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Organisation Européenne pour des Recherches Astronomiques dans l’Hémisphere Austral
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VERY LARGE TELESCOPE

Prima Metrology Safety and Reliability Analysis

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1 Scope

This documents presents the safety analysis for the PRIMA Laser metrology system (PRIMET) as well as the implementation of the safety equipment required to operate it, based on AD 1 and AD 2. It addresses hazards to PRIMET and to personnel during installation, commissioning, maintenance and operation at Paranal.

This document also includes an estimation of the reliability of PRIMET based on information provided by the manufacturers of some PRIMET components, based on the experience gained during the testing of PRIMET in Garching and on other ESO instruments.

Preventive maintenance activities and a spare parts are listed.

2 Applicable and reference Documents

AD 1	Safety conformity assessment procedure, SAF-INS-ESO-00000-3444, issue 1, 10/10/2006
AD 2	ESO General Safety regulations, Laser safety, SAF-INS-ESO-00000-0011, Issue 1
AD 3	Electronic Design Specifications-SPE-ESO-10000-0015, issue 6, 8/12/2005
AD 4	Design Description of the PRIMA Metrology System, VLT-TRE-ESO-15730-3000, Issue 1, March '03
AD 5	As built Phase Meter configuration for the PRIMA Metrology System, VLT-TRE-IMT-15734-3726, issue 1, 20.7.2005.
AD 6	Design of the Laser Assembly of the PRIMA Metrology System, VLT-TRE-IMT-15731-3154, issue 4, 19/12/2003.
AD 7	Prima Metrology Control Electronics, VLT-TRE-ESO-15735-2963, issue 2
AD 8	User Manual Mephisto Laser (www.innolight.de)
AD 9	User Manual: Diode-pumped Fiber-coupled Non planar Ring laser, Model 125-1319-200, Lightwave Electronics.
AD 10	Prima Metrology Test report, VLT-TRE-ESO-15730-4042

RD 1	ESO Garching Laser Safety Instruction, SAF-PRO-ESO-00000-3511, issue 1,2/2/2006
RD 2	Design of the PRIMA Metrology Interlock System, VLT-TRE-ESO-15735-4544, issue 1 April 2008

3 Acronyms

MPE: Maximum permissible exposure limit

MTBF: Mean Time Between Failure

MTTR: Mean time to repair

N/A: Not Applicable

PV: Peak-to-Valley

TBC: To Be Confirmed

TBD: To Be Defined

4 Description of PRIMET

The PRIMA Metrology System (PRIMET) is a component of the PRIMA facility, which monitor the internal optical path of the VLTI using an Infrared laser.

The hardware is distributed in the VLTI storage room where the laser beams are generated inside an enclosure, and in the VLTI laboratory where the laser beams are superimposed on the stellar paths. All the control electronics is located inside the storage room.

The laser beams are transferred from the storage room to the VLTI laboratory using optical fibers. Once in the VLTI laboratory the laser beams are collimated into 1 mm diameter beams and propagate in free space along the VLTI optical path up to the Star-separators of the UT's or the AT's, where they are retro-reflected.

