Australian National University

Project Pro Forma

Prepared For

Advanced Instrumentation and Technology Centre

ANU College of Engineering and Computer Science

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Acronyms

AITC Advanced Instrumentation and Technology Centre.

ANU Australian National University.

AO Adaptive Optics.

AOI Adaptive Optics Imaging.

AOTP Adaptive Optics system for space debris Tracking and Pushing.

CAD Computer Aided Design.

EOS Electro-Optic Systems.

GSL Guide Star Laser.

LGS Laser Guide Star.

OOS Out of Scope.

PDR Preliminary Design Report.

SERC Space Environment Research Centre.

SGL Semiconductor Guidestar Laser.

SSS System Subsystem Specification.

1 Scope

This section outlines the scope of this document, the scope and context of the project, as well as providing a summary of the work of the previous team.

1.1 Document Scope

The scope of this document is to summarise the the GSLI project and its current state, and to detail the plan for continuation of the project.

1.2 Project Context

Sections 1.2.1 through 1.2.3 were produced by the previous team, and may be found in *Handover Document - Stuchbery, Kennedy, Davies, Dirnberger, Nilon, May 2017.*
Section 1.2.4 has been adapted due to an update in the project scope, as the Toptica Guide Star Laser (GSL) has been removed from consideration.

1.2.1 The Telescope

The Electro-Optic Systems (EOS) 1.8m telescope is currently used for satellite and space debris tracking at Mt Stromlo Observatory in Canberra. This telescope is also the site of the Space Environment Research Centre (SERC) project to build an Adaptive Optics Imaging (AOI) system for satellite imaging, and an Adaptive Optics system for space debris Tracking and Pushing (AOTP).

1.2.2 Guide Star Laser Optics

In Adaptive Optics (AO) a GSL is required to produce an artificial star in the atmosphere, which can be used to measure phase distortions caused by atmospheric turbulence above the telescope. This artificial star is known as a Laser Guide Star (LGS). Using a GSL is the current optimum method of creating a light source with acceptable return photon flux and manoeuvrability to track fast moving objects such as satellites.

1.2.3 Adaptive Optics Projects

The Advanced Instrumentation and Technology Centre (AITC) is in the process of developing multiple AO systems for various projects, including the SERC AOI and AOTP systems. They also have an invested interest in the demonstration of ANU's GSL prototype, as it is predicted to be a cheaper and more effective product for AO systems around the world.

1.2.4 System Interface

The AITC initially expressed a preferential preliminary concept for the System Interface that would have enabled the inclusion of three GSL solutions, however the Toptica GSL has since been removed from consideration. The remaining two designs are the EOS GSL and the Australian National University (ANU) Semiconductor Guidestar Laser (SGL).

1.3 Project Status at Handover

The key pieces of work completed in the previous stage were the System Subsystem Specification (SSS), the development of a high-level interface document, and a set of Computer Aided Design (CAD) models for the hardware setup.

1.3.1 System Subsystem Specification

The SSS details the full set of requirements of the GSL project, including information about areas that require further investigation. The document also provides information regarding the conflicts that are present in the requirements, as well as potential solutions to these.

1.3.2 High-Level Interface Document

This document provides information about the interconnections between the four interface systems that are detailed in the SSS document. This requires updating due to the removal of the Toptica GSL from consideration.

1.3.3 CAD Models

The CAD models developed show various potential configurations for the laser combinations. Those including the Toptica GSL are of limited further use, however several models did not include this GSL.

1.4 Project Scope

The minimum project scope is to create a preliminary design for the interface of the EOS GSL and ANU SGL.

1.5 Out of Project Scope

The items out of the project scope were defined in the previously mentioned *Handover Document - Stuchbery Kennedy, Davies, Dirnberger, Nilon, May 2017.*
The capabilities/attributes defined to be Out of Scope (OOS) of the project objectives and deliverables for the Interface System are outlined as below:

a. Beam transfer optics from the laser to the laser launch telescope

b. Laser launch telescope

2 Project Objectives and Deliverables

2.1 Minimum Objectives and Deliverables

2.1.1 The Objective

The minimum objective is to deliver a preliminary design such that end users can develop a final design for an interface between the EOS 1.8m telescope, the EOS GSL, and the ANU SGL.

2.1.2 The Deliverable

The minimum objective will be delivered as a Preliminary Design Report (PDR) with supporting CAD documentation. The PDR will be the major project artefact, and will outline the preliminary design and justifications. It will also identify the areas to address once the ANU SGL system has been finalised.

3 Schedule

The following section outlines the initial project schedule, as well as a a breakdown of the phases of the project.

3.1 Schedule Outline

The project is broken into three phases - the continuation of Subsystem Specifications, the Design Phase, and a final phase reviewing preliminary development and project handover.

