AB Thrust:	40,800 lbf (181.5 kN)
IRT Thrust:	23,400 lbf (104.1 kN)
Length:	221 inches (5.61 m)



Hover Thrust:	39,400 lbf (175.3 kN)
Main Engine	15,700 lbf
Roll Post	3,700 lbf
LiftFan™	20,000 lbf

Length:	369 inches (9.37 m)
LiftFan™ Diameter:	50 inches (1.27 m)
Main Engine Diameter:	46 inches (1.17 m)

Short Take Off Thrust: 38,100 lbf (169.5 kN)

F135 CTOL Development Engines

Meeting pre-test predictions

FX631-01

FX632-01

FX633-1

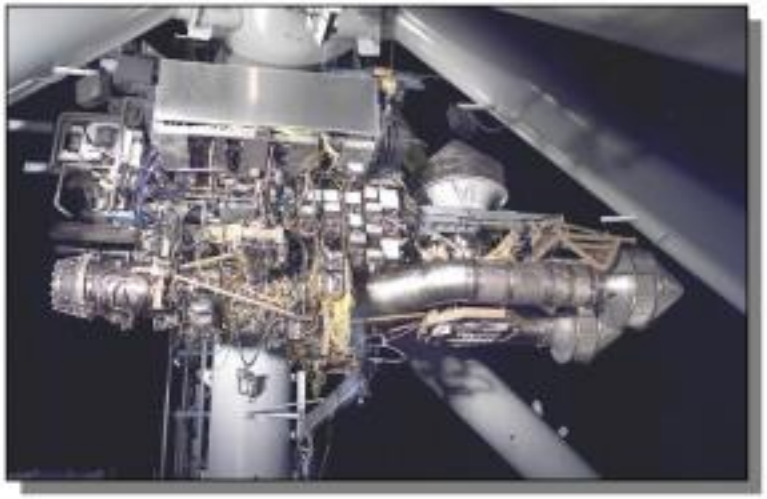
CTOL Test Accomplishments

- **Five engines at test – over 1000 hours total to date**
- **Demonstrated spec level mil and max thrust**
- **Demonstrated inlet/fan compatibility**
- **Successfully completed structural evaluation of compression and low turbine**
- **461+ accelerated mission testing cycles**

Successfully Demonstrated Thrust at 39,750 lbs.

