National Aeronautics and Space Administration

Commercial Orbital Transportation Services (COTS) Status

NASA Advisory Council
Commercial Space Committee
MSFC, AL
February 23, 2012

Alan Lindenmoyer
Manager, Commercial Crew & Cargo Program

COMMERCIAL CREW & CARGO

SpaceX COTS Status

- **COTS Space Act Agreement awarded August 2006 and amended in May 2011 with additional risk reduction milestones**
- **36 of 40 milestones completed for payments totaling $376M out of $396M**
- **Remaining milestones**
  - **Demo Readiness Review 2 ($5M, conducted Feb 8, under review)**
  - **Demo Flight 2 ($5M)**
  - **Demo Readiness Review 3 ($5M)**
  - **Demo Flight 3 ($5M)**

Falcon 9

Dragon Approaching ISS

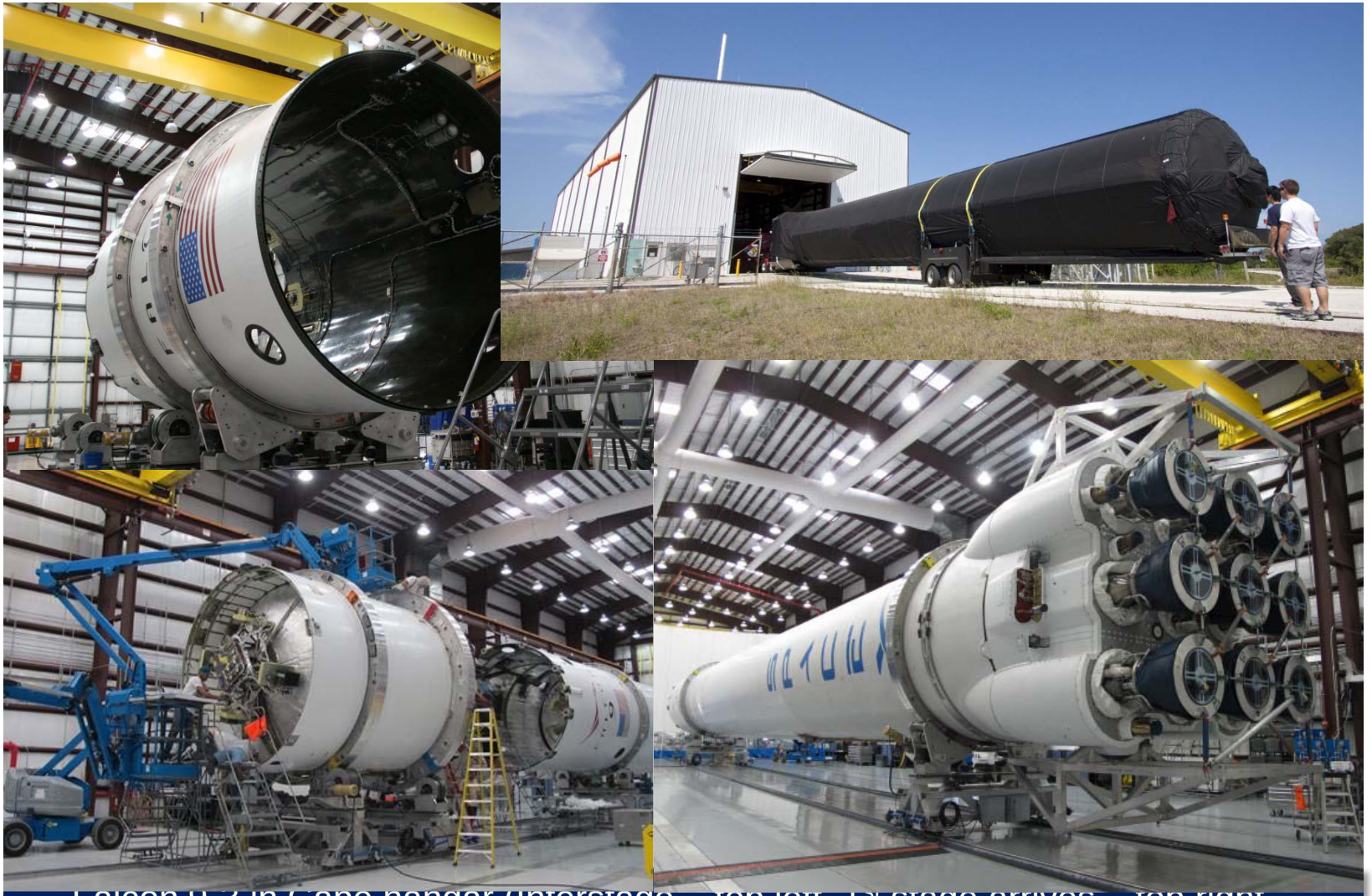
Cape Canaveral Launch Site

Falcon 9-3 Launch Vehicle Status

1st Static fire test

Mvac engine installed on 2nd stage (top left), static fire test of second stage (right), removing second stage from static fire test stand (bottom left)

Falcon 9-3 Launch Vehicle Status

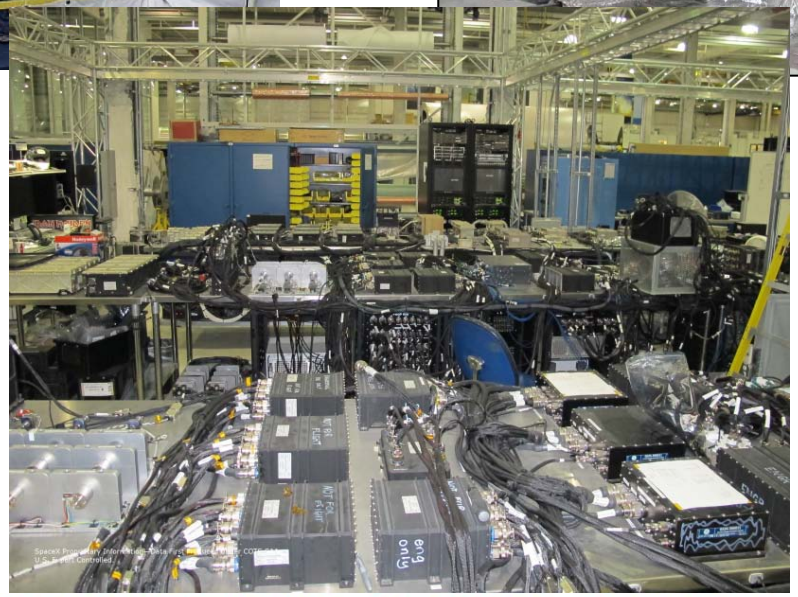


Falcon 9-3 in Cape hangar (Interstage – top left, 1st stage arrives – top right – second stage – bottom left, first stage – bottom right

