GENERAL DYNAMICS
Armament and Technical Products

25mm Gun Systems for the F-35 Joint Strike Fighter (JSF)

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Presentation Outline

- JSF Program Overview
- Key System Requirements
- Technical Approach
  - ↗ Internal Gun System (CTOL)
  - ↗ Missionized Gun System (CV & STOVL)
- Risk Reduction Testing
- Program Status
- Path Forward

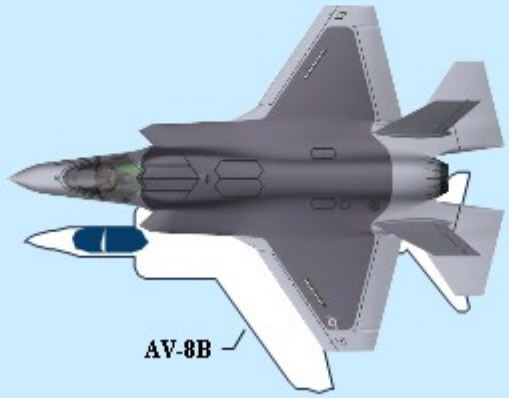
Lockheed Martin F-35 Variants

CTOL

Span (ft)	35
Length (ft)	50.5
Wing Area (ft²)	460

STOVL

Span (ft)	35
Length (ft)	50.5
Wing Area (ft²)	460



CV

Span (ft)	43
Length (ft)	50.8
Wing Area (ft²)	620

Major Program Changes

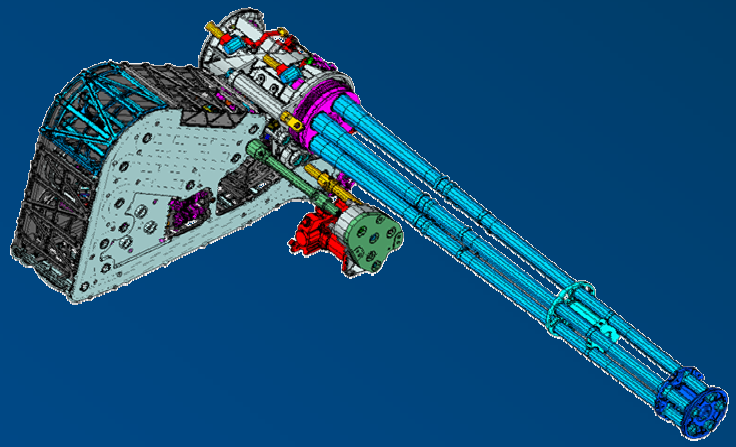
- Program was replanned due to Aircraft level weight initiatives at LM Aero in 2nd quarter of 2004.
- Gun system weight initiatives include:
  - New 4-barrel gun (implemented)
  - Titanium barrel clamps (under development)
  - Removal of Gun System Control Unit (GSCU) regulated power supplies (implemented)
  - CTOL aluminum access unit (implemented)
  - CTOL composite carriers (under parallel development)
- GDATP entered risk reduction testing with the 5-barrel CTOL system in the 4th quarter of 2004.

Major Technical Requirements

- 25mm 4-barrel gun firing at 3000 spm
- Compatible with the following ammunition:
  - PGU-23/U Target Practice (TP)
  - PGU-20/U Armor Piercing Incendiary (API)
- Linkless Ammunition Handling System
  - CTOL: 180 rounds, STOVL/CV: 220 rounds
- GSCU controls gun functions and operation of doors
- Reverse clearing gun
- 2-level maintenance
- Common loader interface for both system types

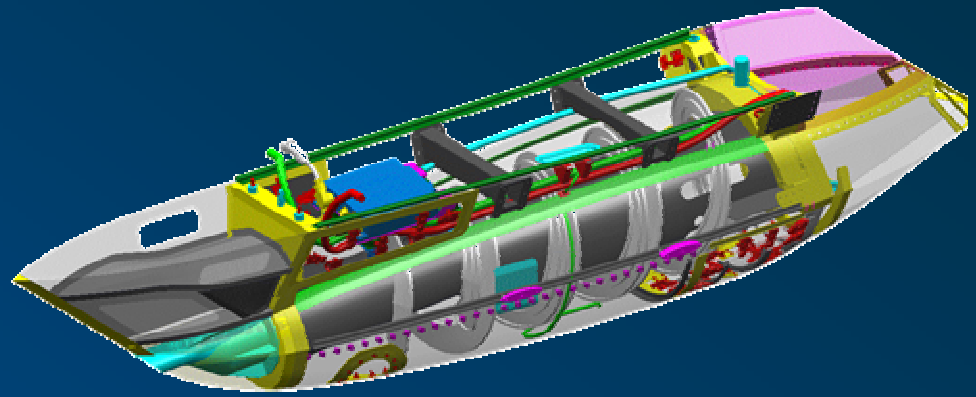
Gun System Overviews

CTOL



- Components
  - Gun Assembly
  - Linear Linkless Ammo Handling System
  - Power Transmission/Hydrive
  - GSCU

