



W. M. KECK OBSERVATORY
Next Generation Adaptive Optics System

NGAO Proposed Work Breakdown Structure

August 28, 2006

NGAO Project

1. Project Management
 - 1.1. Science Requirements
 - 1.1.1. Science Trade Studies
 - 1.1.1.1. Continuous vs. Non-continuous Field of View
 - 1.1.1.2. NGAO Scheduling Options
 - 1.1.2. Science Requirements Document (SRD)
 - 1.1.3. Science Team Meetings
 - 1.2. System Documentation
 - 1.2.1. System Design Phase Documentation
 - 1.2.1.1. System Design Phase Plan
 - 1.2.1.1.1. Work Breakdown Structure
 - 1.2.1.1.2. Cost Estimate
 - 1.2.1.2. System Design Manual
 - 1.2.1.3. Systems Engineering Management Plan (SEMP)
 - 1.2.1.3.1. Project Plan
 - 1.2.1.3.2. Cost Estimation Plan
 - 1.2.1.3.3. Risk Management Plan
 - 1.2.1.3.4. Quality Assurance Plan
 - 1.2.1.3.5. Integration and Testing Plan
 - 1.2.1.3.6. Commissioning Plan
 - 1.2.1.4. Preliminary Design Proposal
 - 1.2.1.4.1. Work Schedule
 - 1.2.1.4.2. Cost Estimate
 - 1.2.1.5. SD Review Report
 - 1.2.2. Preliminary Design Phase Documentation
 - 1.2.2.1. Design Report
 - 1.2.2.2. Review Report
 - 1.2.3. Detailed Design Phase Documentation
 - 1.2.3.1. Proposal
 - 1.2.3.2. Design Report
 - 1.2.3.3. Review Report
 - 1.2.4. Full Scale Development Phase Documentation
 - 1.2.4.1. Deliverable Documentation Package(s)
 - 1.2.4.2. Pre-ship Review Report(s)
 - 1.2.4.3. Acceptance Review Report
 - 1.2.4.4. Operational Readiness Review Report
 - 1.2.4.5. Science Verification Review Report
 - 1.3. Reviews
 - 1.3.1. System Design Review



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- 1.3.2. Preliminary Design Review
 - 1.3.3. Detailed Design Review
 - 1.3.4. Full Scale Development Progress Review(s)
 - 1.3.5. Pre-ship Review(s)
 - 1.3.6. Acceptance Review
 - 1.3.7. Operational Readiness Review
 - 1.3.8. Science Verification Review
 - 1.4. Funding Proposal(s)
 - 1.5. Team Meetings
 - 1.6. Reporting
 - 1.6.1. Technical
 - 1.6.2. Financial
 - 1.6.3. Science Community Liaison
 - 1.7. Contracting
 - 1.8. Other Management Activities
- 2. AO System
 - 2.1. AO System Management
 - 2.2. Systems Engineering
 - 2.2.1. Requirements Document(s)
 - 2.2.1.1. Functional and Performance Requirements Document (FPRD)
 - 2.2.1.2. Optomechanical Requirements Document
 - 2.2.1.3. Laser System Requirements Document
 - 2.2.1.4. Software Requirements Document
 - 2.2.1.5. Operational Tools Requirements Document
 - 2.2.1.6. Calibration System Requirements Document
 - 2.2.2. System Architecture
 - 2.2.2.1. Trade Studies
 - 2.2.2.1.1. Adaptive Secondary Mirror vs. Nasmyth Relay
 - 2.2.2.1.2. K & L Performance Optimization Options
 - 2.2.2.1.3. Keck Interferometer Support Options
 - 2.2.2.1.4. Instrument Balance Considerations
 - 2.2.2.1.5. GLAO for Existing Non-AO Instruments
 - 2.2.2.1.6. Science Instrument Reuse Considerations
 - 2.2.3. Analytical Tools
 - 2.2.3.1. Model Input Assumptions
 - 2.2.3.1.1. Site Monitoring
 - 2.2.3.1.2. Telescope Static Wavefront Errors
 - 2.2.3.1.3. Telescope Dynamic Wavefront Errors
 - 2.2.3.2. Model/Tool Development
 - 2.2.3.3. Model/Tool Validation



- 2.2.4. Performance Budgets
 - 2.2.4.1. Wavefront Error Budget
 - 2.2.4.2. Encircled Energy Budget
 - 2.2.4.3. Photometric Precision Budget
 - 2.2.4.4. Astrometric Precision Budget
 - 2.2.4.5. Polarimetric Precision Budget
 - 2.2.4.6. Optical Transmission and Background
 - 2.2.4.7. Operating Efficiency Budget
- 2.2.5. Observatory Interfaces
- 2.2.6. Specification(s)
- 2.2.7. Document Control
- 2.3. AO Enclosure
 - 2.3.1. Enclosure Structure
 - 2.3.2. Environmental Controls
- 2.4. Optomechanics
 - 2.4.1. Optomechanical Structure
 - 2.4.2. De-rotator
 - 2.4.3. Optical Relay Components
 - 2.4.3.1. Field Lenses
 - 2.4.3.2. Relay Mirrors
 - 2.4.3.3. DM
 - 2.4.3.3.1. Deformable Mirror
 - 2.4.3.3.2. Tip/Tilt Stage
 - 2.4.3.4. Dichroic Switchyard
 - 2.4.3.5. Atmospheric Dispersion Correctors
 - 2.4.4. Optical Relay Mounts
 - 2.4.5. Optical Baffles
 - 2.4.6. De-rotator
- 2.5. Wavefront Sensors
 - 2.5.1. High-order LGS Sensors
 - 2.5.2. High-order NGS Sensor
 - 2.5.3. Low-order NGS Sensors
 - 2.5.4. Slow Wavefront Sensor
- 2.6. Acquisition Camera
- 2.7. Motion Systems
- 2.8. Electronics
 - 2.8.1. RTC
 - 2.8.2. DM Driver
 - 2.8.3. Wavefront Sensor Readout Systems
 - 2.8.4. Motion Control
 - 2.8.5. Supervisory Control
 - 2.8.6. Calibration Systems



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- 2.8.7. Metrology
- 2.9. Software
 - 2.9.1. RTC
 - 2.9.2. Motion Control
 - 2.9.3. Supervisory Control
 - 2.9.4. Operations Tools
 - 2.9.5. Calibration
 - 2.9.6. Diagnostics
 - 2.9.7. Maintenance
- 3. Operations Tools
 - 3.1. Operations Tools Management
 - 3.2. Operations Architecture
 - 3.3. Astronomical Observation Planning
 - 3.4. Observing Setup
 - 3.5. User Interface
 - 3.6. Science Instruments and DCS Interface
 - 3.7. Performance Monitoring
 - 3.8. Automation and Optimization
- 4. Laser Guide Star Facility
 - 4.1. Laser Guide Star Facility Management
 - 4.2. Laser System(s)
 - 4.3. Beam Delivery
 - 4.3.1. Beam Transport
 - 4.3.2. Launch Telescope
 - 4.3.3. Uplink Correction System
 - 4.4. Laser Diagnostics Bench
 - 4.5. Software
 - 4.5.1. Supervisory Control
 - 4.5.2. Beam Diagnostics
- 5. Integration and Test
 - 5.1. Laboratory
 - 5.2. Summit
- 6. Installation
- 7. Commissioning