Dragon 2 Status

TVAC Test

EMI Test



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Dragon 2 Status

Integration at the Cape

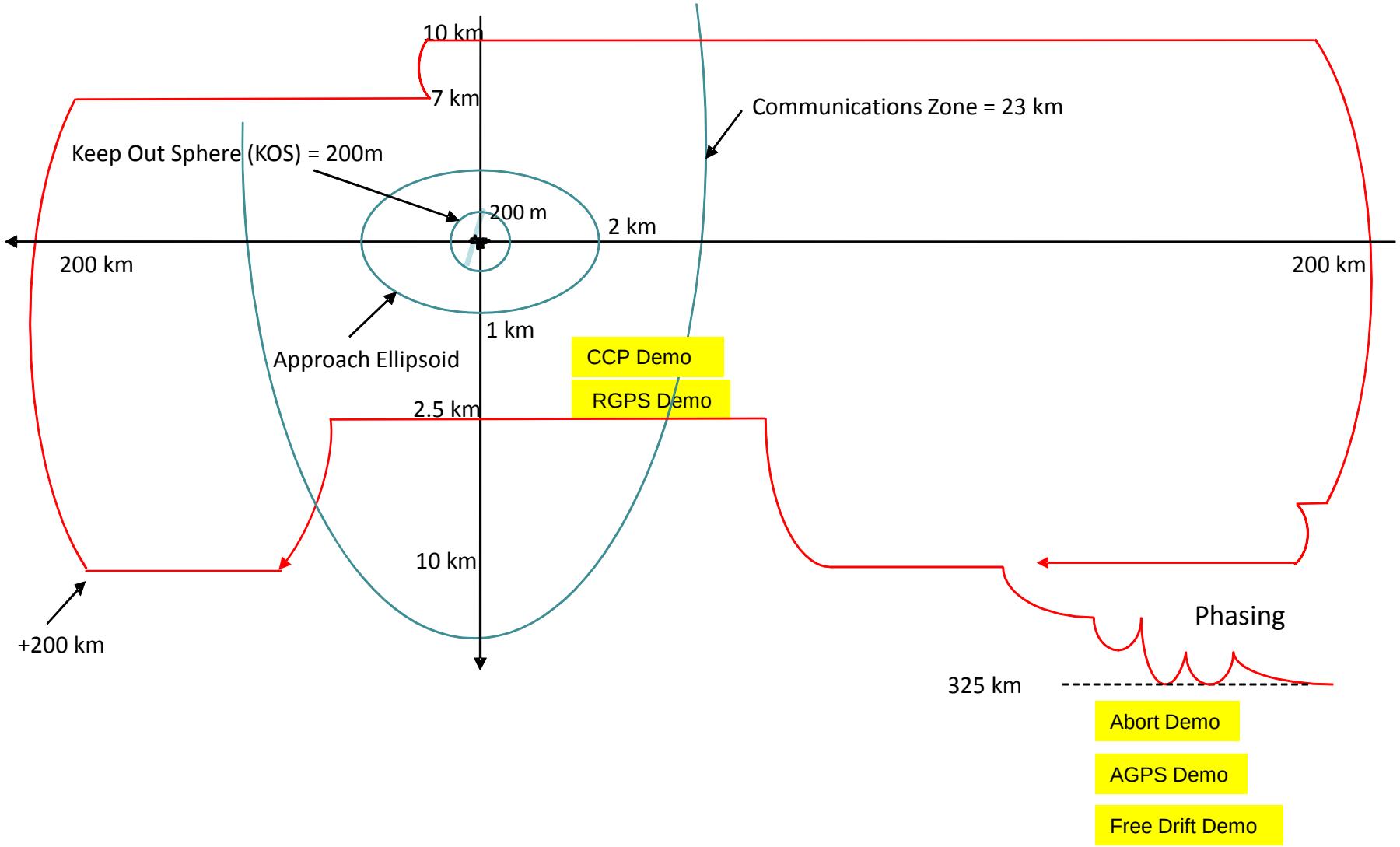
Demo C2+ Key Mission Objectives

- Abort
- GPS Navigation (Absolute and Relative)
- Free Drift

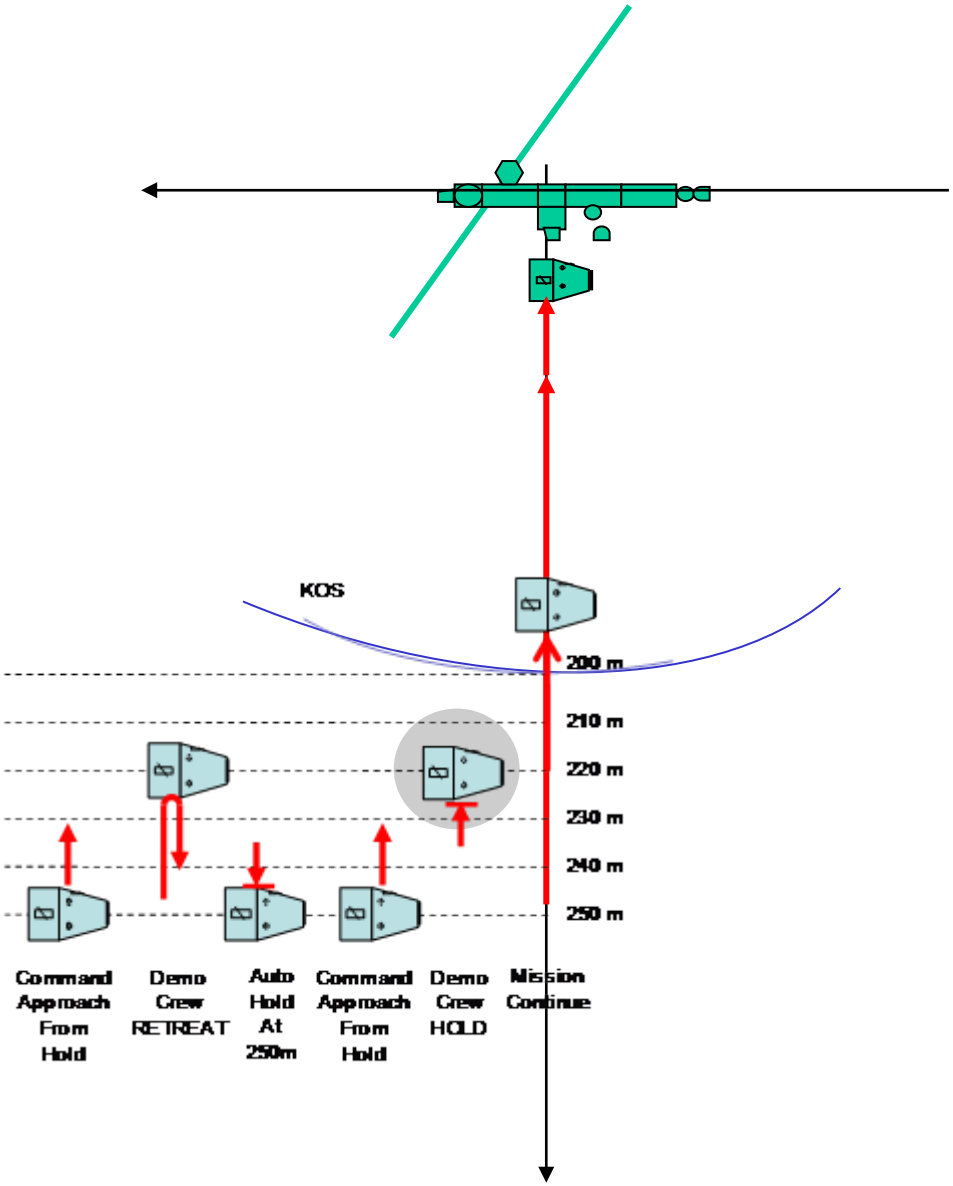
C2
- ISS Communications and Commands

C3
- LIDAR (range/rate)
- Retreat
- Hold
- ISS Berthing
- Cargo Transfer/Return