STOVL/CV



- Components
  - Gun Assembly
  - Helical Ammunition Handling System
  - Power Transmission/Hydrive
  - GSCU
  - Gun Pod

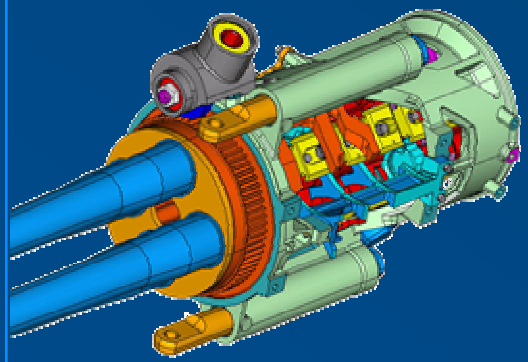
Gun Heritage

GAU-12U

- AV-8 gun system
- 25-mm, 4,000 spm system
- Supported at mid-barrel clamp

5-barrel derivative

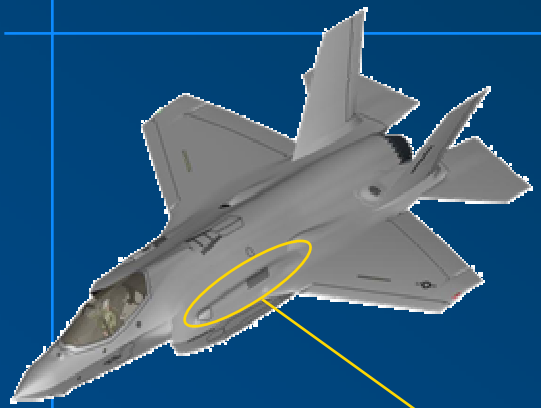
- GAU-12 commonality maximized
- Remote safing incorporated
- Installation requirements
  - Support at muzzle
  - New gun housing

