 GLAST LAT PROJECT MANAGEMENT PLAN	Document # **LAT-MD-00067-01**	Date Effective 2nd Draft 3/5/00
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	Subsystem/Office System Engineering	
Document Title **LAT Risk Management Plan**		

Gamma-ray Large Area Space Telescope

(GLAST)

Large Area Telescope (LAT)

Risk Management Plan

CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes	DCN #
1		Initial Release	LAT-CN-000xx

CONTENTS

1 PURPOSE

This document describes the risk management plan for the GLAST Large Area Telescope (LAT) Project.

2 SCOPE

This document describes the risk management process for the GLAST LAT project and assigns responsibility for carrying out the activities. These activities are applicable to the development, integration and test of the LAT science instrument and the instrument operations center.

3 APPLICABLE DOCUMENTS

NPG 7120.5A, NASA Program and Project Management Processes and Requirements

GSFC 433-MAR-0001, Mission Assurance Requirements (MAR) for Gamma-Ray Large Area Space Telescope (GLAST) Large Area Telescope (LAT)"

LAT-MD-00039, Performance Assurance Implementation Plan

4 POLICY

The LAT project will:

1. Plan and implement a disciplined approach to risk management throughout the project life cycle,
2. Support management decision making by providing integrated risk assessments,
3. Communicate risk status to all project and appropriate NASA management personnel.

5 OVERVIEW

Risk is defined as the likelihood of an undesirable event occurring and the severity of the consequences of the occurrence.

The function of the LAT risk management program is to:

1. Identify the potential sources of risk and identify risk drivers.
2. Quantify risks and assess their impacts on cost, schedule and performance.
3. Determine the sensitivity of these risks to program, product and process assumptions, and the degree of correlation among the risks.
4. Determine and evaluate alternative approaches to mitigate moderate and high risks.
5. Take actions to avoid, control, assume or transfer each risk, and
6. Ensure that risk is factored into decisions on selection of specification requirements and solution alternatives.

The LAT risk management program will achieve cost effectiveness in its risk management approach by comprehensively identifying the risks; rapidly assessing those risks to specify which of them require the expenditure of project resources; taking early actions to mitigate the risks, and iterating the process frequently to be responsive to the dynamic internal and external environments.

6 RISK MANAGEMENT PROCESS AND RESPONSIBILITIES

The risk management process consists of four overlapping (as appropriate) stages: (1) risk planning, (2) risk identification and characterization, (3) risk analysis, and (4) risk mitigation and tracking.

6.1 RISK PLANNING

Risk Planning is the process of defining the project's overall risk policy and objectives; defining the responsibilities, resources, schedules and documentation required for risk management activities; defining the tools and techniques that will be used for risk identification and characterization, risk analysis and risk mitigation; and defining the relationship of the risk management activities with respect to systems analysis, configuration control, reviews, etc.

The overall risk planning activity will be the responsibility of the Instrument System Engineer. The individual Subsysystem Managers will be responsible for those portions of the risk management activity that are required internal to their subsystem developments in support of the project level plan.

The results of the risk planning process are documented in this Risk Management Plan.

A listing of the risk management activities, their scheduled occurrence, and their products is shown in Table 1, Risk Management Activities and Timing. A Gant schedule of these activities is shown in Figure 1, Risk Management Schedule.

A flow diagram of the risk management process is shown in Figure 2, Risk Management Process Flow Chart. Descriptions of the activities and products are contained in the following paragraphs.

6.2 RISK IDENTIFICATION

Risk Identification is the process of understanding what uncertainties the project faces, and which ones require greater management attention and mitigation resources.

Risks are classified in the broad areas of cost risk, schedule risk, technical risk, supportability risk, and programmatic risk.

Technical risk is the possibility that a technical requirement of the system may not be achieved in the system life cycle. Examples of technical risks include the failure to meet performance requirements, the failure to meet operability requirements, the failure to meet testability / verification requirements, and the failure to meet integration requirements.

