CALTECH OPTICAL OBSERVATORIES / NASA JET PROPULSION LABORATORY
PALM-3000 PROJECT

PALM-3000
Project Management Plan (PMP)

CIN #627

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Revision Sheet

Revision No.	Date	Revision Description
0.1	11/7/07	Initial draft of all sections by A. Bouchez and R. Dekany
1.0	11/9/07	Added WBS dictionary, budgets, review guidelines. A. Bouchez.
1.1	11/9/07	Updated budget, including contingency. A. Bouchez

Contents

1 GENERAL INFORMATION

1.1 Purpose

This document is the Project Management Plan for the PALM-3000 adaptive optics system. It describes the management, communications, and risk mitigation functions for the PALM-3000 project.

1.2 Scope

The PMP addresses the following areas:

- Project Scope
- Work Breakdown Structure
- Resource Plan
- Project Schedule
- Risk Management Plan
- Document Control Plan
- Communications Plan

1.3 Acronyms and Abbreviations

AO	Adaptive Optics
BTO	Beam transfer optics (for laser beam transport from Coude to Prime focus)
DPM	Deputy Project Manager
DM	Deformable mirror
ERD	Enclosure Requirements Document
FPRD	Functional and Performance Requirements Document, superseded in P3K by the IRD and subsystem Requirements Documents (e.g. ERD, RRD).
HOWFS	High-order wavefront sensor
IAD	Instrument Architecture Document
IICD	Instrument Interface Control Document
IPT	Integrated Product Team
IRD	Instrument Requirements Document
IRTT	Infrared Tip/tilt Wavefront Sensor
LGS	Laser guide star
LOWFS	Low-order wavefront sensor (for PALM-3000 indicating tip/tilt/focus sensing)
Na	Sodium
NGS	Natural guide star
OSD	Observing Scenarios Document
P3K	PALM-3000
PALAO	The original NGS AO system at Palomar commissioned in December 1999
PALM-3000	The visible light AO upgrade to PALMAO
PALMAO	Upgrades to PALAO, particularly after the April 2003 upgrade
PALM LGS	The laser guide star upgrade to PALMAO
PBS	Product Breakdown Structure
PCP	P3K Commissioning Plan
PM	Project Manager

PS	Project Scientist
PSR	Pre-ship Review
POM	P3K Observer's Manual
RRD	RTC Requirements Document
SDM	System Design Manual
SwRD	Software Requirements Document
SRD	Science Requirements Document
TICD	Telescope Interface Control Document
TT	Tip/tilt
TWFS	Truth wavefront sensor
WBS	Work Breakdown Structure

1.4 Inputs

- P3K Science Requirements Document (SRD, CIN #612), R. Dekany
- P3K Instrument Interface Control Document (IICD, CIN #603), A. Moore
- P3K Observing Scenarios Document (OSD, CIN #623), A. Bouchez

1.5 Related Products

- P3K System Design Manual (SDM); J. Roberts
    - Note: many of the subsystem interfaces will be captured in the SDM, as opposed to a multitudinous collection of subsystem ICD's.
- P3K Observer's Manual (POM); A. Bouchez
- P3K TWiki Pages at: http://www.oir.caltech.edu/twiki_oir/bin/view.cgi/Palomar/Palm3000/WebHome
- P3K Commissioning Plan (PCP); A. Bouchez

1.6 References

- Palomar LGSAO Standard Operating Procedures; R. P. Thicksten, J. Cromer

1.7 Points of Contact

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2 SCOPE MANAGEMENT

2.1 Scope Planning

The PALM-3000 project scope is defined by the science goals described in the Science Requirements Document (SRD), with the significant constraint that this project is an upgrade to the existing facility PALM LGS system. Our approach to scope planning, therefore, is to understand the minimal upgrade work scope that will meet the SRD, while minimizing disruption to the on-going science usage of PALM LGS. Input to this process includes the Observing Scenarios Document (OSD), which details the observational use cases for execution of typical SRD science programs. This work scope will then be organized into a work breakdown structure, based upon an existing product breakdown structure (e.g. the existing instrument), as modified by new PBS elements on the optical bench (such as new wavefront sensors) and new WBS elements specific to PALM-3000 (such as needed observatory infrastructure modifications.) The WBS will be verified by the subsystem Integrated Product Team (IPT) leaders, who have primary responsibility for confirming that all necessary work is captured in the WBS.

2.2 Scope Statement

The PALM-3000 project shall consist of a minimal (10-year lifecycle) cost upgrade of the PALM LGS system to integrate the a new 3,368 actuator DM, along with its supporting high-order wavefront sensor, real-time-computer, and instrument interface modifications to support multiple science instruments. This upgrade shall exploit the potential science benefits on bright NGS and support all PALM functionality in LGS mode. As a goal, PALM-3000 will increase LGS performance for large sky fraction according to the specifications in the IRD. Should higher LGS returns become available, PALM-3000 must have the capability of realizing the potential performance benefits, rivaling NGS performance given sufficient LGS photo-return.

2.2.1 Work Breakdown Structure

Based on the process described above, the top-level work breakdown structure for PALM-3000 has been defined as:

WBS 1	Management
WBS 2	Systems Engineering
WBS 3	Optical Bench
WBS 4	Adaptive Mirrors
WBS 5	Wavefront Sensors
WBS 6	Electronics
WBS 7	Embedded Systems
WBS 8	Operations Systems
WBS 9	Observatory Infrastructure
WBS 10	Laser Guide Star Facility
WBS 11	Commissioning

A WBS dictionary down to WBS level 2 is provided in Appendix A. A fully detailed WBS is provided in Appendix B.

2.2.2 Scope Verification

The formal acceptance of the PALM-300 project scope, its science priorities, instrument requirements, and set of deliverables will be verified at a Project Review to be held on November 12, 2007. All stakeholders, including builders, users, collaborators, and senior management will be invited to this review to be held at the Caltech campus (8:30am-5:30pm, Salvatori Room, 365 S. Mudd building).

2.2.3 Scope Control

Once verified, the project scope, as defined by the WBS, will be placed under control of the project manager and a formal change control process established. This process will be based upon the formal approval of all scope changes by a Change Control Board consisting of the PM, DPM, PS, and the individual IPT Leads. In addition, scope changes resulting in *any* increase in project cost or schedule will require the advice of the Director of Caltech Optical Observatories, as representative of the Caltech Observatory Council.

Formally, the Change Control Process shall follow a standard series of actions:

1. Developing scope changes are discussed by staff and the IPT Leads of the affected work breakdown elements. These conversations should be based upon documented identification of a project variance or actualized technical risk, and be made in the context of several alternate mitigation strategies.
2. IPT Leads, the PM, the DPM, or the PS may initiate a Change Request by written submission to the PM, who is obliged to forward the issue the Change Control Board (CCB) for review.
3. The CCB discusses the Change Request and may undertake a technical study of the proposed change, to be completed within 10 working days.
4. The CCB advises the PM to accept or reject the Change Request.
5. If the Change Request results in project cost or schedule change, the PM shall seek concurrence of the PI and the COO Director.
6. The PM accepts or rejects the Change Request and issues to the full P3k Team a Change Control Notice (CCN) documenting the change.
7. If necessary, the PM revises the schedule or cost estimate to reflect the change in project scope.

3 TIME MANAGEMENT

3.1 Activity Definition and Sequencing

Based upon the initial WBS, the individual IPT Leads will add subsequently revised and expanded levels to the WBS down to the individual activity level. In some cases, where the specific activities cannot be initially predicted (as when the WBS element subsystem requirements are not yet known), the technique of rolling planning will be employed to develop the WBS in more detail as each work package start approaches.

3.2 Resource Estimation

IPT Leads will have primary responsibility for estimating resource requirements for the execution of the work within each of their work breakdown elements. In most cases, the IPT Leads have significant experience with the deployment of the original PALAO system, the PALM LGS upgrade, or both. IPT Leads will consult with staff assigned to the execution of the work to derive resource estimates based upon the experience of the team and our overall understanding of the technical challenge (risk assessment).

3.3 Duration Estimation and Scheduling

The IPT Leads will identify interdependencies of all activities within their work breakdown element. The project manager will then work with the corresponding COO and JPL line managers to negotiate the availability of resources for the execution of the work plan. Based upon the concurrent commitments of staff to other projects, the PM will seek guarantees of availability of staff to P3K for the needed duration of their work packages.

Due to the small scale of the project, overall project sequencing will be performed by the project manager, and reviewed by the DPM, PS, and IPT Leads. The PM will take into account scheduled holidays and expected vacation and sick leave time when leveling the commitment level of all staff. The PM will utilize the critical path method to identify bottlenecks in the execution of the project and to recommend plan changes to maintain overall project schedule.

3.4 Schedule Control

Each IPT Lead will provide the PM with performance reports, which may be informal, detailing schedule performance, including which work packages have been started as schedule, which have been completed as scheduled, or to raise issues requiring management attention in the future.

The schedule change control system will consist of the PM issuing periodic (if not regular) updates to the project schedule, relative to the initial schedule baseline, detailing newly scheduled activities arising from rolling project planning or other schedule modifications. The PM is empowered to issue these changes affecting all work elements contained in the development organizations (COO and JPL), but will seek concurrence from the respective facility or instrument lead for schedule changes effecting infrastructure, instrument I&T, or commissioning activities.

The PM may issue Recommended Corrective Actions to ensure timely completion of scheduled activities and bring future schedule performance in line with the approved schedule baseline. This may include redistribution of work among staff, requests for extended work periods, or scope reductions through the established Change Control Board process.

3.5 Schedule Baseline

The baseline high-level schedule, including key project milestone dates, is shown in Figure 1. Of particular interest are the expected dates of the system-level and subsystem-level reviews, which are listed in Table 4 and Table 3. A fully detailed baseline project schedule is provided Appendix B.

4 COST MANAGEMENT

4.1 Cost Estimation

The PALM-3000 project cost estimate is based primarily on a detailed understanding of the component hardware necessary for the PALM-3000 upgrade and the labor resource estimates developed during the activity resource estimation process described in Section 3.2. The following labor cost bases have been used to generate the cost estimate. They are based on a blended labor rate of all expectd project participants, weighted by their fractional commitment.

- COO Labor $74.50 / work-hour (1808 hours per work-year)
- JPL Labor $80.93 / work-hour (1820 hours per work-year)

Hardware costs are usually based upon firm vendor quotes, but occasionally they rely on engineering judgment. The experience of the P3K team in having developed PALAO and PALM LGS provides significant background for analogous estimation of component costs.

All P3K cost estimates will be provided in FY07 dollars (corresponding to project initiation).

ID	WBS	Task Name	Start	Finish
0	0	P3K WBS v1.3	10/2/06	3/24/11
1	1	Management	11/12/07	11/25/10
2	1.1	Requirements Review	11/12/07	11/12/07
3	1.2	NGS Pre-ship Review	10/15/09	10/15/09
4	1.3	LGS Pre-ship Review	11/25/10	11/25/10
5	2	Systems Engineering	10/2/06	6/22/10
6	2.1	Requirements Definition	10/2/06	10/26/07
7	2.2	Subsystem Requirements & Architecture	11/12/07	4/25/08
8	2.3	System Design Manual & Observers Manual	11/11/09	6/22/10
9	3	Optical Bench	4/27/07	1/19/11
10	3.1	Interim Optical Layout	4/27/07	3/11/08
11	3.1.1	Design Interim Optical Layout	4/27/07	9/5/07
12	3.1.2	AO System Offline for Interim Layout	11/28/07	11/28/07
13	3.1.3	Implement Interim Optical Layout	11/29/07	3/11/08
14	3.2	P3K NGS Optical Layout	5/6/08	1/19/10
15	3.2.1	Design P3K NGS Optical Layout	5/6/08	10/27/08
16	3.2.2	Build P3K NGS Components	10/28/08	8/3/09
17	3.2.3	AO System Offline for P3K NGS Upgrade	10/27/09	10/27/09
18	3.2.4	Implement P3K NGS Upgrade	10/28/09	1/19/10
19	3.3	P3K LGS Optical Layout	10/1/08	1/19/11
20	3.3.1	Design P3K LGS Optical Layout	10/1/08	1/1/09
21	3.3.2	Build P3K LGS Components	2/8/10	8/23/10
22	3.3.3	AO System Offline for P3K LGS Upgrade	12/7/10	12/7/10
23	3.3.4	Implement P3K LGS Upgrade	12/8/10	1/19/11
24	4	Adaptive Mirrors	2/15/08	8/17/09
25	4.1	Design DM3368 Test Equipment	2/15/08	1/19/09
26	4.2	Receive DM3368	8/26/08	8/26/08
27	4.3	DM3368 Acceptance Testing	1/20/09	8/17/09
28	5	Wavefront Sensors	7/9/07	10/13/10
29	5.1	High-Order Wavefront Sensor	7/9/07	8/11/09
30	5.2	Truth Wavefront Sensor	3/20/09	2/1/10
31	5.3	IR Tip/Tilt Wavefront Sensor	10/1/08	10/13/10
32	6	Electronics	7/17/07	8/17/10
33	6.1	P3K NGS Rack & Cabling	11/28/07	7/2/09
34	6.2	P3K LGS Rack & Cabling	4/20/09	8/17/10
35	6.3	Wavefront Processor	7/17/07	3/11/08
36	7	Embedded Systems	11/28/07	6/21/10
37	7.1	NGS Embedded Systems	11/28/07	12/17/09
38	7.2	LGS Embedded Systems	4/30/09	6/21/10
39	8	Operations Systems	11/28/07	8/6/10
40	8.1	NGS Operations Systems	11/28/07	1/15/10
41	8.2	LGS Operations Systems	10/1/09	8/6/10
42	9	Observatory Infrastructure	6/2/08	11/6/09
43	9.1	AO Laboratory	6/2/08	3/6/09
44	9.2	Hale Telescope	9/15/08	11/6/09
45	10	Laser Guide Star Facility	11/16/07	11/23/09
49	11	Commissioning	3/12/08	3/24/11
50	11.1	Interim System Laboratory Integration	3/12/08	4/8/08
51	11.2	PHARO commissioning	4/9/08	4/9/08
52	11.3	SWIFT commissioning	5/10/08	5/10/08
53	11.4	P1640 commissioning	7/8/08	7/8/08
54	11.5	P3K NGS Laboratory Integration	1/20/10	3/26/10
55	11.6	P3K NGS First Light	3/29/10	3/29/10
56	11.7	P3K LGS Laboratory Integration	1/20/11	3/23/11
57	11.8	P3K LGS First Light	3/24/11	3/24/11

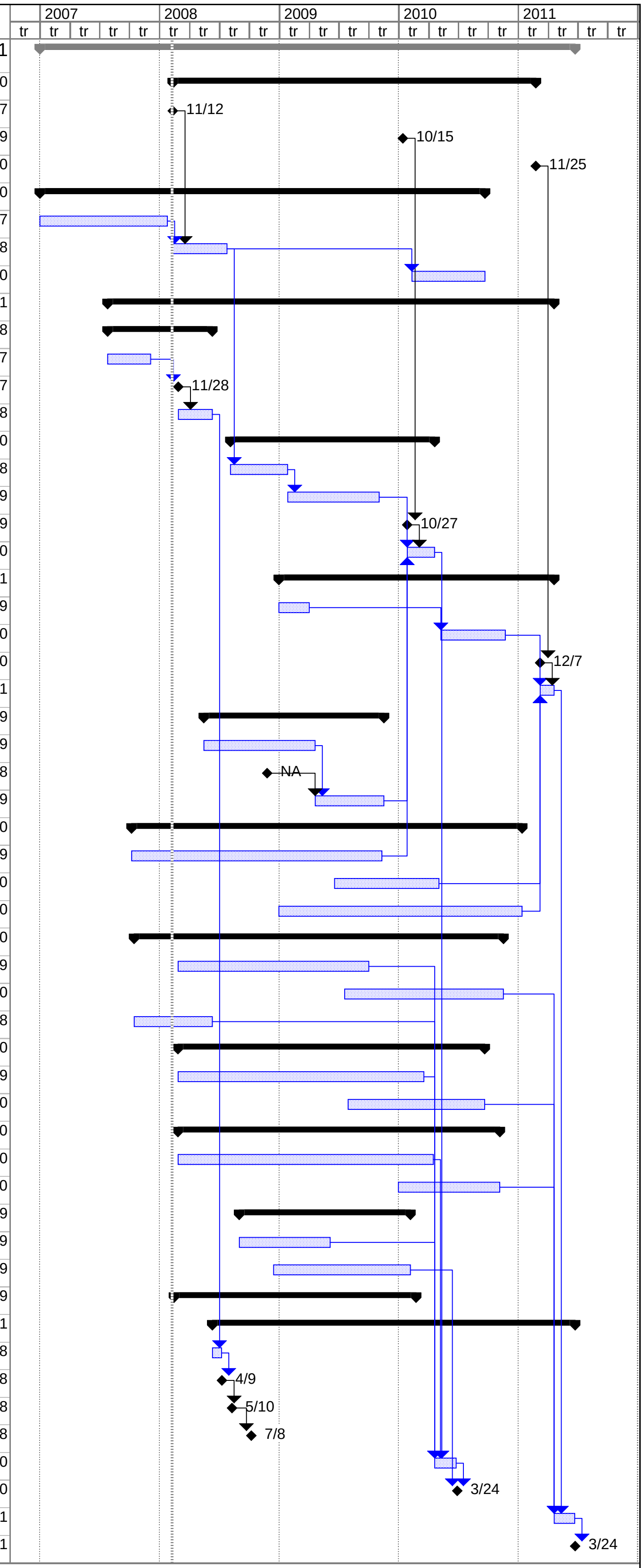


Figure 1: PALM-3000 Baseline Schedule (P3K WBS v1.3), showing only top-level work packages and major milestones.

4.2 Cost Budgeting

The breakdown of projects costs by WBS elements and fiscal year, along with the identified sources of funding, is presented in Table 1. The WBS elements have been combined into four broad categories, against which expenditures will be tracked. Funding sources marked in blue are contingent upon the continuation of the JPL MOU, and funding priorities at COO. A significant shortfall exists in FY09, due to the present lack of identified funds for development of the infrared tip/tilt sensor (IRTT). Our current strategy is to continue to actively seek additional funding for this subsystem and contingencies, while carrying out the NGS PALM-3000 upgrade at the effort level allowed by the available funds.

Project costs by WBS	**FY07**	**FY08**	**FY09**	**FY10**	**FY11**
1-2: Mgmt. & Sys. Eng.	$264,679	$346,793	$338,300	$260,469	$40,222
3-5: Bench, DMs & WFS	$508,383	$723,656	$967,549	$296,821	$47,741
6-8: Software & Electronics	$58,025	$604,342	$598,950	$115,823	$0
9-11: Facility & Commis.	$0	$311,315	$119,230	$159,100	$119,416
Total	**$831,087**	**$1,986,106**	**$2,024,029**	**$832,213**	**$207,379**

Identified Funding Sources					
NSF MRI	$207,057	$492,943	$234,000	$180,000	
JPL MOU	$110,000	$564,784	$580,000	$600,000	
COO		$200,000	$400,000	$200,000	$200,000
Helin Gift	$73,000	$127,000			
DURIP	$43,575	$197,186			
NASA SBIR	$400,000	$400,000			
Total	**$833,632**	**$1,981,913**	**$1,214,000**	**$980,000**	**$200,000**
Shortfall	**$2,545**	**-$4,193**	**-$810,029**	**$147,787**	**-$7,379**
Including 20% contingency		**-$321,414**	**-$1,214,835**	**-$18,656**	**-$48,855**

Table 1: Project costs and identified funding sources ($FY07).

4.3 Cost Control

The PALM-3000 PM will generate, with COO Business Office support, regular financial reports describing performance metrics based upon Earned Value Analysis (TBC). This includes:

- Planned Value (PV) – the budgeted cost for the work scheduled
- Earned Value (EV) – the budgeted amount for work actually performed
- Actual Cost (AC) – the total cost incurred in accomplishing work
- Cost Variance (CV) – Equal to EV – AC
- Schedule Variance (SV) – Equal to EV – PV
- Cost Performance Index (CPI) – Equal to EV/AC
- Schedule Performance Index (SPI) – Equal to EV/PV

These metrics will be tracked from inception to date, though they may also be analyzed on a period basis (particularly AC, EV, CV, and CPI).

Analysis of project performance may result in a Change Request to change some aspect of the project through the standard Change Control Board process when project scope is affected, or in lesser Recommended Corrective Actions for scope neutral changes such as redistribution of activity budgets.