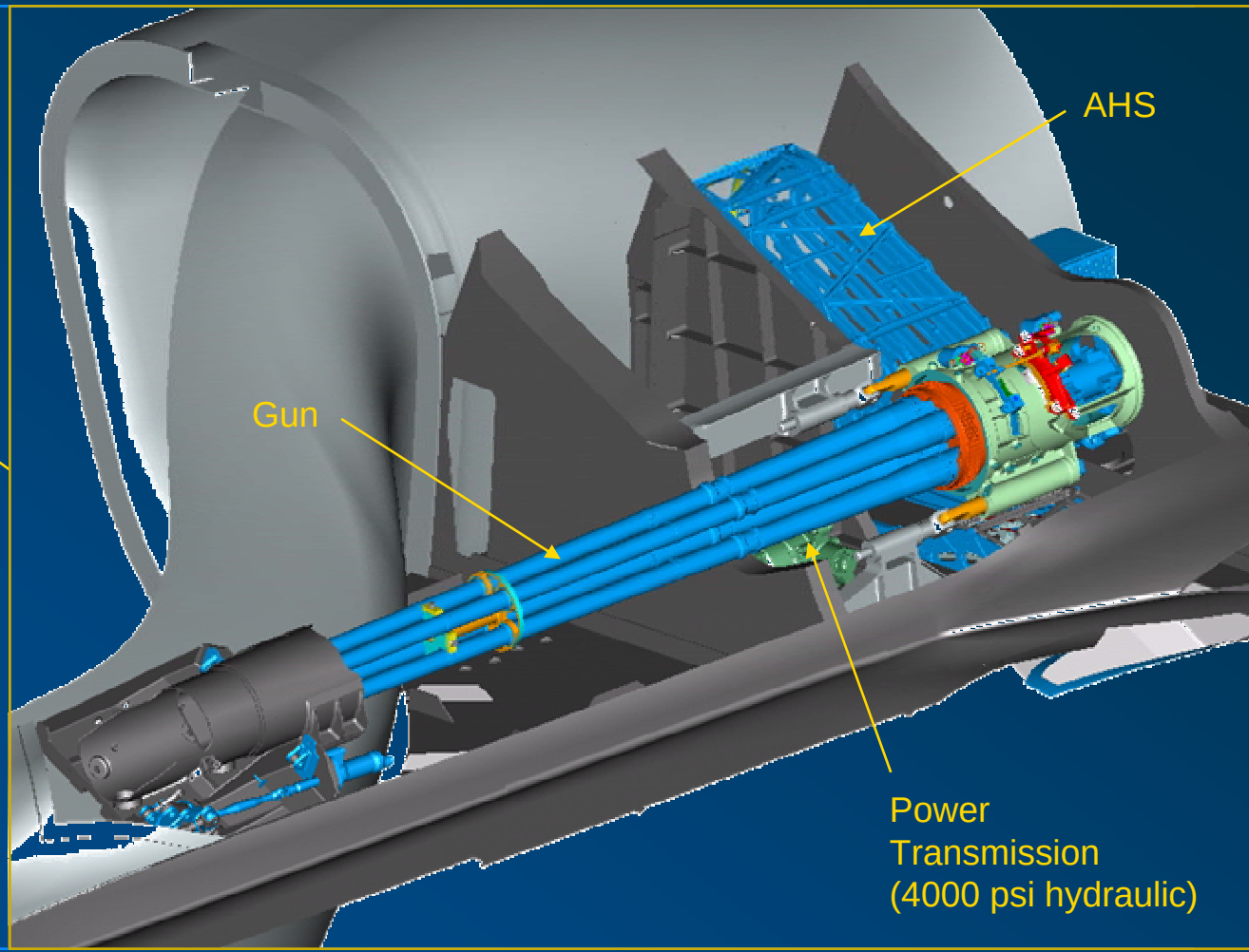


4-barrel derivative

- 3,000 spm system
- Entered design in March of 2004
- Gun mechanism principles retained
- Basic installation geometry retained
- 42 lb weight savings