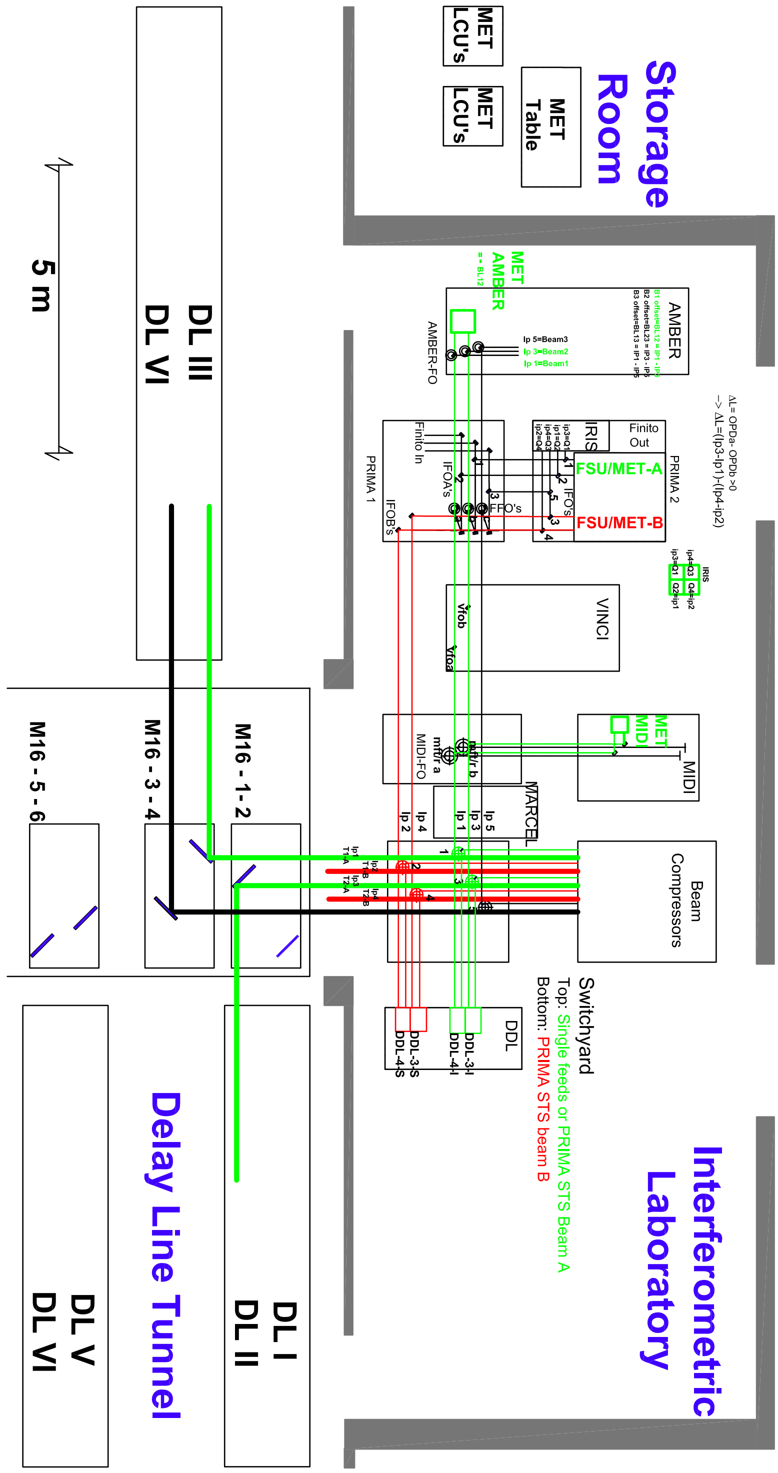


Figure 1 *PRIMA Metrology hardware Overview*

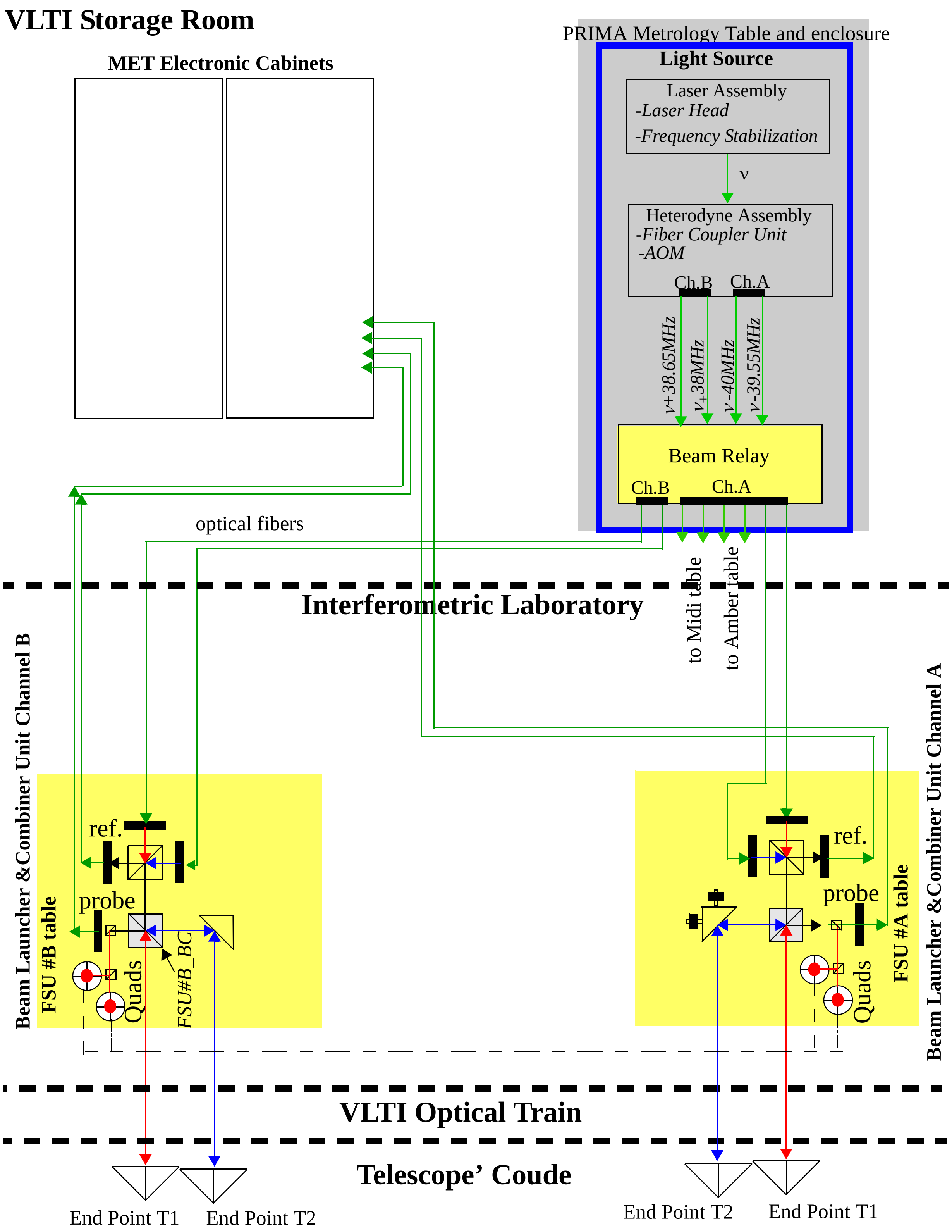


Figure 2 *PRIMA Metrology hardware Overview: green lines represents optical fibers; The red