F135 STOVL Development Engine

First STOVL Engine Initiated Testing Six Weeks Early

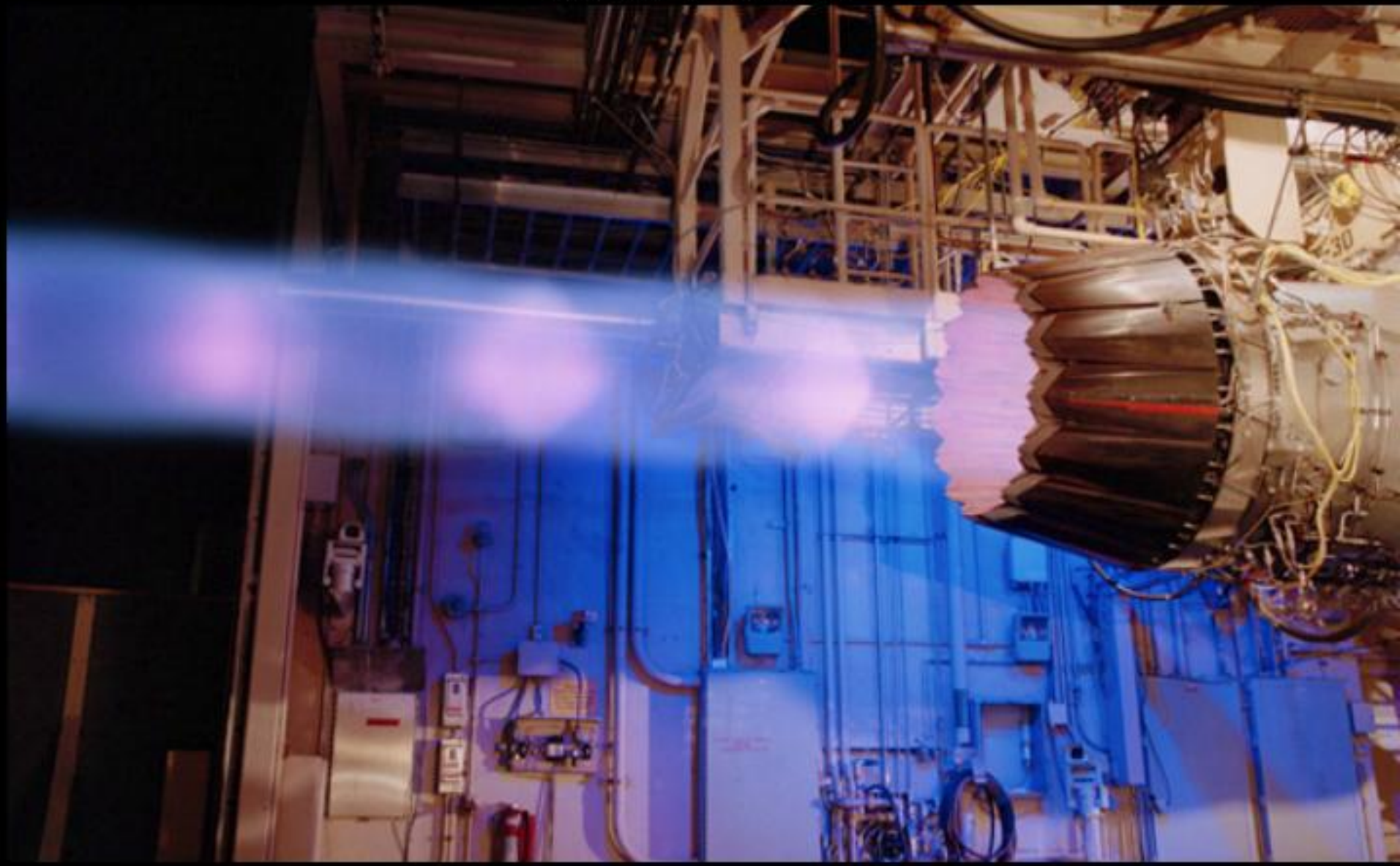


STOVL Test Accomplishments