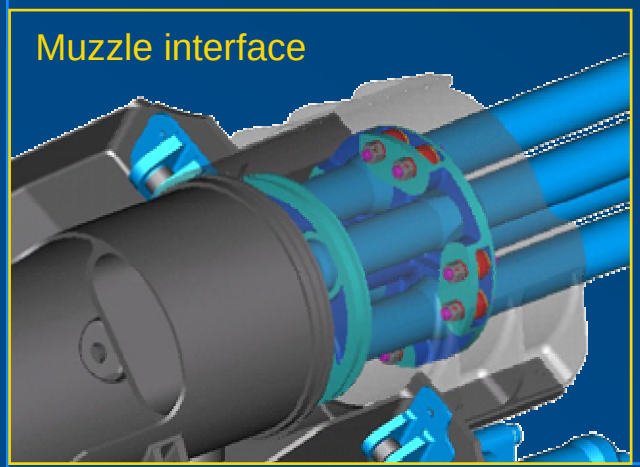
CTOL Gun System

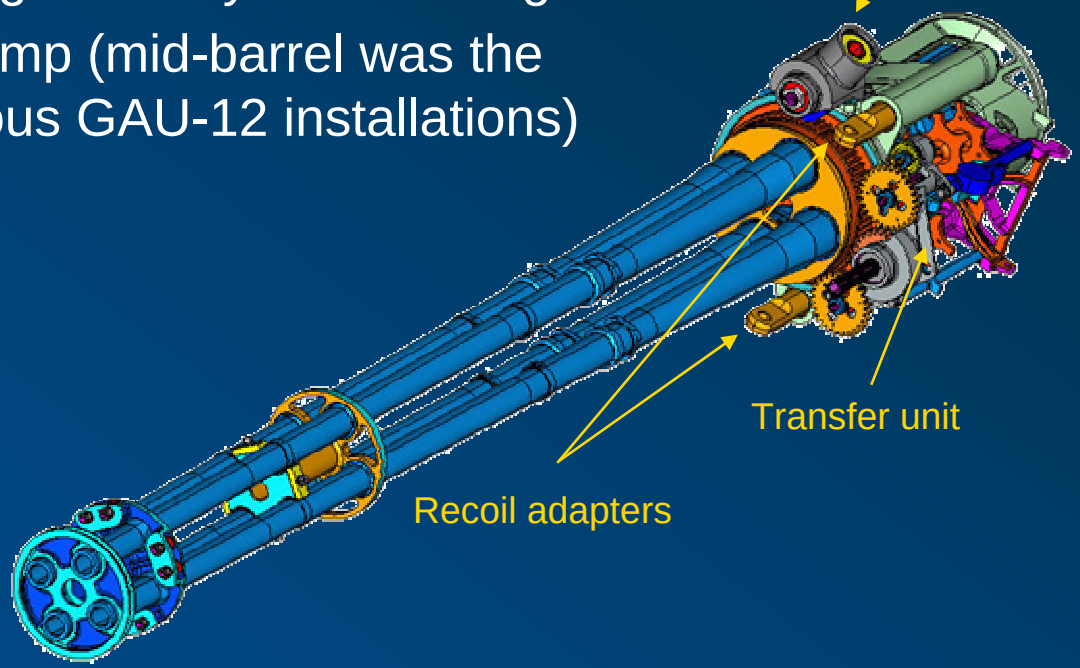




CTOL - Gun Installation

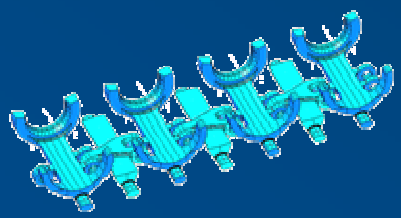
- GD425 (heavily based off GAU-12 to reduce risk)
- AV-8 derivative transfer unit (power through main rotor gear)
- Power input from Power Transmission through transfer unit
- Manual drive input at rotor gear for system loading
- A/C interface at muzzle clamp (mid-barrel was the interface used for all previous GAU-12 installations)



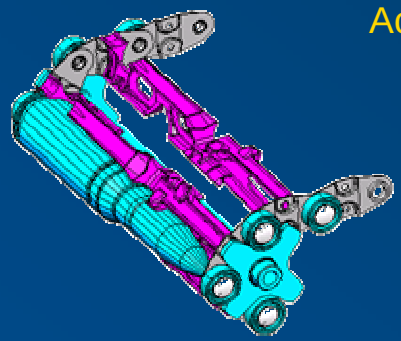


CTOL - Ammunition Handling System

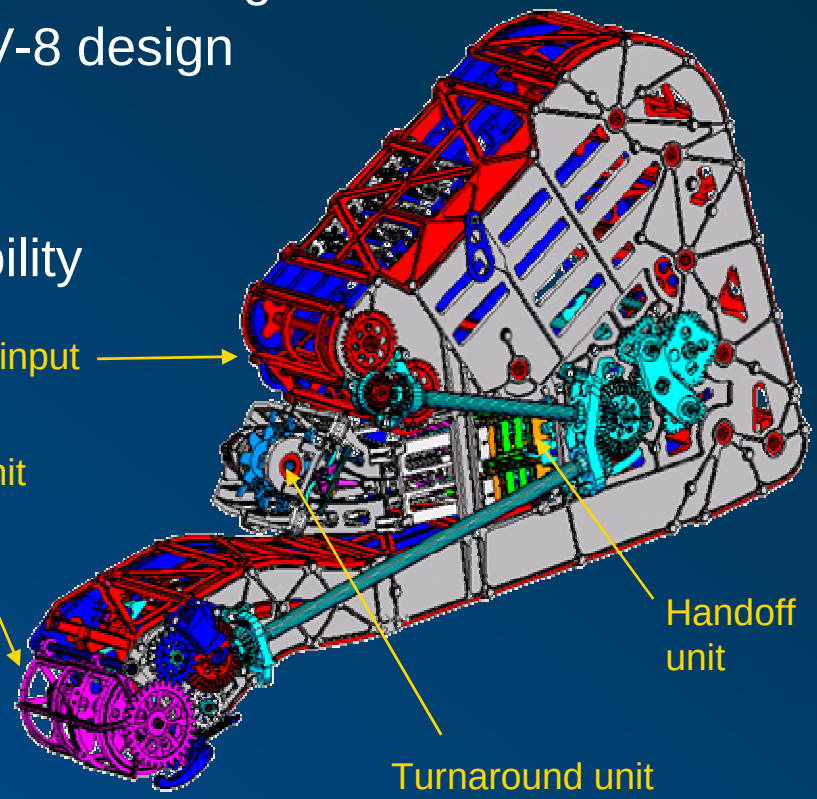
- Linear linkless system in serpentine arrangement – 180 round capacity
- Proven clamshell carrier based on F-15E Design
- Proven gun conveyor identical to AV-8 design
- Elliptically geared Handoff Unit
- Access unit based on AV-8 system
- Positive round control for high reliability