4.4 Major Procurements

PALM-3000 is a capital intensive project, requiring significant project resources expenditures on major hardware components. The major procurements, organized by delivery date, are described in Table 2.

Component	Vendor	Cost ($FY07)	Delivery Date	Risk / Mitigation
DM3368	Xinetics, Inc.	$800,000 including electronics	Expected Aug 2008	This is a single point failure risk for the project. No practical alternative is known matching our optical requirements (pupil size), nor does the project carry any contingency capable to developing alternative mirrors. Risk is mitigated by written specification of mirror requirements and frequent contact with the vendor (the development contract monitor is on the P3K team.)
IR Tip/Tilt Sensor (IRTT)	Custom development with COO based on Teledyne H2RG Detector	Est. $760,000 including $300,000 for the Teledyne array	Teledyne array in hand	Use of the H2RG array in a rapid region-of-interest (ROI) readout is a new application of this device for adaptive optics. Failure to meet IRTT performance goals will reduce performance for certain, high sky fraction science cases.
HOWFS CCD Camera	SciMeasure Analytical Systems, Inc. based upon E2V, Inc. 128x128 pixel CCD50 detector	$80,000 including custom timing control board for LGS synchronization	Delivered Aug 2007	This camera appears functional, but characterization of its fundamental properties (quantum efficiency, dart current, etc.) will not be initiated until 2009 due to limited personnel resources.
Truth WFS (TWFS) CCD Camera	Custom development using SciMeasure CCD39-based detector	$40,000	In hand	This camera will be a previously characterized CCD from the Palomar Tomograph project (R. Dekany, PI). Low risk.
Star Selection Mirrors (SSM's)	TBD	Est. $40,000 hardware cost	TBD	P3K IRD requires the replacement of the current PALM LGS SSM's to meet precision dither motion and flexure control specifications. No commercial solutions are immediately available so may require custom engineering.
Real-time wavefront processor computer	Either Analog Devices TigerSharc or NVIDEA GForce	Up to $210,000	February 2008	RTC funding is provided by an award from the AFOSR through the DURIP program. However, all components must be costed by

(RTC)	Graphic Chip Architectures (TBD)			February 2008. There is some risk that the preferred, lower cost NVIDEA option will not meet performance specifications. However, sufficient DURIP funds are in hand for a fallback TigerSharc architecture expected to meet requirements.

Table 2: Major PALM-3000 procurements.

5 QUALITY ASSURANCE PLAN

5.1 Mini-PDRs

As a project upgrading an existing facility instrument, PALM-3000 will use a series of mini-PDR's (preliminary design reviews) for each major WBS element in lieu of a global PDR for the project (see Table 3.) The overall system-level description of the instrument is described in the IAD (Instrument Architecture Document) and the SoAD (Software Architecture Document). The use of mini-PDR's will allow in-depth concentration on the technical issues relevant to modifying each subsystem. Due to the compressed schedule for the project, there will be no subsequent mini- or global DDR (detailed design review). Instead, there will be for each upgrade phase of the project a PSR (Pre-Ship Reviews), which serve as milestones to assess project readiness for taking the AO system offline for that upgrade phase.

WBS	Subsystem	Date
1.3.4.1	Interim Optical Layout	4/20/07
1.3.4.2	Stimulus	12/14/07
1.3.4.3	Operations Systems	4/17/08
1.3.4.4	Real-time Computer	4/17/08
1.3.4.5	Electronics	6/19/08
1.3.4.6	High Order WFS	6/25/08
1.3.4.7	Embedded Control	8/5/08
1.3.4.8	NGS Optical Layout	11/5/08
1.3.4.9	Observatory Infrastructure	2/4/09
1.3.5.1	LGS Optical Layout	1/13/09
1.3.5.2	IR Tip/Tilt WFS	6/30/09
1.3.5.3	Truth WFS	7/20/09

Table 3: Expected dates for PALM-3000 subsystem mini-PDRs.

The organization, execution, and completion of action items arising from each mini-PDR shall be the responsibility of the WBS element Lead. Guidelines for mini-PDR's applicable to PALM-3000 as well as all Caltech Optical Observatory instrumentation projects are presented below:

- Attendance (minimum)
    - WBS element Leads for all interfacing subsystems
    - Two or more 'project external' experts

        - Can be a remotely located reviewer (supported with prior approval of the PM) or a local technical expert not directly associated with the project
    - Project Management
        - Instrument Engineer, Deputy Project Manager, Project Manager, and PI
- Basic review outline
    - Review of the WBS Dictionary element for each work package
    - Subsystem requirements summary and traceability to governing documents
    - Interfaces
    - Design constraints
    - Proposed technical solution
    - Technical risks
    - Estimate of scope and schedule to completion, noting critical path
- Inputs
    - Documentation in support of the mini-PDR should be completely posted to the appropriate OIR TWiki review page (password protecting file-by-file if necessary) three working days prior to the review.
        - Review participants are expected to have reviewed posted material prior to the mini-PDR.
        - Minor revisions to presentation material leading up to the mini-PDR are acceptable.
- Output
    - Review minutes
        - A designated recorder for the meeting should produce a summary of the mini-PDR discussion, including:
            - Action items including a specific assignment, due date, and a customer to verify action completion (default will be the PM if left unspecified)
    - Observer comments
        - Mini-PDR observers are encouraged to forward notes, comments, or suggestions to the WBS element Lead upon completion of the review, with carbon copy to the PM. The WBS element Lead retains authority, with PM concurrence, to accept or ignore this advisory material.
    - Interface Control Documents
        - All design changes subsequent to mini-PDR that affect subsystem interfaces shall be documented in technical memoranda jointly agreed upon by affected WBS element Leads
    - System Design Manual
        - Design changes wholly internal to the WBS element shall be documented in the SDM, which supercedes the mini-PDR documentation as the final, as-built description of the instrument

5.2 Pre-Ship Reviews

Three pre-ship reviews (PSRs) are planned, to assess our readiness to perform the upgrades at Palomar Observatory at each stage of the project (see Table 4). The organization of the pre-ship reviews shall be the responsibility of the PM, with the relevant WBS leads taking part in the preparation of documentation, presentation of material, and the completion of action items. The guidelines for mini-PDRs apply, supplemented by the additional requirements below:

- Review Committee
    - A review committee consisting of two or more 'project external' experts, the Instrument Engineer, Deputy Project Manager, Project Manager, and PI shall be convened.
- Committee Charge
    - The committee shall develop a consensus recommendation regarding the project's readiness for the proposed work.

WBS	Review	Date
1.3.3.1	Interim Relayout Pre-ship Review	11/21/07
1.3.3.2	PALM-3000 NGS Pre-ship Review	10/15/09
1.3.3.3	PALM-3000 LGS Pre-ship Review	11/25/10

Table 4: Expected dates of PALM-3000 system-level reviews.

6 HUMAN RESOURCE MANAGEMENT

6.1 Project Organization Chart

The key project roles are identified and described in the following Figure 2.

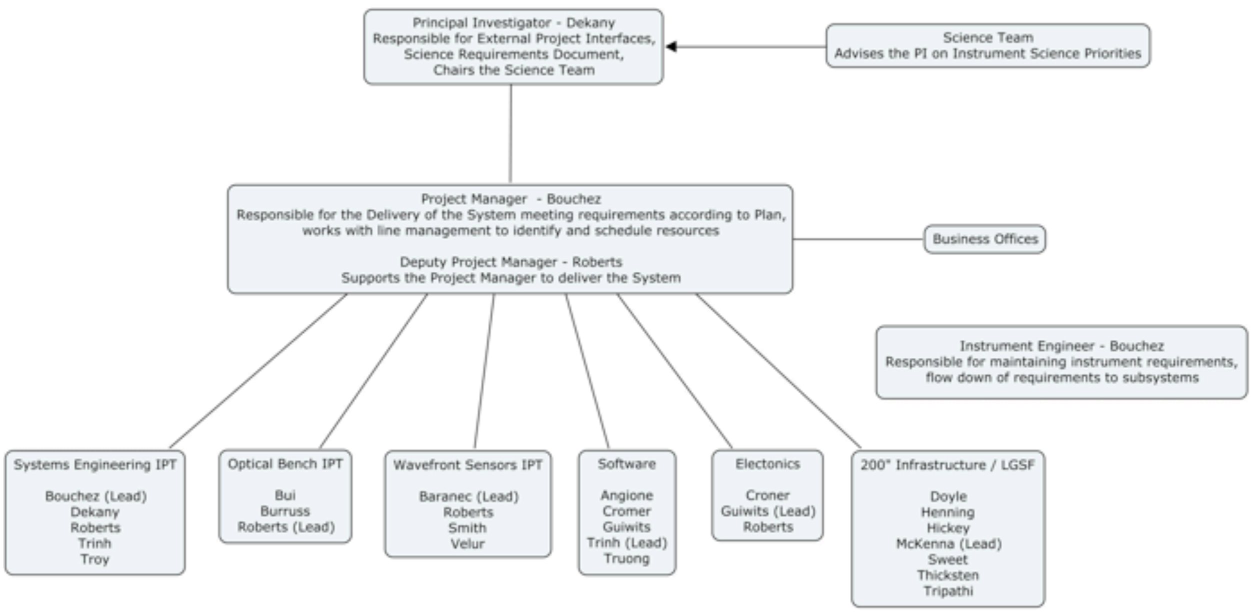


Figure 2: PALM-3000 organizational chart.

The majority of OIR staff report to the Associate Director for Development, Richard Dekany, Palomar staff report to Site Superintendent Dan McKenna, and the majority of JPL staff report to the Group Supervisor for the Adaptive Optics and Astronomical Instrument Group, Mitchell Troy.

6.2 Team Management

PALM-3000 shall be managed as a single project consisting of staff from several organizations, but all reporting to the P3K Project Manager for their responsibilities within the P3K project. The PM will maintain an Team Management Issue Log to capture emergent issues, develop potential solutions with staff involvement, and track through to the successful issue closure.

The Project Manager will track team member performance, provide feedback to staff and line management, resolve issues, and coordinate assignments to enhance project performance.\

7 COMMUNICATIONS MANAGEMENT

7.1 Responsibilities

The Project Scientist shall be responsible for the external distribution of information relevant to ensuring the science productivity of P3K and the overall strategic coordination among stakeholders pursuant to identification of project funding. This will include regular communication with the P3K Science Team, the Caltech Observing Council, external science partners at Oxford University and AMNH, and elsewhere.

The Project Manager shall be responsible for the internal distribution of information to the entire project team, including Approved Change Requests, performance metrics, changes to the schedule from the baseline, an task coordination between IPTs.

The Deputy Project Manager shall be responsible for regular external reporting the JPL STMC.

7.2 Team Meetings

The PM shall call periodic team 'all-hands' meetings to distribute timely information, highlight technical progress, and discuss project-wide management issues. We expect these meetings to be held with an approximately 3-month cadence, punctuated by an annual 2-3 day 'many-hands' retreat to assess annual project performance, identify new opportunities for organizational or execution efficiencies, and recognize personal achievement.

APPENDIX A. WBS DICTIONARY

WBS Number	Element Name	Element Description
1	Management	The business and administrative planning, organizing, directing, coordinating, controlling, and approval processes used to accomplish overall Project objectives that are not associated with specific hardware (HW) or software (SW) elements.
1.1	Science Management (SRD)	The technical and management efforts of directing and controlling the Science investigation aspects of the project. Includes the efforts associated with defining the science requirements and ensuring the integration of the science requirements with the instrument. The Principal Investigator (PI) manages relationships between other elements of the project and the science investigators. Includes maintenance of science documents, implementing support agreements and MOUs with external partners, serving as the scientific spokesperson for the project, coordinating student participation in the project, reporting to the funding institutions. Document products include Science Requirements Document; Observing Scenarios Document. Includes travel, workshops, and publications.
1.2	Planning Management (PMP)	Plan the overall project for delivery of the instrument. Includes project manager, deputy. Products include the Project Management Plan; budget and monthly financial reporting; Project Task Plan and Schedule; inputs to support agreements and MOUs with external partners.
1.3	Execution Management	Lead the overall project for delivery of the instrument. Includes project manager, deputy, IPT Leads. Includes project schedule management; IPT schedule and task management; setting up and participating in reviews (system and subsystem).
1.4	Communications Management	Inform team and sponsors of project progress. Includes team and sponsor meetings; vendor meetings; project website. Provides for setting up and attendance at project meetings. Provides the project internal website, which is the focal point for the project information management.
2	Systems Engineering	The technical and management efforts of directing and controlling an integrated engineering effort for the project. Includes conducting trade studies; the integrated planning and control of the technical program efforts of design engineering and integrated test planning; the effort to transform Project objectives into a description of system requirements and a preferred system configuration; the technical oversight and control effort for planning, monitoring, measuring, evaluating, directing, and replanning the management of the technical program. Documentation Products include Instrument Requirements Document (IRD), Instrument Architecture Document (IAD), Error Budget Summary (EBS), Software Requirements Document (SoRD), Software Architecture Document (SoAD), External Interface Control Documents, PALM-3000 Observer's Manual (POM), System Design Manual (SDM).
2.1	Instrument Requirements Document (IRD)	Top level requirements for the instrument derived directly from the science requirements.
2.2	Instrument Architecture Document (IAD)	Overall system architecture that fulfills the instrument requirements; provide the structure for the subsystems.

2.3	Error Budget Summary (EBS)	Provides estimates of the science performance based on the instrument architecture and environmental parameters
2.4	Software Requirements Document (SwRD)	Top level requirements for the system software derived from the instrument and science requirements.
2.5	Software Architecture Document (SwAD)	Overall system software architecture that fulfills the software requirements.
2.6	External Interface Control Documents	Optical, mechanical and software interface specifications for science instruments and other equipment which can be installed with the system.
2.7	PALM-3000 Observer's Manual (POM)	Instructions for use of the system on the telescope.
2.8	System Design Manual (SDM)	Complete documentation of the final system configuration. Includes optical and mechanical design documents; hardware specifications; software documentation.
3	Optical Bench	Perform overall instrument optical designs so that they meet science and instrument requirements at each stage of the project; Includes requirements definition, optical and mechanical design, procurement, assembly, alignment, and documentation for the final subsystem. Also includes procurement of stages and motors required for the design.
3.1	Interim Optical Layout (new instruments)	Design and implement a modified optical layout to accommodate new science instruments in FY08. Includes requirements definition; opto-mechanical design of layout; procurement; electronic interfaces to system; assembly; alignment; testing; design and performance documentation.
3.2	P3K NGS Optical Layout (DM, HOWFS, LOWFS)	Design and implement an optical layout for P3k NGS to include DM3368, DM349, the P3k HOWFS and the LOWFS. Includes requirements definition; opto-mechanical design of layout; procurement; electronic interfaces to system; assembly; alignment; testing; design and performance documentation.
3.3	P3K LGS Optical Layout (TWFS, IRTT)	Design and implement an optical layout for P3k LGS to include the TWFS, the IRTT and the selection mechanisms for these sensors in addition to the elements of the NGS layout. Includes requirements definition; opto-mechanical design of layout; procurement; electronic interfaces to system; assembly; alignment; testing; design and performance documentation .
4	Adaptive Mirrors	Procure, integrate and test adaptive mirrors. Includes contract management, testing along with the necessary equipment & test facilities, hardware integration and documentation.
4.1	DM3368 procurement	Procure DM3368. Includes requirements definition and contract management.
4.2	DM3368 auxiliary hardware	Design and build DM3368 auxiliary hardware. Includes protective cover, pupil mask and mounting base.
4.3	DM3368 acceptance testing	Test DM3368. Includes test plan, test equipment, testbed setup, actuator spatial and temporal performance measurements, wavefront measurements, documentation.
4.4	DM349 procurement	Procure new driver electronics for DM349. Includes requirements definition.
4.5	DM349 auxiliary hardware	Design and build new DM349 auxiliary hardware as needed. Includes protective cover, pupil mask and mounting base.

4.6	DM349 documentation	Verify and document DM349 performance with new electronics.
5	Wavefront Sensors	Design, build, and test wavefront sensor subsystems. Includes requirements definition, optical and mechanical design, procurement, assembly, alignment, testing and documentation of the final subsystem. Also includes equipment & test facilities needed to align and test each sensor.
5.1	High-order Wavefront Sensor (HOWFS)	Design and implement a visible sensor to measure high spatial frequencies in the wavefront from either an NGS or LGS. Includes requirements definition; WFS design; opto-mechanical design; procurement; electronic and mechanical interfaces to system; testbed setup; assembly; alignment; testing; design and performance documentation.
5.2	Low-order Wavefront Sensor (LOWFS)	Design and implement a visible sensor to measure low spatial frequencies in the wavefront from an NGS. Includes requirements definition; WFS design; opto-mechanical design; procurement; electronic and mechanical interfaces to system; testbed setup; assembly; alignment; testing; design and performance documentation.
5.3	Truth Wavefront Sensor (TWFS)	Design and implement a visible sensor to measure tip/tilt and focus in the wavefront from an NGS. Includes requirements definition; WFS design; opto-mechanical design; procurement; electronic and mechanical interfaces to system; testbed setup; assembly; alignment; testing; design and performance documentation.
5.4	IR Tip/Tilt Wavefront Sensor (IRTT)	Design and implement an IR sensor to measure tip/tilt in the wavefront from an NGS. Includes requirements definition; WFS design; opto-mechanical design; procurement; electronic and mechanical interfaces to system; testbed setup; assembly; alignment; testing; design and performance documentation.
6	Electronics	Design, build, and test instrument electronics for each stage of the project. Includes requirements definition, hardware procurement and assembly (power supply; real-time and supervisory control processors; memory; data storage; data collection; Analog-to-Digital (A to D) conversion; telemetry collection; cabling), testing and documentation of the final subsystem.
6.1	P3K NGS rack electronics	Design and implement electronics to support the P3k NGS system. Includes power, computers, motor controllers, mirror controllers, camera controllers.
6.2	P3K NGS Cabling	Design and implement cabling to support the P3k NGS system. Includes cabling internal to the racks, internal to the bench and between the bench and racks.
6.3	P3K LGS rack electronics	Design and implement electronics to support the P3k LGS system. Includes power, computers, motor controllers, mirror controllers, camera controllers.
6.4	P3K LGS Cabling	Design and implement cabling to support the P3k LGS system. Includes cabling internal to the racks, internal to the bench and between the bench and racks.
6.5	Wavefront Processor	Design and implement electronics to support the wavefront processors in the P3k system.