Mission Profile – C2 Fly-by

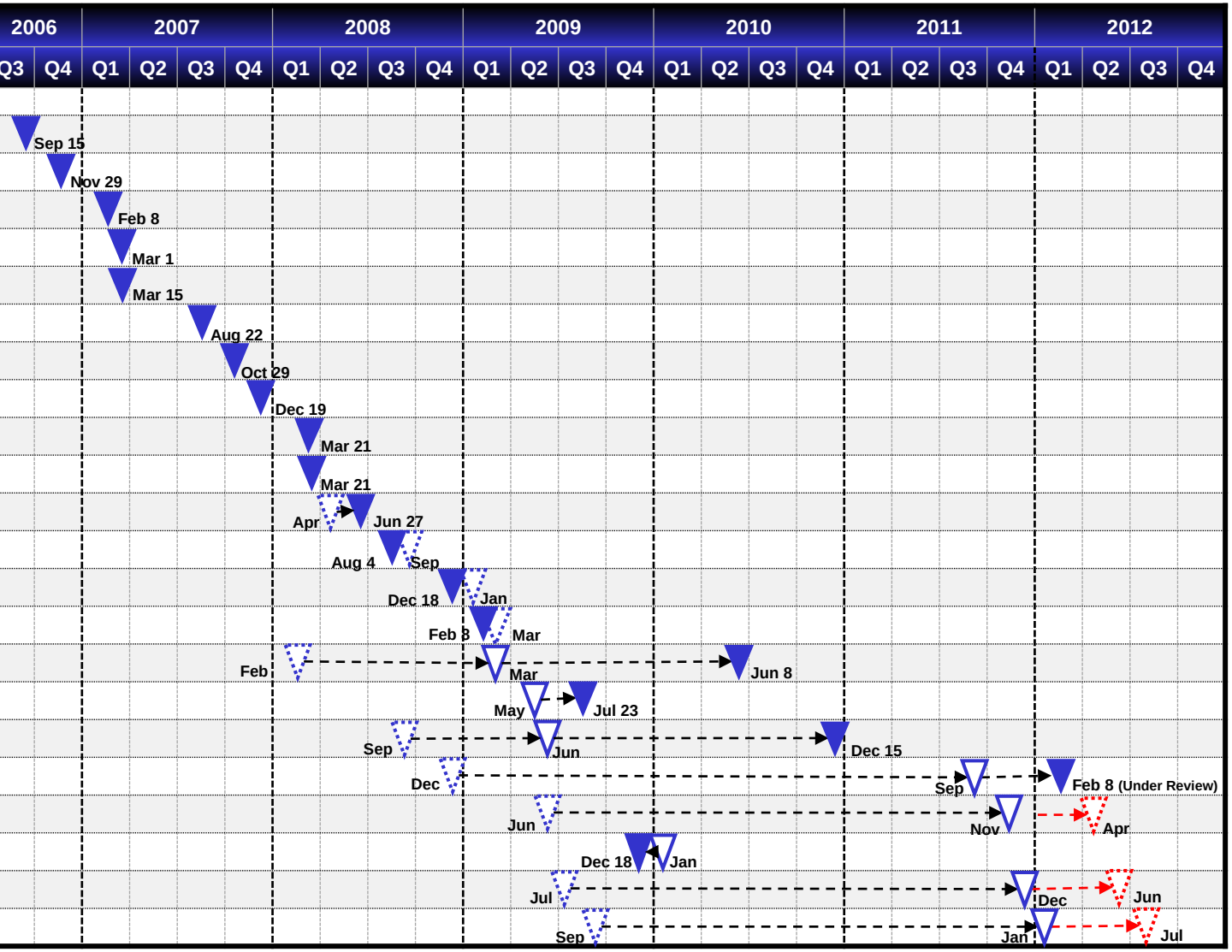


C3 Approach Demonstration Maneuvers



SpaceX COTS Milestones

	Milestones	$M	$M Total
		278.0	
1	Project Mgmt Plan	23.1	23.1
2	Demo 1 SRR	5.0	28.1
3	Demo 1 PDR	18.1	46.2
4	Financing Round 1	10.0	56.2
5	Demo 2 SRR	31.1	87.4
6	Demo 1 CDR	8.1	95.5
7	Demo 3 SRR	22.3	117.8
8	Demo 2 PDR	21.1	139.0
9	Draco Init. Hot fire	6.0	145.0
10	Financing Round 2	10.0	155.0
11	Demo 3 PDR	22.0	177.0
12	Multi-Engine Test	22.0	199.0
13	Demo 2/3 CDR	25.0	224.0
14	Financing Round 3	10.0	234.0
15	Demo 1 RR	5.0	239.0
16	CUCU Flight Unit	9.0	248.0
17	Demo 1 Mission	5.0	253.0
18	Demo 2 RR	5.0	
19	Demo 2 Mission	5.0	
20	Cargo Int. Demo	5.0	258.0
21	Demo 3 RR	5.0	
22	Demo 3 Mission	5.0	



Current Plan

Actual Completion Date

Initial SAA Plan

Projected

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SpaceX Augmented COTS Milestones