Supportability risk is the possibility that a supportability requirement of the system may not be achieved in the system life cycle. Supportability risks include failure to meet operability or availability requirements due to operations support equipment and workforce considerations.

Cost risk is the possibility that the available budget will be exceeded. Cost risks include the possibility that additional resources will have to be expended to solve technical, schedule or programmatic problems.

Schedule risk is the possibility that the development program will fail to meet scheduled milestones. Schedule risks include the possibility that difficulty will be experienced in achieving scheduled technical accomplishments, or that procurement, fabrication and / or integration and test durations will be exceeded.

Programmatic risk is the possibility of events which are detrimental to the system development but which are beyond the control of the project manager.

The LAT Project will perform Risk Identification utilizing (1) Project Team Assessments, (2) Expert Interviews (as required), (3) Lessons Learned, and (4) FMECA / FMEA / Fault Trees. The Project Team Assessments will be input on the LAT Risk Appraisal Form (see Appendix A, item Al). Other risk input vehicles are TBD.

The inputs from these sources will be consolidated by the Instrument System Engineer and presented to the Project's Risk Review Board for disposition. The Project Risk Review Board will consist of the Project Manager, the Principal Investigator, the Instrument Scientist, the Instrument Technical Manager, the Instrument System Engineer, the Performance and Safety Assurance Manager and the Project Control Manager. Key advisors to the board are the Instrument Subsystem Managers, the Instrument Operations Manager, the Chief Electronics Engineer and Mechanical Systems Engineer. The dispositioned risks will be maintained in the Risk Identification / Mitigation Database (see Appendix A, item A2).

The scheduled initial release date and update frequency for the Risk Identification Database utilizing these inputs is shown in Table 1, "Risk Management Activities and Timing."

6.3 RISK ANALYSIS

Risk Analysis is the process of quantifying the likelihood of occurrence and the consequences of potential future events, as well as the attendant uncertainties. The project will decide on a case-by-case basis whether risk identification and classification are adequate to support decision making, or whether more quantified risk analysis is required. The specific risk analysis activities available to the LAT project include (1) decision analysis, (2) probabilistic network schedules, (3) probabilistic cost and effectiveness models, and (4) fault trees / event trees. (Reference Figure 2. Risk Management Process Flow Chart and Table 1, Risk Management Activities and Timing.)

6.4 RISK MITIGATION AND TRACKING

Risk Mitigation and Tracking is the process of formulating, selecting and executing strategies designed to economically reduce risk, and monitoring the effectiveness of those strategies.

The activities and schedule for the risk mitigation and tracking process is shown in Table 1, Risk Management Activities and Timing.

The LAT Project will develop risk mitigation strategies based upon the risk data contained in the risk identification database. These risk mitigation strategies will be reviewed by the Risk

Review Board, and the approved strategies, and watch lists, milestones and contingency planning developed from them will be documented in the Risk Identification /Mitigation Database (see Appendix A, item A2).

The LAT Project will develop a set of performance metrics that will be used to monitor the programmatic and technical performance of the project. In the area of programmatic performance, the project has implemented a Project Management Control System (PMCS) to establish and maintain cost and schedule baselines and to measure actual and forecasted cost and schedule performance. The PMCS is maintained by the Project Controls Manager and is described in the Project Management Plan (LAT-MD-00054).

In the area of technical performance the project will monitor technical performance measures (documented in a set of TPM Charts, see Appendix A item A4) and critical technical resource margins. The Systems Engineering Management Plan (LAT-MD-00066) contains a list of the planned top-level TPM s to be tracked by the LAT Project.

The LAT Project will define a set of critical technical resources that require active margin management. The Risk Review Board will establish required margins for these resources as a function of project life cycle phase (i.e. project milestone occurrence). The Instrument System Engineer will collect appropriate margin data at the project milestones and will report the margin status to the Risk Review Board. The critical resources and the required margins are documented in the Margin Management Matrix (see Appendix A item A5).