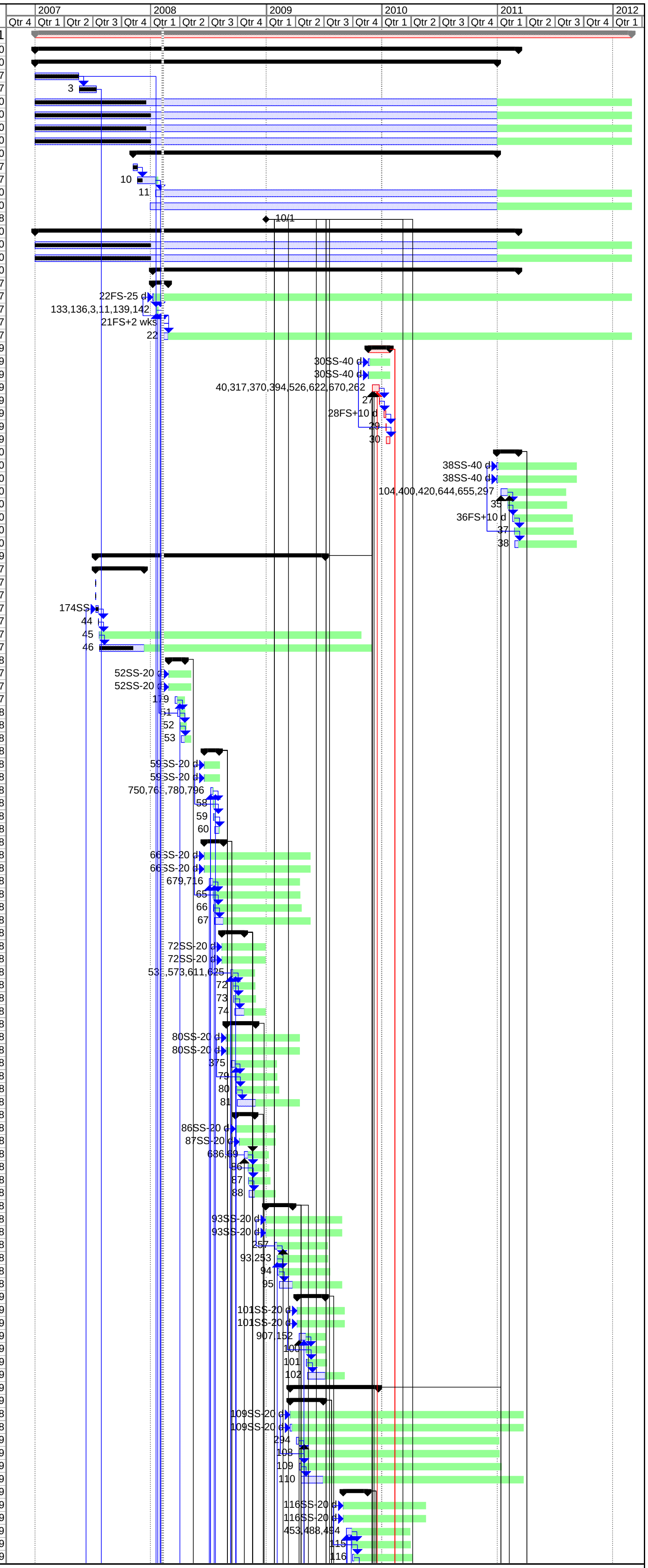
7	Embedded Systems	Design, code, integrate and test the embedded systems software. Includes requirements definition; software to control system hardware, pass information between software subsystems, process WFS data and perform real-time loop calculations; testing; documentation.
7.1	Supervisory Control Software	Design and implement software to control P3k system hardware; control the interaction between the user interface, wavefront processors and telemetry system; provide telemetry on system configuration. Includes requirements definition, coding, hardware test setup, testing and documentation.
7.2	RTC Software	Design and implement real-time software to process data from the wavefront sensors, reconstruct the wavefront, provide open- and closed-loop control to the adaptive mirrors and provide telemetry on the wavefront sensor data, adaptive mirrors and real-time system parameters. Includes requirements definition, coding, hardware test setup, testing and documentation.
8	Operations Systems	Design, code, integrate and test the operations systems and software. Includes requirements definition; software for the user interface and upper level automations; user workstation design and setup; testing of software and hardware; documentation.
8.1	Dataroom workstation	Design and implement a workstation to host the system software, user interface and telemetry system. Includes requirements definition, coding, procurement, hardware test setup, testing and documentation.
8.2	Operations Software	Design and implement software for the user interface, non-real-time system automations and telemetry system. Includes requirements definition, coding, hardware/software test setup, testing and documentation.
9	Infrastructure	External systems that provide support for the instrument. Includes instrument electronic and mechanical requirements on the telescope as well as in the lab and software interfaces to facility data systems.
9.1	Hale Telescope	Installation of the instrument on the telescope. Includes input power (current), output power (thermal) and weight requirements.
9.2	AO Laboratory	Installation of the instrument in the Palomar lab. Includes input power (current), support structure and cleanliness requirements.
9.3	P18 MASS / DIMM	Interface with the MASS/DIMM to transfer atmospheric information to the AO system.
10	Laser Guide Star Facility	Upgrades to existing Laser Guide Star facility to meet science requirements. Includes facility modifications and laser installation.
10.1	Laser Laboratory	Location of Na guidestar laser. Includes modifications to laser facility to improve ease of use, cleanliness and provide space for additional lasers.
10.2	Beam Transfer Optics	Control of laser beam from Laser Lab to Laser Launch Telescope. Includes modifications to the BTO as needed with Laser Lab changes.
10.3	Laser Launch Telescope	Projects Na guidestar laser out to the Na layer.
10.4	CSFL Subsystem	Current Na guidestar laser. Will be used with P3k system as it is with the PALAO system.
10.5	Future Lasers	Additional Na guidestar lasers to be borrowed or purchased. Includes installation and integration of the laser at Palomar.

11	Commissioning	Integrate and functionally test the instrument assembly. Test and verify hardware and software interfaces. Characterize Instrument performance. Includes lab and on-sky testing with each science instrument.
11.1	PALM-241 / PHARO integration and testing	Integrate and test the Interim Optical Bench Layout with PHARO Includes alignment and calibration to PHARO, in-lab closed-loop performance testing, on-sky performance testing (NGS and LGS).
11.2	PALM-241 / SWIFT integration and testing	Integrate and test the Interim Optical Bench Layout with SWIFT. Includes alignment and calibration to SWIFT, in-lab closed-loop performance testing, on-sky performance testing (NGS and LGS).
11.3	PALM-241 / P1640 integration and testing	Integrate and test the Interim Optical Bench Layout with P1640. Includes alignment and calibration to P1640, in-lab closed-loop performance testing, on-sky performance testing (NGS and LGS).
11.4	PALM-3000 NGS integration and testing	Integrate and test the P3k NGS system with PHARO. Includes complete software check-out, alignment and calibration to PHARO, in-lab closed-loop performance testing for all operating modes, on-sky performance testing (NGS and LGS).
11.5	PALM-3000 LGS integration and testing	Integrate and test the P3k LGS system with PHARO. Includes complete software check-out, alignment and calibration to PHARO, in-lab closed-loop performance testing for all operating modes, on-sky performance testing (NGS and LGS).

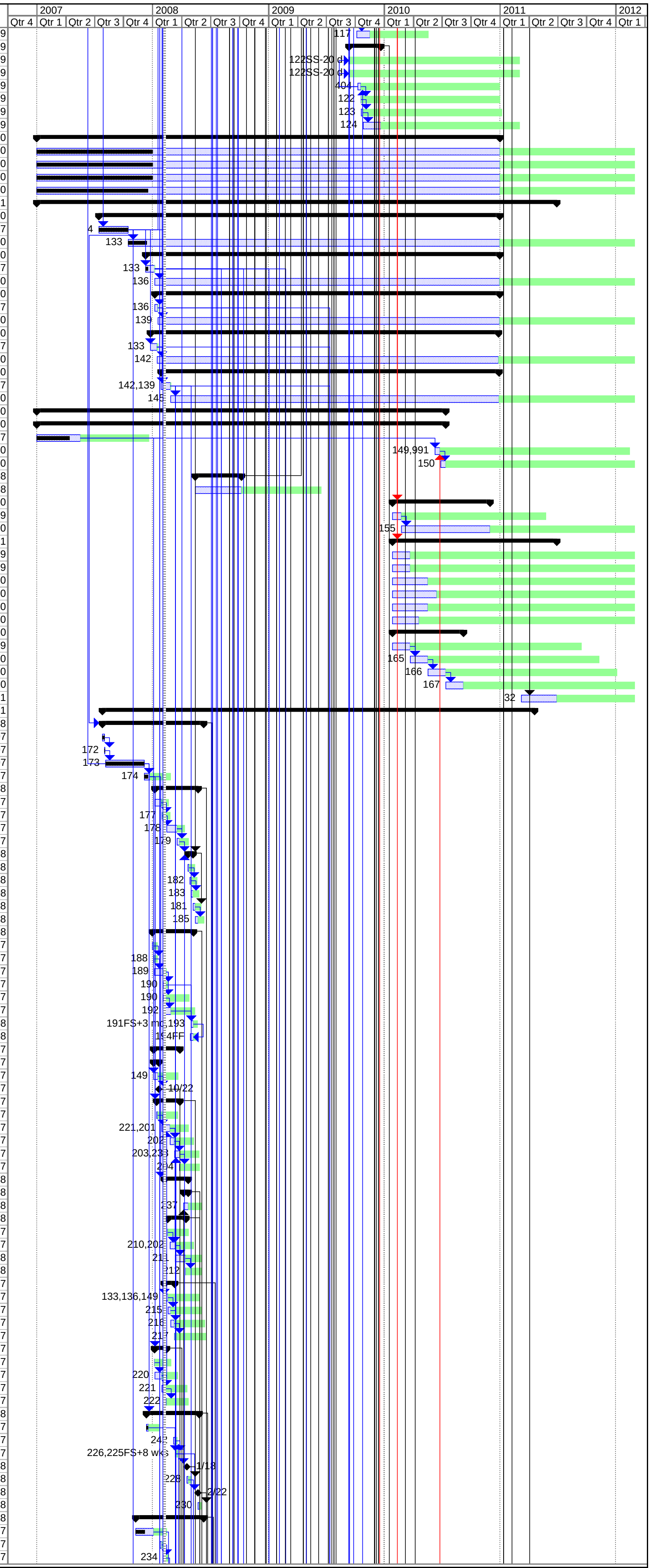
APPENDIX B. DETAILED WBS AND BASELINE SCHEDULE

Appendix B: PALM-3000 Baseline WBS and Schedule

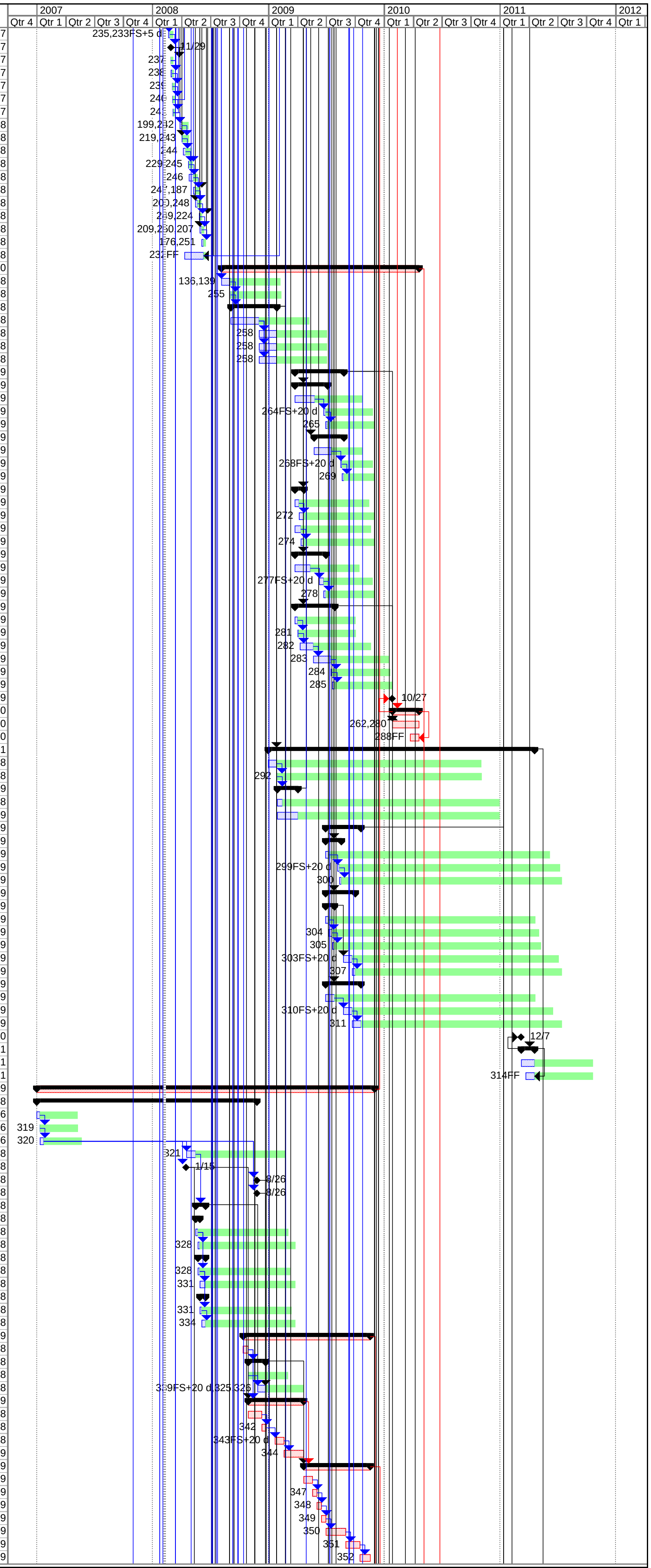
ID	WBS	Task Name	Work	Start	Finish
0	0	P3K WBS v1.3	5,570.5 d	10/2/06	11/30/11
1	1	Management	1,473 d	10/2/06	12/8/10
2	1.1	Science Management (SRD)	59 d	10/2/06	10/1/10
3	1.1.1	Write SRD	7 d	10/2/06	2/16/07
4	1.1.2	Write observing scenarios document	2 d	2/19/07	4/13/07
5	1.1.3	Science Team Reporting	10 d	10/2/06	10/1/10
6	1.1.4	Observatory Council Reporting	20 d	10/2/06	10/1/10
7	1.1.5	STMC Reporting	20 d	10/2/06	10/1/10
8	1.1.6	Summer student support	0 d	10/2/06	10/1/10
9	1.2	Planning Management (PMP)	40 d	8/8/07	10/1/10
10	1.2.1	Draft PMP Outline	1 d	8/8/07	8/21/07
11	1.2.2	Write PMP	25 d	8/22/07	10/17/07
12	1.2.3	Maintain PMP	5 d	10/18/07	10/1/10
13	1.2.4	Monthly Earned Value Reports	9 d	10/1/07	10/1/10
14	1.2.5	P3K LGS funding secured	0 d	10/1/08	10/1/08
15	1.3	Execution Management	1,017 d	10/2/06	12/8/10
16	1.3.1	Project Management	200 d	10/2/06	10/1/10
17	1.3.2	IPT Leadership	400 d	10/2/06	10/1/10
18	1.3.3	System Level Reviews	115 d	10/9/07	12/8/10
19	1.3.3.1	Conceptual Design Review (CoDR)	11 d	10/9/07	11/26/07
20	1.3.3.1.1	Invite CoDR participants	1 d	10/9/07	10/12/07
21	1.3.3.1.2	Distribute CoDR documentation	1 d	10/19/07	10/22/07
22	1.3.3.1.3	Conduct P3K CoDR	7 d	11/12/07	11/12/07
23	1.3.3.1.4	Document CoDR outcome	2 d	11/13/07	11/26/07
24	1.3.3.2	P3K NGS Pre-Ship Review (NGS PSR)	55.5 d	8/20/09	10/27/09
25	1.3.3.2.1	Invite NGS PSR participants	1 d	8/20/09	8/25/09
26	1.3.3.2.2	Schedule date and venue	0.5 d	8/20/09	8/21/09
27	1.3.3.2.3	Produce NGS PSR documentation	28 d	9/2/09	9/23/09
28	1.3.3.2.4	Distribute NGS PSR documentation	1 d	9/24/09	9/24/09
29	1.3.3.2.5	Prepare NGS PSR responses	14 d	10/9/09	10/14/09
30	1.3.3.2.6	Conduct P3K NGS PSR	7 d	10/15/09	10/15/09
31	1.3.3.2.7	Document NGS PSR outcome	4 d	10/16/09	10/27/09
32	1.3.3.3	P3K LGS Pre-Ship Review (LGS PSR)	48.5 d	9/30/10	12/8/10
33	1.3.3.3.1	Invite LGS PSR participants	1 d	9/30/10	10/6/10
34	1.3.3.3.2	Schedule date and venue	0.5 d	9/30/10	10/4/10
35	1.3.3.3.3	Produce LGS PSR documentation	24 d	10/13/10	11/4/10
36	1.3.3.3.4	Distribute LGS PSR documentation	1 d	11/4/10	11/5/10
37	1.3.3.3.5	Prepare LGS PSR responses	12 d	11/19/10	11/25/10
38	1.3.3.3.6	Conduct P3K LGS PSR	6 d	11/25/10	11/26/10
39	1.3.3.3.7	Document LGS PSR outcome	4 d	11/26/10	12/8/10
40	1.3.4	P3K NGS Subsystem Preliminary Design Reviews	223 d	4/11/07	4/6/09
41	1.3.4.1	Interim Optical Layout Preliminary Design Re	22 d	4/11/07	9/11/07
42	1.3.4.1.1	Invite participants	1 d	4/11/07	4/11/07
43	1.3.4.1.2	Schedule date and venue	1 d	4/11/07	4/11/07
44	1.3.4.1.3	Produce documentation	3 d	4/12/07	4/19/07
45	1.3.4.1.4	Conduct Interim Optical Layout PDR	6 d	4/20/07	4/20/07
46	1.3.4.1.5	Document review outcome	1 d	4/23/07	4/23/07
47	1.3.4.1.6	Respond to review action items	10 d	4/24/07	9/11/07
48	1.3.4.2	Stimulus Preliminary Design Review (STIM P	16 d	11/28/07	1/18/08
49	1.3.4.2.1	Invite participants	0.5 d	11/28/07	11/29/07
50	1.3.4.2.2	Schedule date and venue	0.5 d	11/28/07	11/29/07
51	1.3.4.2.3	Produce documentation	2 d	12/18/07	12/26/07
52	1.3.4.2.4	Conduct Stimulus PDR	7 d	12/26/07	1/2/08
53	1.3.4.2.5	Document review outcome	1 d	1/3/08	1/4/08
54	1.3.4.2.6	Respond to review action items	5 d	1/7/08	1/18/08
55	1.3.4.3	Operations Systems Preliminary Design Revi	28 d	3/20/08	5/5/08
56	1.3.4.3.1	Invite participants	0.5 d	3/20/08	3/20/08
57	1.3.4.3.2	Schedule date and venue	0.5 d	3/20/08	3/20/08
58	1.3.4.3.3	Produce documentation	6 d	4/9/08	4/16/08
59	1.3.4.3.4	Conduct Operations Systems PDR	10 d	4/17/08	4/17/08
60	1.3.4.3.5	Document review outcome	1 d	4/18/08	4/21/08
61	1.3.4.3.6	Respond to review action items	10 d	4/22/08	5/5/08
62	1.3.4.4	Real-Time Computer Preliminary Design Rev	28 d	3/19/08	5/19/08
63	1.3.4.4.1	Invite participants	0.5 d	3/19/08	3/20/08
64	1.3.4.4.2	Schedule date and venue	0.5 d	3/19/08	3/20/08
65	1.3.4.4.3	Produce documentation	8 d	4/4/08	4/16/08
66	1.3.4.4.4	Conduct RTC PDR	8 d	4/16/08	4/17/08
67	1.3.4.4.5	Document review outcome	1 d	4/17/08	4/21/08
68	1.3.4.4.6	Respond to review action items	10 d	4/21/08	5/19/08
69	1.3.4.5	Electronics Subsystem Preliminary Design Re	30 d	5/14/08	7/24/08
70	1.3.4.5.1	Invite participants	0.5 d	5/14/08	5/15/08
71	1.3.4.5.2	Schedule date and venue	0.5 d	5/14/08	5/15/08
72	1.3.4.5.3	Produce documentation	6 d	6/11/08	6/19/08
73	1.3.4.5.4	Conduct Electronics PDR	12 d	6/19/08	6/20/08
74	1.3.4.5.5	Document review outcome	1 d	6/20/08	6/24/08
75	1.3.4.5.6	Respond to review action items	10 d	6/24/08	7/24/08
76	1.3.4.6	HOWFS Preliminary Design Review (HOWFS	24 d	5/28/08	8/29/08
77	1.3.4.6.1	Invite participants	0.5 d	5/28/08	5/29/08
78	1.3.4.6.2	Schedule date and venue	0.5 d	5/28/08	5/29/08
79	1.3.4.6.3	Produce documentation	4 d	6/13/08	6/25/08
80	1.3.4.6.4	Conduct HOWFS PDR	8 d	6/25/08	6/26/08
81	1.3.4.6.5	Document review outcome	1 d	6/26/08	7/2/08
82	1.3.4.6.6	Respond to review action items	10 d	7/2/08	8/29/08
83	1.3.4.7	Embedded Control Preliminary Design Reviev	30 d	6/26/08	8/26/08
84	1.3.4.7.1	Invite participants	0.5 d	6/26/08	6/27/08
85	1.3.4.7.2	Schedule date and venue	0.5 d	7/8/08	7/9/08
86	1.3.4.7.3	Produce documentation	8 d	7/24/08	8/5/08
87	1.3.4.7.4	Conduct EC PDR	8 d	8/5/08	8/6/08
88	1.3.4.7.5	Document review outcome	1 d	8/6/08	8/8/08
89	1.3.4.7.6	Respond to review action items	12 d	8/8/08	8/26/08
90	1.3.4.8	P3K NGS Optical Layout Preliminary Design	22 d	9/30/08	12/24/08
91	1.3.4.8.1	Invite participants	0.5 d	9/30/08	10/1/08
92	1.3.4.8.2	Schedule date and venue	0.5 d	9/30/08	10/1/08
93	1.3.4.8.3	Produce documentation	4 d	10/28/08	11/5/08
94	1.3.4.8.4	Conduct NGS Optical Layout PDR	6 d	11/5/08	11/6/08
95	1.3.4.8.5	Document review outcome	1 d	11/6/08	11/12/08
96	1.3.4.8.6	Respond to review action items	10 d	11/12/08	12/24/08
97	1.3.4.9	Infrastructure Preliminary Design Review (Infi	23 d	1/7/09	4/6/09
98	1.3.4.9.1	Invite participants	0.5 d	1/7/09	1/8/09
99	1.3.4.9.2	Schedule date and venue	0.5 d	1/7/09	1/8/09
100	1.3.4.9.3	Produce documentation	4 d	1/13/09	2/4/09
101	1.3.4.9.4	Conduct Infrastructure PDR	7 d	2/4/09	2/5/09
102	1.3.4.9.5	Document review outcome	1 d	2/5/09	2/9/09
103	1.3.4.9.6	Respond to review action items	10 d	2/9/09	4/6/09
104	1.3.5	P3K LGS Subsystems Preliminary Design Review	79 d	12/16/08	9/21/09
105	1.3.5.1	P3K LGS Optical Layout Preliminary Design I	22 d	12/16/08	3/30/09
106	1.3.5.1.1	Invite participants	1 d	12/16/08	12/16/08
107	1.3.5.1.2	Schedule date and venue	1 d	12/16/08	12/22/08
108	1.3.5.1.3	Produce documentation	3 d	1/5/09	1/12/09
109	1.3.5.1.4	Conduct LGS Optical Layout PDR	6 d	1/13/09	1/13/09
110	1.3.5.1.5	Document review outcome	1 d	1/14/09	1/19/09
111	1.3.5.1.6	Respond to review action items	10 d	1/20/09	3/30/09
112	1.3.5.2	IRTT Preliminary Design Review (IRTT PDR)	35 d	6/2/09	8/18/09
113	1.3.5.2.1	Invite participants	0.5 d	6/2/09	6/2/09
114	1.3.5.2.2	Schedule date and venue	0.5 d	6/2/09	6/2/09
115	1.3.5.2.3	Produce documentation	6 d	6/12/09	6/29/09
116	1.3.5.2.4	Conduct IRTT PDR	12 d	6/30/09	7/1/09
117	1.3.5.2.5	Document review outcome	1 d	7/1/09	7/7/09



