APPENDIX A

CHARGE MEMORANDUM

National Aeronautics and Space Administration
and
U.S. Department of Energy

JOINT OVERSIGHT GROUP

TO: Mr. David Betz, NASA/Goddard Space Flight Center; and

Mr. Daniel Lehman, Director, Construction Management Support Division, SC-81

Date: December 7, 2001

RE: Request to Conduct a Preliminary Design Review and Baseline Review of the GLAST LAT Project

The DOE/NASA Joint Oversight Group (JOG) for the Large Area Telescope (LAT) project on the Gamma-ray Large Area Space Telescope (GLAST) mission requests that a Preliminary Design Review and a Baseline Review be conducted on January 8-11, 2002, at the Stanford Linear Accelerator Center (SLAC). The LAT is the principal scientific instrument to be flown on the NASA GLAST mission, scheduled for launch in 2006. It is being designed and built by an international collaboration. Professor Peter Michelson, who holds a joint appointment at Stanford University and SLAC, is the Spokesperson for the LAT Collaboration and Principal Investigator for the LAT project. He has overall responsibility for the technical, cost, and schedule management of the LAT. SLAC is the Host Laboratory for the LAT Project, providing technical and management support.

The purpose of the review is to carry out an integrated examination of each subsystem, the technical progress overall, and the cost, schedule and management planning of the GLAST/LAT project. The committee should evaluate all aspects of the project, keeping in mind the issues highlighted from past reviews. In performance of a general assessment of progress, current status, and the identification of potential issues, the committee should address the following specific items:

1. Technical Progress: Review the technical progress at the system and subsystem levels in order to assure that the proposed design and associated implementation approach satisfies the system and subsystem functional requirements. Review the LAT performance requirements and the adequacy of designs and resources allocated in order to meet the project's scientific goals.

2. Cost Estimates: Is the cost estimate consistent with the plan to deliver the LAT with the stated technical performance? Is the contingency adequate for the risk?

3. International Contributions: What is the status of the international contributions, and what is the schedule for finalizing these commitments? Are these consistent with the schedule?

4. Schedule: Is the proposed schedule reasonable and appropriate in view of the technical tasks and projected funding profiles? Have the various subsystem schedules been incorporated in a well-understood way, relative to product flow, critical paths, and linkage between various activities?

5. Management: Evaluate the management structure, including the relationships to the GLAST Mission organization and relationships with foreign entities, as to its adequacy to deliver the LAT within specifications, budget, and schedule.

We appreciate your assistance in this matter. As you know, these reviews are an important element of the NASA/DOE joint oversight of the GLAST/LAT Project and help to ensure that the U.S. astroparticle physics program remains robust and meets its commitments on cost and schedule.

You are asked to submit a formal report by March 11, 2002. The committee members are asked to contribute draft sections of this report by the end of the closeout of the review, January 11, 2002.

Paul Hertz
NASA Co-Chair
Office of Space Science
NASA Headquarters
Washington, DC 20546

John R. O'Fallon
DOE Co-Chair
Division of High Energy Physics
U.S. Department of Energy
Germantown, MD 20874

APPENDIX B

REVIEW PARTICIPANTS

Department of Energy/National Aeronautics and Space Administration Review
of the
GLAST Large Area Telescope (LAT) Project
January 8-10, 2002

Daniel R. Lehman, DOE Co-Chairperson **David Betz, NASA Co-Chairperson**

SC1 Tracker (WBS 4.1.4)	SC2 Calorimeter (WBS 4.1.5)	SC3 Anti-Coincidence Detector (WBS 4.1.6)	SC4 Electronics, DAQ, Elec. Sys. & Flight S/W (WBS 4.1.7)	SC5 Mechanical Systems (WBS 4.1.8)
* Helmuth Spieler, LBNL	* Ron Ray, Fermilab	* Pawel De Barbaro, Rochester	* Fred Huegel, GSFC	* Jim Ryan, GSFC
Cliff Jackson, GSFC		[Steve Scott, GSFC]	Dennis Albaijes, GSFC	Dennis Hewitt, GSFC
			Bruce Meinhold, GSFC	
			Jon Thaler, U. of Illinois	

SC6 Systems Engineering (WBS 4.1.2)	SC7 Integration and Testing Performance/Safety Assure. (WBS 4.1.9 and WBS 4.1.A)	SC8 Ground Systems/Analysis (WBS 4.1.B and 4.1.D)	SC9 Cost, Schedule and Funding (WBS 4.1.1)	SC10 Project Management (WBS 4.1.1 and 4.1.C)
* Steve Scott, GSFC	* Bill Craig, LLNL	* James Branson, UCSD	* Mark Reichanadter, Fermilab	* Sam Aronson, BNL
[Dennis Hewitt, GSFC]	Jim Kerby, Fermilab	Rob Kutschke, Fermilab	Steve Tkaczyk, DOE/SC	Pepin Carolan, DOE/Fermilab
	Robert Vernier, GSFC			Martin Davis, GSFC

LEGEND

SC Subcommittee
* Chairperson
[ ] Part-time Subcom. Member

Count: 23 (excluding observers)

02/13/2002:q:sc-81:sns:0010rev:revcmglast.xls

APPENDIX C

REVIEW
AGENDA

Department of Energy/National Aeronautics and Space Administration Review of the GLAST Large Area Telescope (LAT) Project