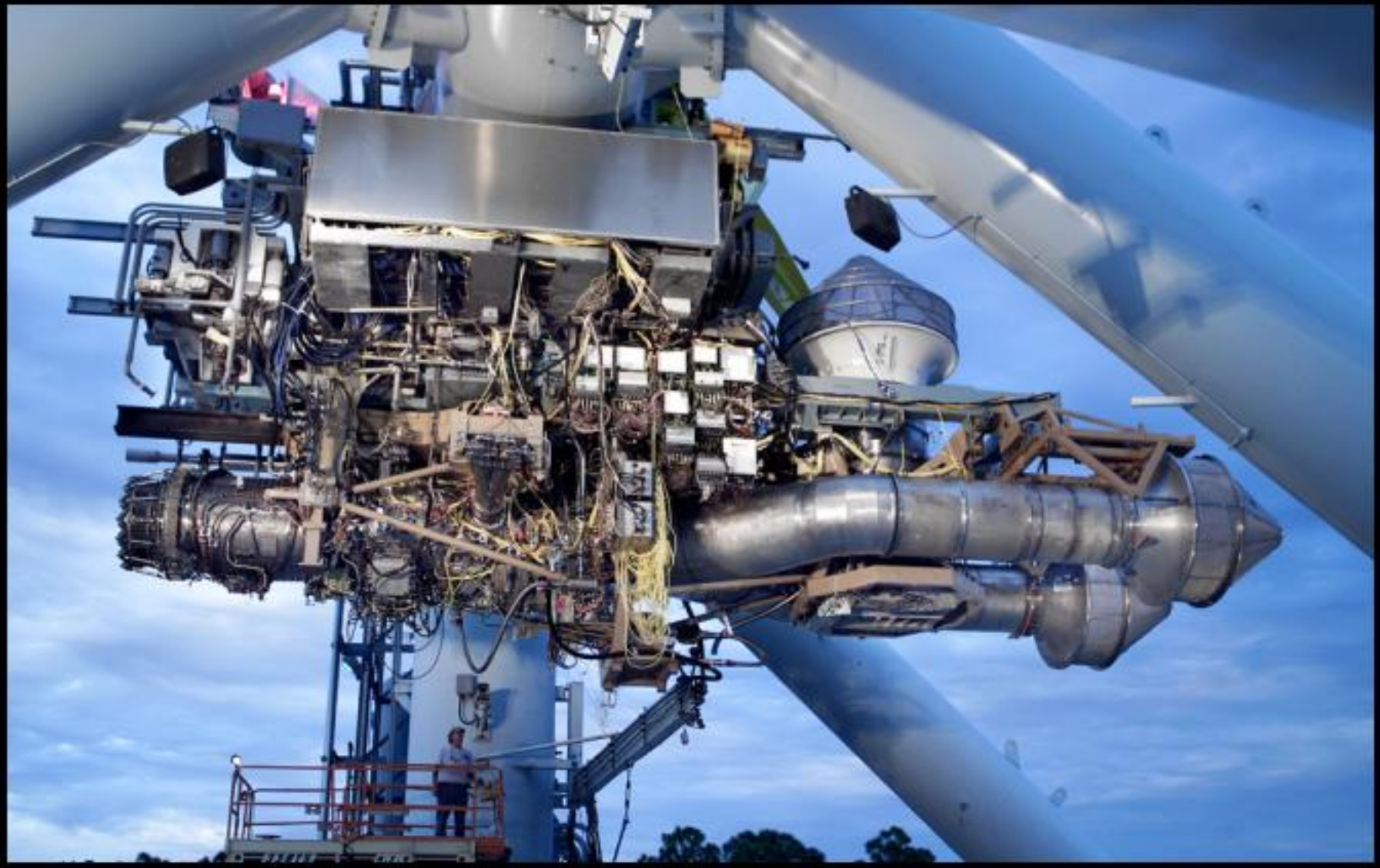
- **85+ hours to date**
- **Demonstrated spec hover thrust**
- **Confirmed low pressure turbine operation in STOVL mode**