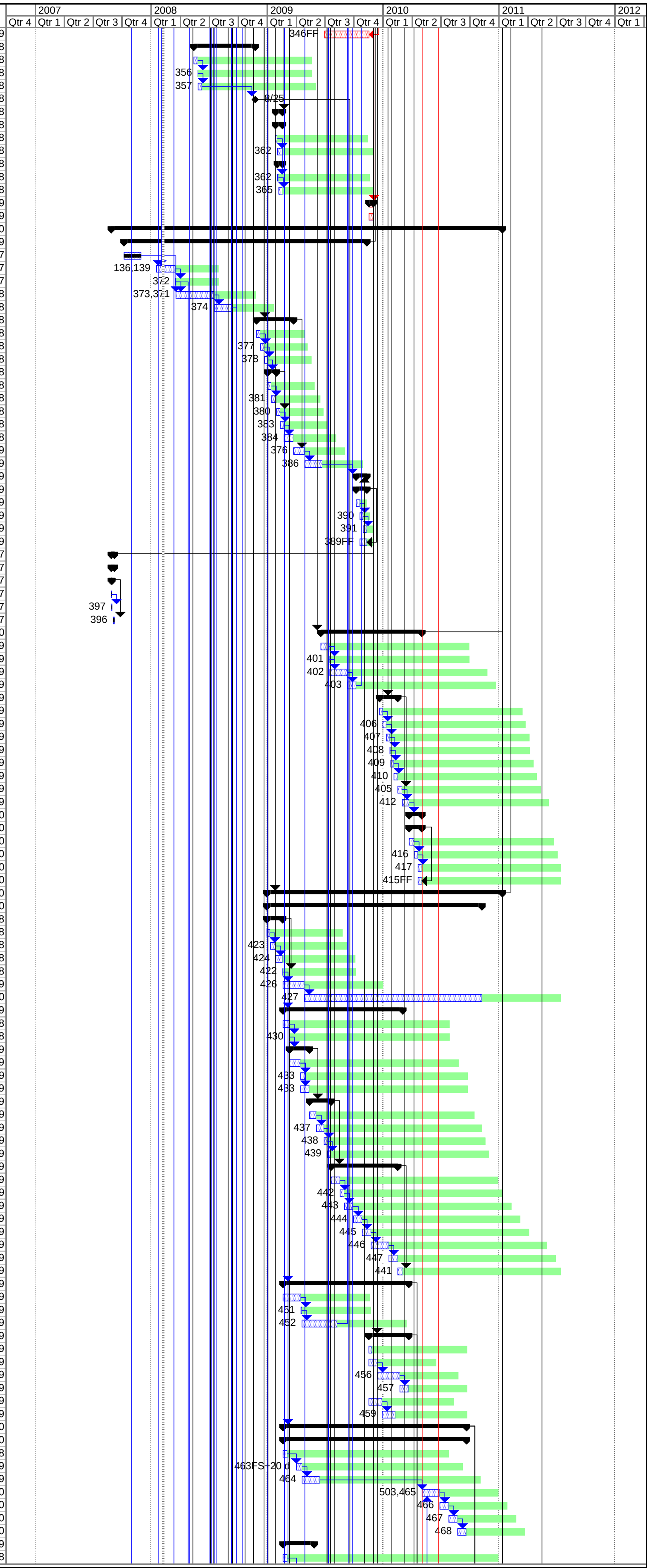
ID	WBS	Task Name	Work	Start	Finish
118	1.3.5.2.6	Respond to review action items	15 d	7/7/09	8/18/09
119	1.3.5.3	Truth WFS Preliminary Design Review (TWF	22 d	6/12/09	9/21/09
120	1.3.5.3.1	Invite participants	0.5 d	6/12/09	6/15/09
121	1.3.5.3.2	Schedule date and venue	0.5 d	6/12/09	6/15/09
122	1.3.5.3.3	Produce documentation	3 d	7/10/09	7/20/09
123	1.3.5.3.4	Conduct TWFS PDR	7 d	7/20/09	7/21/09
124	1.3.5.3.5	Document review outcome	1 d	7/21/09	7/27/09
125	1.3.5.3.6	Respond to review action items	10 d	7/27/09	9/21/09
126	1.4	Communications Management	357 d	10/2/06	10/1/10
127	1.4.1	Team Meetings	280 d	10/2/06	10/1/10
128	1.4.2	Sponsor Meetings	40 d	10/2/06	10/1/10
129	1.4.3	Vendor Meetings	25 d	10/2/06	10/1/10
130	1.4.4	Maintain TWIki collaborative website	12 d	10/2/06	10/1/10
131	2	Systems Engineering	196 d	10/2/06	3/30/11
132	2.1	Instrument Requirements Document (IRD)	20 d	4/16/07	10/1/10
133	2.1.1	Write IRD	15 d	4/16/07	7/17/07
134	2.1.2	Maintain IRD	5 d	7/17/07	10/1/10
135	2.2	Instrument Architecture Document (IAD)	21 d	9/10/07	10/1/10
136	2.2.1	Write IAD	16 d	9/10/07	10/9/07
137	2.2.2	Maintain IAD	5 d	10/9/07	10/1/10
138	2.3	Error Budget Summary (EBS)	9 d	10/9/07	10/1/10
139	2.3.1	Write EBS	4 d	10/9/07	10/19/07
140	2.3.2	Maintain EBS	5 d	10/19/07	10/1/10
141	2.4	Software Requirements Document (SoRD)	23 d	9/25/07	9/27/10
142	2.4.1	Write SoRD	18 d	9/25/07	10/16/07
143	2.4.2	Maintain SoRD	5 d	10/16/07	9/27/10
144	2.5	Software Architecture Document (SoAD)	22 d	10/29/07	9/28/10
145	2.5.1	Write SoAD	17 d	10/29/07	11/27/07
146	2.5.2	Maintain SoAD	5 d	11/28/07	9/28/10
147	2.6	External Interface Control Documents	26 d	10/2/06	4/13/10
148	2.6.1	Instrument ICD (IICD)	16 d	10/2/06	4/13/10
149	2.6.1.1	Write IICD	10 d	10/2/06	2/16/07
150	2.6.1.2	Update IICD for P3K NGS	3 d	3/11/10	3/26/10
151	2.6.1.3	Update IICD for P3K LGS	3 d	3/29/10	4/13/10
152	2.6.2	Telescope ICD (TICD)	10 d	2/14/08	7/8/08
153	2.6.2.1	Write TICD	10 d	2/14/08	7/8/08
154	2.7	PALM-3000 Observer's Manual (POM)	17 d	10/28/09	8/31/10
155	2.7.1	Develop Observer's Manual Outline	2 d	10/28/09	11/24/09
156	2.7.2	Write Observer's Manual	15 d	11/25/09	8/31/10
157	2.8	System Design Manual (SDM)	58 d	10/28/09	3/30/11
158	2.8.1	Optical Design	4 d	10/28/09	12/22/09
159	2.8.2	Mechanical Design	4 d	10/28/09	12/22/09
160	2.8.3	Electronics Design	8 d	10/28/09	2/16/10
161	2.8.4	Software Design	10 d	10/28/09	3/16/10
162	2.8.5	Table Formats	4 d	10/28/09	2/16/10
163	2.8.6	Command Sets	6 d	10/28/09	1/19/10
164	2.8.7	Subsystem Interfaces	16 d	10/28/09	6/8/10
165	2.8.7.1	TAO and AOCP	4 d	10/28/09	12/22/09
166	2.8.7.2	TAO and BTO	4 d	12/23/09	2/16/10
167	2.8.7.3	TAO and LGS Control Computer	4 d	2/17/10	4/13/10
168	2.8.7.4	BTO to Safety System	4 d	4/14/10	6/8/10
169	2.8.8	P3K LGS wavefront sensors	6 d	12/8/10	3/30/11
170	3	Optical Bench	611.5 d	4/27/07	1/19/11
171	3.1	Interim Optical Layout (new instruments)	199 d	4/27/07	3/11/08
172	3.1.1	Document Interim Optical Layout Requirements	1 d	4/27/07	5/3/07
173	3.1.2	Review Interim Optical Layout Requirements	1 d	5/4/07	5/4/07
174	3.1.3	Design Interim Optical Layout	15 d	5/7/07	9/5/07
175	3.1.4	Document interim layout CAD model	5 d	9/6/07	9/24/07
176	3.1.5	Build new stimulus	29 d	10/9/07	2/22/08
177	3.1.5.1	Document stimulus requirements	3 d	10/9/07	10/30/07
178	3.1.5.2	Review stimulus requirements	2.5 d	11/1/07	11/2/07
179	3.1.5.3	Design stimulus	10 d	11/16/07	12/18/07
180	3.1.5.4	Procure stimulus components	2 d	12/18/07	12/26/07
181	3.1.5.5	Install and align stimulus components	6 d	1/22/08	2/6/08
182	3.1.5.5.1	Install NGS source	2 d	1/22/08	1/25/08
183	3.1.5.5.2	Install LGS source	2 d	1/28/08	1/31/08
184	3.1.5.5.3	Install HeNe laser source	2 d	2/1/08	2/6/08
185	3.1.5.6	Verify stimulus functionality	2.5 d	2/7/08	2/13/08
186	3.1.5.7	Document stimulus	3 d	2/14/08	2/22/08
187	3.1.6	Build new SSMs	31.5 d	10/1/07	2/8/08
188	3.1.6.1	Document SSM requirements	2 d	10/1/07	10/5/07
189	3.1.6.2	Review SSM requirements	2.5 d	10/5/07	10/8/07
190	3.1.6.3	Design SSMs	12 d	10/8/07	11/5/07
191	3.1.6.4	Procure SSMs	2 d	11/5/07	11/9/07
192	3.1.6.5	Design 4" optics adapters	3 d	11/5/07	11/9/07
193	3.1.6.6	Build 4" optics adapters	3 d	11/9/07	11/29/07
194	3.1.6.7	Verify SSM functionality	5 d	2/1/08	2/8/08
195	3.1.6.8	Document SSMs	2 d	1/29/08	2/8/08
196	3.1.7	New instrument mounts	14.5 d	10/5/07	12/27/07
197	3.1.7.1	SWIFT mounting pads	2 d	10/5/07	10/22/07
198	3.1.7.1.1	Document SWIFT mounting pad design	2 d	10/5/07	10/19/07
199	3.1.7.1.2	Test mounting pads arrive at Palomar	0 d	10/22/07	10/22/07
200	3.1.7.2	Modify PHARO mount	12.5 d	10/15/07	12/27/07
201	3.1.7.2.1	Document PHARO mount requirements	2 d	10/15/07	10/18/07
202	3.1.7.2.2	Design PHARO mount mods	4 d	10/31/07	11/26/07
203	3.1.7.2.3	Manufacture PHARO mount parts	2 d	11/26/07	12/10/07
204	3.1.7.2.4	Modify PHARO mount	4 d	12/10/07	12/26/07
205	3.1.7.2.5	Test PHARO mount	0.5 d	12/26/07	12/27/07
206	3.1.8	Enclosures and cart standoffs	20 d	11/8/07	1/22/08
207	3.1.8.1	Interim main enclosure	5 d	1/8/08	1/22/08
208	3.1.8.1.1	Modify interim main enclosure	5 d	1/8/08	1/22/08
209	3.1.8.2	FM3 enclosure and cart standoff	8.5 d	11/19/07	1/15/08
210	3.1.8.2.1	Document FM3 enclosure requirements	1 d	11/19/07	11/19/07
211	3.1.8.2.2	Design FM3 enclosure	3 d	11/26/07	12/12/07
212	3.1.8.2.3	Build FM3 enclosure	4 d	12/12/07	1/14/08
213	3.1.8.2.4	Test-fit FM3 enclosure	0.5 d	1/14/08	1/15/08
214	3.1.8.3	SWIFT handling cart standoffs	6.5 d	11/8/07	12/11/07
215	3.1.8.3.1	Document SWIFT cart standoff requirem	2 d	11/8/07	11/20/07
216	3.1.8.3.2	Design SWIFT cart standoffs	2 d	11/20/07	11/28/07
217	3.1.8.3.3	Machine SWIFT cart standoffs	2 d	11/28/07	12/10/07
218	3.1.8.3.4	Test-fit SWIFT cart standoffs	0.5 d	12/10/07	12/11/07
219	3.1.9	PHARO FM3 Mount	9 d	10/8/07	11/15/07
220	3.1.9.1	Document FM3 mount requirements	2 d	10/8/07	10/9/07
221	3.1.9.2	Design FM3 mount	4 d	10/9/07	10/31/07
222	3.1.9.3	Build FM3 mount	2.5 d	10/31/07	11/14/07
223	3.1.9.4	Test-fit FM3 mount	0.5 d	11/14/07	11/15/07
224	3.1.10	Recoat OAPs, FMs, DM	7.5 d	9/13/07	2/26/08
225	3.1.10.1	Contact vendors	1.5 d	9/13/07	9/19/07
226	3.1.10.2	Remove optics, inspect, mark and pack	3 d	12/7/07	12/12/07
227	3.1.10.3	Ship optics	1 d	12/12/07	12/14/07
228	3.1.10.4	Recoated OAPs arrive at Palomar	0 d	1/18/08	1/18/08
229	3.1.10.5	OAP, FM acceptance inspection	1 d	1/18/08	1/23/08
230	3.1.10.6	Recoated DM arrives at Palomar	0 d	2/22/08	2/22/08
231	3.1.10.7	DM acceptance inspection	1 d	2/22/08	2/26/08
232	3.1.11	Install and align interim layout components	59.5 d	8/10/07	3/11/08
233	3.1.11.1	Develop Alignment Plan	4 d	8/10/07	10/5/07
234	3.1.11.2	Replace FM1	1 d	10/25/07	10/31/07
235	3.1.11.3	Document optic and mount locations, test WF	4 d	11/5/07	11/9/07