The Risk Review Board will monitor the project's technical and programmatic performance, and the effectiveness of the risk mitigation actions being taken. Should corrective action be deemed necessary, the Risk Review Board will make appropriate recommendations to the Project Manager. To support the Risk Review Board, the project will develop a listing of potential descopes that could be used by the project to recover resources, or expand resource margins / reserves. These descopes will be developed by the Instrument System Engineer and presented to the Risk Review Board for disposition. The final dispositions will be ACCEPTED, meaning that the descope will be implemented; AVAILABLE, meaning that the descope is available for implementation should the Risk Review Board determine that such action is prudent and appropriate given the risk posture of the project, PENDING, meaning that the descope is in study or under evaluation, and REJECTED, meaning that the descope is not considered a candidate for implementation because of the severity of the adverse consequences, or the lack of benefit comparable to the adverse consequences. The project descopes and their status will be documented in the Project Descope Listing (see Appendix A, item A3).

Table 1: Risk Management Activities and Timing

Activity	LAT Use	Intitial Release	Update Frequency	Product
Risk Identification				
Project Team Assessments	Y	12/1/00	Quarterly	Risk Identification/Mitigation Database
Expert Interviews	A/R	N/A	N/A	Risk Identification/Mitigation Database
Independent Assessment	N			
Risk Templates	N			
Lessons Learned	Y	12/1/00	Quarterly	Risk Identification/Mitigation Database
FMECA/FMEA/Fault Trees	S	N/A	N/A	Input To Project Office
Risk Analysis				
Decision Analysis	A/R	N/A	N/A	Reports As Required
Expert Interviews	N			
Probalistic Network Schedules	A/R	N/A	N/A	Reports As Required
Probabilistic Cost and Effectiveness Models	A/R	N/A	N/A	Reports As Required
Fault Trees/Event Trees	A/R	N/A	N/A	Reports As Required
Risk Mitigation and Tracking				
Watch Lists/ Milestones	Y	12/1/00	Quarterly	Risk Identification/Mitigation Database
Contingency Planning	Y	12/1/00	Quarterly	Risk Identification/Mitigation Database
Descope Planning	Y	12/1/00	Quarterly	Descope Listing
Parallel Development	N			
Cost/schecule Cost Systems	T	????	Quarterly	Network Schedules
Cost/Schedule Reporting	T	????	Quarterly	Work Accomplishment metric Reports
Technical Performance Measure Tracking	T	????	Quarterly	TPM Charts
Technical Margin Management	T	12/1/00	At Proj. Milestones	Margin Management Matrix
Cost/Schedule Reserves	T	????	Quarterly	Work Accomplishment metric Reports