AGENDA

Tuesday, January 8, 2002 — Plenary Session

Panofsky Auditorium

8:00 am	**DOE/NASA Executive Session**	**D. Lehman/D. Betz**
9:00 am	Welcome	J. Dorfan
9:10 am	Introduction and Overview	P. Michelson
9:40 am	LAT Organization and Management	W. Althouse
10:20 am	*Break*	
10:35 am	Science Requirements and Instrument Design	S. Ritz
11:15 am	Balloon Flight Results	T. Kamae
11:45 pm	*Working lunch—Orange Room, Central Laboratory (Bldg 40, Room R140/R150)*	
12:30 pm	Systems Engineering Overview (WBS 4.1.2)	T. Thurston
1:20 pm	Performance, Safety Assurance, and Subsystem Overview (WBS 4.1.A)	D. Marsh
1:40 pm	Tracker (WBS 4.1.4)	R. Johnson
2:00 pm	Calorimeter (WBS 4.1.5)	N. Johnson
2:20 pm	Anti-Coincidence Detector (WBS 4.1.6)	D. Thompson
2:40 pm	Electronics and Flight Software (WBS 4.1.7)	G. Haller/JJ Russell
3:10 pm	*Break*	
3:20 pm	Mechanical Systems (WBS 4.1.8)	M. Nordby
3:40 pm	Instrument Integration and Testing (WBS 4.1.9)	E. Bloom
4:00 pm	Instrument Operation Center (WBS 4.1.B)	S. Williams
4:15 pm	Science Analysis Software (WBS 4.1.D)	R. Dubois

Orange Room

4:30 pm	DOE/NASA Subcommittee Executive Session
5:00 pm	**DOE/NASA Executive Session**
6:30 pm	Adjourn

Wednesday, January 9, 2002—Technical Presentations

Parallel Session A: Mechanical Systems—Orange Room

8:00 am	Structural System Design (WBS 4.1.8)	M. Nordby
8:30 am	Tracker Structural Design (WBS 4.1.4)	T. Borden
8:55 am	Calorimeter Structural Design (WBS 4.1.5)	O. Ferreira
9:20 am	ACD Structural Design (WBS 4.1.6)	T. Johnson
9:45am	*Break*	
10:00 am	Thermal System Design (WBS 4.1.8)	M. Nordby
10:35 am	Tracker Thermal Design (WBS 4.1.4)	T. Borden
11:00 am	Calorimeter Thermal Design (WBS 4.1.5)	O. Ferreira
11:15 am	ACD Thermal Design (WBS 4.1.6)	T. Johnson
11:30 am	Radiators (WBS 4.1.8)	S. Morrison
11:50 am	Summary	M. Nordby

Parallel Session B: Electronics and Flight Software—Panofsky Auditorium

8:00 am	Data Flow Overview (WBS 4.1.7)	G. Haller
8:40 am	System Components: Design and Status (WBS 4.1.7)	G. Haller
9:30 am	General Issues (WBS 4.1.7)	G. Haller
10:00 am	*Break*	
10:15 am	Flight Software (WBS 4.1.7)	J.J. Russell
11:00 am	Power, Grounding, EMI (WBS 4.1.7)	D. Nelson
11:30 am	EEE Parts Plan and Requirements (WBS 4.1.A)	N. Virmani

12:00 pm *Working lunch—Orange Room*

Joint Session—Panofsky Auditorium

12:45 pm	LAT Validation Plan (WBS 4.1.2)	T. Leisgang
Subsystem Fabrication and Test Plans		
1:15 pm	Tracker (WBS 4.1.4)	T. Borden
1:45 pm	Calorimeter (WBS 4.1.5)	E. Grove
2:15 pm	ACD (WBS 4.1.6)	D. Thompson
2:35 pm	Electronics (WBS 4.1.7)	G. Haller
2:55 pm	Mechanical Systems (WBS 4.1.8)	M. Nordby
3:15 pm	*Break*	
LAT Integration and Test Plan (WBS 4.1.9)		
3:30 pm	LAT Integration and Testing	E. Bloom
4:05 pm	Assembly & Test Flow, Environmental Testing	B. Grist

Orange Room

4:30 pm	DOE/NASA Subcommittee Executive Session
5:00 pm	**DOE/NASA Executive Session**

Thursday, January 10, 2002—Breakout Sessions

8:00 am	Breakout Subcommittee Working Sessions—*in rooms listed below* —Detailed discussions of technical, management, cost and schedule issues
10:00 am	*Break*
10:15 am	Continued working sessions
12:00 pm	*Working lunch—Orange Room*
1:00 pm	Continued working sessions—*in rooms listed below*

Subcommittee	Room	WBS	
SC1	*Bldg 50, Rm 359*	4.1.4	Tracker
SC2	*Bldg 50, Rm 359*	4.1.5	Calorimeter
SC3	*Bldg 50, Rm 359*	4.1.6	Anti-Coincidence Detector
SC4	*Orange Room*	4.1.7	Electronics. Data Acquisition and Flight Software
SC5	*Green Room*	4.1.8	Mechanical Systems
SC6	*Bldg 137, Rm 322*	4.1.2	Systems Engineering
SC7	*Bldg 137, Rm 322*	4.1.9	Instrument Integration and Testing
		4.1.A	Performance and Safety Assurance
SC8	*Bldg 41, Rm 223*	4.1.B/D	Ground Systems and Analysis
		4.1.B	Instrument Operation Center
		4.1.D	Science Analysis Software
SC9	*Bldg 28, Rm 1*	4.1.1	Cost and Schedule
SC10	*Bldg 28, Rm 1*	4.1.1	Project Management
		4.1.C	Education and Public Outreach

