



GLAST Large Area Telescope:

Integration & Test

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Integration and Test



Recent Accomplishments

- Held an Integration Kick-off meeting.
- Hired 6 of 10 open I&T positions
- Training Mockup
- Assembly plan released



LAT Assembly sequence from (LAT-MD-676)





Open Issues

- Update LAT-MD-02730 to address Electronics Integration Tests
- Establish plan for release of integration drawings
- Conduct a detailed review of Tower Integration Sequence
- Prioritize I&T procedure development to support need dates for initial and two tower test
- Re-plan commitment dates for all EGSE deliveries to I&T
- Complete definition of FSW I&T support requirements
- Implement policy for I&T script, DB, Software Configuration management
- Identify plan and points of contact for subsystem support to I&T planning
- Re-start Integration planning meetings and finalize documentation
- Identify plan to capture subsystem & LAT level operational constraints
- Finalize ACD test area plan in bldg 33 to accommodate repair contingency requirements – tentative agreement reached





Roadmap to Flight Hardware – Overview



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IFCT - Facility Overview / Monitoring system



Example of monitoring system data:

 Cleanroom operating within limits 99.7% of time in last 4 weeks; hardware bag w/ nitrogen purge covered remaining 0.3% of time



Time: 02/09/04 14:46:41 to 03/08/04 14:46:41, Duration: 28 days + 00:00:00



IFCT - Facility overview / controls, safety

- Cleanroom controls / certification:
- Cleanroom certification (HEPA filter tests, air balance) – complete and report is in hands of LAT QA
- Contamination controls (witness plates, etc.) in place – approved by LAT QA
- Cleaning contract in place approved by LAT QA
- ESD controls in place implemented by NASA certified trainer
- Facility safety
- Building safety program in place passed inspection by OSHA (Feb. 9, 2004)
- Oxygen deficiency alarm system in place (doubly redundant) – final approval on Mar. 10, 2004
- VDG operation approved by SLAC radiation safety, VDG earthquake safety done



Time: 02/09/04 14:35:59 to 03/08/04 14:35:59, Duration: 28 days + 00:00:00

IFCT - Facility Project Schedules

- Building 33 power substation– long item parts on order; completion 30-Sept-04; power contingency plan in place.
- ACD test area plan tentatively approved by Dave Thompson on 11-Feb-04; long lead item parts are ordered as ACD approved final plan on 12-Mar-04; completion 31-May-04.
- BId 33 network firewall– parts in hand; work completed 31-Mar-04
- Purge line certification- work completed on 31-Mar-04
- Electronics subsystem thermal test chamber in room 103 and operational by 01-May-04.
- Electronics subsystem TVAC test chambers installed in room 103 and operational by 31-May-04 (paced by electronics subsystem).



IFCT - Procedures

- Single bay procedures (12 total)
 - 9 procedures partially or fully tested in EM1 test series expect to complete on schedule
 - 3 procedures never exercised yet: Tracker installation, Optical survey, TEM/PSU shimming
- Multi-bay procedures (13 total)
 - Top concern: GASU/PDU test procedures; will be sending IFCT personnel to ELX test lab to exercise procedures

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IFCT - Mock-up

Description of parts:

- Rotation stand supporting plate spanning full-width of LAT
- EM single bay can fasten to central bay
- CAL baseplate external features
- Shear plates
- Cable trays
- Population of cables, electronics boxes for bays 8-15 (50% of LAT)

Status

- All major parts in hand or in manufacturing
- Ready for training 31-Mar-04

ELX test bed – I&T mock-up will have much more mechanical detail, but only 50% LAT population





IFCT – Operations Software GUIs

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GLAST LAT Project

IFCT - Mate/De-mate Log

- Exercised paper-based logs in EM1 series
- Web-based mate/de-mate log in development, not tested; plan to test during mock-up exercises

	MATE/DEMATE Mate								
	GLAST Home	Mate	<u>DeMate</u>	Print					
Date:	2004-03-22 16:33:49 use fo	rmat YYYY-MM-DD	HH24:MI:SS						
Ref Designator:									
Initials:									
Initials Password:									
TorqueValue:									
Witness:									
Witness Password:									
Add Mate									