3.2 Minimum Objectives and Deliverables Schedule

The project will undergo three phases to ensure that the project progresses appropriately within the available time. In the first phase, the Subsystem Specification document will be reviewed and refined. This ensures any changes in the requirements are captured prior to the development of the preliminary design. The team has recognised that the requirements may need to be updated throughout the project as the ANU SGL design progressed. The second phase will be the design phase. The aspects of the design that the previous team has identified include the mechanical interface and the provision of water and clean air into the 1.8m EOS telescope. An analysis of the accessibility into the 1.8m EOS telescope will also be undertaken. The final phase will involve a review of the preliminary design and development of handover documents.

An estimated schedule is as follows:

Phase 1: 7 - 18 August (Weeks 3-4)

Phase 2: 21 August - 8 September (Weeks 5 - 9)

Phase 3: 11 - 15 September (Week 10)

This is shown in the Gantt chart in figure 1, indicating the total number of hours in the document.

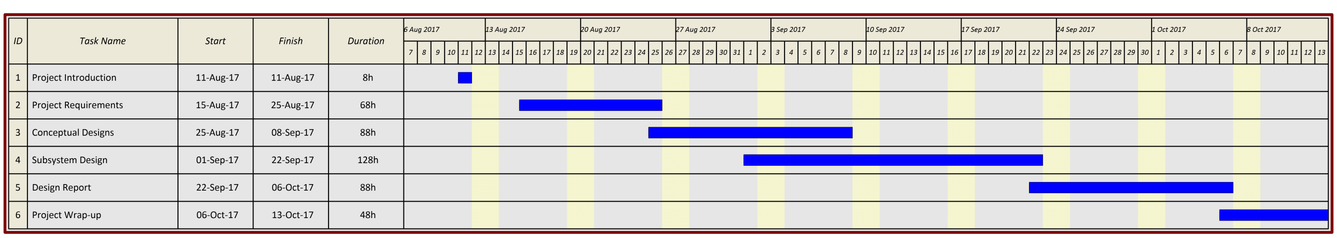

Figure 1: Gantt Chartt of Work Breakdown

4 Project Work Packages Breakdown

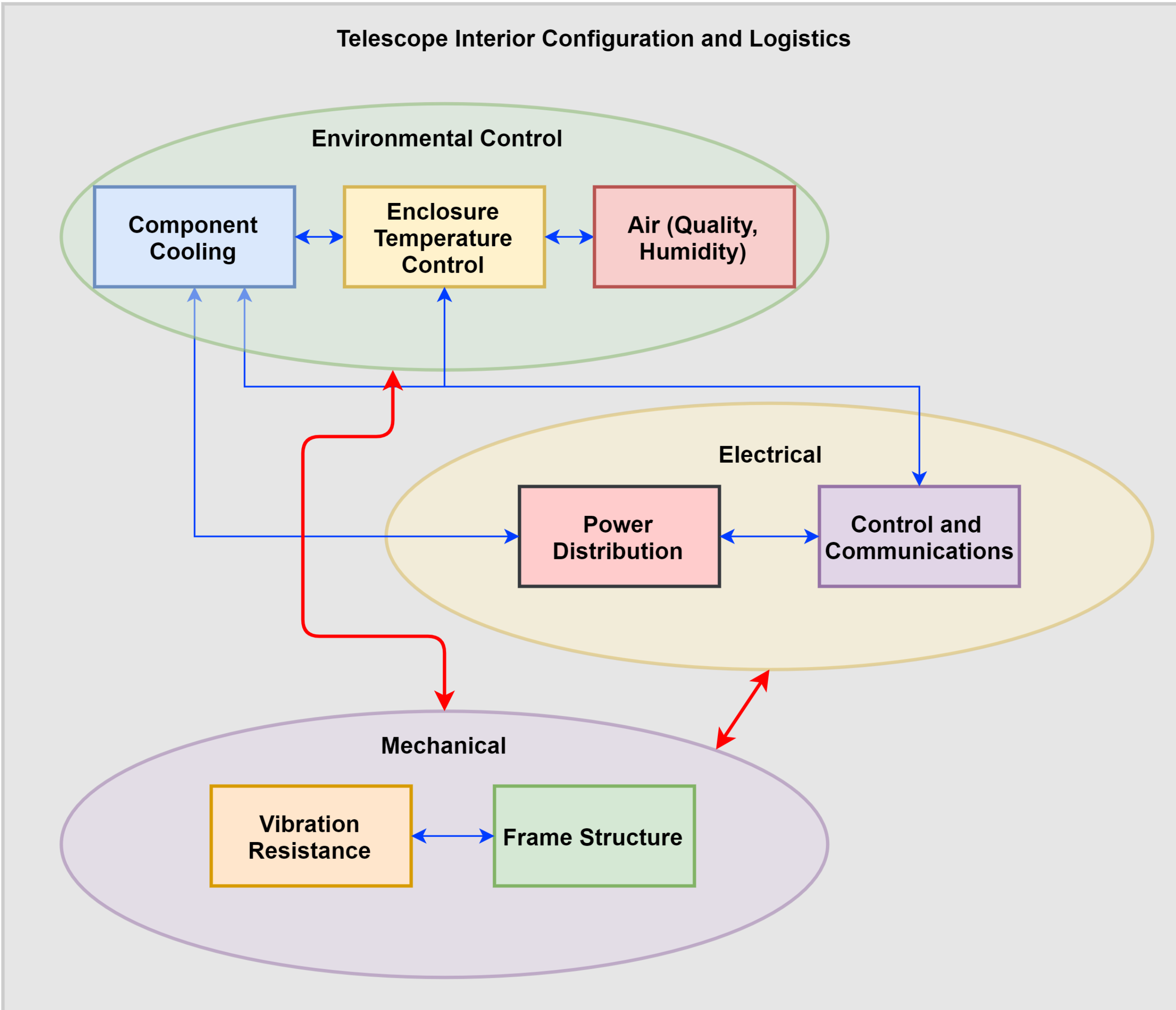

Figure 2: Work Packages

The corresponding package breakdowns are:

1 Cooling Systems (25 hours):

1.1 Follow up with James Webb on cooling system requirements (2.1.10 - 2.1.20), and any other people necessary

1.1.1 Available water supply?

1.1.2 Logistics of water transport to the telescope

1.1.3 Piping requirements, number of pipes needed

1.1.4 Coolant required?

1.1.5 Water quality requirements?

1.1.6 Air transfer system, exhaust?

1.2 Inspect the telescope to assist with these requirements.

1.3 Produce a schematic or design for the implementation of the cooling system at all levels.

2 Environmental - Temperature (10 hours):

2.1 Follow up with James Webb to confirm no ambient temperature requirements

2.2 If any are now in place, create a plan to deal with them

3 Environmental - Air Quality (10 hours):

3.1 Follow up with James Webb on air quality requirements (10,000 clean room standards, dusty environment, humidity requirements, dew formation

3.2 If any are now in place, create a plan to deal with them

4 Electrical (25 hours):

4.1 Produce a list of all components, electrical cabinets and anything else that requires power, and indicate their Voltage, Current, Phase, and number of sockets.

4.2 Follow up on the total power supply available inside of the telescope, and the number of power sockets available

4.3 Create a document showing the distribution of power and sockets in the preliminary design.

5 Communications (10 hours):

5.1 Follow up on the required connections

5.2 Proceed from there (more information required)

6 Logistics (10 hours):