Orange Room

2:00 pm	DOE/NASA Subcommittee Executive Session—*Orange Room*
3:00 pm	**DOE/NASA Executive Session—*Orange Room***

Friday, January 11, 2002

7:30 am	**DOE/NASA Executive Session Closeout Dry Run—*Orange Room***
11:00 am	**Closeout with DOE/NASA and GLAST/LAT Team—*Panofsky Auditorium***
12:00 pm	Adjourn

APPENDIX D

COST
TABLE

GLAST LAT PROJECT

Cost Estimate by Fiscal Year

$K, Then Year Dollars

	FY00	FY01	FY02	FY03	FY04	FY05	FY06	Cumulative
4.1.1 INSTRUMENT MANAGEMENT	389	2,043	2,398	2,176	2,000	1,657	644	11,307
4.1.2 SYSTEM ENGINEERING	26	834	1,121	740	655	526	190	4,092
4.1.4 TRACKER	317	2,926	2,693	1,999	1,183	377	187	9,681
4.1.5 CALORIMETER	698	1,638	3,265	3,631	2,664	1,163	319	13,378
4.1.6 ANTICOINCIDENCE DETECTOR	491	982	3,313	3,084	1,070	693	328	9,960
4.1.7 ELECTRONICS	693	935	2,287	6,968	4,440	1,002	197	16,520
4.1.8 MECHANICAL SYSTEMS	0	1,137	2,567	1,434	1,909	954	287	8,288
4.1.9 INSTRUMENT INTEGRATION AND TESTING	0	0	1,173	2,186	2,397	1,103	436	7,294
4.1.A PERFORMANCE AND SAFETY ASSURANCE	44	198	663	654	374	187	85	2,206
4.1.B LAT INSTRUMENT OPERATIONS CENTER	28	104	240	393	1,162	1,195	589	3,711
4.1.C EDUCATION AND PUBLIC OUTREACH	36	217	375	445	850	675	310	2,908
4.1.D SCIENCE ANALYSIS SOFTWARE	85	215	538	803	834	843	382	3,700
4.1.E SUBORBITAL FLIGHT TEST	49	1,272	0	0	0	0	0	1,321
Grand Totals:	2,854	12,502	20,633	24,511	19,538	10,375	3,954	94,366

GLAST LAT PROJECT

Cost Estimate by Fiscal Year

$K, Then Year Dollars

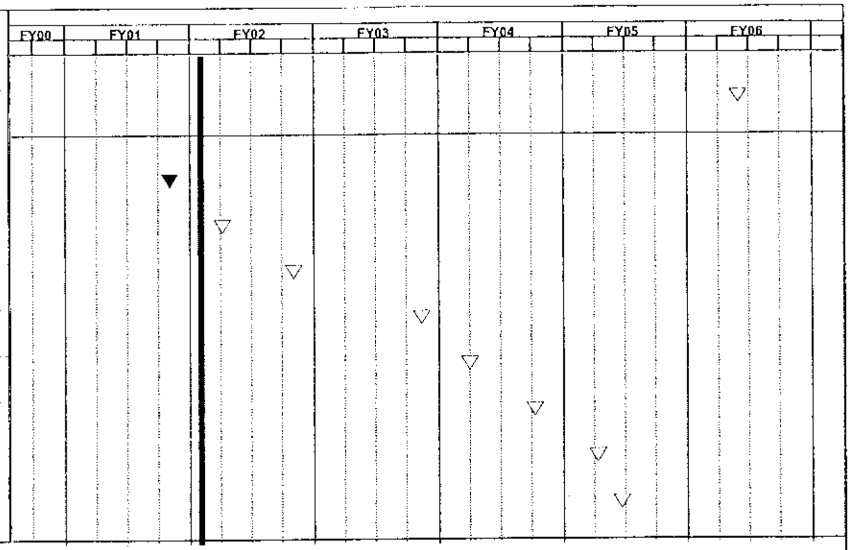
	FY00	FY01	FY02	FY03	FY04	FY05	FY06	Cumulative
DG GSFC	561	1,816	3,715	3,619	1,624	1,255	534	13,124
DH SU-HEPL	793	1,033	1,086	1,468	2,170	2,051	901	9,502
DL SU-SLAC	353	6,555	10,396	12,862	10,742	4,203	1,499	46,611
DN NRL	833	2,330	4,434	5,597	3,809	1,827	527	19,358
DS SSU	36	217	375	445	800	675	310	2,858
DT Texas A&M	0	16	0	0	0	0	0	16
DU UCSC	279	534	626	519	392	364	183	2,898
Grand Totals:	2,854	12,502	20,633	24,511	19,538	10,375	3,954	94,366

APPENDIX E

SCHEDULE CHART

Level 1 and Level 2 Milestones

Activity Description	Finish
DOE / NASA Headquarters (Level	
Launch Instrument	03/01/06*
Project Office (Level 2	
Launch Balloon Flight	08/01/01A
Instrument Preliminary Design Review	01/07/02*
Instrument Critical Design Review	08/05/02*
1st Two Towers Ready for Calibration	08/15/03*
Start LAT Integration	01/02/04*
Pre Environmental Testing Review	07/09/04*
Instrument Pre-Ship Review	01/07/05*
LAT Ready for Integration (RFI) to Spacecraft	03/22/05*