	Milestones	$M	$M Total	2007 Q1	2007 Q2	2007 Q3	2007 Q4	2008 Q1	2008 Q2	2008 Q3	2008 Q4	2009 Q1	2009 Q2	2009 Q3	2009 Q4	2010 Q1	2010 Q2	2010 Q3	2010 Q4	2011 Q1	2011 Q2	2011 Q3	2011 Q4	2012 Q1	2012 Q2	2012 Q3	2012 Q4
		118.0																									
23	Modal Test Plan	5.0	5.0																	Dec 16							
24	Modal Test	5.0	10.0																	Dec 16							
25	LIDAR Test (open loop)	5.0	15.0																	Dec 16							
26	Solar Array Deploy Test	5.0	20.0																	Dec 16							
27	LIDAR Test Plan (closed loop)	5.0	25.0																		Mar 31						
28	Thermal Vacuum Test Plan	5.0	30.0																	Mar	Apr 6						
29	Infrastructure Plan	10.0	40.0																	Mar		May 10					
30	Thermal Vacuum Test	20.0	60.0																		Jul	Sep 14					
31	Test site Infrastructure Implementation	5.0	65.0																			Jun 23					
32	Dragon Trunk Acoustic Test	10.0	75.0																			Jun 23					
33	LIDAR Test 6 DOF (closed loop)	5.0	80.0																		Aug		Oct 26				
34	Design Rev. Enhanced Powered Cargo Accom.	5.0	85.0																			Aug 24					
35	Design Rev. Pressurized Cargo Vol Increase	5.0	90.0																			Aug 24					
36	Dragon EMI/EMC Test (HITL)	10.0	100.0																		Jul	Sep 20					
37	Dragon Cargo Racks & Hatch Simulator	3.0	103.0																			Aug 26					
38	Ground Demo Enhanced Powered Cargo	5.0	108.0																			Sep	Oct 26				
39	Launch site Infrastructure Implementation	5.0	113.0																			Sep	Oct 26				
40	Production Infrastructure Implementation	5.0	118.0																			Sep	Oct 26				
	SAA Total	396.0	376.0																								

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Orbital COTS Status

- **Space Act Agreement awarded February 2008 and amended in December 2011 with additional risk reduction milestones**
- **24 of 29 milestones completed for payments totaling $266.5M out of $288M**
- **Remaining milestones**
  - **Maiden Flight First Stage Assy. ($10M)**
  - **Maiden Test Flight ($4M)**
  - **Demo First Stage Assy. Complete ($2.5M)**
  - **Demo Mission Readiness Review ($2.5M)**
  - **Demo Mission ($2.5)**

Antares

Cygnus

MARS/Wallops Launch Site

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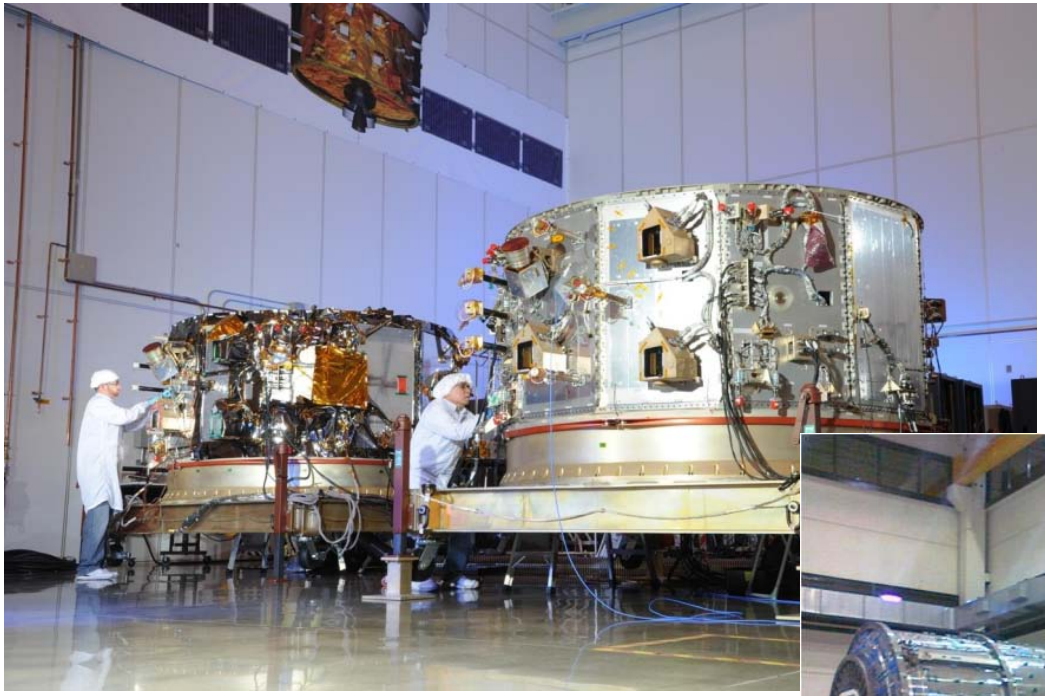
Hardware in flow at Wallops