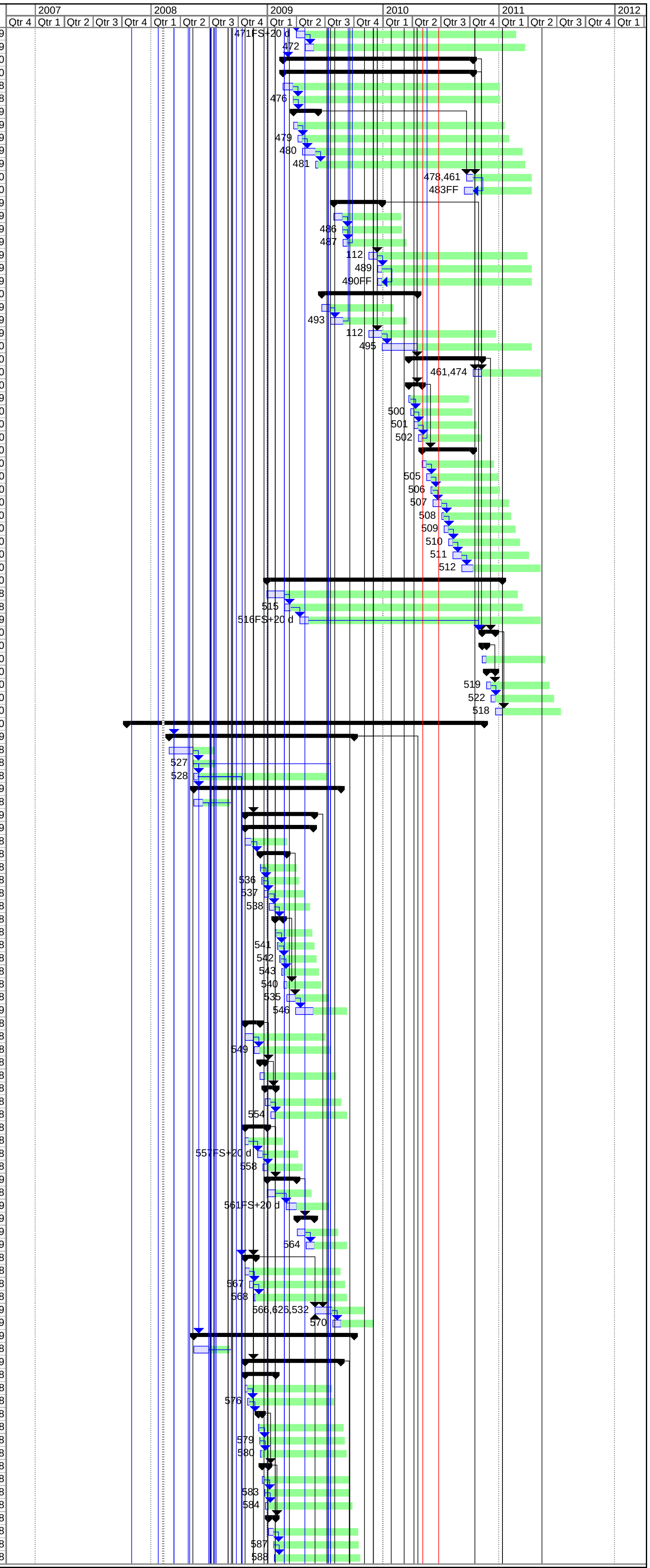
ID	WBS	Task Name	Work	Start	Finish
236	3.1.11.4	Relayout plan review	3 d	11/21/07	11/26/07
237	3.1.11.5	AO system offline for interim relayout	0 d	11/29/07	11/29/07
238	3.1.11.6	Unmount PHARO	0.5 d	11/29/07	11/29/07
239	3.1.11.7	Install WFS at science focus	2 d	11/29/07	12/3/07
240	3.1.11.8	Replace DM with flat	1 d	12/3/07	12/4/07
241	3.1.11.9	Remove stimulus plate	1 d	12/4/07	12/5/07
242	3.1.11.10	Install temporary stimulus	2 d	12/5/07	12/7/07
243	3.1.11.11	Install SWIFT mounting pads	1 d	12/27/07	1/2/08
244	3.1.11.12	Install FM3 mount	2 d	1/3/08	1/4/08
245	3.1.11.13	Reposition WFS, OAP mounts, FSM, FM2, D	6 d	1/7/08	1/14/08
246	3.1.11.14	Reinstall OAPs (FARO)	2 d	1/23/08	1/25/08
247	3.1.11.15	Realign relay optcs	10 d	1/25/08	2/8/08
248	3.1.11.16	Install and align new SSMs	4 d	2/8/08	2/14/08
249	3.1.11.17	Remount PHARO	4 d	2/14/08	2/21/08
250	3.1.11.18	Reinstall DM	2 d	2/26/08	2/28/08
251	3.1.11.19	Install Enclosures	6 d	2/28/08	3/5/08
252	3.1.11.20	Reinstall stimulus plate	4 d	3/5/08	3/11/08
253	3.1.12	Document Interim Optical Layout	6 d	1/11/08	3/11/08
254	3.2	P3K NGS Optical Layout (DM, HOWFS, LOWFS)	273.5 d	5/6/08	1/19/10
255	3.2.1	Document P3K NGS Requirements	6 d	5/6/08	6/4/08
256	3.2.2	Review P3K NGS Requirements	5 d	6/4/08	6/5/08
257	3.2.3	Design P3K NGS Optical Layout	45 d	6/5/08	10/28/08
258	3.2.3.1	Design P3K relay	15 d	6/5/08	9/2/08
259	3.2.3.2	Design LOWFS / TWFS OSM	10 d	9/2/08	10/28/08
260	3.2.3.3	Design HOWFS OSM	10 d	9/2/08	10/28/08
261	3.2.3.4	Design acquisition camera	10 d	9/2/08	10/28/08
262	3.2.4	Assemble P3K NGS Optical Bench components	80 d	12/24/08	5/27/09
263	3.2.4.1	P3K NGS relay	19 d	12/24/08	4/6/09
264	3.2.4.1.1	Procure P3K NGS relay components	15 d	12/24/08	2/25/09
265	3.2.4.1.2	Assemble P3K NGS relay components	2 d	3/25/09	3/31/09
266	3.2.4.1.3	Test P3K NGS relay assemblies	2 d	3/31/09	4/6/09
267	3.2.4.2	LOWFS / TWFS OSM	26 d	2/23/09	5/27/09
268	3.2.4.2.1	Procure LOWFS / TWFS OSM compone	20 d	2/23/09	4/17/09
269	3.2.4.2.2	Assemble LOWFS / TWFS OSM compo	2 d	5/18/09	5/21/09
270	3.2.4.2.3	Test LOWFS / TWFS OSM assemblies	4 d	5/22/09	5/27/09
271	3.2.4.3	HOWFS OSM	10 d	12/24/08	1/22/09
272	3.2.4.3.1	Design 6" optics adapters	3 d	12/24/08	1/6/09
273	3.2.4.3.2	Build 6" optics adapters	3 d	1/6/09	1/22/09
274	3.2.4.3.3	Procure 6" 960nm dichroic	2 d	12/24/08	1/12/09
275	3.2.4.3.4	Procure 6" 50/50 visible beamsplitter	2 d	1/12/09	1/22/09
276	3.2.4.4	Acquisition camera	25 d	12/24/08	4/1/09
277	3.2.4.4.1	Procure acquisition camera components	15 d	12/24/08	2/11/09
278	3.2.4.4.2	Assemble acquisition camera componen	5 d	3/11/09	3/25/09
279	3.2.4.4.3	Test acquisition camera assembly	5 d	3/25/09	4/1/09
280	3.2.5	P3K enclosure	32.5 d	12/24/08	4/29/09
281	3.2.5.1	Develop Requirements	1.5 d	12/24/08	1/2/09
282	3.2.5.2	Review Requirements	2 d	1/2/09	1/5/09
283	3.2.5.3	Design Enclosure	15 d	1/9/09	2/20/09
284	3.2.5.4	Build Enclosure	10 d	2/20/09	4/17/09
285	3.2.5.5	Clean Enclosure	1 d	4/17/09	4/21/09
286	3.2.5.6	Document Enclosure	3 d	4/21/09	4/29/09
287	3.2.6	**AO system offline for P3K NGS relayout**	0 d	10/27/09	10/27/09
288	3.2.7	Install and align P3K NGS components	90 d	10/28/09	1/19/10
289	3.2.7.1	Install and align P3K NGS components	90 d	10/28/09	1/19/10
290	3.2.8	Document P3K NGS Layout	15 d	12/23/09	1/19/10
291	3.3	P3K LGS Optical Layout (TWFS, IRTT)	139 d	10/1/08	1/19/11
292	3.3.1	Document P3K LGS Requirements	12 d	10/1/08	10/28/08
293	3.3.2	Review P3K LGS Requirements	6 d	10/29/08	10/29/08
294	3.3.3	Design P3K LGS Optical Layout	25 d	10/30/08	1/2/09
295	3.3.3.1	Design TWFS OSM	5 d	10/30/08	11/14/08
296	3.3.3.2	Design IRTT relay	20 d	10/30/08	1/2/09
297	3.3.4	Assemble P3K LGS Optical Bench components	36 d	3/31/09	7/20/09
298	3.3.4.1	TWFS OSM	6 d	3/31/09	5/19/09
299	3.3.4.1.1	Procure TWFS OSM components	4 d	3/31/09	4/9/09
300	3.3.4.1.2	Assemble TWFS OSM components	1 d	5/8/09	5/13/09
301	3.3.4.1.3	Test TWFS OSM components	1 d	5/14/09	5/19/09
302	3.3.4.2	IRTT Relay	13 d	3/31/09	7/2/09
303	3.3.4.2.1	Procure IRTT relay components	6 d	3/31/09	4/27/09
304	3.3.4.2.1.1	Procure IRTT relay optomechanics	3 d	3/31/09	4/9/09
305	3.3.4.2.1.2	Procure IRTT beamsplitter	2 d	4/10/09	4/21/09
306	3.3.4.2.1.3	Procure IRTT relay optics	1 d	4/22/09	4/27/09
307	3.3.4.2.2	Assemble IRTT relay components	5 d	5/26/09	6/22/09
308	3.3.4.2.3	Test IRTT relay components	2 d	6/23/09	7/2/09
309	3.3.4.3	IRTT Atmospheric Dispersion Corrector	17 d	3/31/09	7/20/09
310	3.3.4.3.1	Procure IRTT ADC components	7 d	3/31/09	4/27/09
311	3.3.4.3.2	Assemble IRTT ADC	5 d	5/26/09	6/22/09
312	3.3.4.3.3	Test IRTT ADC	5 d	6/23/09	7/20/09
313	3.3.5	AO system offline for P3K LGS upgrade	0 d	12/7/10	12/7/10
314	3.3.6	Install and Align P3K LGS components	45 d	12/8/10	1/19/11
315	3.3.6.1	Install and align P3K LGS components	45 d	12/8/10	1/19/11
316	3.3.7	Document P3K LGS Layout	15 d	12/22/10	1/19/11
317	4	Adaptive Mirrors	142 d	10/2/06	9/1/09
318	4.1	DM3368 procurement	9 d	10/2/06	8/26/08
319	4.1.1	Document DM3368 requirements	3 d	10/2/06	10/11/06
320	4.1.2	Review DM3368 requirements	2 d	10/12/06	10/12/06
321	4.1.3	Order DM3368	2 d	10/12/06	10/24/06
322	4.1.4	Document DM3368 design	2 d	1/17/08	2/15/08
323	4.1.5	Receive DM3368 driver prototype	0 d	1/15/08	1/15/08
324	4.1.6	Receive DM3368 driver	0 d	8/26/08	8/26/08
325	4.1.7	Receive DM3368	0 d	8/26/08	8/26/08
326	4.2	DM3368 auxillary hardware	12 d	2/15/08	3/17/08
327	4.2.1	DM3368 protective cover	3 d	2/15/08	2/28/08
328	4.2.1.1	Design DM3368 protective cover	2 d	2/15/08	2/22/08
329	4.2.1.2	Build DM3368 protective cover	1 d	2/22/08	2/28/08
330	4.2.2	DM3368 pupil mask	5 d	2/22/08	3/17/08
331	4.2.2.1	Design DM3368 pupil mask	2 d	2/22/08	2/28/08
332	4.2.2.2	Build DM3368 pupil mask	3 d	2/28/08	3/17/08
333	4.2.3	DM3368 base	4 d	2/28/08	3/17/08
334	4.2.3.1	Design DM3368 base	2 d	2/28/08	3/5/08
335	4.2.3.2	Build DM3368 base	2 d	3/5/08	3/17/08
336	4.3	DM3368 acceptance testing	100 d	7/14/08	8/18/09
337	4.3.1	Develop Test Plan	3 d	7/14/08	7/29/08
338	4.3.2	DM3368 test bench	6 d	7/30/08	9/22/08
339	4.3.2.1	Order DM3368 test hardware	1 d	7/30/08	7/31/08
340	4.3.2.2	Assemble DM3368 test bench	5 d	8/29/08	9/22/08
341	4.3.3	DM3368 test computer	16 d	7/30/08	1/20/09
342	4.3.3.1	Design DM3368 test computer	3 d	7/30/08	9/10/08
343	4.3.3.2	Order DM3368 test computer hardware	1 d	9/11/08	9/24/08
344	4.3.3.3	Build DM3368 test computer	2 d	10/23/08	11/19/08
345	4.3.3.4	Write DM3368 test computer software	10 d	11/20/08	1/20/09
346	4.3.4	Perform DM3368 acceptance tests	70 d	1/21/09	8/18/09
347	4.3.4.1	Verify Temporal Response of Several Actuato	10 d	1/21/09	2/17/09
348	4.3.4.2	Verify Hysteresis	5 d	2/18/09	3/3/09
349	4.3.4.3	Verify Open-loop Functionality at Each Actuat	5 d	3/4/09	3/17/09
350	4.3.4.4	Verify Surface Stroke	5 d	3/18/09	3/31/09
351	4.3.4.5	Verify Mirror Protection Strategy	20 d	4/1/09	6/2/09
352	4.3.4.6	Measure Actuator Influence Functions	15 d	6/2/09	7/17/09
353	4.3.4.7	Create Stand-alone DM3368 Flat Map	10 d	7/17/09	8/18/09



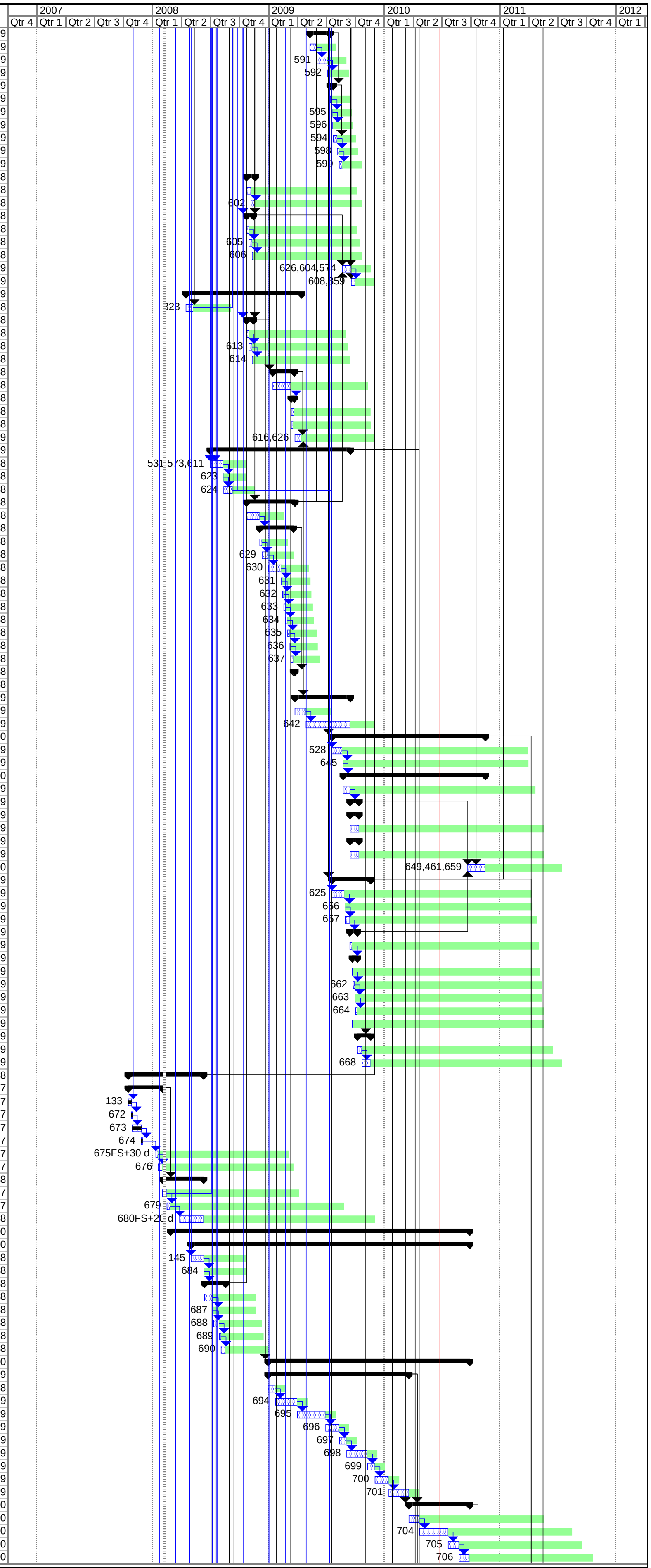
ID	WBS	Task Name	Work	Start	Finish
354	4.3.5	Document DM3368 Performance	5 d	4/1/09	8/18/09
355	4.4	DM349 procurement	7 d	2/14/08	8/25/08
356	4.4.1	Document DM349 driver requirements	3 d	2/14/08	2/26/08
357	4.4.2	Review DM349 driver requirements	2 d	2/27/08	2/27/08
358	4.4.3	Order DM349 driver	2 d	2/27/08	3/10/08
359	4.4.4	Receive DM349 driver	0 d	8/25/08	8/25/08
360	4.5	DM349 auxillary hardware	9 d	10/28/08	11/19/08
361	4.5.1	DM349 pupil mask	5 d	10/28/08	11/19/08
362	4.5.1.1	Design DM349 pupil mask	2 d	10/28/08	11/3/08
363	4.5.1.2	Build DM349 pupil mask	3 d	11/3/08	11/19/08
364	4.5.2	DM349 base	4 d	11/3/08	11/19/08
365	4.5.2.1	Design DM349 base	2 d	11/3/08	11/7/08
366	4.5.2.2	Build DM349 base	2 d	11/7/08	11/19/08
367	4.6	DM349 documentation	5 d	8/19/09	9/1/09
368	4.6.1	Document DM349 Performance	5 d	8/19/09	9/1/09
369	5	Wavefront Sensors	802.5 d	5/30/07	10/13/10
370	5.1	High-order Wavefront Sensor (HOWFS)	113 d	7/9/07	8/12/09
371	5.1.1	Procure HOWFS camera	6 d	7/9/07	8/31/07
372	5.1.2	Document HOWFS requirements	10 d	10/19/07	12/18/07
373	5.1.3	Review HOWFS requirements	9 d	12/18/07	12/19/07
374	5.1.4	Design HOWFS	25 d	12/19/07	4/17/08
375	5.1.5	Design HOWFS test bench	12 d	4/17/08	6/13/08
376	5.1.6	Procure HOWFS components	21 d	8/29/08	12/24/08
377	5.1.6.1	Procure HOWFS test bench components	2 d	8/29/08	9/11/08
378	5.1.6.2	Procure HOWFS optomechanics	2 d	9/11/08	9/23/08
379	5.1.6.3	Procure HOWFS optics (field stop, collimator,	2 d	9/23/08	10/3/08
380	5.1.6.4	Procure HOWFS lenslet exchanger	5 d	10/3/08	10/31/08
381	5.1.6.4.1	Exchanger Mechanism	2 d	10/3/08	10/15/08
382	5.1.6.4.2	Lenslet arrays	3 d	10/15/08	10/31/08
383	5.1.6.5	Procure HOWFS chopper	2 d	10/31/08	11/12/08
384	5.1.6.6	Procure HOWFS alignment fixtures	2 d	11/12/08	11/24/08
385	5.1.6.7	Build HOWFS Enclosure	6 d	11/24/08	12/24/08
386	5.1.7	Integrate HOWFS test bench	5 d	12/24/08	1/28/09
387	5.1.8	Integrate HOWFS	15 d	1/28/09	3/25/09
388	5.1.9	Characterize HOWFS Performance	10 d	7/9/09	8/12/09
389	5.1.9.1	Characterize HOWFS lab performance	6 d	7/9/09	8/12/09
390	5.1.9.1.1	Evaluate Read Noise	2 d	7/9/09	7/21/09
391	5.1.9.1.2	Evaluate Dark Current	2 d	7/21/09	7/31/09
392	5.1.9.1.3	Evaluate Sensor Linearity	2 d	7/31/09	8/12/09
393	5.1.9.2	Document HOWFS lab performance	4 d	7/21/09	8/12/09
394	5.2	Low-order Wavefront Sensor (LOWFS)	4 d	5/30/07	6/8/07
395	5.2.1	Characterize LOWFS performance	4 d	5/30/07	6/8/07
396	5.2.1.1	Characterize LOWFS lab performance	2 d	5/30/07	5/31/07
397	5.2.1.1.1	Evaluate Read Noise	1 d	5/30/07	5/30/07
398	5.2.1.1.2	Evaluate Dark Current	1 d	5/31/07	5/31/07
399	5.2.1.2	Document LOWFS lab performance	2 d	6/5/07	6/8/07
400	5.3	Truth Wavefront Sensor (TWFS)	74.5 d	3/20/09	2/1/10
401	5.3.1	Document TWFS requirements	5 d	3/20/09	4/16/09
402	5.3.2	Review TWFS requirements	4.5 d	4/17/09	4/17/09
403	5.3.3	Design TWFS	16 d	4/17/09	6/12/09
404	5.3.4	Design TWFS test bench	6 d	6/12/09	7/10/09
405	5.3.5	Procure TWFS components	15 d	9/21/09	11/17/09
406	5.3.5.1	Procure TWFS test bench components	2 d	9/21/09	10/1/09
407	5.3.5.2	Procure TWFS optomechanics	2 d	10/1/09	10/13/09
408	5.3.5.3	Procure TWFS optics (field stop, collimator, fi	2 d	10/13/09	10/23/09
409	5.3.5.4	Procure TWFS lenslet array	1 d	10/23/09	10/26/09
410	5.3.5.5	Procure TWFS alignment fixtures	2 d	10/26/09	11/5/09
411	5.3.5.6	Build TWFS Enclosure	6 d	11/5/09	11/17/09
412	5.3.6	Integrate TWFS test bench	5 d	11/17/09	12/1/09
413	5.3.7	Integrate TWFS	12 d	12/1/09	12/23/09
414	5.3.8	Characterize TWFS Performance	11 d	12/23/09	2/1/10
415	5.3.8.1	Characterize TWFS lab performance	9 d	12/23/09	2/1/10
416	5.3.8.1.1	Evaluate TWFS Read Noise	4 d	12/23/09	1/8/10
417	5.3.8.1.2	Evaluate TWFS Dark Current	3 d	1/8/10	1/20/10
418	5.3.8.1.3	Evaluate TWFS Sensor Linearity	2 d	1/20/10	2/1/10
419	5.3.8.2	Document TWFS Lab Performance	2 d	1/20/10	2/1/10
420	5.4	IR Tip/Tilt Wavefront Sensor (IRTT)	611 d	10/1/08	10/13/10
421	5.4.1	Management	34 d	10/1/08	8/9/10
422	5.4.1.1	Document IRTT requirements	13 d	10/1/08	11/19/08
423	5.4.1.1.1	IRTT Camera Scope Definition	2 d	10/1/08	10/10/08
424	5.4.1.1.2	Acquisition Mode	5 d	10/13/08	10/28/08
425	5.4.1.1.3	ROI Mode	6 d	10/29/08	11/19/08
426	5.4.1.2	Review IRTT requirements	9 d	11/20/08	11/20/08
427	5.4.1.3	Scope Planning	4 d	11/21/08	1/26/09
428	5.4.1.4	Track progress	8 d	1/27/09	8/9/10
429	5.4.2	HgCdTe Detector Characterization	102.5 d	11/21/08	12/3/09
430	5.4.2.1	Document Characterization Requirements	3 d	11/21/08	12/10/08
431	5.4.2.2	Review Characterization Requirements	2.5 d	12/11/08	12/11/08
432	5.4.2.3	Configure SNAP dewar	13 d	12/11/08	2/12/09
433	5.4.2.3.1	Configure SNAP Dewar	5 d	12/11/08	1/15/09
434	5.4.2.3.2	Verify Mechanical Fit	3 d	1/15/09	2/2/09
435	5.4.2.3.3	Verify Wiring Functionality	5 d	1/15/09	2/12/09
436	5.4.2.4	Warm vaccuum tests	16 d	2/12/09	4/21/09
437	5.4.2.4.1	Verify Vacuum (Leak Check)	4 d	2/12/09	3/6/09
438	5.4.2.4.2	Verify Thermal Stability	4 d	3/6/09	3/30/09
439	5.4.2.4.3	Verify Electrical Integrity	4 d	3/30/09	4/9/09
440	5.4.2.4.4	Verify Temperature Control	4 d	4/9/09	4/21/09
441	5.4.2.5	Cold vaccuum tests	60 d	4/21/09	11/17/09
442	5.4.2.5.1	Evaluate Detector Linearity	10 d	4/21/09	5/19/09
443	5.4.2.5.2	Verify Cooling Rate, End Temperature, a	5 d	5/19/09	6/2/09
444	5.4.2.5.3	Evaluate Cosmetic Defects	7 d	6/2/09	6/30/09
445	5.4.2.5.4	Characterize Persistence	7 d	6/30/09	7/28/09
446	5.4.2.5.5	Evaluate Noise Performance	7 d	7/28/09	8/25/09
447	5.4.2.5.6	Optimize Performance vs. Read Algorith	14 d	8/25/09	10/20/09
448	5.4.2.5.7	Verify Continuous Real-time Data Transf	10 d	10/20/09	11/17/09
449	5.4.2.6	Document HgCdTe Performance	8 d	11/17/09	12/3/09
450	5.4.3	IRTT Dewar	96 d	11/21/08	12/22/09
451	5.4.3.1	Document IRTT dewar requirements	5 d	11/21/08	1/16/09
452	5.4.3.2	Review IRTT dewar requirements	6 d	1/16/09	1/19/09
453	5.4.3.3	Design IRTT dewar	33 d	1/19/09	5/11/09
454	5.4.3.4	Procure IRTT dewar components	52 d	8/18/09	12/22/09
455	5.4.3.4.1	Dewar Procurement (tank)	2 d	8/18/09	8/28/09
456	5.4.3.4.2	Dewar Base (manufacture)	10 d	8/18/09	9/15/09
457	5.4.3.4.3	Baffles	5 d	9/15/09	11/24/09
458	5.4.3.4.4	Detector Mount	5 d	11/24/09	12/22/09
459	5.4.3.4.5	Internal Dewar Wiring	15 d	8/18/09	9/29/09
460	5.4.3.4.6	External Controller Wiring	15 d	9/29/09	11/10/09
461	5.4.4	IR Camera Electronics	57 d	11/21/08	6/22/10
462	5.4.4.1	Leach Controller	45 d	11/21/08	6/22/10
463	5.4.4.1.1	Procure Components	2 d	11/21/08	12/4/08
464	5.4.4.1.2	Freezer Test Components	3 d	1/2/09	1/19/09
465	5.4.4.1.3	Configure Controller	10 d	1/20/09	3/16/09
466	5.4.4.1.4	Verify Voltages and Clock Waveforms	15 d	2/2/10	3/30/10
467	5.4.4.1.5	Perform Video Loopback Test for Biases	5 d	3/30/10	4/27/10
468	5.4.4.1.6	Perform Short Circuit Input Test for Nois	5 d	4/27/10	5/25/10
469	5.4.4.1.7	Test ADC's using Histograms	5 d	5/25/10	6/22/10
470	5.4.4.2	Lakeshore Temperature Controller	12 d	11/21/08	2/26/09
471	5.4.4.2.1	Procure Components	2 d	11/21/08	12/4/08