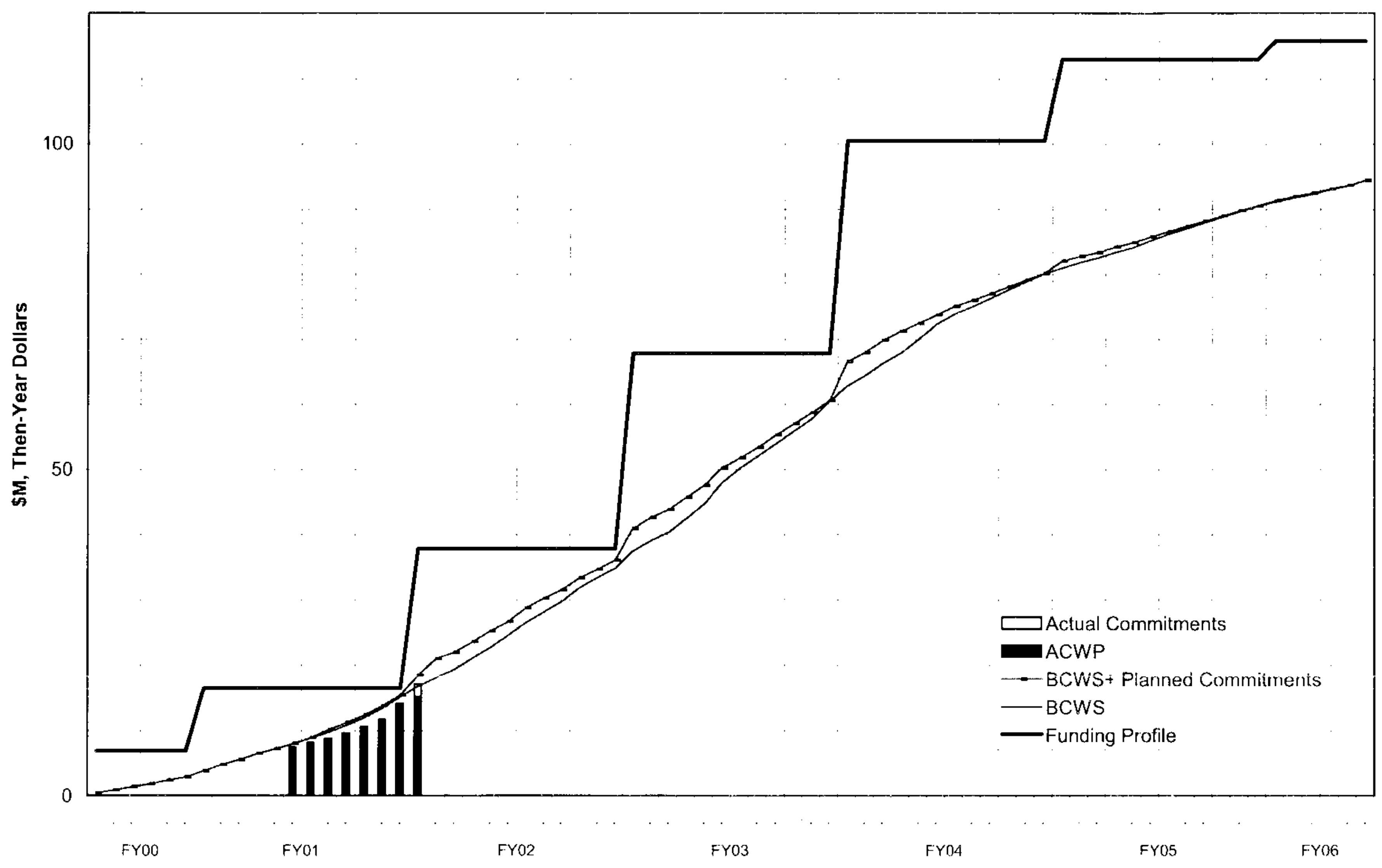


Run Date 12/17/01 10:03	GLAST - LAT PROJECT Project Milestones (Level 1-2)	Sheet 1
© Primavera Systems, Inc.		

APPENDIX F

FUNDING TABLE

Budget vs Actuals vs Funding
DOE + NASA Project Expenditures



APPENDIX G

DOE
ACTION ITEMS

ACTION ITEMS

Resulting from the January 8-11, 2002
Department of Energy/NASA
Review of the Large Area Telescope (LAT) Project

	Action	Responsibility	Due Date
1.	Approve Implementing Agreement	DOE/NASA	ASAP
2.	Resolve Cost/Funding Issues	DOE/NASA Joint Oversight Group	February 2002
3.	Notify DOE/NASA when project will be ready for the Delta Baseline/PDR Review	LAT	Feb 2002
4.	Conduct a DOE/NASA Delta Baseline/PDR Review	DOE/NASA & LAT	Prior to April 2002
5.	Conduct a DOE/NASA CDR	DOE/NASA & LAT	September 2002

