

National Aeronautics and Space Administration



JWST Program Office

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JWST Program Director

Briefing to the APS
April 17, 2013





Staying Focused



Focus on

- Execution: Do what we said we are going to do – and where possible, better
- Communication: Maintain and increase open communications with NASA senior management, partners, customers and stakeholders
- Education: Highlighting the tremendous science returns we will achieve from JWST
- **Execution: Know where we are now and project ahead**
 - Tight teamwork between Program and Project Office – Clearly understand and respect the roles
 - Develop the PP&C capability for the HQ Program Office partnering with GSFC Code 400 for an integrated evaluation capability for the day-to-day (monthly) monitoring/assessment/and projection capabilities
 - Both GSFC and HQ see the data at the same time
 - Increase the technical capability in support of the HQ Program Office for targeted opportunities
 - Series of daily, weekly, monthly, quarterly interchange meetings
- **Communication: Maintain open communications with partners, customers and stakeholders**
 - Standardize the messaging focusing on key swing point issues for a consistent message with NASA Senior Management, Hill, OMB, OSTB, etc
 - Senior Executive quarterlies with senior leadership with contractors, Centers, and HQ
 - Close coordination of the integrated Program assessment with senior management working with all HQ oversight organizations.
 - Establishment of HQ level milestones reported to stakeholders
 - All-hands with Centers and contractors
 - Quarterly tag ups with International Partners
 - Deputy Program Director oversees the communication planning ensuring an integrated message leading to a crescendo at launch
- **Education: Highlighting the tremendous science returns we will achieve from JWST**
 - Partner with the outreach office and NASA Chief Scientist for Agency strategic messaging related to science



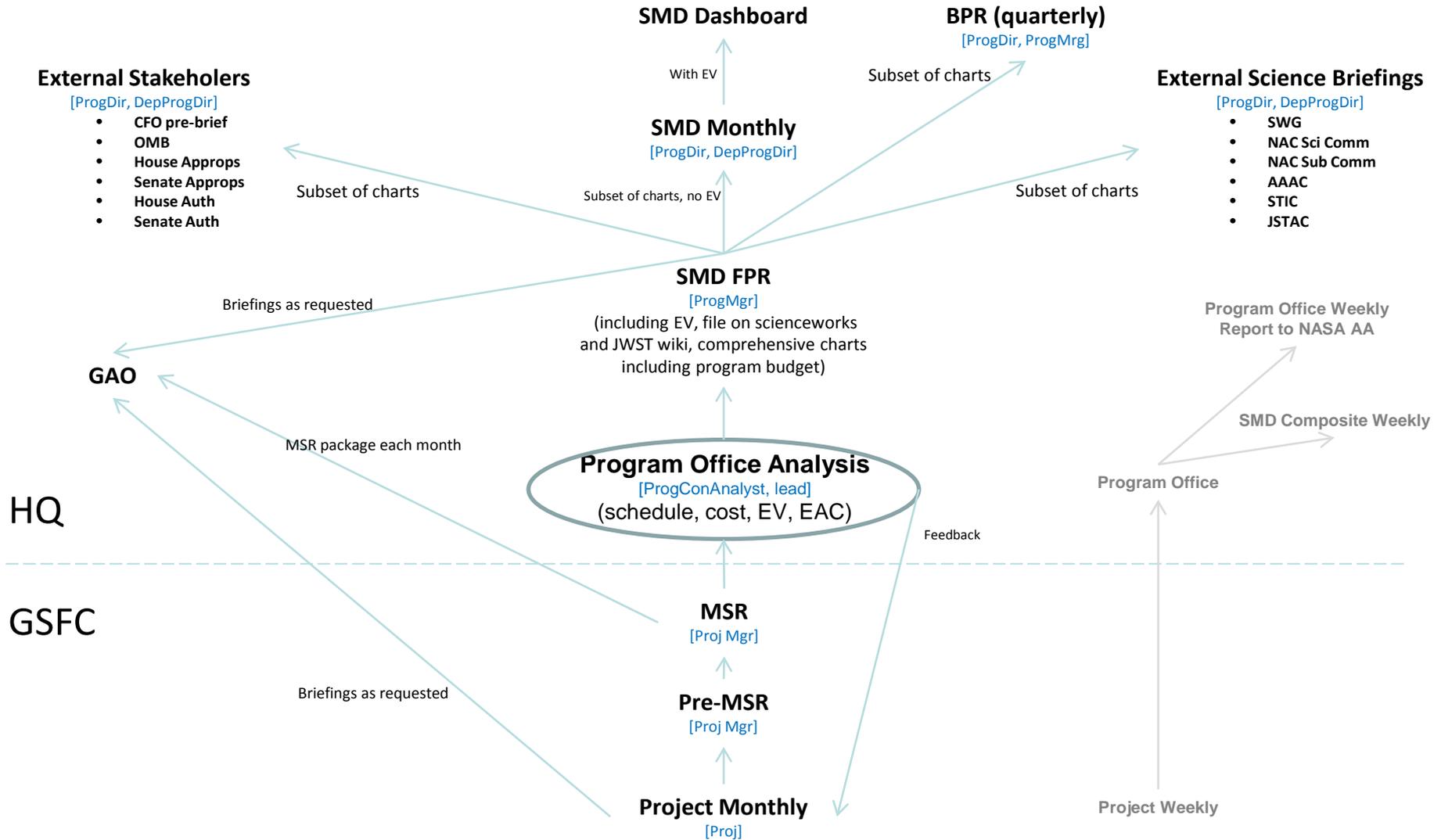
Keeping our Partners and Stakeholders Informed



- Daily tag-ups with the Project Manager (Program Manager)
- Weekly or more meetings with NASA AA and SMD AA (Director/Deputy Program Director)
- Weekly meetings/telecons with GSFC Project Manager (Program Director/Program office)
- Weekly meetings/telecons with GSFC Center Director (Program Director)
- Weekly tag ups with APD Director (Director/Deputy Director)
- Weekly telecons with project science team (Deputy Director)
- Monthly Flight Program Review with SMD (Program Office)
- Monthly meetings with AURA, Inc. (Director/Deputy Program Director)
- Monthly presentations to OMB/OSTP with more detailed quarterly briefings (Director/Deputy Program Director)
- Quarterly briefings to House authorization committee staff, House appropriations staff, Senate authorization committee staff, Senate appropriations staff (Director/Deputy Program Director)
- Quarterly presentations to the NAC Science Committee, and scientific groups such as; SWG, AAAC, STIC, JSTAC, etc. (Director/Deputy Program Director)
- Senior Executive Quarterly meetings with Center Director, NGAS VP, LM VP, other senior members of industrial team (NASA AA, Director/Deputy Program Director, Program Manager)
- Quarterly (or as needed) telecons/meetings with ESA and CSA directors (Program Director)
- All-Hands with Centers and Contractors (Director/Deputy Program Director, Scientists)