S=Support to Glast Project Office
A/R=As Required
N/A=Not Applicable

Figure 1: Risk Management Schedule

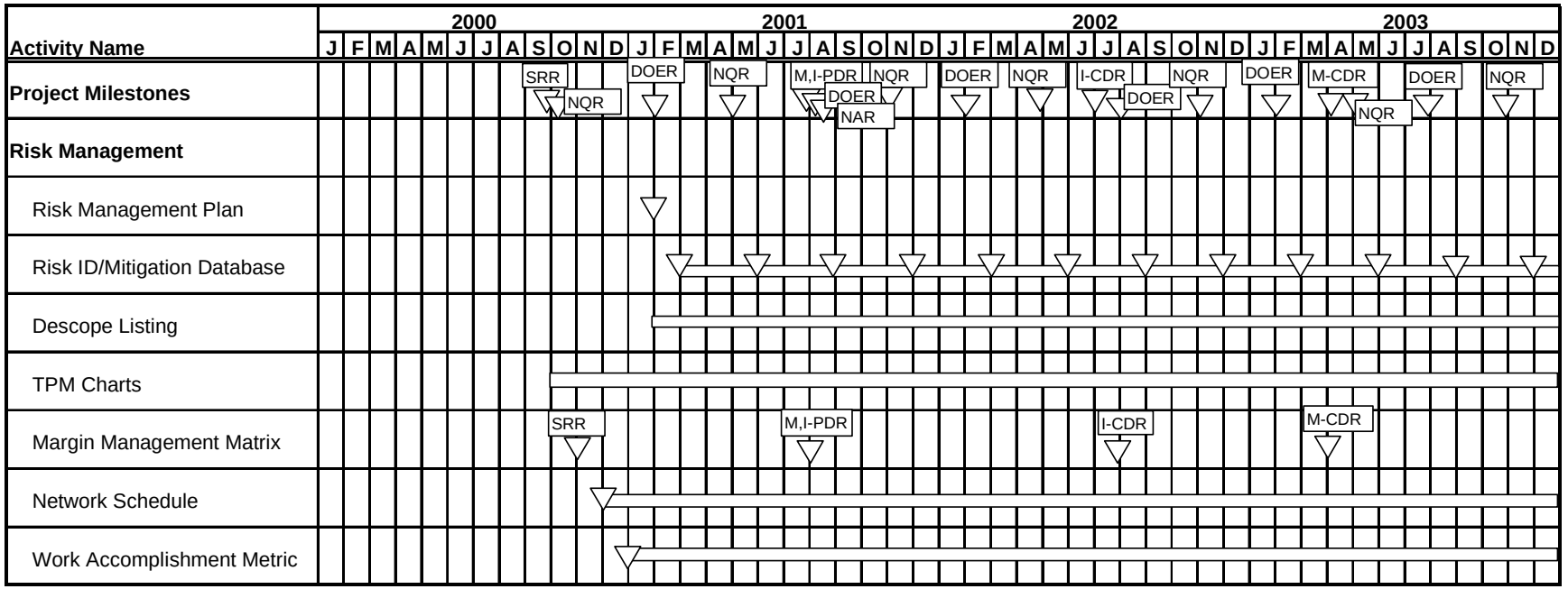
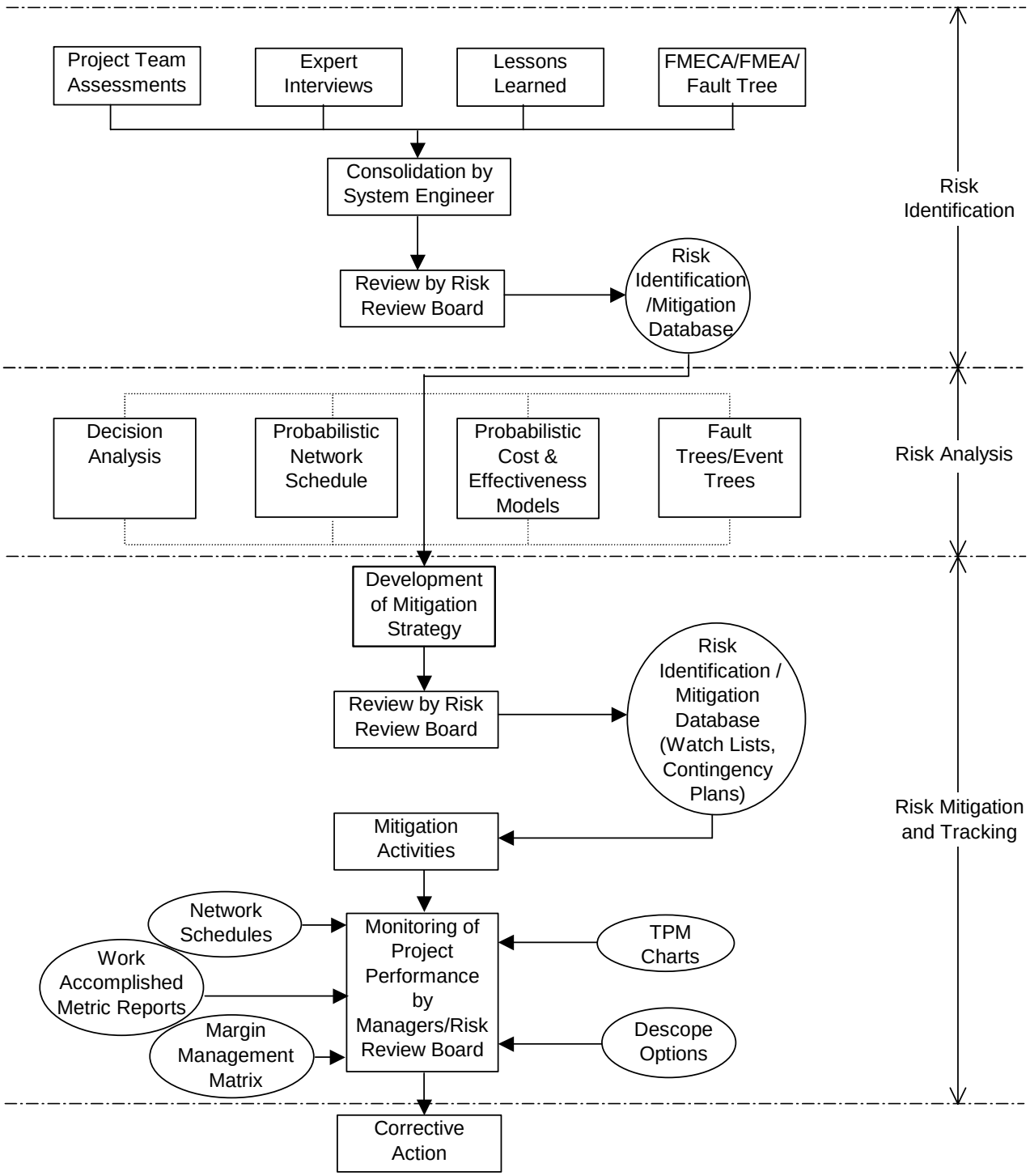