ID	WBS	Task Name	Work	Start	Finish
472	5.4.4.2.2	Configure Controller	5 d	1/2/09	1/29/09
473	5.4.4.2.3	Verify Basic Operation	5 d	1/30/09	2/26/09
474	5.4.5	IRTT software	158 d	11/21/08	7/13/10
475	5.4.5.1	IRTT camera control	65 d	11/21/08	7/13/10
476	5.4.5.1.1	Document IRTT camera control requirem	10 d	11/21/08	12/22/08
477	5.4.5.1.2	Review IRTT camera control requiremen	7 d	12/23/08	12/23/08
478	5.4.5.1.3	IRTT camera control software implemen	28 d	12/24/08	3/11/09
479	4.5.1.3.1	Configure Acqisition Mode Software	5 d	12/24/08	1/6/09
480	4.5.1.3.2	Configure ROI Readout Software	5 d	1/7/09	1/20/09
481	4.5.1.3.3	Configure Multiple ROI Software	15 d	1/21/09	3/3/09
482	4.5.1.3.4	Configure Temperature Controller S	3 d	3/4/09	3/11/09
483	5.4.5.1.4	Verify IR Camera Control Software Func	10 d	6/22/10	7/13/10
484	5.4.5.1.5	Document IR Camera Software	10 d	6/15/10	7/13/10
485	5.4.5.2	IRTT user interface	38 d	4/30/09	9/29/09
486	5.4.5.2.1	Document IRTT UI requirements	6 d	4/30/09	5/27/09
487	5.4.5.2.2	Review IRTT UI requirements	7 d	5/28/09	5/28/09
488	5.4.5.2.3	IRTT UI design	5 d	5/29/09	6/11/09
489	5.4.5.2.4	IRTT UI implementation	10 d	8/18/09	9/15/09
490	5.4.5.2.5	IRTT UI functionality	5 d	9/15/09	9/29/09
491	5.4.5.2.6	Document IRTT UI software	5 d	9/15/09	9/29/09
492	5.4.5.3	IRTT-P3K interface	55 d	3/23/09	1/19/10
493	5.4.5.3.1	Define IRTT-P3K Interface Requirement	10 d	3/23/09	4/17/09
494	5.4.5.3.2	Define IRTT-P3K Interface Architecture	15 d	4/20/09	5/29/09
495	5.4.5.3.3	IRTT-P3K Interface Implementation	10 d	8/18/09	9/29/09
496	5.4.5.3.4	Test IRTT-P3K Interface Functionality	20 d	9/29/09	1/19/10
497	5.4.6	Integrate IRTT	112 d	12/22/09	8/10/10
498	5.4.6.1	Verify IRTT software control	14 d	7/13/10	8/10/10
499	5.4.6.2	Warm Vacuum Integration	15 d	12/22/09	2/2/10
500	5.4.6.2.1	Clean Components	2 d	12/22/09	12/28/09
501	5.4.6.2.2	Assemble	4 d	12/28/09	1/7/10
502	5.4.6.2.3	Verify Vacuum (Leak Check)	5 d	1/7/10	1/21/10
503	5.4.6.2.4	Verify Electrical Continuity to Detector	4 d	1/21/10	2/2/10
504	5.4.6.3	Cold Vacuum Integration	83 d	2/2/10	7/13/10
505	5.4.6.3.1	Verify Cooling Rate, End Temperature, a	5 d	2/2/10	2/16/10
506	5.4.6.3.2	Install Detector	5 d	2/16/10	3/2/10
507	5.4.6.3.3	Evaluate Cosmetic Defects	3 d	3/2/10	3/8/10
508	5.4.6.3.4	Evaluate Detector Linearity in e- per ADU	10 d	3/8/10	4/5/10
509	5.4.6.3.5	Characterize Persistence	5 d	4/5/10	4/12/10
510	5.4.6.3.6	Evaluate Noise Performance	10 d	4/12/10	4/26/10
511	5.4.6.3.7	Measure Dark Current	5 d	4/26/10	5/10/10
512	5.4.6.3.8	Optimize Performance vs. Read Algorith	20 d	5/10/10	6/7/10
513	5.4.6.3.9	Verify Continuous Real-time Data Transf	20 d	6/7/10	7/13/10
514	5.4.7	Characterize IRTT Performance	51.5 d	10/1/08	10/13/10
515	5.4.7.1	Design IRTT test bench	12 d	10/1/08	11/25/08
516	5.4.7.2	Procure IRTT test bench components	3 d	11/26/08	12/15/08
517	5.4.7.3	Integrate IRTT test bench	10 d	1/13/09	2/9/09
518	5.4.7.4	Characterize IRTT lab performance	22.5 d	8/10/10	9/21/10
519	5.4.7.4.1	Acquisition Mode	7.5 d	8/10/10	8/24/10
520	4.7.4.1.1	Measure Flat-Fielding Accuracy	7.5 d	8/10/10	8/24/10
521	5.4.7.4.2	ROI Mode	15 d	8/24/10	9/21/10
522	4.7.4.2.1	Measure Centroid Gain Curve	7.5 d	8/24/10	9/7/10
523	4.7.4.2.2	Measure Low Light Level Performar	7.5 d	9/7/10	9/21/10
524	5.4.7.5	Document HOWFS lab performance	4 d	9/21/10	10/13/10
525	6	Electronics	545 d	7/17/07	8/17/10
526	6.1	P3K NGS rack electronics	317.5 d	11/28/07	7/3/09
527	6.1.1	Document P3K NGS rack electronics requirement	15 d	11/28/07	2/12/08
528	6.1.2	Review P3K NGS rack electronics requirements	6 d	2/13/08	2/13/08
529	6.1.3	Procure electronics racks	2 d	2/14/08	2/26/08
530	6.1.4	P3K NGS controller rack	145 d	2/14/08	5/22/09
531	6.1.4.1	Layout P3K NGS Controller Rack Electronics	8 d	2/14/08	3/13/08
532	6.1.4.2	Build P3K NGS Controller Rack Electronics	100 d	7/24/08	2/27/09
533	6.1.4.2.1	Embedded AO Controller	50 d	7/24/08	2/24/09
534	1.4.2.1.1	Design embedded AO controller	7 d	7/24/08	8/13/08
535	1.4.2.1.2	Build embedded AO controller comp	23 d	9/10/08	12/2/08
536	4.2.1.2.1	Chassis	1 d	9/10/08	9/12/08
537	4.2.1.2.2	Video Daughter Board	2 d	9/15/08	9/19/08
538	4.2.1.2.3	RTC Boards	5 d	9/22/08	10/8/08
539	4.2.1.2.4	DM Interface Boards	5 d	10/8/08	10/24/08
540	4.2.1.2.5	IP Carrier Board	8 d	10/27/08	11/21/08
541	2.1.2.5.1	DAC Module	2 d	10/27/08	10/31/08
542	2.1.2.5.2	ADC Module	2 d	11/3/08	11/7/08
543	2.1.2.5.3	Serial Port Module	2 d	11/10/08	11/14/08
544	2.1.2.5.4	DIO Module	2 d	11/17/08	11/21/08
545	4.2.1.2.6	Power Supply	2 d	11/24/08	12/2/08
546	1.4.2.1.3	Perform Benchmarks	10 d	12/3/08	12/30/08
547	1.4.2.1.4	Verify Interfaces	10 d	12/30/08	2/24/09
548	6.1.4.2.2	HOWFS Camera Controller Chassis	8 d	7/24/08	9/9/08
549	1.4.2.2.1	HOWFS Camera Controller	5 d	7/24/08	8/21/08
550	1.4.2.2.2	LGS Timing Board	3 d	8/21/08	9/9/08
551	6.1.4.2.3	LOWFS Camera Controller	3 d	9/9/08	9/25/08
552	1.4.2.3.1	LOWFS Camera Controller	3 d	9/9/08	9/25/08
553	6.1.4.2.4	Auxilliary controllers	6 d	9/25/08	10/29/08
554	1.4.2.4.1	Chopper Controller	3 d	9/25/08	10/13/08
555	1.4.2.4.2	Video Switchbox	3 d	10/13/08	10/29/08
556	6.1.4.2.5	Motion Controllers	13 d	7/24/08	10/2/08
557	1.4.2.5.1	Procure Motion Controller	3 d	7/24/08	8/4/08
558	1.4.2.5.2	Configure Motion Controller	5 d	9/2/08	9/18/08
559	1.4.2.5.3	Verify Motion Controller Functionalit	5 d	9/18/08	10/2/08
560	6.1.4.2.6	Monster Motor Cable Panel	10 d	10/2/08	1/2/09
561	1.4.2.6.1	Design Monster Motor Cable Panel	5 d	10/2/08	10/30/08
562	1.4.2.6.2	Implement Monster Motor Cable Pa	5 d	12/1/08	1/2/09
563	6.1.4.2.7	Rack Power Supply	10 d	1/5/09	2/27/09
564	1.4.2.7.1	Power supply	5 d	1/5/09	1/30/09
565	1.4.2.7.2	Remote Power Switch	5 d	2/2/09	2/27/09
566	6.1.4.3	Modify controller rack for P200 installation	12 d	7/24/08	8/27/08
567	6.1.4.3.1	Cooling Enclosure	5 d	7/24/08	8/7/08
568	6.1.4.3.2	Heat Exchanger	5 d	8/7/08	8/21/08
569	6.1.4.3.3	Mounting hardware	2 d	8/21/08	8/27/08
570	6.1.4.4	Integrate P3K NGS Controller Rack Electroni	10 d	3/2/09	4/24/09
571	6.1.4.5	Verify P3K NGS Controller Electronics Functi	15 d	4/27/09	5/22/09
572	6.1.5	Lights and Drivers Rack	107.5 d	2/14/08	7/3/09
573	6.1.5.1	Layout lights and drivers rack electronics	8 d	2/14/08	3/31/08
574	6.1.5.2	Build lights and drivers rack electronics	66.5 d	7/24/08	5/22/09
575	6.1.5.2.1	Laser Plate	21.5 d	7/24/08	10/29/08
576	1.5.2.1.1	Design laser plate	3 d	7/24/08	8/1/08
577	1.5.2.1.2	Order laser plate optomechanics	2 d	8/1/08	8/7/08
578	1.5.2.1.3	HeNe Laser Source	4 d	9/4/08	9/16/08
579	5.2.1.3.1	633nm HeNe laser	1 d	9/4/08	9/8/08
580	5.2.1.3.2	Power supply	1 d	9/8/08	9/10/08
581	5.2.1.3.3	633nm HeNe laser shutter or r	2 d	9/10/08	9/16/08
582	1.5.2.1.4	NGS Light Source	7 d	9/16/08	10/6/08
583	5.2.1.4.1	NGS light soure	3 d	9/16/08	9/24/08
584	5.2.1.4.2	NGS light source power supply	1 d	9/24/08	9/26/08
585	5.2.1.4.3	NGS light source brightness cc	3 d	9/26/08	10/6/08
586	1.5.2.1.5	LGS Light Source	5.5 d	10/6/08	10/29/08
587	5.2.1.5.1	LGS light source	3 d	10/6/08	10/22/08
588	5.2.1.5.2	LGS light source power supply	1 d	10/22/08	10/24/08
589	5.2.1.5.3	LGS light source brightness co	1.5 d	10/24/08	10/29/08



ID	WBS	Task Name	Work	Start	Finish
590	6.1.5.2.2	DM 349 Driver	23 d	2/9/09	4/14/09
591	1.5.2.2.1	Interface Board	8 d	2/9/09	3/3/09
592	1.5.2.2.2	Driver Boards	12 d	3/3/09	4/6/09
593	1.5.2.2.3	DM 349 Cable Interface Panel	3 d	4/6/09	4/14/09
594	6.1.5.2.3	Fiber Interface Panel	4 d	4/14/09	4/24/09
595	1.5.2.3.1	Shutter Connector	2 d	4/14/09	4/20/09
596	1.5.2.3.2	White Light Fiber Connector	1 d	4/20/09	4/22/09
597	1.5.2.3.3	Laser Fiber Connector	1 d	4/22/09	4/24/09
598	6.1.5.2.4	High Voltage Power Supply	4 d	4/24/09	5/6/09
599	6.1.5.2.5	Video Monitor	2 d	5/6/09	5/12/09
600	6.1.5.2.6	Cooling Fan	2 d	5/12/09	5/22/09
601	6.1.5.2.7	Rack Power Supply	10 d	7/24/08	8/21/08
602	1.5.2.7.1	Power supply	5 d	7/24/08	8/7/08
603	1.5.2.7.2	Remote Power Switch	5 d	8/7/08	8/21/08
604	6.1.5.3	Modify lights and drivers rack for P200 installa	8 d	7/24/08	8/15/08
605	6.1.5.3.1	Cooling Enclosure	3 d	7/24/08	8/1/08
606	6.1.5.3.2	Heat Exchanger	3 d	8/1/08	8/11/08
607	6.1.5.3.3	Mounting hardware	2 d	8/11/08	8/15/08
608	6.1.5.4	Integrate Lights and Drivers Rack Electronics	10 d	5/22/09	6/19/09
609	6.1.5.5	Verify Lights and Drivers Electronics Function	15 d	6/19/09	7/3/09
610	6.1.6	DM3368 Rack	42 d	1/15/08	1/14/09
611	6.1.6.1	Layout DM3368 rack electronics	4 d	1/15/08	2/7/08
612	6.1.6.2	Modify DM3368 rack for P200 installation	8 d	7/24/08	8/15/08
613	6.1.6.2.1	Cooling Enclosure	3 d	7/24/08	8/1/08
614	6.1.6.2.2	Heat Exchanger	3 d	8/1/08	8/11/08
615	6.1.6.2.3	Mounting hardware	2 d	8/11/08	8/15/08
616	6.1.6.3	Install DM3368 Electronics	15 d	10/15/08	12/22/08
617	6.1.6.3.1	DM3368 Drivers	10 d	10/15/08	12/12/08
618	6.1.6.3.2	Power Supply	5 d	12/12/08	12/22/08
619	1.6.3.2.1	Power supply	3 d	12/12/08	12/22/08
620	1.6.3.2.2	Remote power switch	2 d	12/12/08	12/18/08
621	6.1.6.4	Verify DM 3368 electronics functionality	15 d	12/24/08	1/14/09
622	6.2	P3K NGS Cabling	84 d	4/1/08	6/17/09
623	6.2.1	Document P3K NGS cabling requirements	10 d	4/1/08	5/12/08
624	6.2.2	Review P3K NGS cabling requirements	3 d	5/13/08	5/13/08
625	6.2.3	Design P3K NGS cabling	10 d	5/13/08	6/11/08
626	6.2.4	Build P3K NGS Cables	37 d	7/24/08	12/24/08
627	6.2.4.1	Rack - Rack Cables	10 d	7/24/08	9/4/08
628	6.2.4.2	Bench - Rack Cables	26 d	9/4/08	12/19/08
629	6.2.4.2.1	Monster Motor Cable	2 d	9/4/08	9/11/08
630	6.2.4.2.2	DM 349 Cables	5 d	9/11/08	10/2/08
631	6.2.4.2.3	DM 3326 Cables	10 d	10/2/08	11/11/08
632	6.2.4.2.4	Laser Light Source Fiber	1 d	11/11/08	11/14/08
633	6.2.4.2.5	NGS Source Fiber	1 d	11/14/08	11/19/08
634	6.2.4.2.6	Yellow Light Fiber	1 d	11/19/08	11/24/08
635	6.2.4.2.7	HOWFS Power Cable	1 d	11/24/08	12/1/08
636	6.2.4.2.8	HOWFS Data Cable	2 d	12/1/08	12/8/08
637	6.2.4.2.9	LOWFS Power Cable	1 d	12/8/08	12/11/08
638	5.2.4.2.10	LOWFS Data Cable	2 d	12/11/08	12/19/08
639	6.2.4.3	Rack - Instrument Cables	1 d	12/19/08	12/24/08
640	6.2.4.3.1	Instrument Shutter Signal Cable	1 d	12/19/08	12/24/08
641	6.2.5	Document P3K NGS Cabling	24 d	12/24/08	6/17/09
642	6.2.5.1	Document P3K NGS Installation and Deinstal	4 d	12/24/08	1/28/09
643	6.2.5.2	Document P3K LGS Full System Schematics	20 d	1/28/09	6/17/09
644	6.3	P3K LGS rack electronics	34.5 d	4/20/09	8/17/10
645	6.3.1	Document P3K LGS rack electronics requirements	7.5 d	4/20/09	5/22/09
646	6.3.2	Review rack electronics requirements	3 d	5/25/09	5/25/09
647	6.3.3	P3K LGS Controller Rack	24 d	5/25/09	8/17/10
648	6.3.3.1	Layout P3K LGS Controller Rack Electronics	4 d	5/25/09	6/16/09
649	6.3.3.2	Build P3K LGS Controller Rack Electronics	10 d	6/16/09	7/14/09
650	6.3.3.2.1	TWFS Camera Controller Chassis	5 d	6/16/09	7/14/09
651	3.3.2.1.1	TWFS Camera Controller	5 d	6/16/09	7/14/09
652	6.3.3.2.2	IRTT Camera Controller Chassis	5 d	6/16/09	7/14/09
653	3.3.2.2.1	IRTT Camera Controller	5 d	6/16/09	7/14/09
654	6.3.3.3	Integrate P3K LGS Controller Rack Electronic	10 d	6/22/10	8/17/10
655	6.4	P3K LGS Cabling	34 d	4/20/09	8/20/09
656	6.4.1	Document P3K LGS cabling requirements	10 d	4/20/09	5/29/09
657	6.4.2	Review P3K LGS cabling requirements	3 d	6/1/09	6/1/09
658	6.4.3	Design P3K LGS cabling	5 d	6/1/09	6/15/09
659	6.4.4	Build P3K LGS Cables	10 d	6/15/09	7/9/09
660	6.4.4.1	Rack - Rack Cables	3 d	6/15/09	6/23/09
661	6.4.4.2	Bench - Rack Cables	7 d	6/23/09	7/9/09
662	6.4.4.2.1	TWFS Power Cable	1 d	6/23/09	6/25/09
663	6.4.4.2.2	TWFS Data Cable	2 d	6/25/09	7/1/09
664	6.4.4.2.3	IRTT Power Cable	1 d	7/1/09	7/3/09
665	6.4.4.2.4	IRTT Data Cable	2 d	7/3/09	7/9/09
666	6.4.4.2.5	Temperature controller cables	1 d	6/23/09	6/25/09
667	6.4.5	Document P3K LGS Cabling	6 d	7/9/09	8/20/09
668	6.4.5.1	Document P3K LGS Installation and Deinstall	2 d	7/9/09	7/23/09
669	6.4.5.2	Document P3K LGS Full System Schematics	4 d	7/23/09	8/20/09
670	6.5	Wavefront Processor	75 d	7/17/07	3/11/08
671	6.5.1	Wavefront Processor Development System	43 d	7/17/07	11/2/07
672	6.5.1.1	Document WFP requirements	2 d	7/17/07	7/27/07
673	6.5.1.2	Review WFP requirements	4 d	7/27/07	7/30/07
674	6.5.1.3	Design WFP development system	20 d	7/30/07	8/27/07
675	6.5.1.4	Procure WFP development system	2 d	8/27/07	8/31/07
676	6.5.1.5	Integrate WFP development system	5 d	10/12/07	10/19/07
677	6.5.1.6	Evaluate WFP development system performa	10 d	10/19/07	11/2/07
678	6.5.2	Wavefront Processor	32 d	11/2/07	3/11/08
679	6.5.2.1	Design WFP	10 d	11/2/07	11/16/07
680	6.5.2.2	Procure WFP	7 d	11/16/07	11/28/07
681	6.5.2.3	Integrate WFP chassis	15 d	12/26/07	3/11/08
682	7	Embedded Systems	502 d	11/28/07	6/28/10
683	7.1	Supervisory Control Software	182 d	2/1/08	6/28/10
684	7.1.1	Document Requirements	7 d	2/1/08	3/12/08
685	7.1.2	Review Requirements	6 d	3/13/08	3/13/08
686	7.1.3	Embedded control software architecture	25 d	3/14/08	5/19/08
687	7.1.3.1	Design Software Architecture	10 d	3/14/08	4/10/08
688	7.1.3.2	Review Software Architecture	2 d	4/11/08	4/11/08
689	7.1.3.3	Design Software Interfaces	6 d	4/11/08	4/29/08
690	7.1.3.4	Document Constraints	2 d	4/29/08	5/5/08
691	7.1.3.5	Document Architecture	5 d	5/5/08	5/19/08
692	7.1.4	Software Implementation	144 d	9/30/08	6/28/10
693	7.1.4.1	P3K NGS Supervisory Control software imple	110 d	9/30/08	12/18/09
694	7.1.4.1.1	Main Supervisory Control	6 d	9/30/08	10/23/08
695	7.1.4.1.2	Command Processor	16 d	10/23/08	1/1/09
696	7.1.4.1.3	Motion Control	22 d	1/1/09	3/31/09
697	7.1.4.1.4	Video Control	11 d	3/31/09	5/13/09
698	7.1.4.1.5	High-Order WFS Control	6 d	5/13/09	6/5/09
699	7.1.4.1.6	HOWFP Download/Upload Data Control	16 d	6/5/09	8/10/09
700	7.1.4.1.7	LOWFP Download/Upload Data Control	6 d	8/10/09	9/2/09
701	7.1.4.1.8	Instrument Shutter Signal	11 d	9/2/09	10/16/09
702	7.1.4.1.9	Status Monitoring	16 d	10/16/09	12/18/09
703	7.1.4.2	P3K LGS Supervisory Control software imple	34 d	12/18/09	6/28/10
704	7.1.4.2.1	Truth WFS Control	6 d	12/18/09	1/21/10
705	7.1.4.2.2	Tip/Tilt WFS Control	16 d	1/21/10	4/21/10
706	7.1.4.2.3	TWFP Download/Upload Data Control	6 d	4/21/10	5/25/10
707	7.1.4.2.4	TTWFP Download/Upload Data Control	6 d	5/25/10	6/28/10