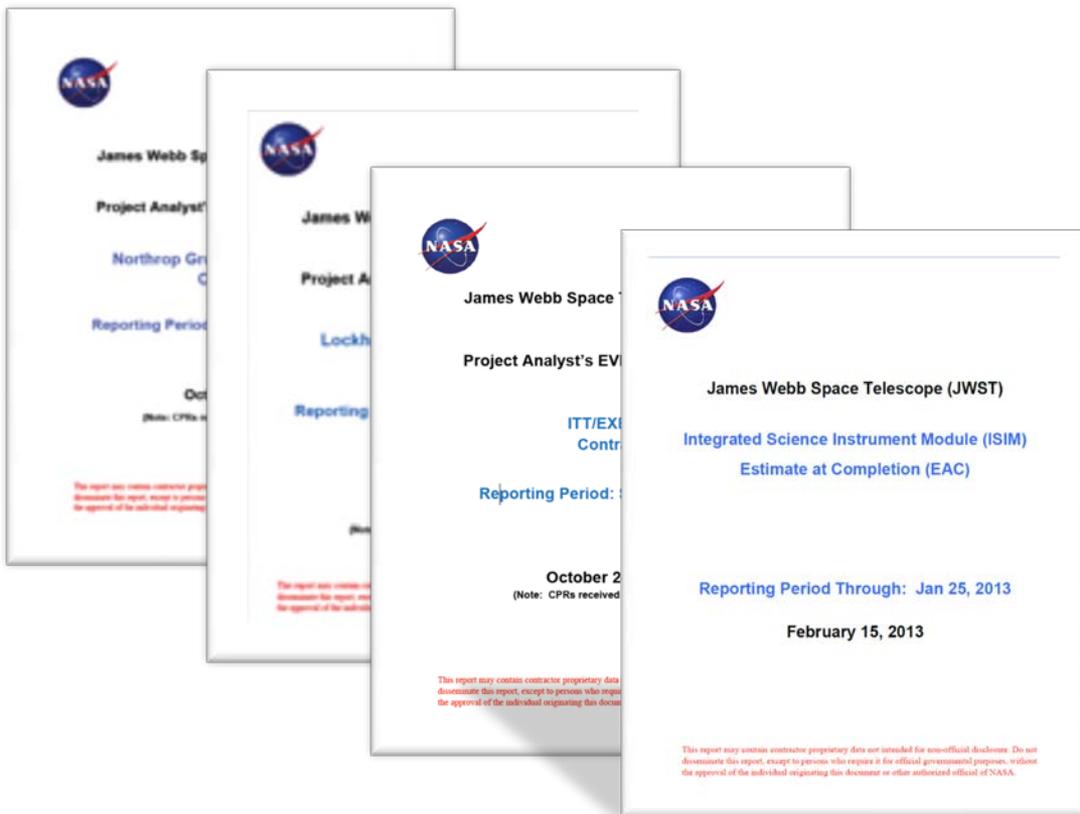


JWST Program and Project Data and Analysis Flow Internal and External Interactions





Cost/Schedule Metrics



Cost metrics: CPI, TCPI, Cost variances, Budget-at-complete, management reserve, burn rates, *etc.* (>20 in total)

Schedule metrics: schedule variances, logical consistency, leads, lags, constraints, float, missed tasks, critical path index, tripwires, *etc.* (23 in total)

👉 STScI prototype metrics under test.

Tracking good performance and forecasting problem areas

The James Webb Space Telescope

Science Instrument Module

Houses all of Webb's cameras and science instruments

Trim flap

Helps stabilize the satellite

Solar power array

Always facing the Sun, panels convert sunlight into electricity to power the observatory

Earth-pointing antenna

Sends science data back to Earth and receives commands from NASA's Deep Space Network

Spacecraft bus

Contains most of the spacecraft steering and control machinery, including the computer and the reaction wheels

Primary Mirror

18 hexagonal segments made of the metal beryllium and coated with gold to capture faint infrared light

Secondary Mirror

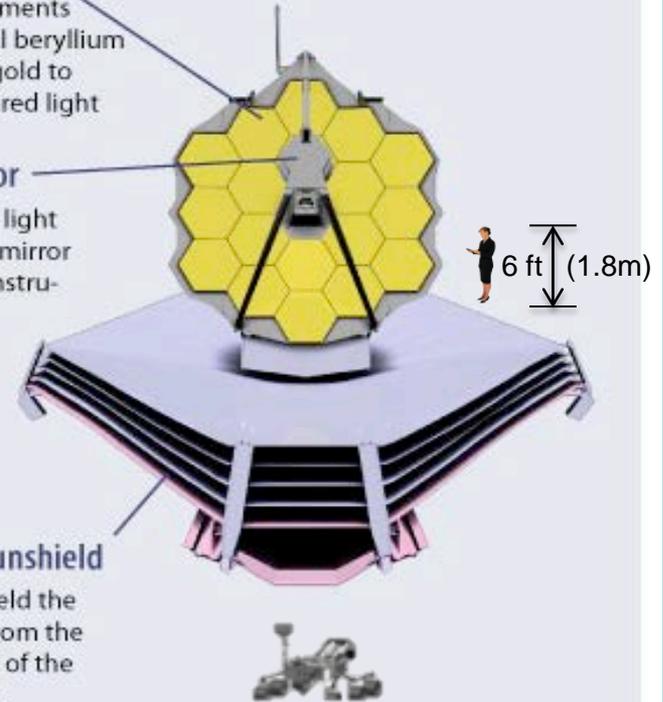
Reflects gathered light from the primary mirror into the science instruments