W. Althouse
LAT Project Manager

D. Lehman
Review Co-Chairman
DOE/NASA

E. Citrin
GLAST Project Manager,
NASA

P. Michelson
LAT Principal Investigator

D. Betz
Review Co-Chairman
NASA/GSFC

S. Horowitz
Program Executive
Astronomy and Physics Div
NASA

J. Dorfan
SLAC Director

K. Turner
Program Manager
Div of High Energy
Physics, DOE

D. Kniffen
GLAST Program Scientist
Astronomy and Physics Div
NASA

E. Valle
Federal Project Manager
SLAC Site Office

APPENDIX H

NASA
REQUESTS FOR ACTION

GLAST PDR RFAs: January 8-11, 2002

RFA #	Subject Area	Originator	Phone #	Organization	Specific Request	Supporting Rational	Status
1	Science	Steven S. Scott	301 286-2529	NASA/GSFC/Code 500	Provide a list of the Minimum Science Mission Requirements and a copy of the descope plan. A copy of the science requirements document and descope plan from the proposal would be sufficient if they are still relevant.	No presentation of the current baseline versus the minimum mission was provided. No descope plan was provided. Descoping by omitting towers gets harder as the project proceeds. It is not clear how much "margin" exists for meeting the minimum science mission requirements	Open
2	Systems Engineering	Steven S. Scott	301 286-2529	NASA/GSFC/Code 500	Provide a copy of the Requirements Verification Traceability Plan. A plan for developing it would be sufficient for PDR	No integrated RVTM currently exists. Requirements and their method of verification are spread across subsystem performance specifications.	Open
3	Systems Engineering	Steven S. Scott	301 286-2529	NASA/GSFC/Code 500	Provide a copy of the current Risk List. (that is, a full summary of LAT risks to date, open and retired) and the plan for updating it and actively using it on the project.	The continuous risk management system has not been implemented for the LAT.	Open
4	Systems Engineering	Steven S. Scott	301 286-2529	NASA/GSFC/Code 500	Provide a list of key LAT technical budgets that are monitored regularly or will be (e.g. , mass power, thermal, processing and memory resources, alignments, etc.)	Currently only mass and power budgets are tracked and managed.	Open

5	Systems Engineering	Steven S. Scott	301 286-2529	NASA/GSFC/Code 500	Provide a list of all trade studies cutting across subsystems.	This is systems engineering's responsibility and was not covered in the review Trade studies should be completed before CDR.	Open
6	Systems Engineering	Steven S. Scott	301 286-2529	NASA/GSFC/Code 500	Provide a list of spacecraft requirements and constraints derived from the unique instrument requirements. Provide a list of the instrument requirements and constraints derived from using an RSDO spacecraft bus for the GLAST Mission. If the IRD captures this, providing the final IRD will suffice.	It is not clear that all the potential liens against the instrument and spacecraft designs have been identified.	Open
7	Systems Engineering	Steven S. Scott	301 286-2529	NASA/GSFC/Code 500	Provide a status of technical drawings and provide the plan for how they will be tracked.	This information was not provided in the review. A system for tracking drawing status (and its effect on schedule) has not been developed.	Open
8	Systems Engineering	Steven S. Scott	301 286-2529	NASA/GSFC/Code 500	Provide a list of RFAs (Action Items) from the subsystem and system engineering Peer Reviews and their closure		Open
9	Systems Engineering	Steven S. Scott	301 286-2529	NASA/GSFC/Code 500	Provide a list of all cables and harnesses and who is responsible for designing and fabricating them.	This information not provided in review. Shown as systems responsibility in Project Management Plan	

10	Systems Engineering & Product Assurance	Steven S. Scott	301 286-2529	NASA/GSFC/Code 500	Describe the (expected) transition of LAT configuration Management and Problem Reporting and Corrective Action process from instrument I & T to observatory I & T and from observatory I & T to operations.	This could be provided in an updated CM plan if it is not currently addressed there. Otherwise, may be an area of disagreement between the instrument and spacecraft.	Open
11	Systems Engineering & Testing	Steven S. Scott	301 286-2529	NASA/GSFC/Code 500	Provide descriptions of the LAT Comprehensive Performance Test (CPT) Limited Performance Test (LPT) and Aliveness Test and determine where they will be conducted in the instrument I & T flow and in the observatory I & T flow.	Neither the test flow nor the schedule for I & T is credible without having some idea about the nature of these tests. It is not clear the Aliveness Test or the LPT will be adequate for determining continuing performance of the instrument for where they are indicated in the flow.	Open

12	Systems Engineering & Testing	Steven S. Scott	301 286-2529	NASA/GSFC/Code 500	Describe the LAT internal alignment tests and where they will be conducted in the instrument test flow. Describe the LAT instrument to spacecraft alignment requirements and how they will be measured and verified during observatory I & T flow. Determine whether an alignment test needs to be performed between LAT dynamics and thermal vacuum testing. Determine whether a LAT to spacecraft alignment test needs to be performed between observatory dynamics and T/V testing. This could be summarized in the Alignment Plan/Procedures.	The alignment tests are known but not documented. It is not clear where alignment tests need to and will be performed.	Open
13	Systems Engineering	Steven S. Scott	301 286-2529	NASA/GSFC/Code 500	Provide a list of the time accuracy requirements allocated to and affecting the LAT instrument and Instrument Operations Center. Describe the instrument, observatory, and mission time management approach and how it can be verified.	Systems Engineering should be tracking the time accuracy and time error budgets. The time accuracy allocations to various system elements should be clearly defined.	Open
14	Systems Engineering & Reliability	Steven S. Scott	301 286-2529	NASA/GSFC/Code 500	Describe how levels of redundancy were determined. Describe the influence FMEA's have had on the design.	It is not clear that all units are being designed for a five year mission life.	Open