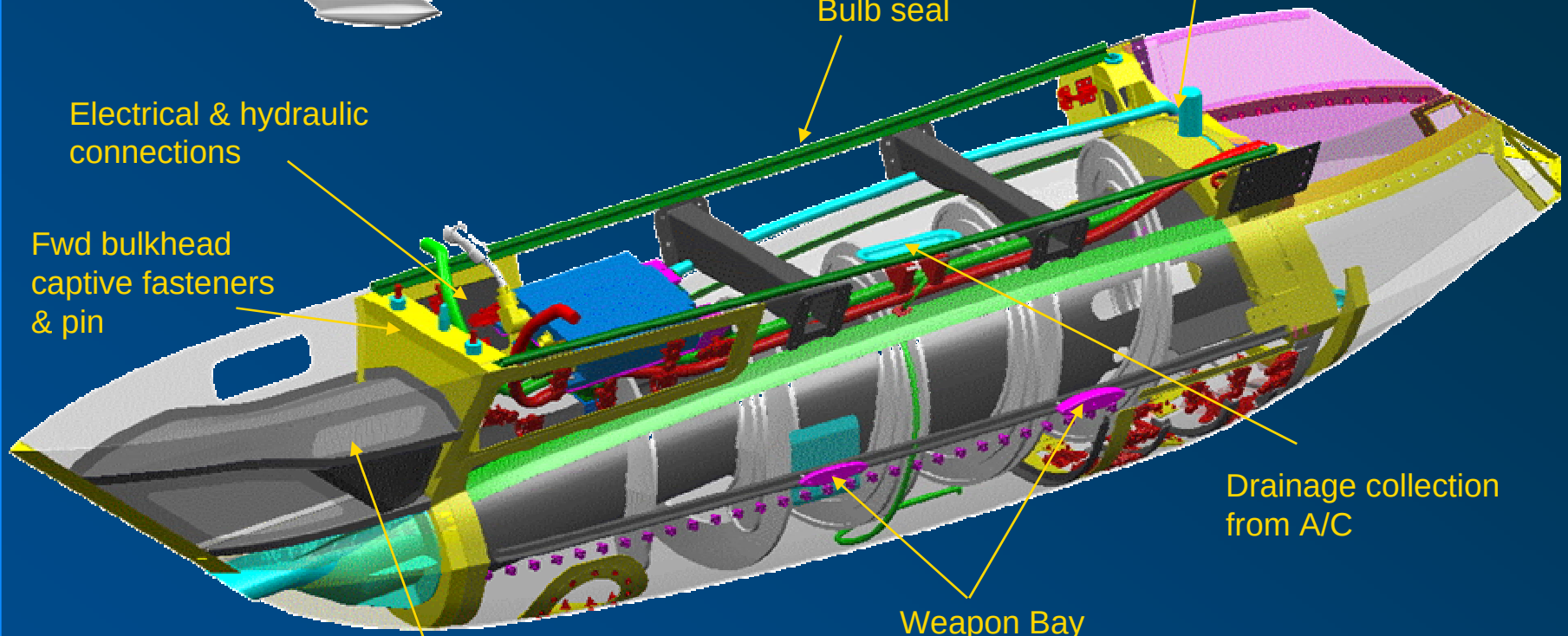
Gun conveyor



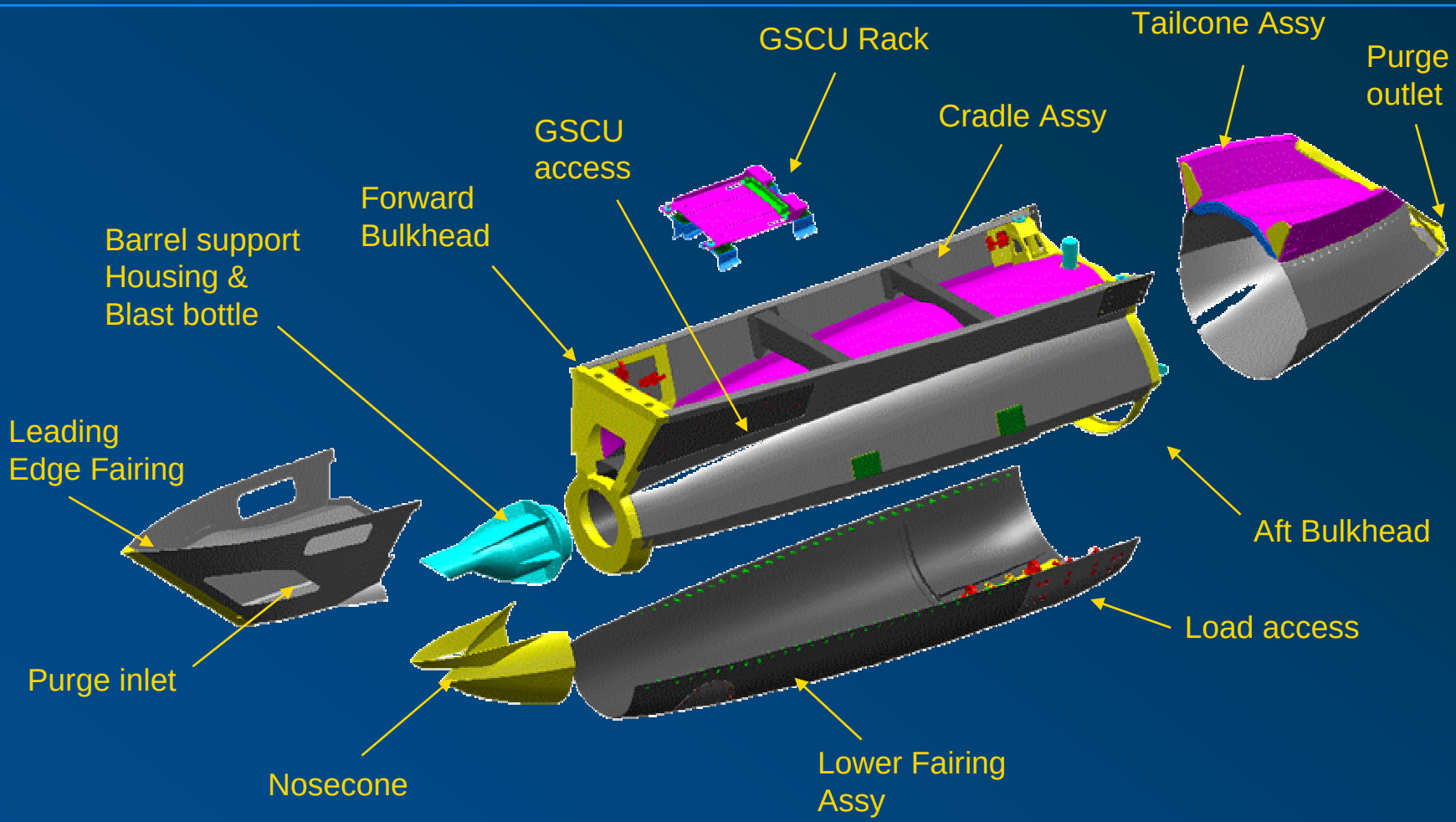
Clamshell carrier



STOVL/CV Gun System

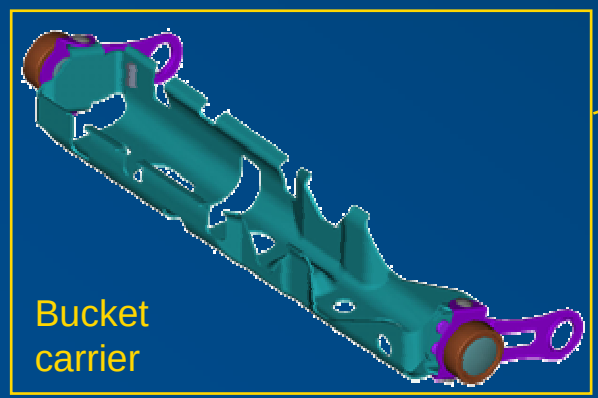


