Next Generation Adaptive Optics System

K2 Laser Removal Plan

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VersionV1.0

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REVISION HISTORY

Revision	Date	Author (s)	Reason for revision / remarks
1.0	February 14, 2009	JC	Initial release
1.1	June 2, 2009	JC	Minor Updates to Schedule and Effort

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1 INTRODUCTION

As part of the NGAO system installation, the K2 laser will be removed to provide the adequate room for the new laser(s) on the elevation ring. The existing K2 laser has two major parts, the laser enclosure on the elevation ring of the telescope and the laser room on the dome floor. Auxiliary equipment is also located at the observatory such as the K2 AO electronics enclosure and control room. The amount of equipment that must be removed will heavily depend on the requirements of the new laser, the possibility to re-use existing infrastructure for NGAO or other systems, and the amount of funds available. This document provides a plan for removing the K2 laser system.

References

1.1 Referenced Documents

Documents referenced in the requirements are listed in Table 1. Copies of these documents may be obtained from the source listed in the table.

Ref. #	Document #	Revision or Effective Date	Source	Title
1		Version 1	LLNL	K2 Laser System Manual

Table 1: Reference Document.

1.2 Acronyms and Abbreviations

Table 2 defines the acronyms and abbreviations used in this document.

Acronym/Abbreviation	Definition
AO	Adaptive Optics
DMO	Dye Master Oscillator
K1	Keck 1 Telescope
K2	Keck 2 Telescope
LLNL	Lawrence Livermore National Labs
NGAO	Next Generation Adaptive Optics System

Table 2: Acronyms and Abbreviations.

2 PLANNING AND REVIEWS

The plan is structured in three phases. Phase I will accomplish the necessary steps to provide adequate room for the new laser system. In theory, only phase 1 is needed for NGAO to proceed. In phase 2, the laser room on the dome floor is removed. In phase 3, all remaining equipment will be removed as well as software references that must be resolved. The three phases are detailed in subsequent sections of this document.

The installation of the K2 laser system required a telescope shutdown. It is likely that a shutdown will improve the efficiency of the tasks and may be a necessary requirement for phase 1; but not for phase 2 and 3. Further considerations must be made during the detailed planning phase to determine if a shutdown is necessary or desired to improve efficiency.

In addition to supporting the preliminary design and detailed design phases, removing the K2 laser will add two additional reviews. The first review is held prior to the activities to assure all aspects of the plan are captured with an emphasis on safety. The K2 laser uses an ethanol based dye which is highly flammable. Care must be taken to remove this dye. A second review will be held at the end of the effort to verify equipment has been removed and properly stored.

3 PHASE 1: REMOVAL OF THE LASER TABLE AND ENCLOSURE

Based on the existing laser designs, the NGAO lasers will be integrated onto the K2 elevation ring similar to the existing K2 laser table. The K2 laser table (optical bench) contains the optical preamplifier and amplifier for the K2 laser system. This enclosed table is mounted to the elevation ring within a laser enclosure for personnel to operate and service the table (Figure 1).

Figure 1: Laser Table and Enclosure

In this phase, the goal is to remove the existing laser table and its supporting equipment on the elevation ring and the side launch telescope on the telescope structure. The removal of these two components will allow the NGAO laser system to proceed in its installation. The laser enclosure itself as well as the supporting platform for the floor grating and enclosure will remain.

In order to remove the laser table, the flammable ethanol dye must be drained from the system. Although it is only necessary to remove the amplifier and preamplifier dye loops, the plan calls for removal of all dye in the system, including the DMO. This additional step eliminates the hazardous substance from the entire system. Once the dye is removed from the dye lines, the lines will be flushed with de-ionized water and capped for storage.

Once the dye lines are removed, the remaining interfaces such as electronics cabling, glycol and pneumatics will be disconnected from the laser table and enclosure (Figure 2). Since it is likely the new laser system will require similar interfaces, some of the infrastructure equipment such as enclosure interlocks will remain to support the new laser system. After the interfaces are disconnected and removed, the laser enclosure ceiling and walls can be removed temporary to access the laser table. This structure can be removed as a single unit once it is unbolted from the elevation ring and floor gratings (Figure 3). This enclosure will be reinstalled as it is planned to be reused for the NGAO system.

Figure 2: Laser Table Interfaces

Figure 3: Laser Enclosure Structure

After removal of the enclosure, the laser table and auxiliary electronics unit can be removed from the elevation ring. The floor and structural supports will remain for NGAO. The final step of this phase is to remove the L4 optic and its structures (Figure 4). Extreme care is needed to remove the 50cm lens without damage.