Multilayer sunshield

Five layers shield the observatory from the light and heat of the Sun and Earth

Star trackers

Small telescopes that use star patterns to target the observatory



Curiosity Rover



JWST 2013 Progress



Spacecraft



Sunshield Template



Folded Sunshield Template



Solid State Recorder

Science Instruments



MIRI



FGS/NIRISS



NIRCam



NIRSpec

Telescope



Secondary Mirror



Aft Optics System



Primary Backplane Center Section



Primary Wings



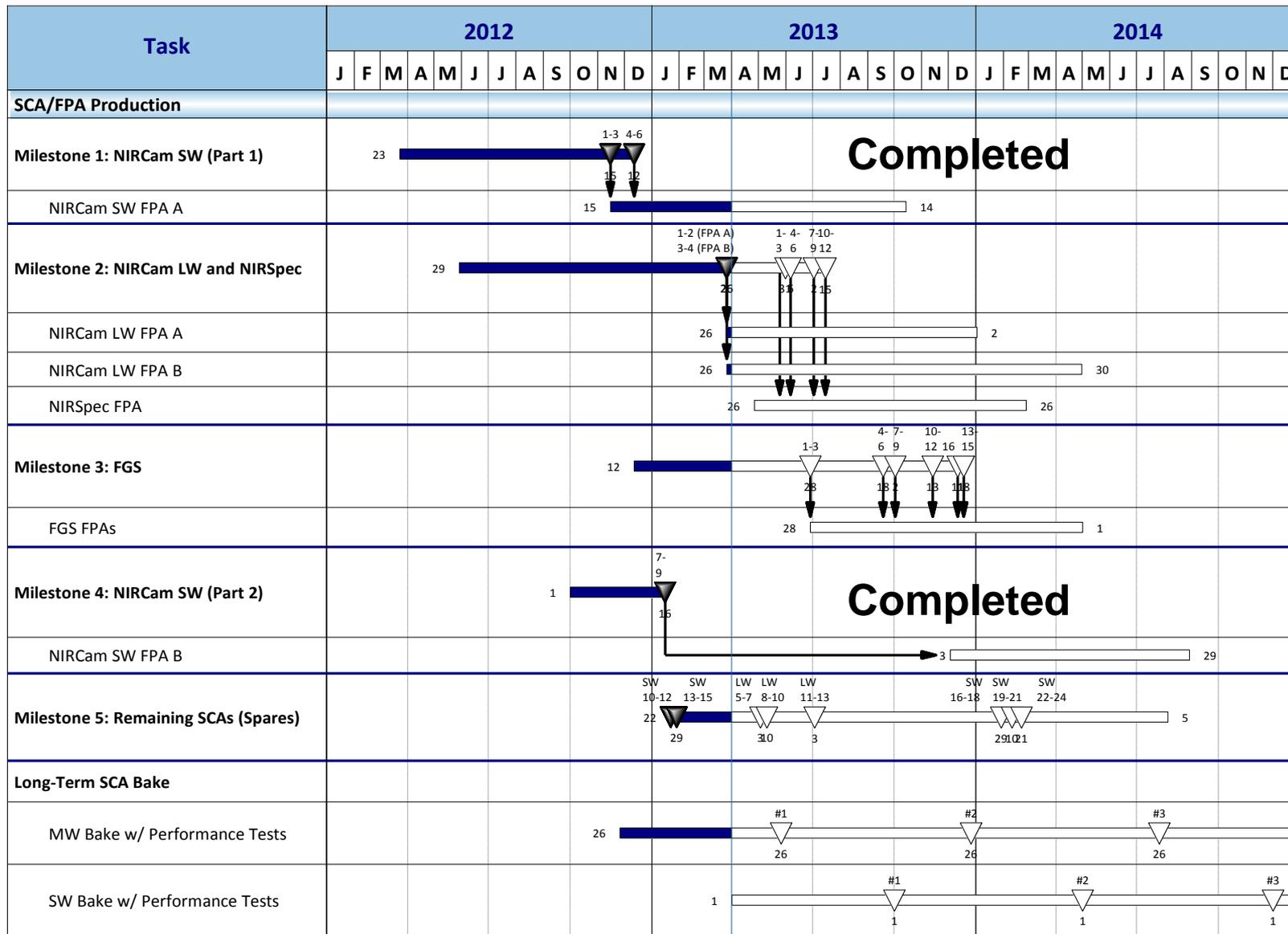
Primary Mirror Segments



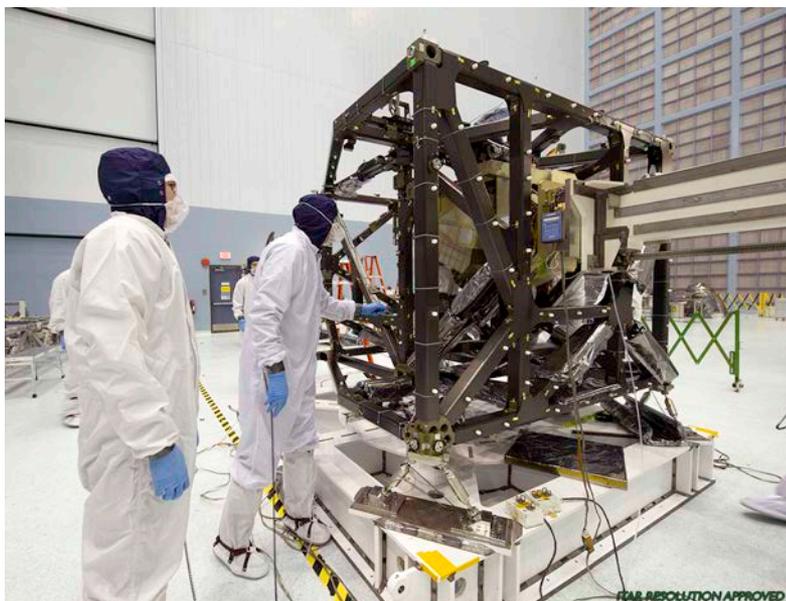
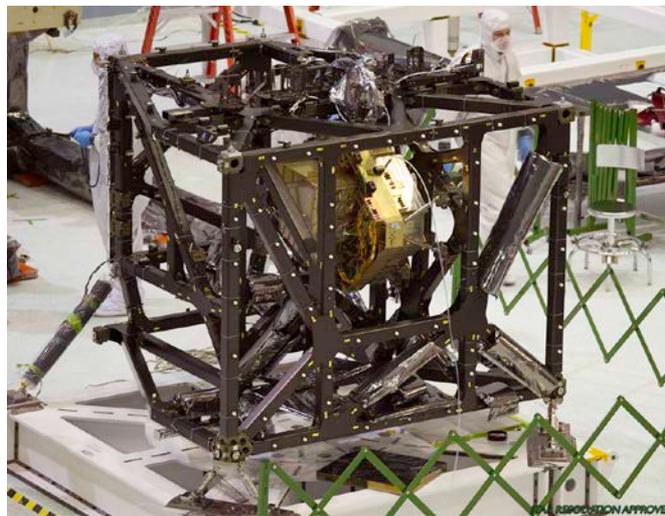
NIR SCA and FPA Fabrication Summary



07/24/2010



Completed Flight FGS installation onto ISIM Structure

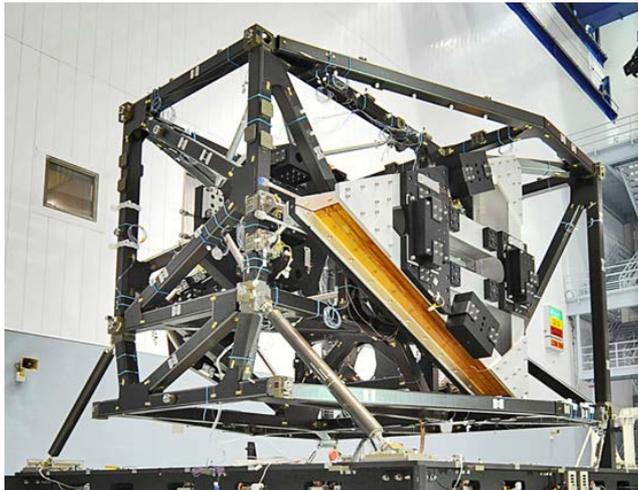




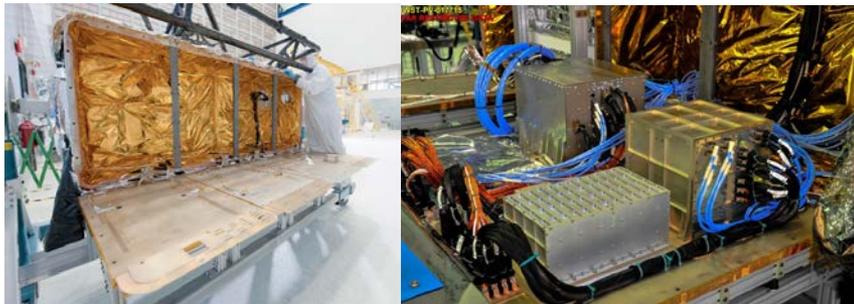
Integration of the Integrated Science Instrument Module (ISIM) Is Well Underway



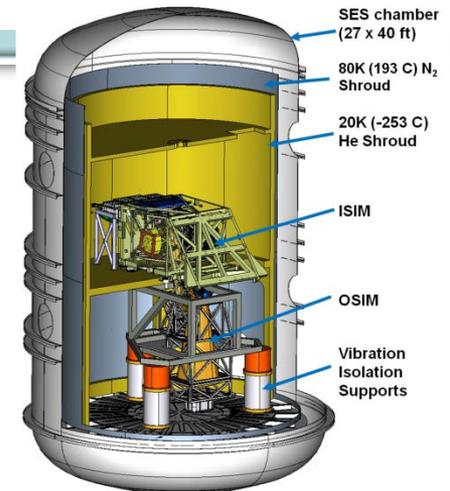
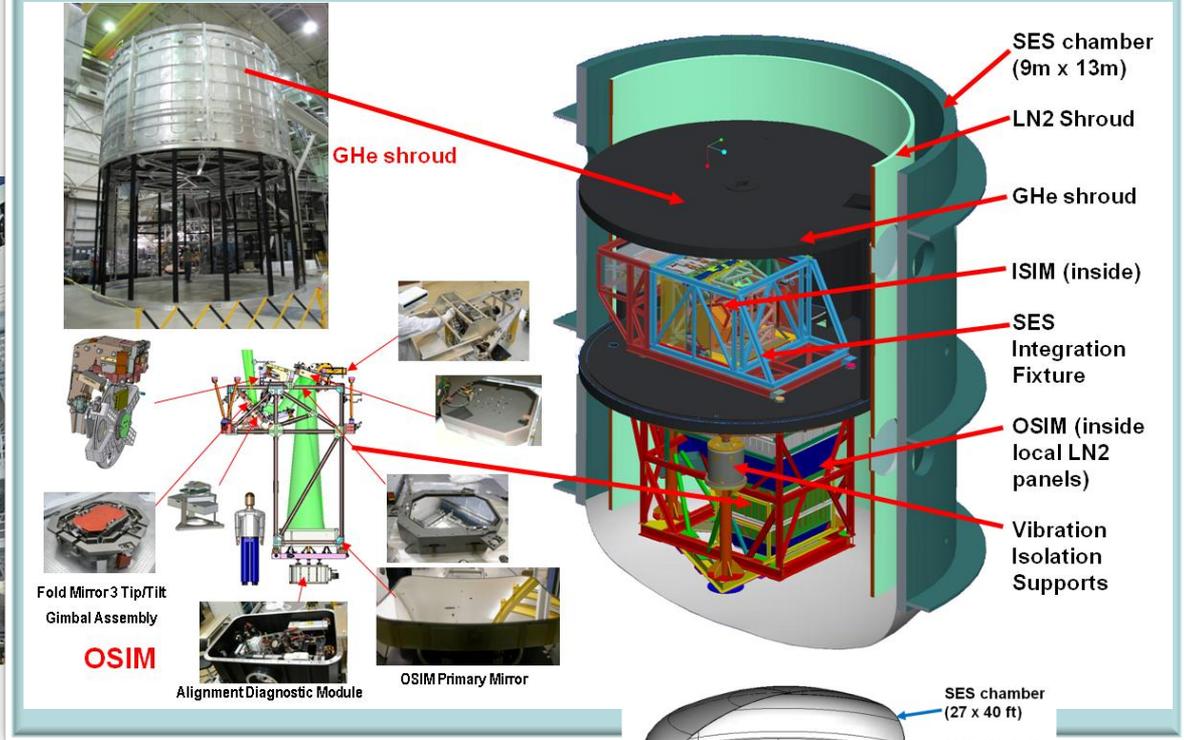
ISIM Structure