15	Systems Engineering	Steven S. Scott	301 286-2529	NASA/GSFC/Code 500	Develop/provide a Logistics Support Plan and a list of all expected spares for the LAT instrument, ground support equipment, and instrument operations center.	There are spares in various subsystems, but the spares philosophies differ. This has not been examined from a systems level (i.e., across the instrument).	Open
16	Software	Steven S. Scott	301 286-2529	NASA/GSFC/Code 500	Perform a formal qualification test (Acceptance Test) of the flight software prior to delivery to I & T to show the software meets all its requirements and functions correctly.	To much time will be spent in I & T debugging code, otherwise. See recommendation 7 from the PDR Systems Engineering Report.	Open
17	Product Assurance	Steven S. Scott	301 286-2529	NASA/GSFC/Code 500	Describe the metrology program that will be used to ensure that equipment used in assembly and testing will measure and assemble correctly. For example, how does an assembler know that the tools and equipment being used are calibrated?	This is a normal part of a PA program, but it is not clear what is being done for the LAT	Open
18	Software	Steven S. Scott	301 286-2529	NASA/GSFC/Code 500	Conduct software peer reviews. I suggest the following as a minimum: Software Requirements Review, Software Preliminary Design Review, Software Critical Design Review, Software Test Readiness Review (per build), Software Acceptance Review, and Operations Readiness Review.	Software was presented for a few minutes under the Electronics Subsystem. With 300,000 SLOC estimated this is a major flight software development effort. Software has not been thoroughly reviewed and it is not clear that a disciplined, formal, systematic software development process is being followed.	Open

19	Software	Steven S. Scott	301 286-2529	NASA/GSFC/Code 500	Provide a copy of the GLAST LAT Software Requirements specification, an item which should be fairly mature at PDR	The SRS is not released. It is not clear all the software requirements are captured and understood. The software development will be ad hoc and unlikely to function correctly without clear and stable requirements.	Open
20	Software	Steven S. Scott	301 286-2529	NASA/GSFC/Code 500	Describe the role, if any, of the NASA Independent Verification and Validation (IV & V) facility in the LAT software development, verification, and validation program.	Every GSFC program needs to define this.	Open
21	EGSE	Steven S. Scott	301 286-2529	NASA/GSFC/Code 500	Describe how the Electrical Ground Support Equipment (EGSE) hardware and software will be verified and validated.	The EGSE will be used to determine the correct functioning and performance of the LAT Instrument.	Open
22	Software	Steven S. Scott	301 286-2529	NASA/GSFC/Code 500	Describe the software maintenance approach from delivery of the instrument to observatory level I & T through launch plus 5 years.	The software team has not developed an approach to software maintenance beyond instrument delivery to I & T.	Open
23	Systems Engineering	Steven S. Scott	301 286-2529	NASA/GSFC/Code 500	Conduct a peer review of the cabling and harnessing.	This area has not been peer reviewed and could slip through the cracks, affecting numerous other subsystems.	Open

24	EMI/EMC	Cliff Jackson	301 286-6862	NASA/GSFC/Code 556	EMI/EMC acceptance testing needs to be performed on all flight boxes, not just the qualification unit (which receives qualification level EMI/EMC testing). This needs to be included in the verification plans.	EMI/EMC workmanship problems could occur on the flight units and not be caught.	Open
25	Systems Engineering	Cliff Jackson	301 286-6862	NASA/GSFC/Code 556	Re-examine the operational and survival temperature limits prior to the start of the component qualification testing. Consider whether it is feasible to establish survival limits that are 15 degrees C beyond normal operational ranges. This will assure that operational performance 10 degrees C beyond the normal operational range can be verified without significant risk of exceeding survival limits.	Current temperature limits would require testing at or beyond survival limits if a 10 degree margin is applied to the operational limits.	Open
26	Systems Engineering	Cliff Jackson	301 286-6862	NASA/GSFC/Code 556	Finalize, sign-off, and begin implementation of the Systems Engineering Management Plan (SEMP). It calls for the validation of requirements allocation when the SS requirements documents are signed-off, and also specifies the technical parameters that will be tracked and reported on (via trending and/or budgets/margins) during the life of the project.	The SEMP seems well thought out, and its finalization, sign-off and implementation will reduce project risk and address many of the systems engineering related questions that were raised during the review.	Open

27	Thermal	D. Hewitt/T. McCarthy	301 286-5115	NASA/GSFC/Code 545	Pursue a system solution to the thermal design needed for the radiator repackaging effort. Insure system margin is provided via heat rejection capability (margin of 20%) and by the consideration of margin to be added to temperature predictions for modeling uncertainties. The system solution should strive to return to single radiators on the +/- sides of LAT using 5.4 m^2 by: a) Expanding the max EOL temperature level of stack detectors, b) Reducing the specified instrument max power level, c) Incorporating realistic solar array transient temperature profiles into analysis, and d) Increasing the survival heater allocation. The system solution should also strive for simplicity and testability, especially at the LAT T/V and TB level. The system solution should	The PDR TCS did not meet requirements. The radiator repackaging design presented in a splinter meeting appears unacceptably complex.	Open
28	Thermal	D. Hewitt/T. McCarthy	301 286-5115	NASA/GSFC/Code 545	Factor in the long thermal time constant into planning for LAT TV and TB as well as observatory thermal testing at RSDO S/C vendor. This may mean that more cycles are needed at the component/subsystem level (e.g. , tracker stacks that now only get 6 cycles).	The large mass of LAT and its MLI will require special planning and test configurations to overcome the excessive times for cycling LAT between temperature profiles.	Open