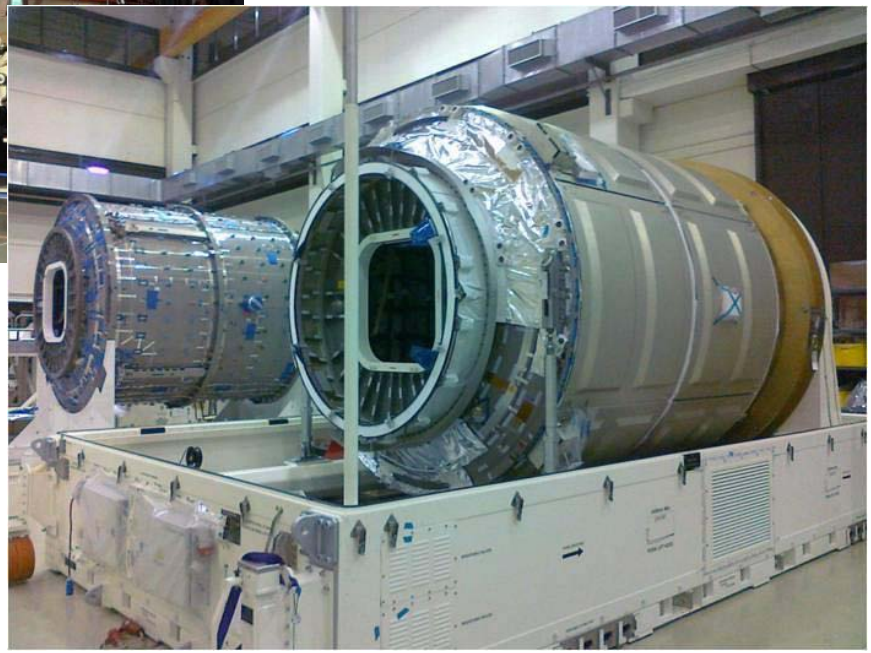
Pathfinder Testing at Wallops Launch Pad

AJ-26 Engine Testing Continues at SSC

Cyngus Processing



Cygnus Service Modules at Dulles



Pressurized Cargo Modules

Orbital COTS Milestones

	Milestones	$M	$M Total	2008 Q1	2008 Q2	2008 Q3	2008 Q4	2009 Q1	2009 Q2	2009 Q3	2009 Q4	2010 Q1	2010 Q2	2010 Q3	2010 Q4	2011 Q1	2011 Q2	2011 Q3	2011 Q4	2012 Q1	2012 Q2	2012 Q3	2012 Q4
		170.0																					
1	Program Plan Review	10.0	10.0	Mar 31																			
2	Demo Mission SRR	20.0	30.0	Jun	Jul 17																		
3	UCM PDR	10.0	40.0	Jul	Aug 14																		
4	DELETED																						
5	COTS Int/Ops Facility	10.0	50.0	Sep 22	Oct																		
6	PCM PDR	10.0	60.0	Oct 9	Nov																		
7	DELETED																						
8	IP&CL Submission	10.0	70.0					Feb 18															
9	ISS Phase 1 SRP	10.0	80.0					Mar 27															
10	COTS System PDR	20.0	100.0			Sep		Apr	May 22														
11	PCM CDR	10.0	110.0						Jul 31														
12	Cygnus Avionics Test	10.0	120.0						Jun	Aug 13													
13	ISS Phase 2 SRP	10.0	130.0							Aug	Nov 6												
14	COTS System CDR	10.0	140.0					Mar		Sep		Mar 23											
15	SM Core Assembly Complete	7.5	147.5							Oct	Dec			Aug 30									
16	SM Test Readiness Review	7.5	155.0								Jan		Apr		Nov 17								
17	SM Initial CPT	5.0	160.0										May				Jun		Dec 14				
18	LV Stage I Assy. Complete	2.5												Sep				Sep				3rd Qtr	
19	Cargo Int. Demo	2.5	162.5												Dec 6								
20	Mission Readiness Review	2.5													Oct			Oct				3rd Qtr	
21	System Demo Flight	2.5													Dec				Dec				3rd Qtr