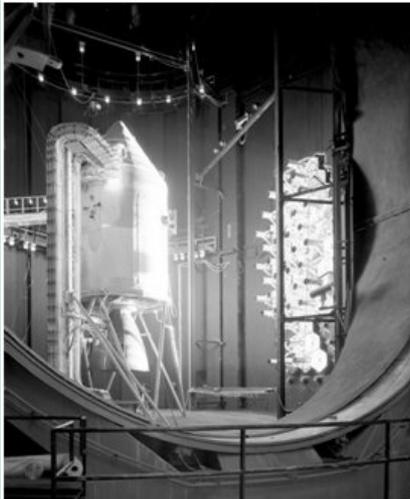
ISIM Electronics



Space Environment Simulator Chamber at GSFC



Chamber A at the Johnson Space Center



*Boilerplate Apollo S/C
008 in Chamber A with
side-sun solar*



http://www.nasa.gov/mission_pages/webb/news/chamber-a.html



OTIS Test and Subsystems Progress and Status



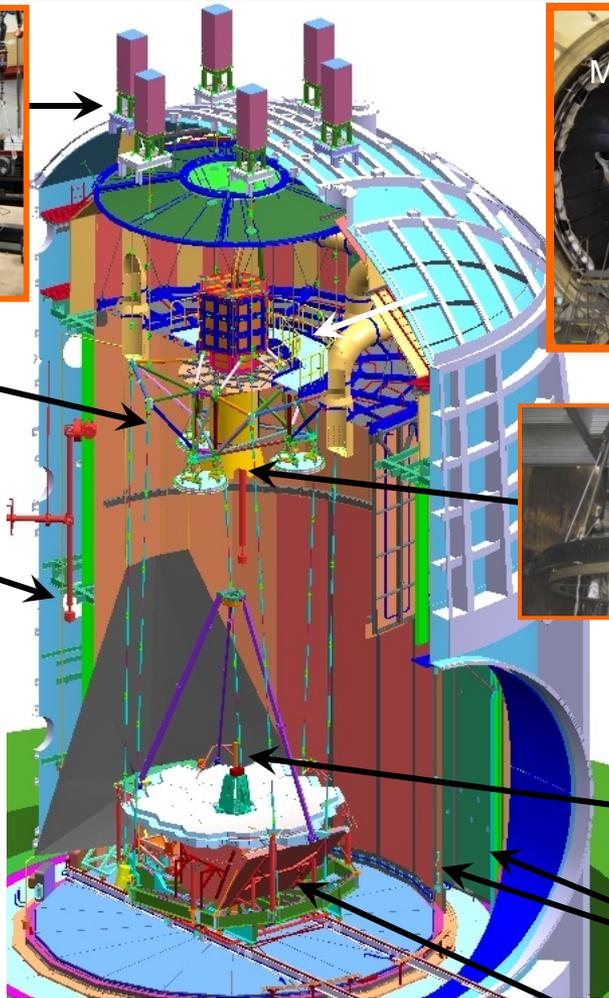
Chamber Isolator Units

- Isolators Assembled
- Testing will start this month



Hanging Configuration

- HOSS and USF Weldment Fab started, machining and welding has started
- Telescope Rods rough machined and heat treated for stress.
- Joint Qual Testing underway at CTD.



Center of Curvature Optical Assembly (COCO)A

- Multiwavelength interferometer, null, calibration equipment, coarse/fine PM phasing tools, Displacement Measuring Interferometer
- Storage at XRCF

3 Autocollimating Flat Mirrors (ACFs)

- Piston and Tilt actuation
- Test Chamber re-configured
- Mirrors are queued for processing

AOS Source Plate and Cable Support

- Supporting design requirements and documentation for design started

LN2 and Helium Cryogenic Shrouds and "barn door"

- Deep Space Edge Radiation Sink (DSERS) – supporting structural frame design has started

Cryo Position Metrology (CPM)

- Completed CDA – working Actions
- Absolute Distance Measurement (ADM) on HOSS – design effort started

Space Vehicle Thermal Simulator (SVTS)

- SVTS-SRR – Review Jan. 23rd.
 - Working Cryocooler and thermal interfaces
- TTS – Thermal Telemetry System
- IDR – Jan 24th
 - Completed field work at JSC in Dec.

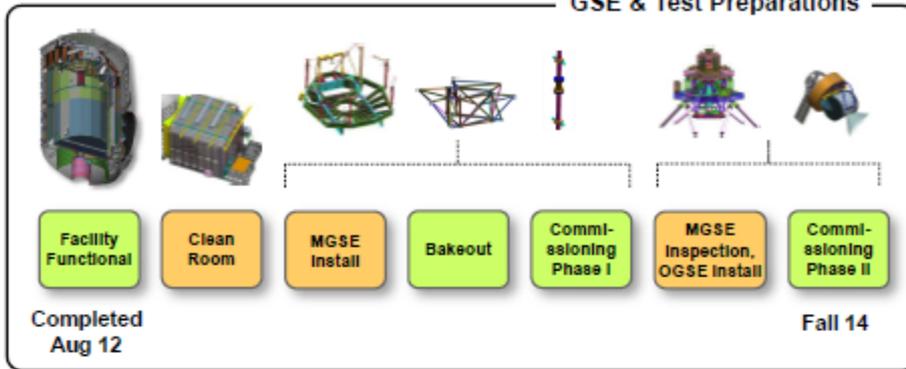
http://www.nasa.gov/mission_pages/webb/news/chamber-a.html