29	Thermal	D. Hewitt/T. McCarthy	301 286-5115	NASA/GSFC/Code 545	Pursue with the GLAST Project whether funding can be found to fabricate the radiators on the original schedule (rather than a 1 year slip apparently mandated by the funding profile)	This is a programmatic risk that should be avoided if possible	Open
30	Thermal	D. Hewitt/T. McCarthy	301 286-5115	NASA/GSFC/Code 545	Consider second sourcing thermal control components, such as VCHPs and CCHPs, due to the LM facility relocation to Mississippi.	Not clear whether acceptable product production will be in place for LAT component deliveries. This is a risk.	Open
31	Thermal	D. Hewitt/T. McCarthy	301 286-5115	NASA/GSFC/Code 545	Provide a matrix that shows TCS qualification and acceptance testing from component to subsystem to all-up LAT testing. Include mechanical and thermal environments	Radiator repackaging will effect verification plans. The TCS needs to be qualified and acceptance tested before delivery to the S/C vendor.	**Open**
32	Thermal	D. Hewitt/T. McCarthy	301 286-5115	NASA/GSFC/Code 545	Review individual box temperature requirements to ensure these limits are based on box capability not on the TCS capability.	The results of the review demonstrated that box temperature limits were being set by the capability of the TCS versus designing a TCS to use the allowable limits of the boxes, i.e. electronics boxes limits at 15 degrees C versus its capability of 40 degrees C	**Open**
33	Thermal	D. Hewitt/T. McCarthy	301 286-5115	NASA/GSFC/Code 545	Conduct a delta mechanical/thermal PDR to present technical. cost and schedule impacts of the thermal changes necessary to meet requirements with margin	The PDR design did not meet requirements and did not factor in the impacts of moving the radiators outboard and/or additional heat pipes.	**Open**

34	Thermal	D. Hewitt/T. McCarthy	301 286-5115	NASA/GSFC/Code 545	Investigate using thermal coatings with higher emmisivity for the radiator such as 10 mil AgTef or white paint.	Presented radiator coating was 5 mil AgTef. Higher emmisivity coatings will increase net heat rejection of radiators.	**Open**
35	Thermal	D. Hewitt/T. McCarthy	301 286-5115	NASA/GSFC/Code 545	Perform a thermal vacuum cycle test on the Flight Grid Assembly with grid heat pipes installed to verify workmanship.	Test flow shows a T/V test on Flight Grid only. Cycling the grid with the bonded heat pipes assembled to it is critical to verify the integrity of the thermal joints.	**Open**
36	Thermal	D. Hewitt/T. McCarthy	301 286-5115	NASA/GSFC/Code 545	Define who will control the LAT survival heaters, the S/C or the instrument.	This item does not seem to be clearly defined.	Open
37	Thermal	D. Hewitt/T. McCarthy	301 286-5115	NASA/GSFC/Code 545	Provide a summary matrix showing candidate interface materials to be used in the thermal design. This should show location and advantage/disadvantage of each	Thermal interface materials were discussed generically (wet versus dry thermal joints). However, these materials can have other significant system impacts in terms of outgassing, electrical conductivity, permanence, ease of removal, etc.	Open
38	Thermal	D. Hewitt/T. McCarthy	301 286-5115	NASA/GSFC/Code 545	Define the blanket equivalent sink temperatures for the XLAT panel (facing the S/C) and the backside of the radiators. Ensure that these boundaries are reasonably assessed for the worst case hat and cold design cases.	These S/C boundary conditions were not discussed	Open
39	Thermal	D. Hewitt/T. McCarthy	301 286-5115	NASA/GSFC/Code 545	Develop the thermal control system risks and risk mitigation list. Implement management of this list.	No process for risk mitigation was presented.	Open

40	Thermal	D. Hewitt/T. McCarthy	301 286-5115	NASA/GSFC/Code 545	Perform a high beta angle analysis to ensure the selected PDR analysis worst case hot/cold cases properly envelope all orbital scenarios. Also analyze "rocking" sky survey modes.	Results presented did not include any analysis for high Beta angles or rocking sky surveys.	Open
41	Thermal	D. Hewitt/T. McCarthy	301 286-5115	NASA/GSFC/Code 545	How will the risks of freezing and thawing the VCHP/CCHP ammonia be mitigated. Identify freezing and thawing scenarios. Identify operational limitations.	Temperature results presented show ammonia in heat pipes will freeze under certain on-orbit conditions. Improper thawing of either a CCHP or VCHP could cause	Open
42	Thermal	D. Hewitt/T. McCarthy	301 286-5115	NASA/GSFC/Code 545	Evaluate the sensitivity of the tracker tray temperature with respect to the thermal interface gasket. Verify heat transfer coefficient in T/V cycling.	The main heat transfer path for the tracker tray stack of electronics is across an interface that is mechanically decoupled, but thermally connected to the grid. The integrity of this joint is critical to the thermal design.	Open
43	Mechanical	Jim Ryan	301 286-4975	NASA/GSFC/Code 543	Provide an initial, top-level estimate of the cost/schedule impact of replacing a tracker tower after complete instrument assembly	A concern exists over the extensive disassembly of the LAT that would be required if a tracker tower had to be replaced. Nearly all major structural interfaces would have to be broken to remove a tower.	Open