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		118.0																					
22	Test Flight Mission Review	20.0	20.0													Dec 15							
23	Test Flight Mission Analys.	10.0	30.0													Feb 23							
24	Cygnus Mass Sim. (CMS) DR	10.0	40.0													Mar 03							
25	Install Add'l PITL Simulators	5.0	45.0													Apr	May 6						
26	PROX FEU Test Unit	5.0	50.0													May	Jun 17						
27	Maiden Flt Stg 1 Core Del.	24.0	74.0														Apr 28						
28	Maiden Flt Uppr Stage Del.	20.0	94.0														Jun 21						
29	Maiden Flt CMS Delivered	10.0	104.0														Jun 20						
30	Maiden Flt Stage 1 Assy.	10.0																Jul			2nd Qtr		
31	Maiden Test Flight	4.0																	Oct		2nd Qtr		
	SAA Total	288.0	266.5																				

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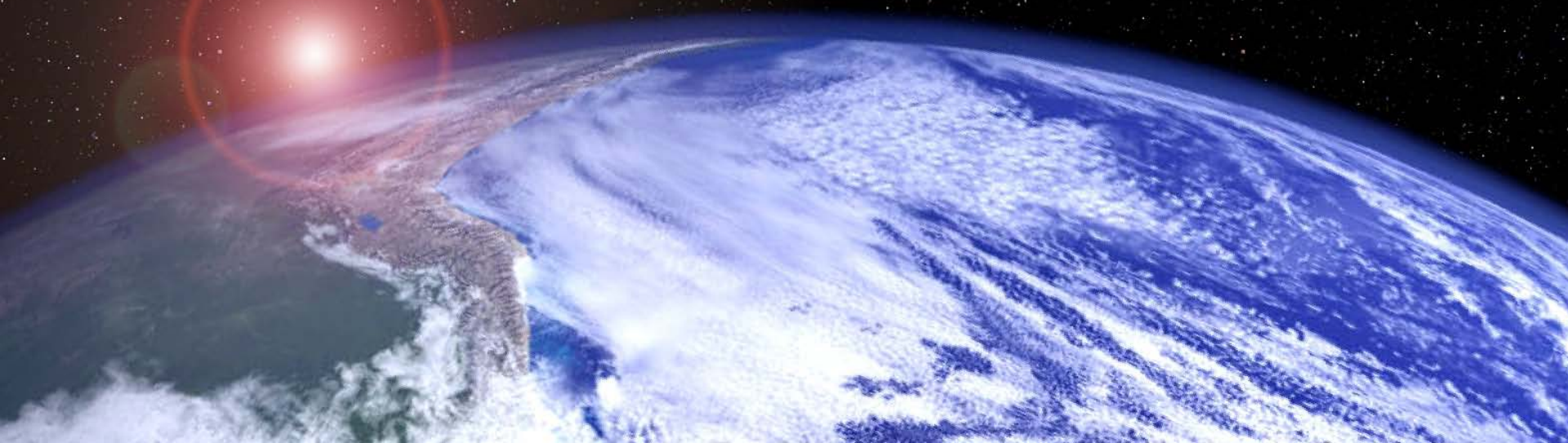
01-31-12

A New Era In Spaceflight Is Beginning...

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