Figure 2: Risk Management Process Flow Chart



Appendix A

A1. Risk Appraisal Form

A2. Risk Identification / Mitigation Database

A3. Project Descope Listing

A4. TPM Charts

A5. Margin Management Matrix

A6. Risk Taxonomy

LAT Risk Appraisal Form

Ref. No. _____ Date:_____

(for project use only)

Risk No.	Probability	Cost Impact	Describe Risk or Source of Risk
1			
2			
3			
4			
5			

Probability (choose one):

10% Low – risk will in all likelihood not occur

30% Medium – risk may occur despite normal care

50% High – risk may occur even with special management

90% Very High – risk is nearly certain to occur

Cost Impact:

Estimate the extra cost to the program if the risk occurs;
express all schedule and technical risk in terms of cost.
Choose a cost impact value only from the following:
$10K, $20K, $50K, $100K, $200K, $500K, $1M, $2M, $5M

LAT Risk Identification / Mitigation Database

Ref No.	Probabilistic Cost ($K)	Probability (%)	Potential Cost ($K)	Date	Risk Description	Mitigation Action Plan / Results

Ref No. – Identification number for reference only

Probabilistic Cost – The probabilistic cost impact of the risk, = Probability x Potential Cost

Probability – Probability that the risk will occur

Potential Cost – Cost impact if the risk occurs

Date – Date that the risk was identified

Risk Description – Narrative description of the risk

Mitigation Action Plan / Results – Project mitigation plan and results achieved

LAT Project Descopes Database

Ref No.	Title	Mass (kg)	Cost ($K)	Decision Date	Action Plan	Status	Description	DISP	PRI

Ref No. – Identification number for reference only

Title – Short descriptive title for the descope

Mass (kg) – Mass savings (-) or increase (+) resulting from the descope

Cost ($K) – Cost savings (-) or increase (+) resulting from the descope

Decision Date – Date by which a decision on implementing the descope is required in order to achieve the indicated resource reductions

Action Plan – Near term plan for action to support a descope disposition

Status – Description of the current status of studies on the descope viability and impacts

Description – Detailed narrative describing the descope

DISP – Disposition. A = Accepted, descope will be or has been implemented; AV = Available, descope is available for implementation; P = Pending, descope is under evaluation; R = Rejected, descope is not considered a candidate for implementation

PRI – Priority as assigned to pending items to indicate the order of evaluative studies. Order is 1 through 3 with 4 = undetermined.