Successfully Demonstrated Dynamic Clutch Engagement & Hover Thrust Demo at 39,700 lbs.

CTOL Video



STOVL Video



F136 First Engine To Test Assembly Complete - 9 July 04

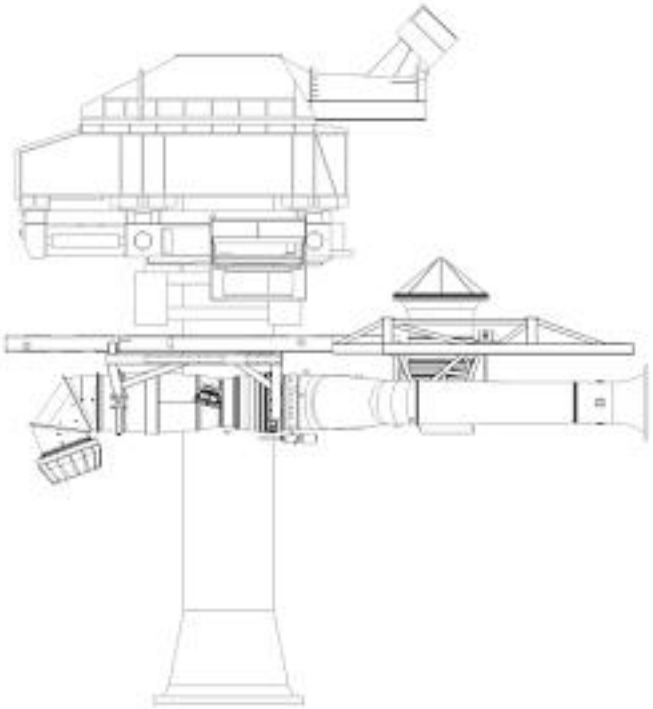
F136
A STEP BEYOND

Over 2000 Lines of Instrumentation

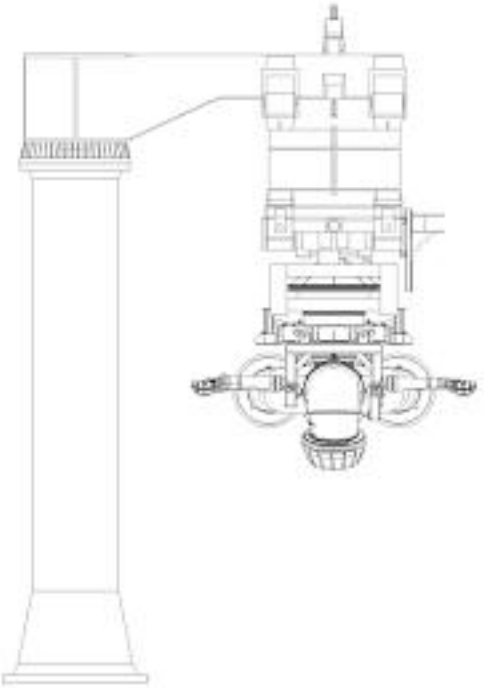
Second Engine To Test STOVL

F136
A STEP BEYOND

Elevation View

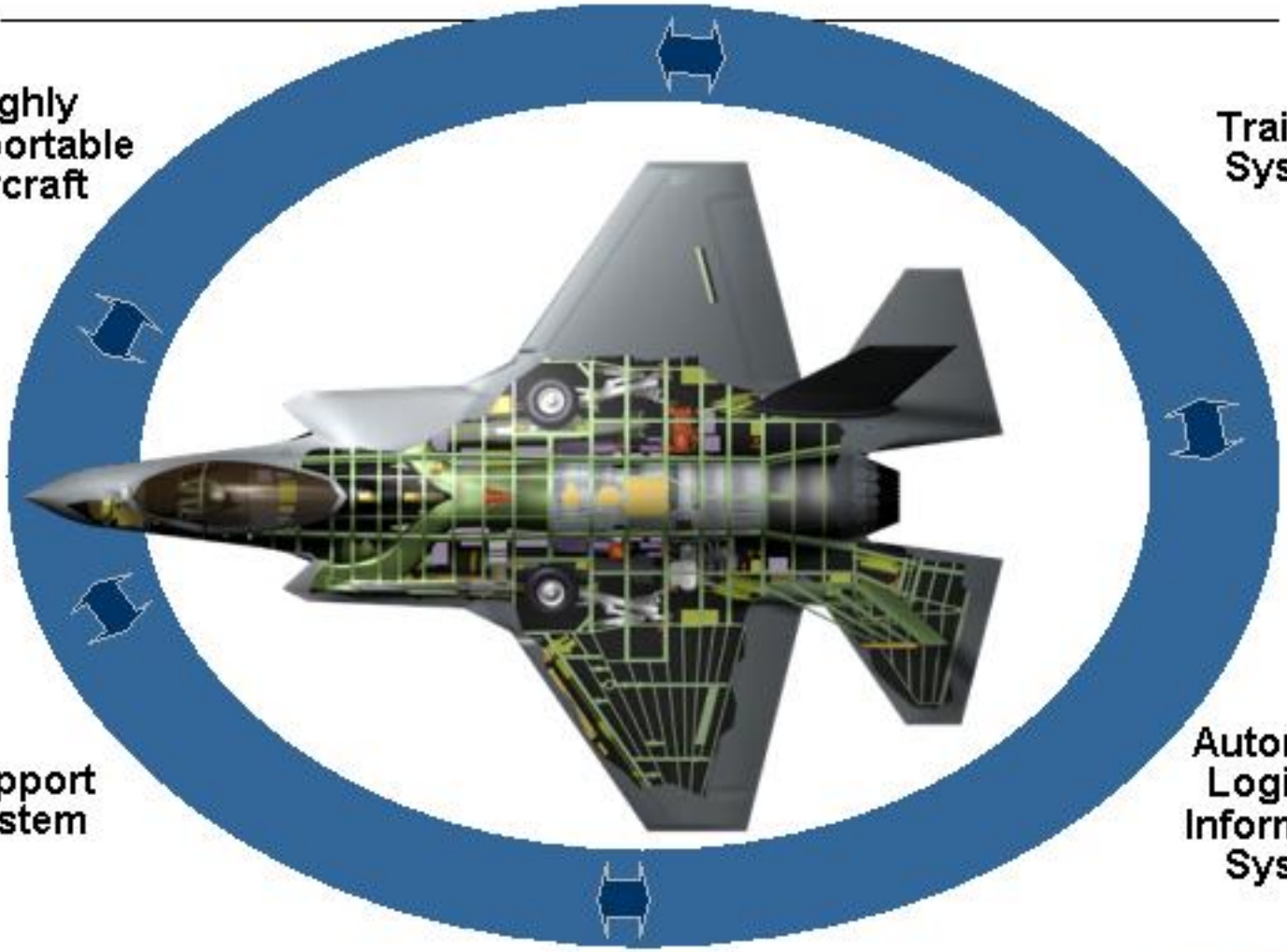


Aft View



All Test Preparation Activities are Defined and on Schedule to Support Target Date to Fire

JSF Autonomic Logistics System



Autonomic Logistics Provides Order Of Magnitude O&S Savings

Summary

All Variants Projected to Meet Key Performance Parameters

First CTOL Aircraft Being Built

F-35 Provides Revolutionary:

- Airframe Design
- Assembly Line
- Sustainment

F-35 Provides Revolutionary Capability to Joint Coalition Operations

WORKING TO AFFORDABLY MEET THE REQUIREMENTS OF THE WARFIGHTER

JOINT STRIKE FIGHTER
the next generation strike fighter