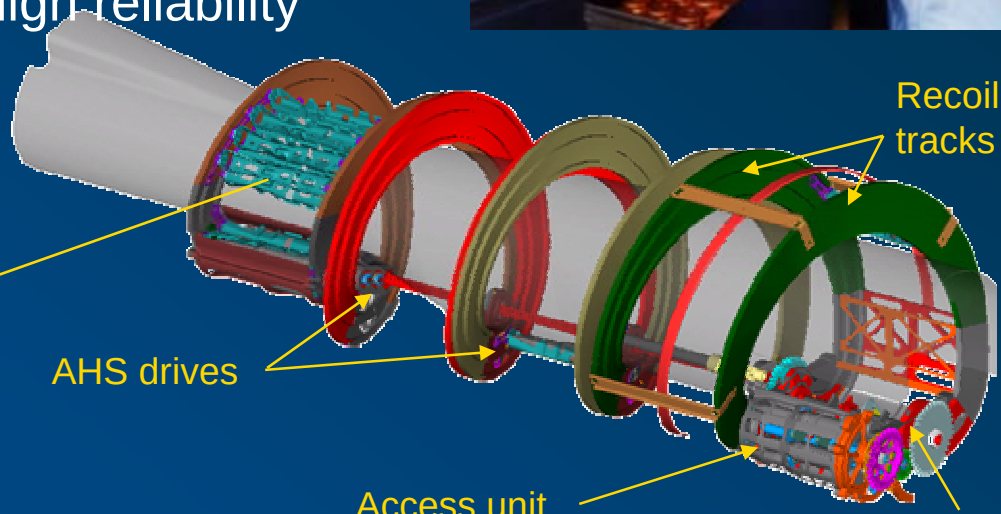
STOVL/CV – Pod Structure



STOVL/CV - Ammunition Handling System

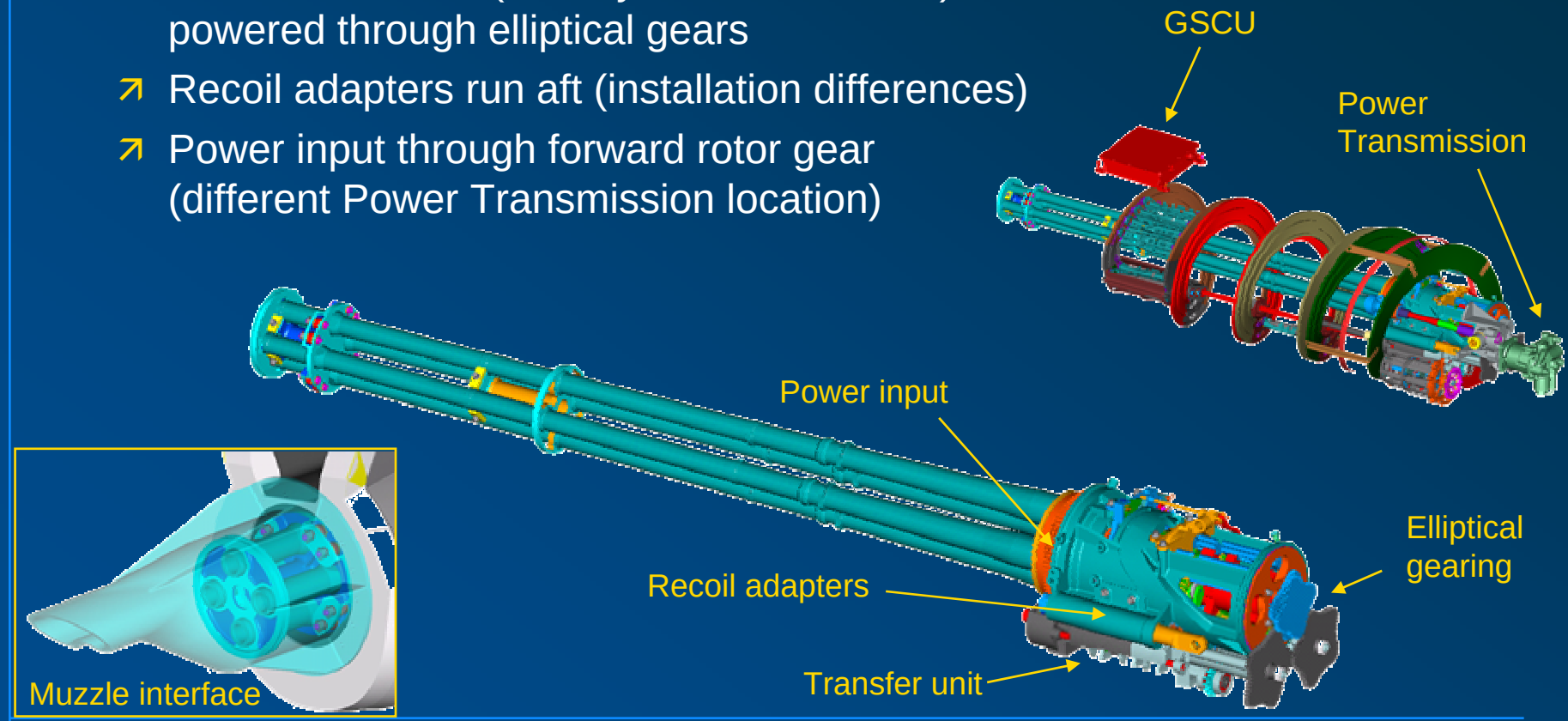
- GPU-5A architecture
  - Linear linkless system in helical arrangement
    - 220 round capacity
  - Proven aluminum bucket carrier design
- Access unit is a derivative of the AV-8B
- Positive round control for high reliability