IFCT - Daily Operations Planning - Status

- Flight qualified manpower for 2-shift loading hiring in process
- Building 33 meeting area operational, tested in EM1 series
- Web-based shift scheduler / logbook- tested in EM1 series (up to 3-shift operations)
- Web-based work order system (J. Clinton) operational, tested in EM1 series
- Web-based non-conformance reporting system (D. Marsh) operational, tested in EM1 series

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MGSE – Status (Complete by IRR)

LAT I&T MGSE Item	Stress Analysis		Design - Drafting			Procurement		Assembly	
	Status	Report	Modeled	Detailed	Released	Ordered	In-House	Status	Proof Test
4x4 Integration Stand									
4x4 Rotation / Support Stand	\checkmark			90%		9%			
Grid Perimeter Ring - Brackets			\checkmark	99%					
Support Shaft - Flange Assemblies			\checkmark	99%		50%			
Personnel Access Platforms			65%	15%					
Z Axis Up Lift Fixture									
Z Axis Up Lift Spreader			\checkmark	90%					
Z Axis Up Tension Rod Assemblies			30%	45%		10%			
Z Axis Horizontal Lift Fixture									
Z Axis Horizontal Lift Spreader			\checkmark	95%					
Z Axis Horizontal Shackles			\checkmark	95%					
Z Axis Horizontal, Crane Scale Mod			\checkmark	95%					
Crane Scale Height Modification			\checkmark	95%					
4x4 MGSE Proof Test Assemblies									
CAL -Z Up Lift Fixture			\checkmark		95%	\checkmark			\checkmark
CAL Alignment Tool			\checkmark			\checkmark		\checkmark	n/a
CAL Alignment Rods			90%	90%		100%			
CAL Inversion Stand / Interface			\checkmark	\checkmark	95%	\checkmark		\checkmark	\checkmark
E-Box Shimming									
Metrology Bay with Stand	n/a		\checkmark		\checkmark	\checkmark			n/a
Clamps, Align Rods, Lift Eyes, etc	n/a		\checkmark	\checkmark	\checkmark	40%	50%		n/a
TWR Mass Simulators		\checkmark	\checkmark	80%					n/a
EM-2 Single Bay (TKR Interface Plate)		n/a							n/a
1x4 Lift Fixture									
1x4 Lift Spreader			\checkmark						
1x4 Tension Rod Assemblies						10%			
TKR - TKR No Touch at Ascent Tool									n/a

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MGSE – Hardware Models



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MGSE – Integration Room Layout



Integration Stand is Placed to Allow Range of Motion for PAPs

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EGSE/ONLINE – EM1



LCB: LAT Communication Module

Transition-card: Trigger Module

TEM DAQ Assembly

Tower Power Supply Assembly

(1.5V/2.5V/3.3V/ 0-100V/0-150V)

- Processor: Motorola Power-PC
- Flight Software
- **PMCIA LAT Communication Board for**
 - LAT Communication
- Transition Board
 - Trigger
- TEM DAQ Assembly
- TEM Power-Supply Assembly
- 28-V Supply
- LAT-TD-00861





Integration and Test



EGSE/Online - Test Stand Definitions

		Num	ber			Contents
1	2a	2b	2c	3x	4x	
Χ	X	X	Х			PC
Х	X	X	X			VME crate
Χ	X	X	X			SBC
Χ	X	X	X			LCB
Χ	X		X			X board
Χ	*	*				TEM
Χ	*	*				TEMPS
		X	Χ			GASU (EGSE or flight)
				X		Various combinations of EGSE SIU, EPU and
						external test crate
					X	SIIS, Flight SIU and EPU, external test crate

*Flight TEM/TEMPS installed in test article

External crate in configs 3 and 4 has a lot of capability, but firm test requirements needing those capabilities are not defined. The crate can:

1-Run subsystem scripts

2-Run flight software

3-With the addition of a 1553 interface, can replace the SIU

4-Can "snoop" on traffic to gather intermediate data for off line analysis



EGSE/Online - Test Stand vs Test

Test description	Stand No	Power	EGSE s/w	FSW
Tracker or Cal receiving test	1	Bench	>=LATTE 2	EM1(register drivers + event support +)
TKR installation in EM single bay	1	Bench	>=LATTE 2	EM1(register drivers + event support +)
ACD receiving test	2c	Bench ?	TBD	TBD
Cal/TEM/TEMPS integration	2a	Bench	LATTE 2+	EM1' (adds monitoring, housekeeping, config support)
Tower integration in EM Single Bay and in grid	2 a	Bench	LATTE 2+	EM1'
2+ towers in grid through GASU and PDU installation, can be used up to launch for low level tests including ACD	2b	EM or flight PDU	LATTE 3	EM2 (PDU support, power up, queuing support, CCSDS packets)
Tests EPU and SIU after installation, including before all 16 towers are integrated	3x	EM or flight PDU	LATTE 3	TBD (EM2+, FSW?)
Full up LAT testing	4x	Flight PDU	TBD	Flight Software



Single Tower EGSE Configuration (TS-1 / 2a)



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Multi-Tower EGSE (TS-2b)



Integration and Test



EGSE Configuration Control

- The I &T CCB maintains a list of I&T CCB controlled items.
- The I &T CCB can make changes to this list at their discretion.
- Changes that exceed the Level 4 change control threshold or impact Level 3 requirements shall be promoted to the LAT CCB process.
- LAT I & T is responsible for maintaining an appropriate baseline of validated test products.
- The I&T CCB includes the following representatives:
 - I&T Manager (CCB Chair) E. Bloom
 - I&T Management support (alternate chair) Brian Grist
 - Systems engineering –Pat Hascall
 - Systems engineering shall act as the CCB Secretary and exercise control of the CCB documentation through LAT CM.
 - Online Manager Ric Claus
 - FSW Test Lead Eric Hansen
- The entire process is defined by LAT-MD-03492-01

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Particle Test – Van de Graaff Facility

- Equipment
 - 100% uptime during EM test
 - Van de Graaff
 - BGO Monitor
 - Cosmic Ray Scintillator
- Van de Graff EM results
 - VdG makes photons and BGO sees them
 - The EM tracks them
- Van de Graff rates
 - 1 kHz γ into 4π sr during EM test
 - > 100 kHz γ into 4π sr with upgraded VdG
- Particle Test Procedures
 - 4 procedures to configure special equipment (3 needed for integration complete by 7/1/04)
- Spare Parts
 - 22 components to spare (8 already have, 14 will be ordered by 4/15/04)
- Equipment Readiness
 - Bi-weekly verification of VdG by recording BGO spectrum
 - Bi-weekly verification of Scintillator telescope by recoding cosmic rate













SVAC



Integration and Test

data

example,





Schedule - Slips in Schedule Since Baseline

- Budgeted Cost of Work Scheduled (BCWS): 3125 k\$
- Budgeted Cost of Work Performed (BCWP): 3111 k\$
- Schedule Variance: -14 k\$ or 0.5%
- The Integration and Test Subsystem schedule is under control.







Completion Date (Baseline Variance)

Integration and Test



Staffing plan and actual staffing



Integration and Test



Approved Cost Changes Since Rebaseline

(k\$)

4.1.9 Baseline, November 03	\$6,384		
Changes:			
 Additional I&T Manpower 	\$	523 *	
IFCT Engineering/Design	\$	284	
Tracker/Grid Interface Redesign	\$	35	
Stanford Benefits Rate Increase	<u>\$</u>	147	
Total Change	\$	989	
4.1.9 Baseline, February 04	\$7	7,373	

*Corresponding NASA funding increase



Cost and Budget

- Budgeted Cost of Work Performed (BCWP): 3111 k\$
- Actual Cost of Work Performed (ACWP): 3037 k\$
- Cost Variance: +74 k\$ or 2.4%
- The Integration and Test Subsystem costs are under control.



Where will I&T be in 6 months?

- The Integration Readiness review will have been completed.
 - The procedures for integration have will been completed.
 - The MGSE for LAT integration will have been built and tested.
 - The EGSE/Online for integration will have been completed and tested in place.
 - Facility will be certified
 - Van de Graaff will be certified for high rate
- The Grid will have been received and installed in on the rotation stand.
- The first two towers will have been received, installed and testing will be underway.



Summary

• I&T is on track to begin integration as currently scheduled.