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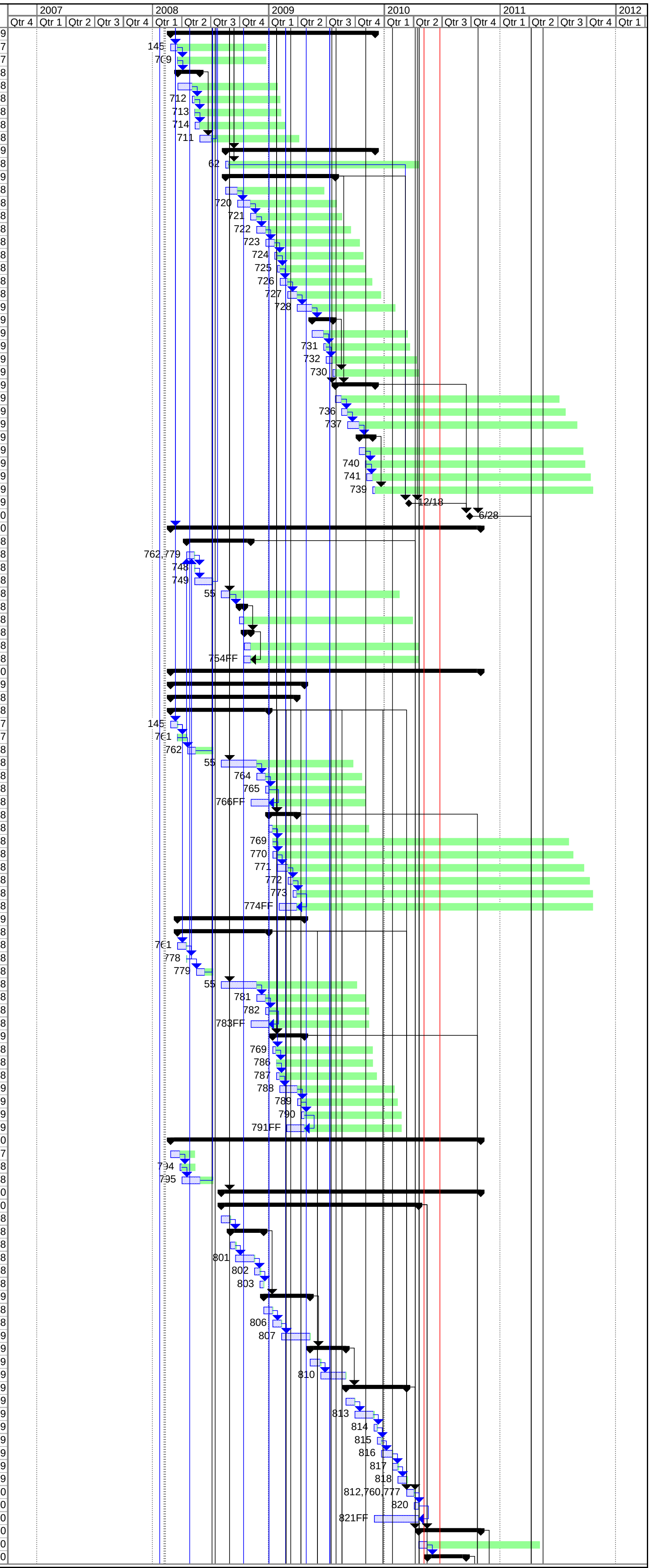
708	7.2	RTC Software	320 d	11/28/07	9/3/09
709	7.2.1	Document Requirements	12 d	11/28/07	12/19/07
710	7.2.2	Review Requirements	6 d	12/20/07	12/20/07
711	7.2.3	RTC Software Architecture	30 d	12/21/07	2/28/08
712	7.2.3.1	Architecture Design	20 d	12/21/07	2/4/08
713	7.2.3.2	Document Constraints	3 d	2/4/08	2/12/08
714	7.2.3.3	Review Architecture	2 d	2/12/08	2/13/08
715	7.2.3.4	Document Architecture	5 d	2/13/08	2/28/08
716	7.2.4	Design Control Algorithms	20 d	2/28/08	4/4/08
717	7.2.5	Write RTC Software	252 d	5/19/08	9/3/09
718	7.2.5.1	Build Reconstructors	5 d	5/19/08	5/29/08
719	7.2.5.2	P3K NGS RTC software implementation	180 d	5/19/08	4/30/09
720	7.2.5.2.1	DSP Control Routines	20 d	5/19/08	6/26/08
721	7.2.5.2.2	Scale Control Routines to Multiple DSP's	20 d	6/26/08	8/6/08
722	7.2.5.2.3	Interface to HOWFS Camera	10 d	8/6/08	8/25/08
723	7.2.5.2.4	Telemetry Data Upload	15 d	8/25/08	9/23/08
724	7.2.5.2.5	Interface to DM	15 d	9/23/08	10/21/08
725	7.2.5.2.6	Interface to TTM	5 d	10/21/08	10/30/08
726	7.2.5.2.7	Interface to UTT	5 d	10/30/08	11/7/08
727	7.2.5.2.8	Servo Algorithms	10 d	11/7/08	12/1/08
728	7.2.5.2.9	Process WFP Tables Load	15 d	12/1/08	12/31/08
729	.2.5.2.10	Telemetry Subsystem	25 d	12/31/08	2/16/09
730	.2.5.2.11	Verify RTC Software	36 d	2/16/09	4/23/09
731	.5.2.11.1	Verify Function Points	20 d	2/16/09	3/25/09
732	.5.2.11.2	Verify Error Handling	4 d	3/25/09	4/1/09
733	.5.2.11.3	Evaluate Performance	12 d	4/1/09	4/23/09
734	.2.5.2.12	Document Performance	4 d	4/23/09	4/30/09
735	7.2.5.3	P3K LGS RTC software implementation	67 d	4/30/09	9/3/09
736	7.2.5.3.1	Interface to TWFS Camera	10 d	4/30/09	5/20/09
737	7.2.5.3.2	Interface to IRTT Camera	10 d	5/20/09	6/8/09
738	7.2.5.3.3	Telemetry Subsystem	20 d	6/8/09	7/15/09
739	7.2.5.3.4	Verify RTC Software	23 d	7/15/09	8/26/09
740	.2.5.3.4.1	Verify Function Points	10 d	7/15/09	8/3/09
741	.2.5.3.4.2	Verify Error Handling	3 d	8/3/09	8/7/09
742	.2.5.3.4.3	Evaluate Performance	10 d	8/7/09	8/26/09
743	7.2.5.3.5	Document Performance	4 d	8/26/09	9/3/09
744	7.3	P3K NGS embedded systems complete	0 d	12/18/09	12/18/09
745	7.4	P3K LGS embedded systems complete	0 d	6/28/10	6/28/10
746	8	Operations Systems	653 d	11/28/07	8/2/10
747	8.1	Dataroom workstation	38.5 d	1/17/08	8/6/08
748	8.1.1	Document dataroom workstation requirements	4 d	1/17/08	2/11/08
749	8.1.2	Review dataroom workstation requirements	3.5 d	2/11/08	2/11/08
750	8.1.3	Design dataroom workstation	10 d	2/12/08	4/8/08
751	8.1.4	Procure dataroom workstation components	5 d	5/6/08	6/3/08
752	8.1.5	Integrate dataroom workstation components	5 d	7/2/08	7/17/08
753	8.1.5.1	placeholder	5 d	7/2/08	7/17/08
754	8.1.6	Evaluate dataroom workstation performance	7 d	7/18/08	8/6/08
755	8.1.6.1	placeholder	7 d	7/18/08	8/6/08
756	8.1.7	Document dataroom workstation	4 d	7/16/08	8/6/08
757	8.2	Operations Software	614.5 d	11/28/07	8/2/10
758	8.2.1	Telemetry Database	125.5 d	11/28/07	1/23/09
759	8.2.1.1	AO Data Recorder (AODR)	61.5 d	11/28/07	12/30/08
760	8.2.1.1.1	P3K NGS AO Data Recorder	41 d	11/28/07	10/2/08
761	.2.1.1.1.1	Document AODR requirements	4 d	11/28/07	12/19/07
762	.2.1.1.1.2	Review AODR requirements	3 d	12/20/07	12/20/07
763	.2.1.1.1.3	Update AODR Architecture	5 d	1/21/08	2/15/08
764	.2.1.1.1.4	AODR Implementation	20 d	5/6/08	8/25/08
765	.2.1.1.1.5	Verify AODR Functionality	5 d	8/26/08	9/22/08
766	.2.1.1.1.6	Evaluate AODR Performance	2 d	9/23/08	10/2/08
767	.2.1.1.1.7	Document AODR Tool	2 d	8/8/08	10/2/08
768	8.2.1.1.2	P3K LGS AO Data Recorder	20.5 d	10/3/08	12/30/08
769	.2.1.1.2.1	Document Requirements	2 d	10/3/08	10/14/08
770	.2.1.1.2.2	Review Requirements	3 d	10/15/08	10/15/08
771	.2.1.1.2.3	Update AODR Architecture	2.5 d	10/15/08	10/29/08
772	.2.1.1.2.4	AODR Implementation	6 d	10/29/08	12/2/08
773	.2.1.1.2.5	Verify AODR Functionality	3 d	12/2/08	12/18/08
774	.2.1.1.2.6	Evaluate AODR Performance	2 d	12/18/08	12/30/08
775	.2.1.1.2.7	Document AODR Tool	2 d	11/4/08	12/30/08
776	8.2.1.2	AO Data Server (AODS)	64 d	12/20/07	1/23/09
777	8.2.1.2.1	P3K NGS AO Data Server	41 d	12/20/07	10/2/08
778	.2.1.2.1.1	Document AODS requirements	4 d	12/20/07	1/16/08
779	.2.1.2.1.2	Review AODS requirements	3 d	1/17/08	1/17/08
780	.2.1.2.1.3	Update AODS Architecture	5 d	2/18/08	3/14/08
781	.2.1.2.1.4	AODS Implementation	20 d	5/6/08	8/25/08
782	.2.1.2.1.5	Verify AODS Functionality	5 d	8/26/08	9/22/08
783	.2.1.2.1.6	Evaluate AODS Performance	2 d	9/23/08	10/2/08
784	.2.1.2.1.7	Document AODS Tool	2 d	8/8/08	10/2/08
785	8.2.1.2.2	P3K LGS AO Data Server	23 d	10/15/08	1/23/09
786	.2.1.2.2.1	Document Requirements	2 d	10/15/08	10/24/08
787	.2.1.2.2.2	Review Requirements	3 d	10/27/08	10/27/08
788	.2.1.2.2.3	Update AODS Architecture	2 d	10/27/08	11/6/08
789	.2.1.2.2.4	AODS Implementation	10 d	11/6/08	1/1/09
790	.2.1.2.2.5	Verify AODS Functionality	2 d	1/1/09	1/13/09
791	.2.1.2.2.6	Evaluate AODS Performance	2 d	1/13/09	1/23/09
792	.2.1.2.2.7	Document AODS Tool	2 d	11/28/08	1/23/09
793	8.2.2	User interface	207 d	11/28/07	8/2/10
794	8.2.2.1	Document user interface requirements	5 d	11/28/07	12/27/07
795	8.2.2.2	Review user interface requirements	6 d	12/28/07	1/2/08
796	8.2.2.3	Design user interface	10 d	1/3/08	2/29/08
797	8.2.2.4	User interface implementation	186 d	5/6/08	8/2/10
798	8.2.2.4.1	P3K NGS UI implementation	146 d	5/6/08	1/18/10
799	.2.2.4.1.1	P3K NGS Command Handler	5 d	5/6/08	6/3/08
800	.2.2.4.1.2	Automations	18 d	6/4/08	9/16/08
801	.2.4.1.2.1	Select Light Source	3 d	6/4/08	6/19/08
802	.2.4.1.2.2	DM-to-Lenslet Registration	10 d	6/20/08	8/18/08
803	.2.4.1.2.3	HOWFS Skies	3 d	8/19/08	9/4/08
804	.2.4.1.2.4	LOWFS Skies	2 d	9/5/08	9/16/08
805	.2.2.4.1.3	Background Processes	25 d	9/17/08	2/9/09
806	.2.4.1.3.1	Tip/Tilt Offloading	5 d	9/17/08	10/14/08
807	.2.4.1.3.2	Focus Offloading	5 d	10/15/08	11/11/08
808	.2.4.1.3.3	Other	15 d	11/12/08	2/9/09
809	.2.2.4.1.4	GUI	26 d	2/10/09	6/3/09
810	.2.4.1.4.1	Command Control (Buttons)	6 d	2/10/09	3/13/09
811	.2.4.1.4.2	Plots	20 d	3/16/09	6/3/09
812	.2.2.4.1.5	External Interfaces	49 d	6/3/09	12/11/09
813	.2.4.1.5.1	AO Supervisory Control	5 d	6/3/09	7/1/09
814	.2.4.1.5.2	Acquisition Cameras	15 d	7/1/09	8/28/09
815	.2.4.1.5.3	BTO	3 d	8/31/09	9/10/09
816	.2.4.1.5.4	Laser Control Computer	3 d	9/10/09	9/23/09
817	.2.4.1.5.5	Science Instruments	10 d	9/23/09	10/28/09
818	.2.4.1.5.6	Telescope	5 d	10/28/09	11/13/09
819	.2.4.1.5.7	Safety Systems	8 d	11/13/09	12/11/09
820	.2.2.4.1.6	Verify TAO Functionality	8 d	12/11/09	1/4/10
821	.2.2.4.1.7	Evaluate TAO Performance	5 d	1/4/10	1/18/10
822	.2.2.4.1.8	Document TAO	10 d	8/31/09	1/18/10
823	8.2.2.4.2	P3K LGS UI implementation	40 d	1/18/10	8/2/10
824	.2.2.4.2.1	P3K LGS Command Handler	5 d	1/18/10	2/15/10
825	.2.2.4.2.2	Automations	22 d	2/15/10	6/17/10