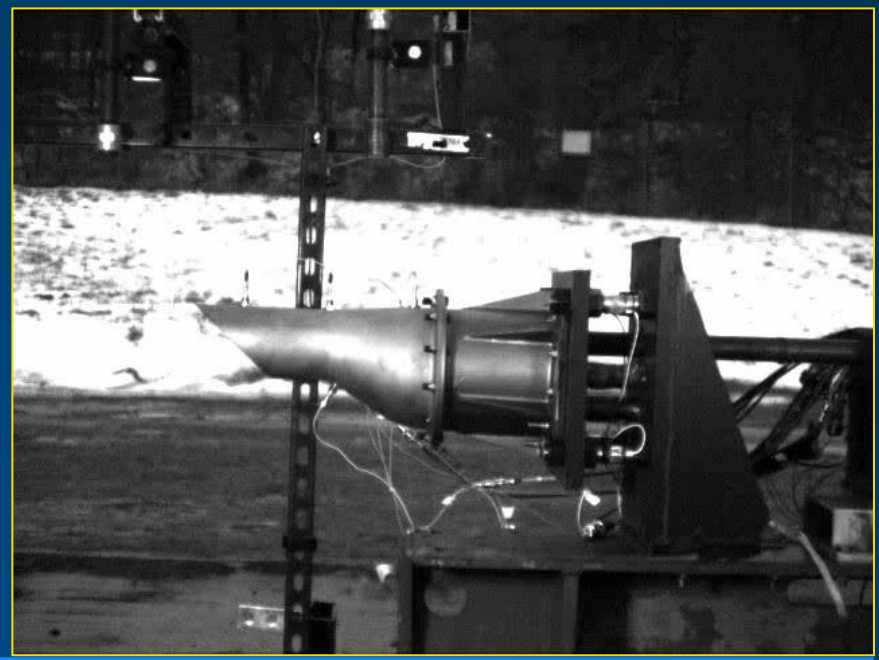
STOVL/CV - Gun Installation

- 90% common with CTOL
  - New transfer unit (feed system differences) powered through elliptical gears
  - Recoil adapters run aft (installation differences)
  - Power input through forward rotor gear (different Power Transmission location)



Risk Reduction Testing

- CTOL fire test
- 5-barrel hydraulic drive qualification
- STOVL/CV blast bottle single shot testing
- STOVL/CV recoil track characterization (April/May 2005)



Challenges

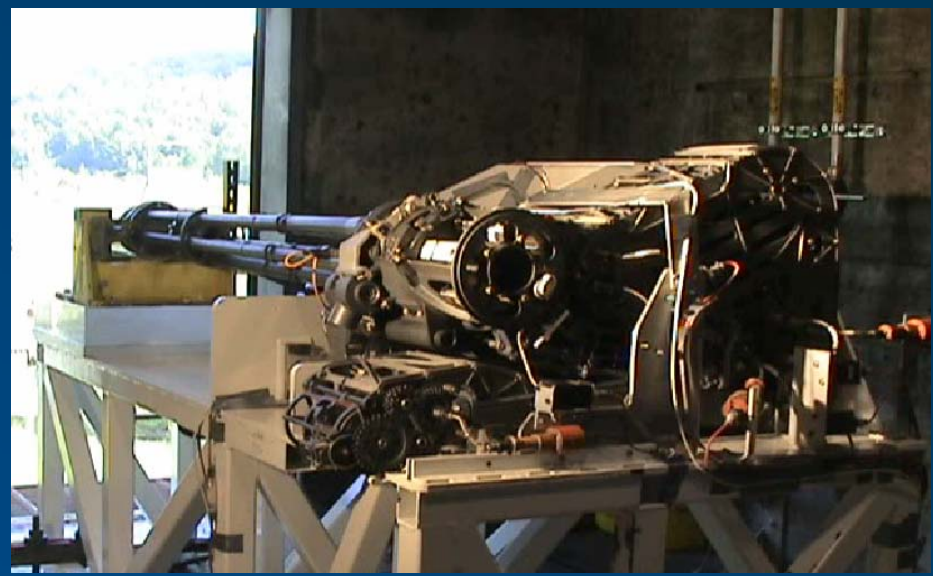
- Complex STOVL/CV Pod to gun system interfaces
- Short design cycle
  - Base on heritage designs where possible
  - Rapid prototyping for long lead castings
- Aggressive schedule for delivery
  - Release CTOL Units 3 & 4 before Engineering test is complete
- Overlap of CTOL and STOVL/CV schedules

JSF Gun System Master Schedule

Task Name	2005				2006				2007			
	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4
CTOL													
Detailed Design													
Fabrication & Assembly													
5K Round Gun Engineering Test													
10K Round System Engineering Test													
30K Round System Qualification Test													
Environmental Test													
Delivery													
STOVL/CV Gun System													
Detailed Design													
Fabrication & Assembly													
5K Round Gun Engineering Test													
Gun Pod SDD #1 Delivery													
10K Round System Engineering Test													
30K Round System Qualification Test													
Environmental Test													
Delivery													

Path Forward Prior to the 2006 Guns & Ammo Symposium

- Complete
  - STOVL/CV Critical Design Review
  - 4-barrel Gun Engineering Test (10,000 Rounds)
  - CTOL 10,000 Round Engineering Test
- Begin
  - STOVL/CV 10,000 Round Engineering Test
  - CTOL 30,000 Round Qualification Test
  - CTOL Environmental Qualification



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