OTIS Integration and Test



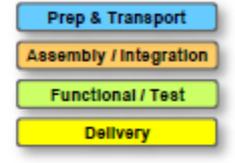
GSE & Test Preparations



JWST OTIS Integration and Test

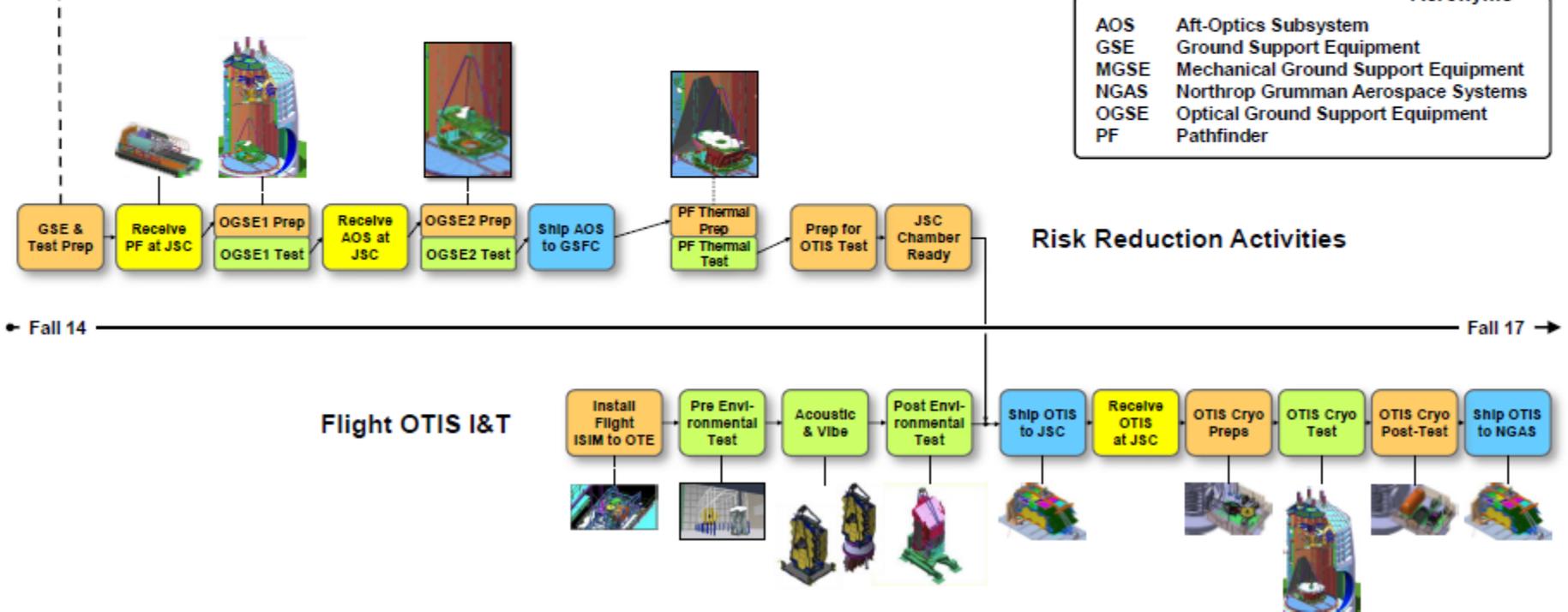
updated March 4, 2013

Legend



Acronyms

AOS	Aft-Optics Subsystem
GSE	Ground Support Equipment
MGSE	Mechanical Ground Support Equipment
NGAS	Northrop Grumman Aerospace Systems
OGSE	Optical Ground Support Equipment
PF	Pathfinder





Spacecraft Critical Design Review



- Spacecraft is the final major element to undergo CDR (December 2013)
- JWST will need to have mass margin issue resolved ~6 months prior to CDR
- Project and NGAS on a good trajectory to solve issue
- Analyses by ESA/Arianespace to see what extra margin may be releasable by launch vehicle.



Budget



Current (FY14 Budget, FY15 guidelines) Life-Cycle Cost Estimate by Year and Phase/ Includes Program-held UFE, Indirect, Labor and CoF

	Prior	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	CTC	Total
Total	3528.9	530.6	627.6	659.1	646.6	621.6	571.1	536.9	305.0	197.5	610.0	8834.9
Pre-Formulation and Formulation	1800.1	-	-	-	-	-	-	-	-	-	-	1800.1
Development	1728.8	530.6	627.6	659.1	646.6	621.6	571.1	536.9	228.0	47.5	-	6197.8
Operations	-	-	-	-	-	-	-	-	77.0	150.0	610.0	837.0
PY2014				658.2	645.4	620	569.4	534.9				8827.5
EPO Reduction				0.9	1.2	1.6	1.7	2				



JWST Schedule



2012			2013			2014			2015			2016			2017			2018																																																					
J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D

OTE = Optical Telescope Element

OTIS = Optical Telescope + ISIM

k months of critical path (mission pacing) slack

Spacecraft



Science Instruments



Telescope

	Northrop-Grumman
	Goddard Space Flight Center
	Ball Aerospace
	ATK
	Johnson Space Center
	Guiana Space Center

Red = Critical Path



Milestone Performance



- Since the September 2011 replan JWST reports high-level milestones monthly to numerous stakeholders

	Total Milestones	Total Milestones Completed	Number Completed Early	Number Completed Late	Deferred to Next Year
FY 2011	21	21	6	3	0
FY2012	37	34	16	2	3
FY2013	41	14	9	3*	0

*Late milestones are forecast to complete in FY13

Fiscal 2013 Milestones



Month	Milestone	Comment
October 2012	<ol style="list-style-type: none"> Headquarters delivery to project of funding plan for fiscal 2013 Spacecraft batteries preliminary design review Spacecraft command & telemetry computer review (Northrop internal review) Second review of optical test equipment for Johnson Space Center (JSC) thermal vacuum chamber test of telescope and instruments (OTIS) 	<ol style="list-style-type: none"> Completed 9/15 Completed 9/6 Completed 8/30 Completed 10/17
November 2012	<ol style="list-style-type: none"> Spacecraft-to-Optical Telescope Element/science instruments stray light and thermal barrier structures preliminary design review Port side spacecraft equipment panel design review (Northrop internal review) Complete electrical checkout of combined mid-infrared instrument (MIRI) and integrated science instrument module (ISIM) 	<ol style="list-style-type: none"> Completed 10/18 Completed 10/4 Completed 11/19, 2 days of testing required in Jan. due to FSW bug (divide by zero)
December 2012	<ol style="list-style-type: none"> First engineering model of the spacecraft command and telemetry computer delivered to test bed Reinstall beam image analyzer onto telescope simulator (OSIM) used in ISIM cryogenic testing Complete electrical checkout of combined fine guidance sensor (FGS) and ISIM 	<ol style="list-style-type: none"> Completed 11/8 Completed 12/19 Completed 12/20
January 2013	<ol style="list-style-type: none"> Aft optical system complete Receive JWST carrier container to be used in moving the observatory to testing and launch sites System design review of the software employed in managing all the data returned from the spacecraft to the operations center Deliver MIRI cover/thermal shield to ISIM integration and test (I&T) 	<ol style="list-style-type: none"> Completed 1/10 Completed 11/16 Completed 12/6 Dynamics and Thermal issue have delayed delivery to 4/19
February 2013	<ol style="list-style-type: none"> Secondary Mirror Support Structure I&T tooling fixture complete Primary mirror backplane support wing assemblies complete Spacecraft Primary Structure Manufacturing Readiness Review Start cryogenic certification test of OSIM 	<ol style="list-style-type: none"> Completed 2/27 Completed 2/19 Completed 1/28 Completed 3/14– delayed by Global Precipitation Measurement exit from SES chamber
March 2013	<ol style="list-style-type: none"> Deliver last primary mirror actuator motor electronics unit (Cryo Multiplex Unit) Spacecraft fine sun sensor critical design review Space Vehicle Thermal Simulator systems requirements review Complete FGS & MIRI integration onto ISIM 	<ol style="list-style-type: none"> Units completed, ship date is 4/26 Completed 1/15 Completed 1/23 FGS installed, MIRI installation delayed till Apr. to accommodate MIRI Shield to I&T delivery

Fiscal 2013 Milestones



Month	Milestone	Comment
April 2013	<ul style="list-style-type: none"> 24. Sunshield Template Membrane Layer #2 fabrication complete 25. Spacecraft-to-ground communications subsystem critical design review 26. Software build v 1.1 for the system that senses and controls Webb's active mirrors 	25. Completed 3/12
May 2013	<ul style="list-style-type: none"> 27. Telescope primary mirror backplane support fixture (BSF) assembly complete (holds ISIM, primary mirror and spacecraft together for launch) 	
June 2013	<ul style="list-style-type: none"> 28. Spacecraft thermal control system critical design review 29. Spacecraft wiring critical design review 30. Rods that suspend telescope and instruments from ceiling of JSC thermal vacuum chamber for testing complete 31. Start first ISIM cryogenic test (risk reduction activity) 	31. Moved to July 2013 – delayed by Global Precipitation Measurement exit from SES Chamber
July 2013	<ul style="list-style-type: none"> 32. MIRI detector cooling attachment (flight Cold Head Assembly) delivered to GSFC [delayed fiscal 2012 milestone] 33. Spacecraft flight software build 2.1 test readiness review 	
August 2013	<ul style="list-style-type: none"> 35. Latest acceptable date of Near Infrared Camera (NIRCam) into ISIM integration and test flow for inclusion in second ISIM cryogenic test 36. BSF/ Primary mirror backplane center section integration complete 	
September 2013	<ul style="list-style-type: none"> 37. Latest acceptable arrival of Flight Near Infrared Spectrograph (NIRSpec) for inclusion in second ISIM cryogenic test 38. Sunshield membrane cover manufacturing readiness review 39. Completion of studies and trades for mission mass margin in preparation of spacecraft critical design review 40. Complete first ISIM cryogenic test 41. JSC thermal vacuum chamber frame that holds test equipment suspended above the JWST mirror and instruments ready for painting 	

Blue font denotes milestones accomplished ahead of schedule, orange font denotes milestones accomplished late.