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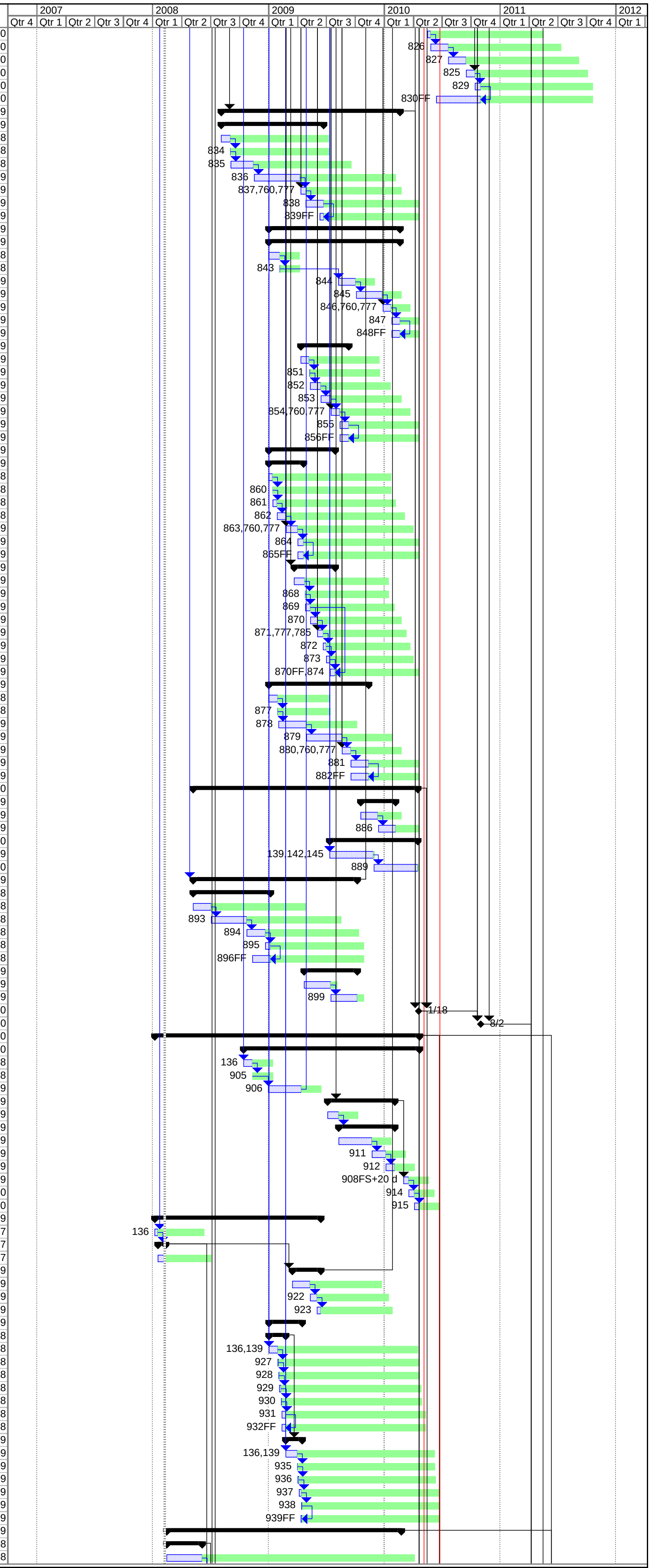
826	2.4.2.2.1	TWFS Skies	2 d	2/15/10	2/25/10
827	2.4.2.2.2	TT WFS Skies	10 d	2/25/10	4/22/10
828	2.4.2.2.3	TWFS Focus Loops	10 d	4/22/10	6/17/10
829	2.2.4.2.3	Verify TAO Functionality	5 d	6/17/10	7/15/10
830	2.2.4.2.4	Evaluate TAO Performance	3 d	7/15/10	8/2/10
831	2.2.4.2.5	Document TAO	5 d	3/15/10	8/2/10
832	8.2.3	Tools and automations	233 d	5/6/08	11/20/09
833	8.2.3.1	Performance Monitoring Stripcharts Tool	31 d	5/6/08	3/24/09
834	8.2.3.1.1	Document AO stripchart requirements	2 d	5/6/08	6/3/08
835	8.2.3.1.2	Review AO stripchart requirements	5 d	6/4/08	6/4/08
836	8.2.3.1.3	Stripcharts Tool Design	5 d	6/5/08	8/15/08
837	8.2.3.1.4	Stripcharts Tool Implementation	10 d	8/18/08	1/9/09
838	8.2.3.1.5	Verify Stripcharts Tool Functionality	3 d	1/12/09	1/27/09
839	8.2.3.1.6	Evaluate Stripcharts Tool Performance	4 d	1/28/09	3/24/09
840	8.2.3.1.7	Document Stripcharts Tool	2 d	3/13/09	3/24/09
841	8.2.3.2	Background Processes	88 d	10/3/08	11/20/09
842	8.2.3.2.1	Flatmap Updater	50 d	10/3/08	11/20/09
843	2.3.2.1.1	Document Requirements	5 d	10/3/08	11/6/08
844	2.3.2.1.2	Review Requirements	5 d	11/7/08	11/7/08
845	2.3.2.1.3	Flatmap Updater Design	10 d	5/11/09	7/3/09
846	2.3.2.1.4	Flatmap Updater Implementation	15 d	7/6/09	9/25/09
847	2.3.2.1.5	Verify Tool Functionality	5 d	9/28/09	10/23/09
848	2.3.2.1.6	Evaluate Tool Performance	5 d	10/26/09	11/20/09
849	2.3.2.1.7	Document Tool	5 d	10/26/09	11/20/09
850	8.2.3.2.2	Flexure and Atmospheric Refraction Cor	38 d	1/12/09	6/12/09
851	2.3.2.2.1	Document Requirements	5 d	1/12/09	2/6/09
852	2.3.2.2.2	Review Requirements	6 d	2/9/09	2/10/09
853	2.3.2.2.3	Flexure and Atmospheric Refractior	6 d	2/10/09	3/16/09
854	2.3.2.2.4	Flexure and Atmospheric Refractior	6 d	3/16/09	4/17/09
855	2.3.2.2.5	Verify Tool Functionality	5 d	4/17/09	5/15/09
856	2.3.2.2.6	Evaluate Tool Performance	5 d	5/15/09	6/12/09
857	2.3.2.2.7	Document Tool	5 d	5/15/09	6/12/09
858	8.2.3.3	LGS Automations	44 d	10/3/08	4/30/09
859	8.2.3.3.1	LOWFS Acquisition	23 d	10/3/08	1/20/09
860	2.3.3.1.1	Document Requirements	2 d	10/3/08	10/14/08
861	2.3.3.1.2	Review Requirements	2.5 d	10/15/08	10/15/08
862	2.3.3.1.3	LOWFS Acquisition Design	2.5 d	10/15/08	10/29/08
863	2.3.3.1.4	LOWFS Acquisition Implementation	5 d	10/29/08	11/26/08
864	2.3.3.1.5	Verify LOWFS Acquisition Function	5 d	11/26/08	1/2/09
865	2.3.3.1.6	Evaluate LOWFS Acquisition Perfor	3 d	1/2/09	1/20/09
866	2.3.3.1.7	Document LOWFS Acquisition	3 d	1/2/09	1/20/09
867	8.2.3.3.2	TWFS Acquisition	21 d	12/22/08	4/30/09
868	2.3.3.2.1	Document Requirements	2 d	12/22/08	1/23/09
869	2.3.3.2.2	Review Requirements	2 d	1/26/09	1/26/09
870	2.3.3.2.3	TWFS Acquisition Design	3 d	1/26/09	2/11/09
871	2.3.3.2.4	TWFS Acquisition Implementation	4 d	2/11/09	3/5/09
872	2.3.3.2.5	Verify TWFS Acquisition Functional	3 d	3/5/09	3/23/09
873	2.3.3.2.6	Evaluate TWFS Acquisition Perforr	2 d	3/23/09	4/2/09
874	2.3.3.2.7	Optimize TWFS Acquisition Perforr	2 d	4/2/09	4/14/09
875	2.3.3.2.8	Document TWFS Acquisition	3 d	4/14/09	4/30/09
876	8.2.3.4	Phase Retrieval Tool	70 d	10/3/08	8/13/09
877	8.2.3.4.1	Document Requirements	5 d	10/3/08	10/30/08
878	8.2.3.4.2	Review Requirements	5 d	10/31/08	10/31/08
879	8.2.3.4.3	Phase Retrieval Tool Design	15 d	11/3/08	1/29/09
880	8.2.3.4.4	Phase Retrieval Tool Implementation	20 d	1/30/09	5/21/09
881	8.2.3.4.5	Verify Phase Retrieval Tool Functionality	5 d	5/22/09	6/18/09
882	8.2.3.4.6	Evaluate Phase Retrieval Tool Performa	10 d	6/19/09	8/13/09
883	8.2.3.4.7	Document Phase Retrieval Tool	10 d	6/19/09	8/13/09
884	8.2.4	Engineering Support Software	49 d	2/7/08	1/15/10
885	8.2.4.1	Legacy MATLAB routines	8 d	7/20/09	11/6/09
886	8.2.4.1.1	Review Legacy Routines	4 d	7/20/09	9/11/09
887	8.2.4.1.2	Update Routines	4 d	9/14/09	11/6/09
888	8.2.4.2	Legacy IDL routines	20 d	4/13/09	1/15/10
889	8.2.4.2.1	Review Legacy Routines	10 d	4/13/09	8/28/09
890	8.2.4.2.2	Update Routines	10 d	8/31/09	1/15/10
891	8.2.4.3	SciMeasure Lil Joe Interface	21 d	2/7/08	7/9/09
892	8.2.4.3.1	Lil Joe Sequences	15 d	2/7/08	10/8/08
893	2.4.3.1.1	Document Requirements	2 d	2/7/08	4/4/08
894	2.4.3.1.2	Generate Sequences	4 d	4/4/08	7/25/08
895	2.4.3.1.3	Verify Operation	4 d	7/25/08	9/22/08
896	2.4.3.1.4	Evaluate Performance	3 d	9/22/08	10/8/08
897	2.4.3.1.5	Document Sequences	2 d	8/12/08	10/8/08
898	8.2.4.3.2	Lil Joe Calibration / Testing Software on	6 d	1/22/09	7/9/09
899	2.4.3.2.1	Review Software Functionality	3 d	1/22/09	4/16/09
900	2.4.3.2.2	Verify Software Functionality	3 d	4/16/09	7/9/09
901	8.3	P3K NGS operations systems complete	0 d	1/18/10	1/18/10
902	8.4	P3K LGS operations systems complete	0 d	8/2/10	8/2/10
903	9	Observatory Infrastructure	127.5 d	10/9/07	1/21/10
904	9.1	Hale Telescope	76.5 d	7/15/08	1/21/10
905	9.1.1	Document Requirements	3 d	7/15/08	8/12/08
906	9.1.2	Review Requirements	2.5 d	8/12/08	8/12/08
907	9.1.3	Design P200 Mods	20 d	10/1/08	1/13/09
908	9.1.4	Implement P200 Mods	33 d	4/6/09	11/4/09
909	9.1.4.1	Top-End Counterweights	5 d	4/6/09	5/11/09
910	9.1.4.2	Cass Cage	28 d	5/11/09	11/4/09
911	9.1.4.2.1	Glycol Lines	15 d	5/11/09	8/24/09
912	9.1.4.2.2	Power	8 d	8/24/09	10/7/09
913	9.1.4.2.3	Communications	5 d	10/7/09	11/4/09
914	9.1.5	Verify P200 Functionality	6 d	12/2/09	12/18/09
915	9.1.6	Evaluate P200 Systems Performance	6 d	12/18/09	1/5/10
916	9.1.7	Document P200 Systems	6 d	1/5/10	1/21/10
917	9.2	AO Laboratory	28 d	10/9/07	3/16/09
918	9.2.1	Document AO Lab Requirements	2 d	10/9/07	10/19/07
919	9.2.2	P3K Instrument lab upgrades	10 d	10/19/07	11/12/07
920	9.2.2.1	Implement AO lab reorganization	10 d	10/19/07	11/12/07
921	9.2.3	P3K AO lab upgrades	16 d	12/16/08	3/16/09
922	9.2.3.1	Glycol Lines	10 d	12/16/08	2/10/09
923	9.2.3.2	Power	4 d	2/10/09	3/4/09
924	9.2.3.3	Communications	2 d	3/4/09	3/16/09
925	9.3	P18 MASS / DIMM	23 d	10/3/08	1/16/09
926	9.3.1	Hardware	13.5 d	10/3/08	11/25/08
927	9.3.1.1	Document Requirements	2 d	10/3/08	10/31/08
928	9.3.1.2	Review Requirements	1.5 d	10/31/08	11/3/08
929	9.3.1.3	Design P18 MASS / DIMM modifications	1 d	11/3/08	11/5/08
930	9.3.1.4	Implement P18 MASS / DIMM modifications	4 d	11/5/08	11/11/08
931	9.3.1.5	Verify P18 MASS / DIMM functionality	1 d	11/11/08	11/13/08
932	9.3.1.6	Evaluate P18 MASS / DIMM performance	2 d	11/13/08	11/25/08
933	9.3.1.7	Document P18 MASS / DIMM modifications	2 d	11/13/08	11/25/08
934	9.3.2	Software	9.5 d	11/25/08	1/16/09
935	9.3.2.1	Document Requirements	2 d	11/25/08	1/1/09
936	9.3.2.2	Review Requirements	1.5 d	1/1/09	1/2/09
937	9.3.2.3	P18 Data Server Design	1 d	1/2/09	1/6/09
938	9.3.2.4	P18 Data Server Implementation	3 d	1/6/09	1/14/09
939	9.3.2.5	Verify P18 Data Server Functionality	1 d	1/14/09	1/16/09
940	9.3.2.6	Document P18 Data Server	1 d	1/12/09	1/16/09
941	10	Laser Guide Star Facility	12 d	11/16/07	11/24/09
942	10.1	Laser Laboratory	0 d	11/16/07	3/6/08
943	10.1.1	Outfit Lower Coude Lab	0 d	11/16/07	3/6/08



ID	WBS	Task Name	Work	Start	Finish
944	10.2	Beam Transfer Optics	12 d	11/21/07	3/18/08
945	10.2.1	Design BTO mods	4 d	11/21/07	12/4/07
946	10.2.2	Implement BTO mods	8 d	3/7/08	3/18/08
947	10.3	Laser Launch Telescope	0 d	11/16/07	3/6/08
948	10.3.1	Evaluate LLT optical quality	0 d	11/16/07	12/13/07
949	10.3.2	Design LLT mods	0 d	12/14/07	1/10/08
950	10.3.3	Implement LLT mods	0 d	1/11/08	3/6/08
951	10.4	CSFL Subsystem	0 d	11/26/07	11/24/09
952	10.4.1	CSFL 07B servicing mission	0 d	11/26/07	3/14/08
953	10.4.2	Move CSFL to Lower Coude	0 d	3/18/08	3/18/08
954	10.4.3	CSFL operations	0 d	3/19/08	11/24/09
955	10.5	Future Lasers	0 d	5/11/09	10/23/09
956	11	Commissioning	506 d	3/11/08	11/30/11
957	11.1	PALM-241 / PHARO integration and testing	39 d	3/11/08	4/29/08
958	11.1.1	PALM-241 / PHARO laboratory I&T	18 d	3/11/08	4/2/08
959	11.1.1.1	Verify PALM-241 / PHARO laboratory perforn	12 d	3/11/08	3/21/08
960	11.1.1.2	Document PALM-241 / PHARO laboratory pe	6 d	3/21/08	4/2/08
961	11.1.2	PALM-241 / PHARO commissioning	21 d	4/9/08	4/29/08
962	11.1.2.1	Verify PALM-241 / PHARO on-sky performan	12 d	4/9/08	4/11/08
963	11.1.2.2	Document PALM-241 / PHARO on-sky perfor	9 d	4/14/08	4/29/08
964	11.2	PALM-241 / SWIFT integration and testing	68 d	4/1/08	7/7/08
965	11.2.1	PALM-241 / SWIFT laboratory I&T	22 d	4/1/08	5/7/08
966	11.2.1.1	SWIFT arrives at Palomar	0 d	4/1/08	4/1/08
967	11.2.1.2	Receive SWIFT	1 d	4/1/08	4/1/08
968	11.2.1.3	Integrate PALM-241 / SWIFT system	10 d	4/17/08	4/30/08
969	11.2.1.4	Verify PALM-241 / SWIFT functionality	5 d	5/1/08	5/7/08
970	11.2.1.5	Document PALM-241 / SWIFT functionality	6 d	4/18/08	5/7/08
971	11.2.2	PALM-241 / SWIFT commissioning	46 d	5/10/08	7/7/08
972	11.2.2.1	Verify PALM-241 / SWIFT on-sky performanc	37 d	5/10/08	6/17/08
973	1.2.2.1.1	SWIFT commissioning run 1	25 d	5/10/08	5/16/08
974	1.2.2.1.2	SWIFT commissioning run 2	12 d	6/12/08	6/17/08
975	11.2.2.2	Document PALM-241 / SWIFT on-sky perforn	9 d	6/18/08	7/7/08
976	11.3	PALM-241 / P1640 integration and testing	63 d	5/1/08	8/29/08
977	11.3.1	PALM-241 / P1640 laboratory I&T	22 d	5/1/08	6/16/08
978	11.3.1.1	P1640 arrives at Palomar	0 d	5/1/08	5/1/08
979	11.3.1.2	Receive P1640	1 d	5/1/08	5/1/08
980	11.3.1.3	Integrate PALM-241 / P1640 system	10 d	5/27/08	6/9/08
981	11.3.1.4	Verify PALM-241 / P1640 functionality	5 d	6/10/08	6/16/08
982	11.3.1.5	Document PALM-241 / P1640 functionality	6 d	6/5/08	6/16/08
983	11.3.2	PALM-241 / P1640 commissioning	41 d	7/8/08	8/29/08
984	11.3.2.1	Verify P1640 Performance	32 d	7/8/08	8/13/08
985	1.3.2.1.1	P1640 commissioning run 1	20 d	7/8/08	7/11/08
986	1.3.2.1.2	P1640 commissioning run 2	12 d	8/8/08	8/13/08
987	11.3.2.2	Document PALM-241 / P1640 on-sky perforn	9 d	8/14/08	8/29/08
988	11.4	PALM-3000 NGS integration and testing	183 d	1/20/10	11/30/11
989	11.4.1	PALM-3000 NGS laboratory I&T	96 d	1/20/10	3/10/10
990	11.4.1.1	Integrate PALM-3000 NGS system	60 d	1/20/10	2/16/10
991	11.4.1.2	Verify PALM-3000 NGS laboratory performan	24 d	2/17/10	3/10/10
992	1.4.1.2.1	Verify PALM-3000 NGS closed-loop perf	6 d	2/17/10	2/22/10
993	1.4.1.2.2	Verify PALM-3000 NGS automations	6 d	2/23/10	2/26/10
994	1.4.1.2.3	Verify PALM-3000 NGS external interfac	6 d	3/1/10	3/4/10
995	1.4.1.2.4	Verify PALM-3000 NGS background pro	6 d	3/5/10	3/10/10
996	11.4.1.3	Document PALM-3000 NGS laboratory perfo	12 d	2/23/10	3/10/10
997	11.4.2	PALM-3000 NGS commissioning	72 d	3/24/10	5/3/10
998	11.4.2.1	Verify PALM-3000 NGS on-sky performance	56 d	3/24/10	5/3/10
999	1.4.2.1.1	**PALM-3000 NGS first light**	0 d	3/24/10	3/24/10
1000	1.4.2.1.2	P3K NGS / PHARO commissioning run 1	28 d	3/25/10	3/30/10
1001	1.4.2.1.3	P3K NGS / PHARO commissioning run 2	28 d	4/28/10	5/3/10
1002	11.4.2.2	Document PALM-3000 NGS on-sky performa	16 d	4/12/10	5/3/10
1003	11.4.3	PALM-3000 NGS commissioning science	15 d	5/4/10	5/31/10
1004	11.4.3.1	Analyze PALM-3000 NGS commissioning sci	7.5 d	5/4/10	5/17/10
1005	11.4.3.2	Write PALM-3000 NGS commissioning scien	7.5 d	5/18/10	5/31/10
1006	11.4.3.3	Submit PALM-3000 NGS commissioning scie	0 d	5/31/10	5/31/10
1007	11.4.4	18 months later	0 d	11/30/11	11/30/11
1008	11.5	PALM-3000 LGS integration and testing	153 d	1/19/11	5/31/11
1009	11.5.1	PALM-3000 LGS laboratory I&T	66 d	1/19/11	3/10/11
1010	11.5.1.1	Integrate PALM-3000 LGS system	30 d	1/19/11	2/16/11
1011	11.5.1.2	Verify PALM-3000 LGS laboratory performan	24 d	2/16/11	3/10/11
1012	1.5.1.2.1	Verify PALM-3000 LGS closed-loop perf	6 d	2/16/11	2/22/11
1013	1.5.1.2.2	Verify PALM-3000 LGS automations	6 d	2/22/11	2/28/11
1014	1.5.1.2.3	Verify PALM-3000 LGS external interfac	6 d	2/28/11	3/4/11
1015	1.5.1.2.4	Verify PALM-3000 LGS background proc	6 d	3/4/11	3/10/11
1016	11.5.1.3	Document PALM-3000 LGS laboratory perfor	12 d	2/22/11	3/10/11
1017	11.5.2	PALM-3000 LGS commissioning	72 d	3/24/11	5/3/11
1018	11.5.2.1	Verify PALM-3000 LGS on-sky performance	56 d	3/24/11	5/3/11
1019	1.5.2.1.1	PALM-3000 LGS first light	0 d	3/24/11	3/24/11
1020	1.5.2.1.2	P3K LGS commissioning run 1	28 d	3/24/11	3/30/11
1021	1.5.2.1.3	P3K LGS commissioning run 2	28 d	4/27/11	5/3/11
1022	11.5.2.2	Document PALM-3000 LGS on-sky performa	16 d	4/11/11	5/3/11
1023	11.5.3	PALM-3000 LGS commissioning science	15 d	5/3/11	5/31/11
1024	11.5.3.1	Analyze PALM-3000 LGS commissioning sci	7.5 d	5/3/11	5/17/11
1025	11.5.3.2	Write PALM-3000 LGS commissioning scienc	7.5 d	5/17/11	5/31/11
1026	11.5.3.3	Submit PALM-3000 LGS commissioning scie	0 d	5/31/11	5/31/11