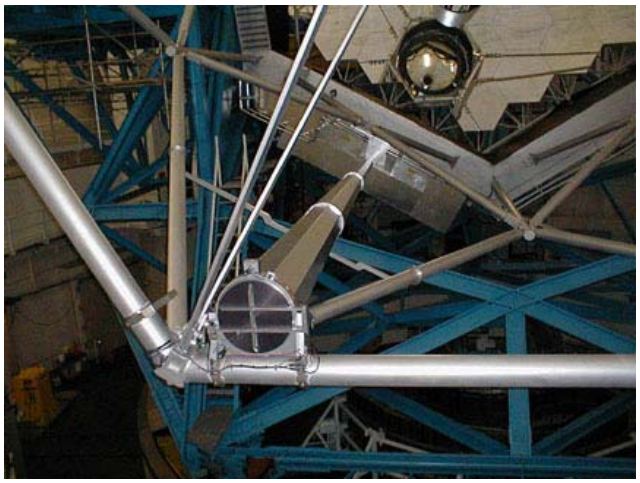

Figure 4: L4 Lens and Structure

4 PHASE 2: LASER ROOM REMOVAL

In this second phase, the goal is to remove the laser equipment from the laser room; but leave the room in place for other possible uses. Examples of possible uses include a thermally controlled room for running experiments, a clean room, or possibly a room to install a new laser system that can be fiber fed onto the telescope. None of the task in this phase will require the telescope to be shutdown.

During this phase, some equipment in the laser room must remain in tact or moved to other areas such as the computer room to maintain operability for other subsystems. These may include the equipment to operate aircraft detection for the K1 laser system or the K2 laser server to interface with the K2 AO System. Although the laser is not available during these periods, it is possible to run the AO System in NGS mode.

Figure 5: Laser Room on Dome Floor

Figure 6: Laser Room Equipment

5 PHASE 3: AUXILIARY EQUIPMENT REMOVAL AND SOFTWARE CLEANUP

In this final phase, the goal is to remove the remaining equipment from the summit facility. These include cabling, fibers, and dye lines on the telescope, as well as electronics in the AO enclosure. The software

references will be resolved for the remaining computer servers to be removed. Computers such as k2laserpc in the control room can be disabled as well. In this final phase, all documentation will be updated as necessary for proper removal of the K2 laser system.

6 EFFORT ESTIMATE

The following table provides the effort estimates for removing the K2 laser system and leaving the enclosure in place for NGAO use.

Personnel	**FY10**	**FY11**	**FY12**	**FY13**
	PDR		**DDR**	**FSD**
Systems Engineer	10		16	4
Lead Mechanical Engineer				
Mechanical Engineer 1	10		16	54
Mechanical Engineer 2				
Electronics Engineer 1				14
Electronics Engineer 2				
Software Engineer 1	10		8	54
Software Engineer 2				
Mechanical Technician 1				224
Mechanical Technician 2				140
Electronics Technician 1				432
Electronics Technician 2				40
System Administrator				11
Facilities Engineer	10		16	44
Mechanical Design Drafter				40
Laser Engineer	10		16	16
Safety Officer			8	4
Optics Engineer				4
Laser Technician				288
Facilities Technician				410
Subtotal	50	0	80	1779
Total				**1909**

Table 3: Personnel Effort

7 SCHEDULE

Depending on fiscal year needed to install the NGAO laser system; the detailed planning should take place in the previous fiscal year to ensure manpower is available. The schedule assumes a K2 laser shutdown at the start of a fiscal year. It is expected phase 1 can be implemented within a month once work commence. Only phase 1 is needed to prepare for NGAO.