LAT Power TPM

Item	Estimate (Watts)	Reserve (Watts)	%
ACD	29.0	26.0	89.7%
Tracker	219.0	40.0	18.3%
Calorimeter	116.0	16.0	13.8%
Trigger & Data Flow	98.0	44.0	44.9%
Grid/thermal	31.0	20.0	64.5%
Instrument Total	493.0	146.0	29.6%
Inst. + Reserve	639.0		
Instrument Allocation	650.0		
Unalocated Margin	11.0		
% Margin	1.7%		
Margin + Reserve	157.0		
% Margin + Reserve	31.8%		

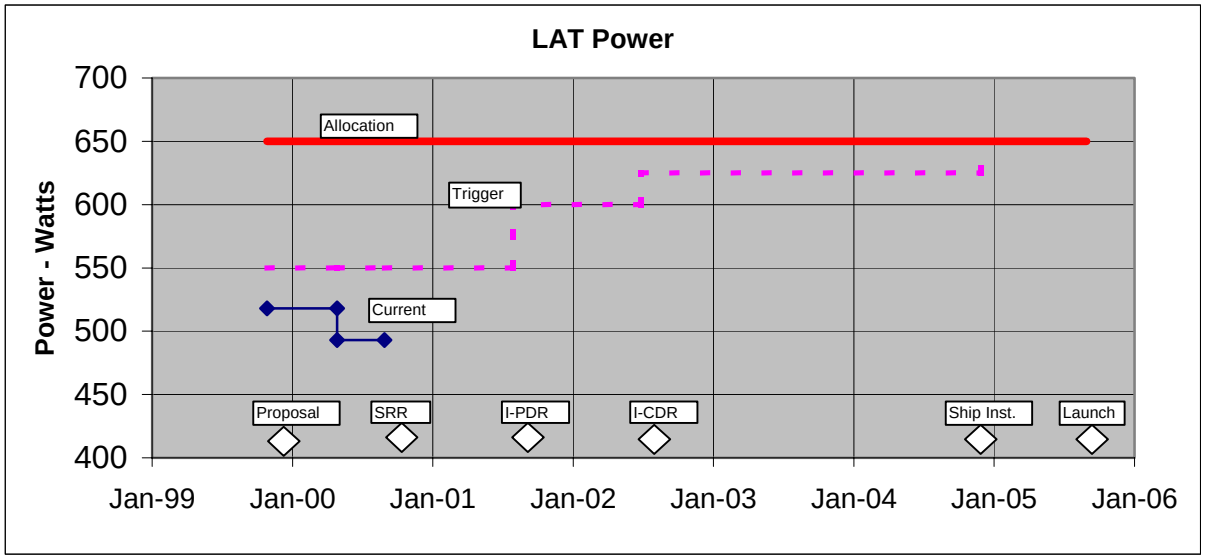
Goals estimated using guidelines given in ANSI/AIAA G-020-1992 "Estimating and Budgeting Weight and Power Contingencies for Space Craft Systems"

Total Instrument Margin plus Reserve at Proposal was 25.5%.

SRR Margin plus Reserve is 31.8%

Goal for PDR Margin plus Reserve > %

Goal for CDR Margin plus Reserve > %



LAT Mass TPM

Item	Estimate (Kg)	Reserve (Kg)	Reserve %
ACD	171.3	52.5	30.7%
Tracker	522.7	104.4	20.0%
Calorimeter	1,483.1	101.8	6.9%
Trigger & Data Flow	180.3	75.2	41.7%
Grid/thermal	216.0	85.5	39.6%
Instrument Total	2,573.3	419.4	16.3%
Inst. + Reserve	2,992.7		
Instrument Allocation	3,000.0		
Unalocated Margin	7.3		
% Margin	0.2%		
Margin + Reserve	426.7		
% Margin + Reserve	16.6%		