6.1 Follow up on the logistics of deploying required components into telescope (by crane?).

6.2 Create a plan for moving all of the required components into the telescope.

7 Interior Configuration (50 hours):

7.1 Create a list of all components that take up space, (i.e. coolers, electrical cabinets) with a list of their sizes and positioning requirements

7.2 Measure space within the telescope, and find acceptable spaces where components can be located.

7.3 Create a diagram or document illustrating acceptable setups, and identify any conflicts and potential solutions.

8 Mechanical - Conceptual (25 hours):

8.1

9 Mechanical - Vibration (25 hours):

9.1

10 Mechanical - Design/CAD (50 hours):

10.1

5 Project Risks

Tables 1 through 3 detail the risks associated with the project, their likelihood, impact, area affect, and the associated mitigation strategies.

Table 1: Initial risk matrix

		Likelihood				
		1-Very Unlikely	**2-Remote**	**3-Occasional**	**4-Probable**	**5-Frequent**
Impact	**5-Critical**	(1)				
	4-High		(5),(8)		(1)	
	3-Medium		(7)		(6)	
	2-Low		(3)	(9)	(4)	
	1-Minimal					

Table 2: Risk matrix colour legend

Colour	**Legend**
	Not Acceptable- Risk reduction required
	Acceptable using ALARP. Consider further risk reduction.
	Acceptable.

Table 3: Risk Table

Risk	Severity	Likelihood	Areas Affected	Mitigation
1. Change of information about ANU Laser (Incorrect Assumptions or updated information)	4	4	Design of the mounting, environmental control hardware changes, timeframe of the project	Continuously update information, design for worst case, multiple / flexible designs
2. Cancellation of ANU Laser	5	1	Potential cancellation of main project component	Make sure design is still useful for other laser
3. Scope creep or new requirements to be addressed	2	2	Entire project, timeframe, resources	Recognising limitations, sticking to timeframe
4. Group Transportation Problems (Semi-remote working location)	2	4	Ability to access the work site	Planning alternative transport, making work accessible offsite
5. Information leaks	4	2	IP of the project	Proper handling of information, keep confidential information offline
6. Laser information does not become available in time for it to be addressed	3	4	Design tolerances or numbers may be incorrect	Include high tolerance bands, design for multiple cases
7. ANU Laser ready for installation before the EOS laser	3	2	Additional mounting method required for the time before the EOS laser is ready	Design a simple secondary mount
8. EOS Laser cancelled	4	2	Main mounting no longer available for EOS	Design of permanent mounting for ANU Laser
9. Installation of additional equipment to the telescope	2	3	Anticipated infrastructure is no longer available (eg. power sockets)	Inclusion of tolerances, design to have the lowest impact on infrastructure

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