	Task Name	Work	Start	Finish
1	**K2 Laser Removal**	**1,949 hrs**	**Mon 2/9/09**	**Mon 2/25/13**
2	**Milestones**	**0 hrs**	**Mon 10/1/12**	**Mon 2/25/13**
3	K2 Laser goes Offline	0 hrs	Mon 10/1/12	Mon 10/1/12
4	Phase 1 Removal of Equipment on Telescope	0 hrs	Wed 11/14/12	Wed 11/14/12
5	Phase 2 Removal of Laser Room	0 hrs	Tue 1/15/13	Tue 1/15/13
6	Phase 3 Removal of Auxiliary Equipment and Software	0 hrs	Fri 2/22/13	Fri 2/22/13
7	Project Completion	0 hrs	Mon 2/25/13	Mon 2/25/13
8	**Planning and Review**	**194 hrs**	**Mon 2/9/09**	**Mon 2/25/13**
9	Preliminary Design Review Planning	40 hrs	Mon 2/9/09	Fri 2/13/09
10	Detailed Design Review Planning	50 hrs	Mon 5/3/10	Mon 5/10/10
11	Final Detailed Review prior to dismantling; review safety issues	80 hrs	Mon 7/9/12	Thu 7/19/12
12	Final Review	24 hrs	Fri 2/22/13	Mon 2/25/13
13	**Phase 1 Removal of Equipment on Telescope**	**552 hrs**	**Mon 10/1/12**	**Wed 11/14/12**
14	**L4 Removal**	**62 hrs**	**Mon 10/1/12**	**Thu 10/4/12**
19	**Laser Table and Auxiliary Electronics in Laser Enclosure**	**290 hrs**	**Fri 10/5/12**	**Wed 10/31/12**
30	Transport, Tag, Store, and Disposal (if necessary) of Equipment	140 hrs	Wed 10/31/12	Wed 11/7/12
31	Documentation	60 hrs	Wed 11/7/12	Wed 11/14/12
32	**Phase 2 Removal of Laser Room**	**726 hrs**	**Wed 11/14/12**	**Tue 1/15/13**
33	Packaging Preparaton	40 hrs	Wed 11/14/12	Wed 11/21/12
34	**Remove External Interfaces**	**80 hrs**	**Wed 11/21/12**	**Mon 12/3/12**
37	**Remove or move internal equipment**	**266 hrs**	**Wed 11/21/12**	**Tue 12/11/12**
41	Disconnect infrastructure; electrical power, conduits and HVAC	80 hrs	Tue 12/11/12	Tue 12/25/12
42	Disassemble laser room and remove	100 hrs	Tue 12/25/12	Tue 1/1/13
43	Transport, Tag, Store, and Disposal (if necessary) of Equipment	120 hrs	Tue 1/1/13	Tue 1/8/13
44	Documentation Cleanup and Correction	40 hrs	Tue 1/8/13	Tue 1/15/13
45	**Phase 3 Removal of Auxiliary Equipment and Software**	**477 hrs**	**Tue 1/15/13**	**Fri 2/22/13**
46	Packaging Preparaton	40 hrs	Tue 1/15/13	Tue 1/22/13
47	**AO Electronics**	**40 hrs**	**Tue 1/15/13**	**Fri 1/18/13**
49	**Telescope Cabling**	**150 hrs**	**Fri 1/18/13**	**Mon 2/4/13**
52	**Amp and Preamp Dye Cabinet**	**40 hrs**	**Mon 2/4/13**	**Fri 2/8/13**
56	**Software**	**64 hrs**	**Tue 1/22/13**	**Thu 1/31/13**
60	**Auxiliary hardware**	**63 hrs**	**Fri 2/8/13**	**Tue 2/12/13**
63	Transport, Tag, Store, and Disposal (if necessary) of Equipment	40 hrs	Wed 2/13/13	Tue 2/19/13
64	Documentation Cleanup and Correction	40 hrs	Wed 2/20/13	Fri 2/22/13

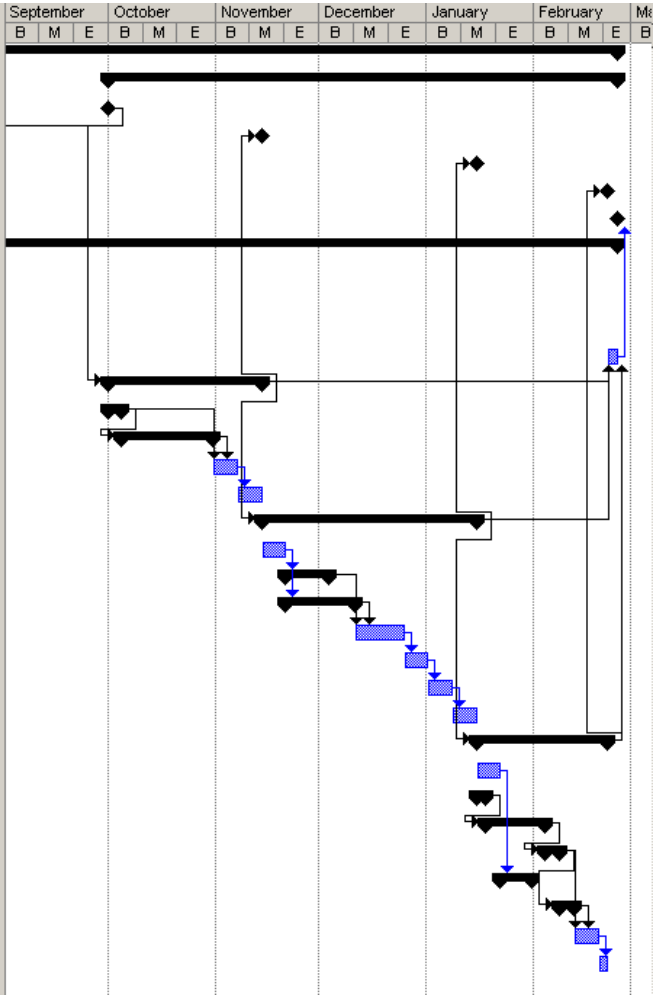

Figure 7: Schedule

8 RISK

There are two risk considerations for this plan. The first is to ensure the tasks can be accomplished with minimum or no down time to the telescope. It is not clear at this time whether telescope down time is absolutely necessary. Further investigation is needed in the detailed design phase to quantify this risk. A second risk is related to safety and to ensure the plan provides adequate backup to support the removal and disposal of the dye. This is a lower risk since dye has been removed and replaced during maintenance operations. Both risk are considered low and should be manageable.