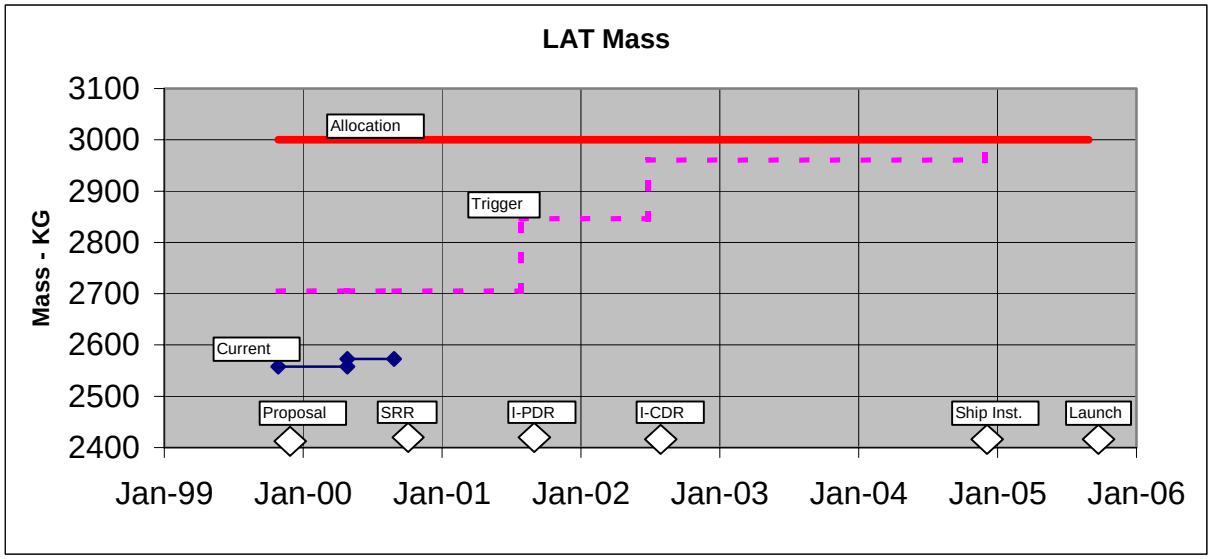
Goals estimated using guidelines given in ANSI/AIAA G-020-1992 "Estimating and Budgeting Weight and Power Contingencies for Space Craft Systems"

Total Instrument Margin plus Reserve at Proposal was 17.2%.

SRR Margin plus Reserve is 16.6%

Goal for PDR Margin plus Reserve > 9.9%

Goal for CDR Margin plus Reserve > 5.4%



LAT Margin Management Matrix

Resource	Allocation	Margin Requirements							
		SRR		PDR		M, I CDR		M CDR	
		Required	Actual	Required	Actual	Required	Actual	Required	Actual

RISK TAXONOMY

This listing is meant to serve as a reminder of potential areas of risk for consideration.

A. Product Engineering

1. Requirements
    a. Unstable
    b. Incomplete
    c. Unclear
    d. Non-verifiable
    e. Infeasible
    f. Unprecedented
    g. Scale

2. Design & Implementation
    a. Difficult
    b. Infeasible
    c. Performance
    d. Untestable
    e. Constraints
    f. Documentation
    g. Development Test

3. Integration and Test
    a. Comp / Assy Test
    b. S/S Integration
    c. S/S Test
    d. System Integration
    e. System Test
    f. Test Facilities

4. Engineering Specialties
    a. Maintainability
    b. Reliability
    c. Safety
    d. Quality Assurance
    e. Config Management
    f. Parts, Materials, Processes
    g. Contamination

B. Development Environment

1. Work Environment
    a. Quality Attitude
    b. Communication

2. Development Process
    a. Informality
    b. Suitability
    c. Design Control
    d. Process Control

3. Development System
    a. Capacity
    b. Suitability
    c. Reliability
    d. System Support

4. Management Process
    a. Planning
    b. Monitoring
    c. Project Organization

C. Program Constraints

1. Resources
    a. Staff
    b. Budget
    c. Schedule
    d. Facilities

2. Externals
    a. External Dependency
    b. Technical Factors
    c. Customer
    d. Vendors
    e. Interfacing Orgs.