44	Mechanical	Jim Ryan	301 286-4975	NASA/GSFC/Code 543	All LAT Instrument designs incorporating composite joints should have these designs tested for joint allowables. In some cases, testing was already planned.	Composite joint strengths should be tested to determine more accurately the joint strengths so that more realistic joint safety margins can be determined. Of particular concern are the composite panels that preliminary design shows will be bolted to the sides of the tracker towers with flat head screws. Also, the calorimeter structure which houses all of the Cel logs should be tested for joint allowables. Upon completion of testing, test reports should be provided for review	Open
45	Mechanical	Jim Ryan	301 286-4975	NASA/GSFC/Code 543	LAT Instrument and subsystems should be procuring fasteners in accordance with GSFC Fastener Integrity Requirements, 541-PG-8072.1.2	This document defines fastener integrity requirements for all fasteners used in flight hardware and for critical nuts and bolts used on GSE, including all flight hardware/GSE interfaces	Open

46	Mechanical	Jim Ryan	301 286-4975	NASA/GSFC/Code 543	Re-examine all primary structure and alignment sensitive interfaces for LAT Instrument and provide positive shear restraint, if possible, at these critical interfaces. Also, ensure that locking features have been incorporated into bolted joint designs.	Carrying shear loads through bolted interfaces via friction and fastener preload is not preferred for flight hardware. Incorporating positive shear restraints (shear pins, close tolerance shoulder bolts, rivets, etc.) where possible, is a better approach. All fasteners should have locking features that inhibit loss of pre-load due to vibration environment.	Open
47	Mechanical	Jim Ryan	301 286-4975	NASA/GSFC/Code 543	Provide the sine test philosophy for the LAT instrument/subsystems.	It is well known that the Delta launch vehicle imparts a significant sine input to it's payload. From the presentation, it was not clear if the LAT instrument is to be subjected to sine sweep testing. Several charts that were presented provided contradictory information on this. Also, some subsystems were planning sine sweep tests and others were not. A consistent test philosophy should be adopted that will adequately sine test the LAT instrument/subsystems.	Open

48	Mechanical	Jim Ryan	301 286-4975	NASA/GSFC/Code 543	Generate a comprehensive strength qualification plan for the LAT Instrument.	There is no instrument level strength test planned. A comprehensive document defining the strength qualification plans will ensure that all interfaces and subsystems will be adequately strength qualified.	Open
49	Systems Engineering and Schedule	Dave Betz	301 286-8337	NASA/GSFC/Code 301	Provide an overall flow diagram which delineates, to the PCB or component level, what major organization (SLAC, NRL, International partner, GSFC) is responsible for the development, test and qualification. Include where and when the delivery occurs. Include integration and test at the next level of assembly. Please provide this information as a chronological flow rather than a tabular presentation. Include all software development, test, qualification and deliveries.	This will provide a valuable tool to assess the slack in your schedule. It also provides an understanding of transportation requirements and associated risks.	Open
50	Electrical	Fred Huegel	301-286-2285	NASA/GSFC/Code 560	Work with GSFC parts branch to study the feasibility of qualifying polyswitches for use in the tracker electronics	A short circuit in any area of the tracker can bring down the entire stack. Fuses can not be used due to space limitations	Open

51	Electrical	Fred Huegel	301-286-2286	NASA/GSFC/Code 561	Ensure that flight tantalum caps receive 100% surge current testing and conservative derating to provide for maximum protection against short circuit failures in the tracker electronics	A large number of tantalum capacitors are used in the tracker electronics. A short in any of them can bring down an entire tracker stack	Open
52	Electrical	Fred Huegel	301-286-2287	NASA/GSFC/Code 562	Review the schedule and budget for the power supply development to ensure adequate resources have been identified.	The recent reassignment of power supply development responsibilities from Freance to SWRI	Open
53	Electrical	Fred Huegel	301-286-2288	NASA/GSFC/Code 563	LAT parts engineer should verify that the use of the optocouplers in the SWRI power supplies falls within GSFC approved guidelines	Recent on orbit problems have surfaced with optocouplers	Open
54	Electrical	Fred Huegel	301-286-2289	NASA/GSFC/Code 564	Continue to investigate backup options fro the RAD750. Evaluate schedule, cost and technical impacts of candidate backups	No Flight RAD750 processors have been delivered as of yet and the development is behind schedule	Open
55	Electrical	Fred Huegel	301-286-2290	NASA/GSFC/Code 565	Review the schedule for the burn-in and screening of the flight ASICS.	The time currently allotted appears to be a minimum. There are almost 20,000 ASICS used in the LAT.	Open
56	Electrical	Fred Huegel	301-286-2291	NASA/GSFC/Code 566	Correct the discrepancies in the ACD flight ASIC schedules	Discrepencies were noted in the ACD Flight ASIC development schedule presented at the CDR.	Open

57	Electrical	Fred Huegel	301-286-2292	NASA/GSFC/Code 567	Re-evaluate the need for additional resources in the flight software development area	Based on the upper level estimate of 300K lines of code for the flight software and the current support level of 5.5 FTEs it appears that the development pace will be comparable to the intensive effort on the balloon flight. With the added testing requirements for flight software the schedule could be verv difficult to meet.	Open