Sunshield Flight Material Edge Waviness



● Sunshield Material Edge Waviness (PM&P – 1)

■ Issue

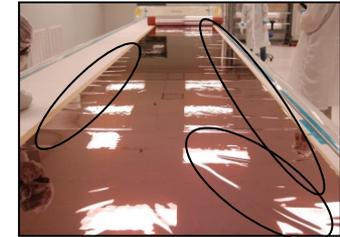
- Edge waviness discovered in Sunshield material
- Edge waviness may prevent proper seam alignment

■ Investigation Activities

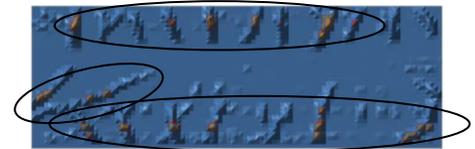
- Completed investigation activities.
 - Review of qualification creep test data under constant load at 395K and storage loads showed little movement. This does not support Creep or storage as possible root causes but does not eliminate them as a contributing causes.
 - The film casting process was determined to be the main contributor to wavy film.
 - The lack of a flatness requirement was also identified as a contributing cause.

■ Corrective Actions

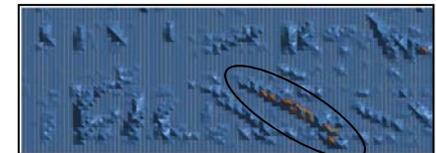
- All corrective actions determined. Documentation in-work.
- Measure material waviness before and after coating and select acceptable material
 - Flatness measurements of new Kapton E material completed and indicated a mix of flat and wavy material.
 - Sufficient material produced to select only flat film.
- Work with Nexolve to improve kitting and seaming operations.



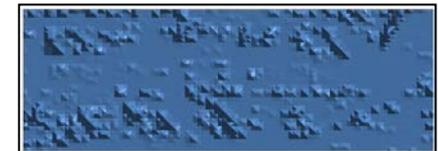
Old Not Acceptable film - 2-mil Kapton/VDA/Si



Old film with displacements up to 10 mils/in as shown in Red – Not Acceptable.



New film with displacements up to 10 mils/in – Not Acceptable.



New film displacements no larger than 2 mils/in – Acceptable.



Cooler Hardware on JWST

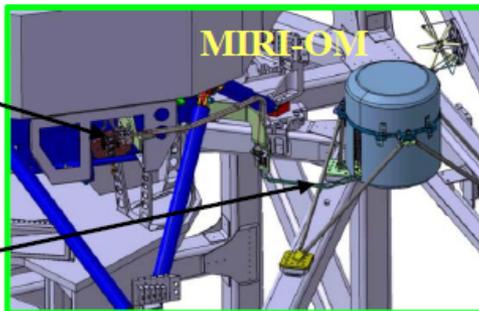
Astronomy, Physics and Space Technology Directorate

MIRI

Cold Head Assy (CHA)/Region 1

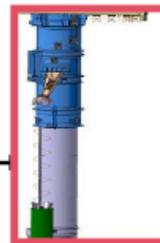
Optics Module Stage (OMS)
(6K heat exchanger)

Heat exchanger Stage
Assembly (HSA)
(Recuperator, valves)



Cooler Tower Assy (CTA)/Region 2

Refrig. Line Deploy. Assy (RLDA)



