

| Level | WBS Element | Title                                   | Responsible Cost Estimator | Consultant 1     | Consultant 2 |
|-------|-------------|---|----------------------------|------------------|--------------|
| 1     | NGAO        | Next Generation AO Program              |                            |                  |              |
| 2     | 1           | Design                                  |                            |                  |              |
| 3     | 1.1         | Proposal                                | Richard Dekany             |                  |              |
| 3     | 1.2         | System Design                           | Richard Dekany             |                  |              |
| 3     | 1.3         | Preliminary Design                      | Peter Wizinowich           |                  |              |
| 3     | 1.4         | Detailed Design                         | Peter Wizinowich           |                  |              |
| 2     | 2           | Management                              |                            |                  |              |
| 3     | 2.1         | Planning & Contracting                  | Peter Wizinowich           |                  |              |
| 3     | 2.2         | Project Management & Meetings           | Peter Wizinowich           |                  |              |
| 3     | 2.3         | Tracking & Reporting                    | Peter Wizinowich           |                  |              |
| 3     | 2.4         | Proposals & Fundraising                 | Peter Wizinowich           |                  |              |
| 3     | 2.5         | Science Advisory Team                   | Claire Max                 |                  |              |
| 2     | 3           | Systems Engineering                     |                            |                  |              |
| 3     | 3.1         | Requirements Maintenance                | Erik Johansson             |                  |              |
| 3     | 3.2         | System Architecture                     | Richard Dekany             |                  |              |
| 3     | 3.3         | Modeling & Analysis                     | Richard Dekany             |                  |              |
| 3     | 3.4         | Performance Budget Maintenance          | Richard Dekany             |                  |              |
| 3     | 3.5         | External Interface Control              | Erik Johansson             |                  |              |
| 3     | 3.6         | Configuration Management                | Erik Johansson             |                  |              |
| 3     | 3.7         | Documentation Control                   | Erik Johansson             |                  |              |
| 2     | 4           | AO System Development                   |                            |                  |              |
| 3     | 4.1         | AO Enclosure                            | Don Gavel                  | Jim Bell         |              |
| 3     | 4.2         | Optomechanical                          | Don Gavel                  |                  |              |
| 4     | 4.2.1       | Rotator                                 | Don Gavel                  | Reni Kupke       |              |
| 4     | 4.2.2       | Optical Relays                          | Don Gavel                  | Reni Kupke       |              |
| 4     | 4.2.3       | Optical Switchyard                      | Don Gavel                  | Reni Kupke       |              |
| 4     | 4.2.4       | AO Support Structure                    | Don Gavel                  | Jim Bell         |              |
| 4     | 4.2.5       | LGS Wavefront Sensors                   | Viswa Velur                |                  |              |
| 4     | 4.2.6       | NGS Wavefront Sensor                    | Viswa Velur                |                  |              |
| 4     | 4.2.7       | Low Order Wavefront Sensors             | Richard Dekany             |                  |              |
| 4     | 4.2.8       | Truth Wavefront Sensors                 | Viswa Velur                |                  |              |
| 4     | 4.2.9       | DM's and Tip/Tilt Stages                | Don Gavel                  | Reni Kupke       |              |
| 4     | 4.2.10      | Tip/Tilt Vibration Mitigation           | Peter Wizinowich           |                  |              |
| 4     | 4.2.11      | Acquisition Cameras                     | Viswa Velur                |                  |              |
| 4     | 4.2.12      | Atmospheric Dispersion Correctors       | Don Gavel                  | Reni Kupke       |              |
| 3     | 4.3         | Alignment, Calibration, and Diagnostics |                            |                  |              |
| 4     | 4.3.1       | Simulator                               | Chris Neyman               |                  |              |
| 4     | 4.3.2       | System Alignment Tools                  | Chris Neyman               | Reni Kupke       |              |
| 4     | 4.3.3       | Atmospheric Profiler                    | Richard Dekany             |                  |              |
| 4     | 4.3.4       | PSF Monitoring Camera                   | Viswa Velur                |                  |              |
| 4     | 4.3.5       | DM Interferometer                       | Chris Neyman               |                  |              |
| 3     | 4.4         | Non-real-time Control                   | Erik Johansson             |                  |              |
| 3     | 4.5         | Real-time Control                       | Don Gavel                  |                  |              |
| 3     | 4.6         | AO System Lab I&T                       | Peter Wizinowich           |                  |              |
| 3     | 4.7         | AO System Acceptance                    | Peter Wizinowich           |                  |              |
| 2     | 5           | Laser System Development                |                            |                  |              |
| 3     | 5.1         | Laser Enclosure                         | Chris Neyman               |                  |              |
| 3     | 5.2         | Laser                                   | Sean Adkins                |                  |              |
| 3     | 5.3         | Laser Launch Facility                   | Chris Neyman               | Viswa Velur      |              |
| 3     | 5.4         | Laser Safety Systems                    | Chris Neyman               |                  |              |
| 3     | 5.5         | Laser System Control                    | Chris Neyman               |                  |              |
| 3     | 5.6         | Laser System Lab I&T                    | Chris Neyman               |                  |              |
| 3     | 5.7         | Laser System Acceptance                 | Peter Wizinowich           |                  |              |
| 2     | 6           | Science Operations Tools Development    |                            |                  |              |
| 3     | 6.1         | Observing Setup                         | David le Mignant           |                  |              |
| 3     | 6.2         | User Interfaces                         | David le Mignant           |                  |              |
| 3     | 6.3         | Astronomer Planning                     | David le Mignant           |                  |              |
| 3     | 6.4         | System Control & Interfaces             | Erik Johansson             | David le Mignant |              |
| 3     | 6.5         | Performance Monitoring                  | David le Mignant           |                  |              |
| 3     | 6.6         | Automation and Optimization             | David le Mignant           |                  |              |
| 3     | 6.7         | User Documentation                      | David le Mignant           |                  |              |
| 2     | 7           | Telescope & Summit Engineering          |                            |                  |              |
| 3     | 7.1         | Telescope Performance                   | Peter Wizinowich           |                  |              |
| 3     | 7.2         | Infrastructure Mods for AO              | Chris Neyman               | Jim Bell         |              |
| 3     | 7.3         | Infrastructure Mods for Laser           | Chris Neyman               | Jim Bell         |              |
| 3     | 7.4         | OSIRIS Modifications                    | Sean Adkins                |                  |              |
| 3     | 7.5         | Interferometer and OHANA Mods           | Chris Neyman               |                  |              |
| 3     | 7.6         | Old AO/Laser Removal                    | Peter Wizinowich           | Jim Bell         |              |
| 3     | 7.7         | Laser Enclosure Integration             | Chris Neyman               | Jim Bell         |              |
| 3     | 7.8         | AO Enclosure Integration                | Chris Neyman               | Jim Bell         |              |
| 2     | 8           | Telescope Integration & Test            |                            |                  |              |
| 3     | 8.1         | AO System Install + I&T                 | Peter Wizinowich           |                  |              |
| 3     | 8.2         | Laser System Install + I&T              | Chris Neyman               |                  |              |
| 3     | 8.3         | LGS AO System On-sky I&T                | David le Mignant           |                  |              |
| 3     | 8.4         | Performance Characterization            | Richard Dekany             |                  |              |
| 3     | 8.5         | Science Verification                    | David le Mignant           |                  |              |
| 2     | 9           | Operations Transition                   |                            |                  |              |
| 3     | 9.1         | Operations Personnel Training           | David le Mignant           |                  |              |
| 3     | 9.2         | Operations Acceptance                   | David le Mignant           |                  |              |