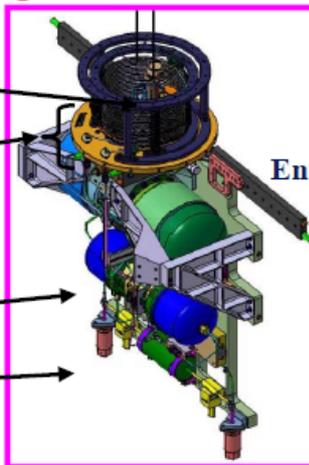
Cooler Compressor Assy (CCA)/Region 3

PT Pre-cooler
Coldhead

JT Recuperator

PT Compressor

JT Compressor



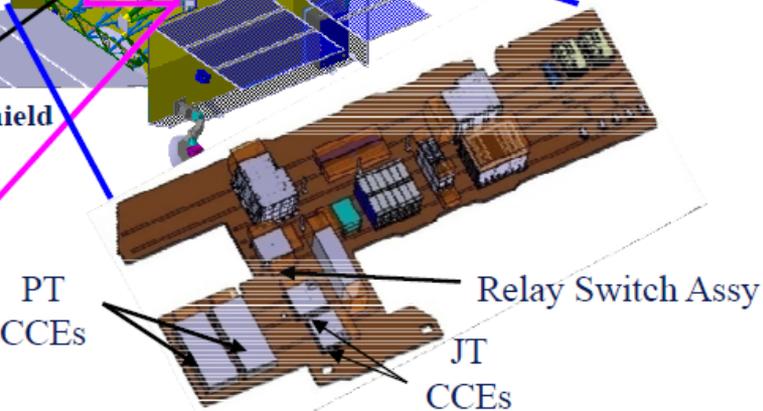
Environmental Shield

PT
CCEs

JT
CCEs

Relay Switch Assy

Cooler Control Electronics Assy (CCEA)/Region 3

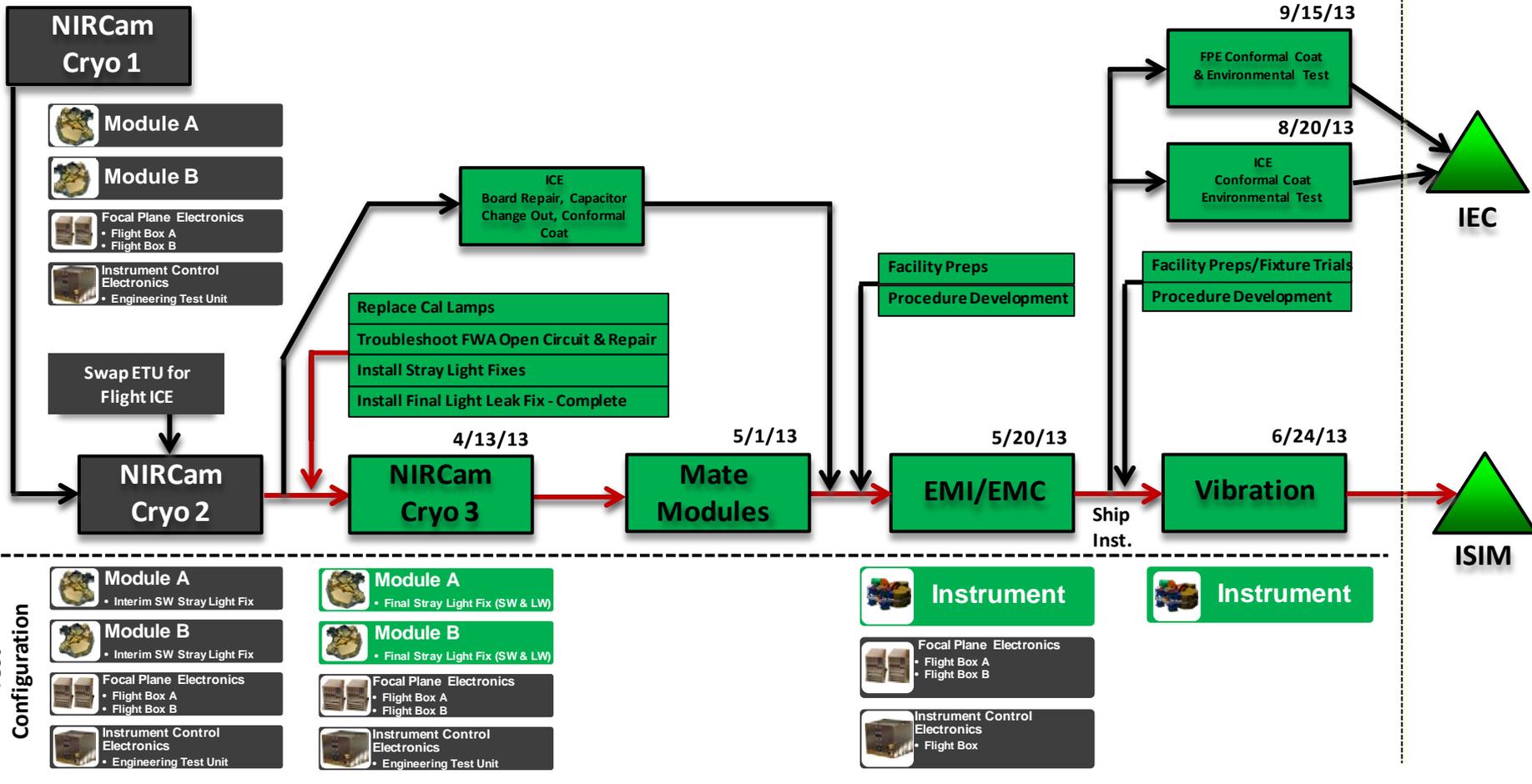




NIRCam Test & Delivery Flow



JWST



Legend

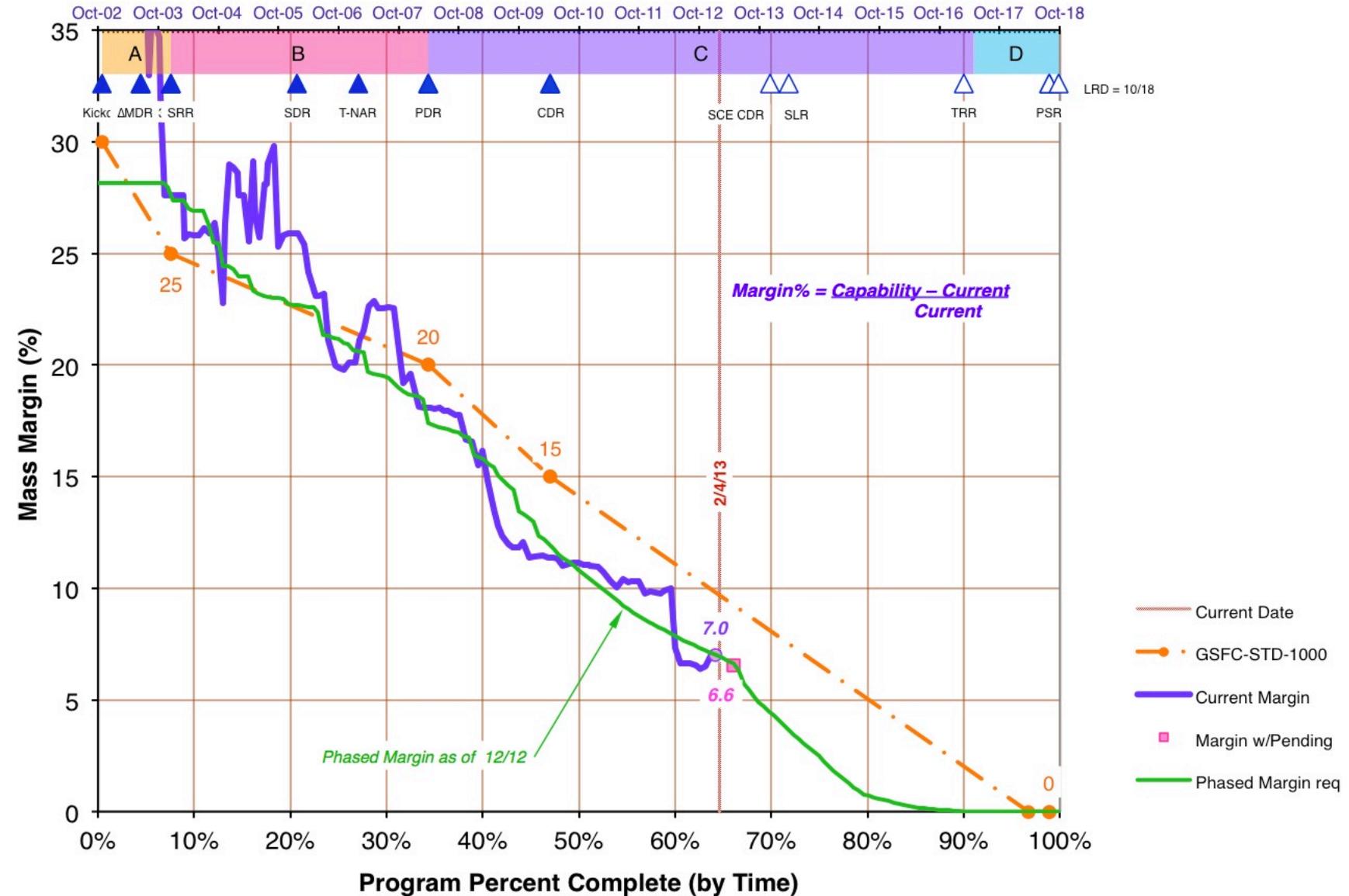
- Red Arrows are Critical Path
- ISIM = Integrated Science Instrument Module
- IEC = Instrument Electronics Compartment



TPM - Mass Margin



Status as of: 2/4/13





Recent Program/Project Images

Pathfinder Structure



Pathfinder on ROF in M8 at NGAS



- Demonstrations of placement of mirror mass model on BESTA

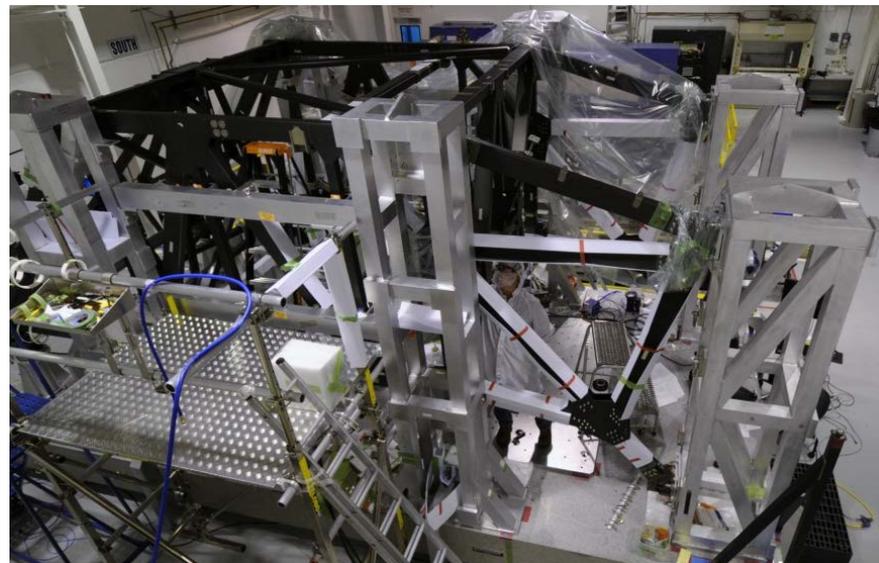


- **Wing Assembly: Completed**
 - Wings delivered to MSFC's XRCF for testing 3/20

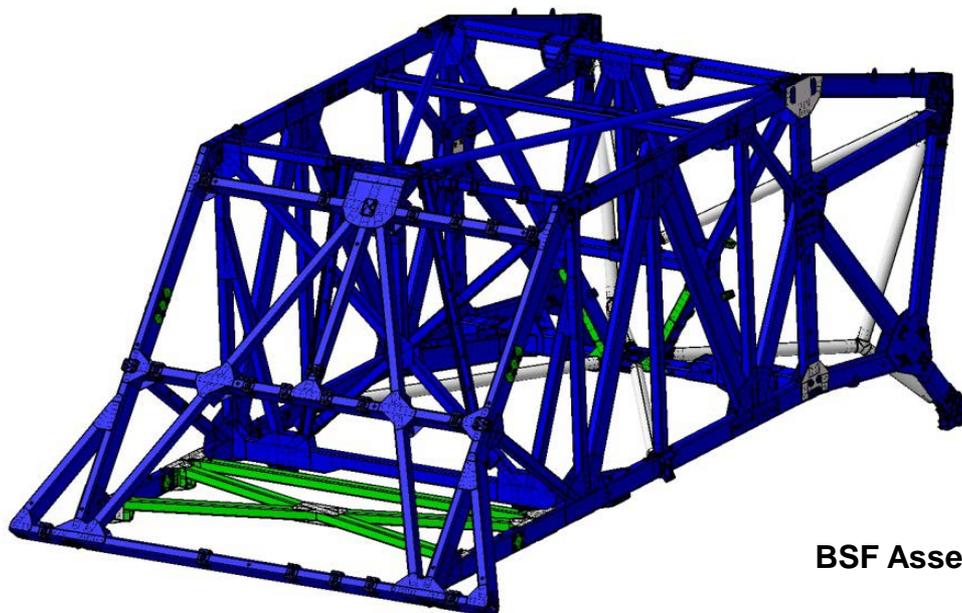


Backplane Support Fixture assembly efforts:

- Removable round strut fittings are bonded
- Roof support tube and gusset plates are bonded
- Floor structure rework completed
- Integration 6 efforts are underway
 - +V3 end cross struts in dryfit
 - -V3 cross struts in dryfit



BSF Assembly Mar 20, 2013



- : Not Assembled
- : Assembled
- : Assembled since last month

BSF Assembly - Integration 1 - 6



Backplane Support Fixture





Yearly Themes



- ✓ **2013: Instrument Integration:** The Science instruments will be finished and begin their testing as an integrated science payload
- ✓ **2014: Manufacturing the Spacecraft:** Construction will commence of the spacecraft that will carry the science instruments and the telescope
- ✓ **2015: Assembling the Mirror:** The mirror segments, secondary mirror and aft optics will all be assembled into the telescope
- ✓ **2016: Observatory Assembly:** The three main components of the observatory will be completed (instruments, telescope, spacecraft)
- ✓ **2017: Observatory Testing:** The three main components of the observatory will be tested and readied for assembly (instruments, telescope, spacecraft) into a single unit
- ✓ **2018: Kourou Countdown:** All parts of the observatory will be brought together, tested and readied for launch in Kourou, French Guiana



Staying Current



www.jwst.nasa.gov

webbtelescope.org

National Aeronautics and Space Administration

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- November 28, 2012: Video Hails Arrival of 2 Different Webb Telescope Mirrors [View feature](#)

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NASA Webb Telescope **NASAWebbTelesc**

NASAWebbTelesc @PaxitaQuilian Gracias! 2 days ago · reply · retweet · favorite

NASAWebbTelesc @DocBrown11 @Crfobqg Our primary mirror has 18 segments. 2 days ago · reply · retweet · favorite

NASAWebbTelesc @Crfobqg Our sunshield is the size of a tennis court if that helps give you scale! 3 days ago · reply · retweet · favorite

Crfobqg @NASAWebbTelesc Holy cats JWST is big! I just realised the scale. Each mirror SEGMENT is the size of a person. Best mission of the decade? 3 days ago · reply · retweet · favorite

Join the conversation

The James Webb Space Telescope (sometimes called JWST) is a large, infrared-optimized space telescope. The project is working to a 2018 launch date. Webb will find the first galaxies that formed in the early Universe, connecting the Big Bang to our own Milky Way Galaxy. Webb will peer through dusty clouds to see stars forming planetary systems, connecting the Milky Way to our own Solar System. Webb's instruments will be designed to work primarily in the infrared range of the electromagnetic spectrum, with some capability in the visible range.

Webb will have a large mirror, 6.5 meters (21.3 feet) in diameter and a sunshield the size of a tennis court. Both the mirror and sunshade won't fit onto a rocket fully open, so both will fold up and open once Webb is in outer space. Webb will reside in an orbit about 1.5 million km (1 million miles) from the Earth.

The James Webb Space Telescope was named after the NASA administrator who staffed the Apollo program, and who was a staunch supporter of space science.

Want more information?

Watch the Webb Telescope being built on our "Webb-gram"

Webmaster: Maggie Masetti
Responsible NASA Official: John Durning
Privacy Policy and Important Notices

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WE CAN SEE THE BEGINNING

The birth of stars
New solar systems
Evolving galaxies

A new telescope orbiting almost a million miles from Earth
Gazing into the past
Watching the universe come into being
Seeing in a light invisible to human eyes

SCIENCE ON THE EDGE

What will we see?
Webb will cast its gaze on distant supernovae, infant galaxies, and much more. Learn about the science that awaits with the launch of the telescope.

Behind the Webb Video Podcast
Get a behind-the-scenes look at the people and places involved in building this great new observatory.
Latest episode:
Show 16: Canada's Dynamic Duo

James Webb

Books > Science & Nature > Astronomy > HubbleSite.org

James Webb Space Telescope Science Guide

Description

With a mirror three times the size of the Hubble Space Telescope's, and an orbit far beyond Earth's Moon, the Webb Space Telescope is preparing to show us a universe we've never seen before. Webb will see the first stars flickering to life in the most distant universe, penetrate clouds of dust to reveal newly forming stars and solar systems, and analyze planets around other stars for traces of potentially life-giving water.

This highly interactive eBook features video, image galleries and more to tell the story of the Webb Telescope – the science it will reveal and the cutting-edge technology designed to not just cope with the harsh conditions of space, make them into an advantage.

CHAPTER 1 Introduction

Science Overview

2.1 Dark Ages to First Light
2.2 The Cosmic Web
2.3 Building Blocks
2.4 New Stars, New Worlds
2.5 Living Planets

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Level: Grades 6-17
Category: Astronomy
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ACRONYM LIST



ASIC	Application Specific Integrated Circuit	NGST	Northrop Grumman Space Technology
BATC	Ball Aerospace	NIRCam	Near Infrared Camera
BP	Backplane	NIRSpec	Near Infrared Spectrograph
CBE	Current Best Estimate	OM	Optical Module
CCOS	Computer Controlled Optical Surfacing	OSIM	OTE Simulator
CDA	Critical Design Audit	OTE	Optical Telescope Element
CMU	Cryo Mux Unit	PM	Primary Mirror
ECP	Engineering Change Proposal	PMBSS	Primary Mirror Backplane Support Structure
EDU	Engineering Development Unit	PMSA	Primary Mirror Segment Assembly
EMTB	Engineering Model Testbed	PDA	Preliminary Design Audit
EOL	End of Life	PIT	Product Integrity Team
ESPI	Electronic Speckle Pattern Interferometer	PSF	Point Spread Function
ETU	Engineering Test Unit	RFA	Request for Action
FGS	Fine Guidance Sensor	RLDA	Refrigerant Line Deployment Assembly
FPE	Focal Plane Electronic	RTC	Request for Technical Change
HIP	Hot Isostatic Pressure	S&OC	Science and Operations Center
ICE	Independent Cost Estimate	SBC	Single Board Computer
ICE	ISIM Control Electronics	SC	Spacecraft
IDR	Integrated Design Review	SCTS	Spacecraft Cargo Transportation System
IEA	ISIM Enclosure Assembly	SDR	System Definition Review
IEC	ISIM Electronics Compartment	SIDU	Science Instrument Development Unit
IPAO	Independent Program Assessment Office	SM	Secondary Mirror
IPT	Integrated Product Team	SMD	Science Mission Directorate
IRT	Independent Review Team	SRB	Standing Review Board
ISIM	Integrated Science Instrument Module	STScI	Space Telescope Science Institute
ITAR	International Traffic in Arms Regulations	SV	Space Vehicle
JT	Joule-Thomson	SWG	Science Working Group
JWST	James Webb Space Telescope	TBT	Testbed Telescope
LM ATC	Lockheed Martin	TFI	Tunable Filter Instrument
LRD	Launch Readiness Date	TM	Tertiary Mirror
MIRI	Mid Infrared Instrument	TRR	Test Readiness Review
MOR	Mission Operations Review	VM	Verification Model
MOU	Memorandum of Understanding	WFE	Wavefront Error
MRB	Material Review Board	WFSC	Wavefront Sensing & Control
MSS	Micro-shutter Subsystem	XRCF	X-Ray & Cryogenic Facility