and blue lines are free-space laser beams, superimposed on the stellar beams. ν=c/λ represents the frequency of the laser*

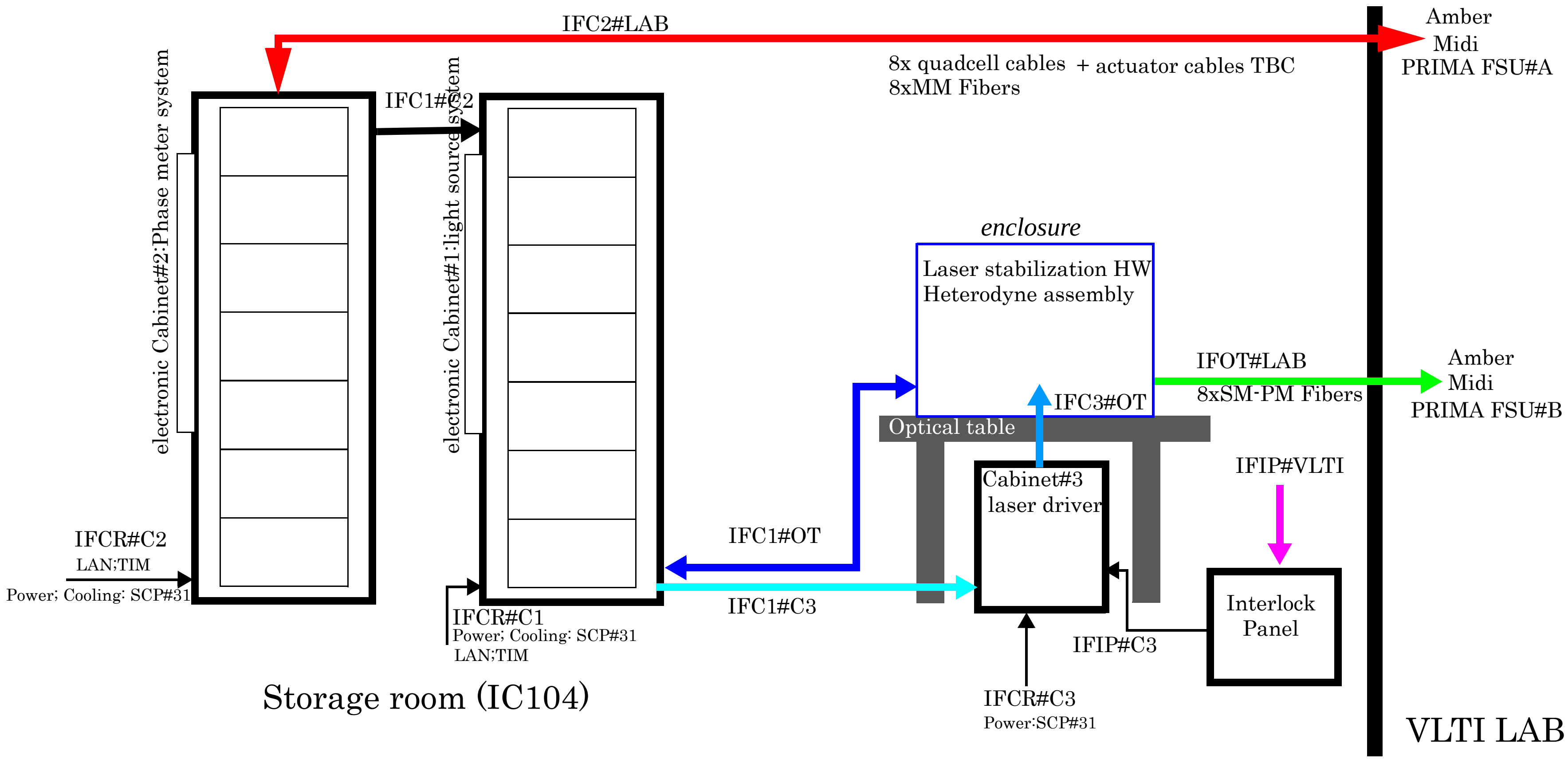


Figure 3 *Overview of the Metrology HW located in the Storage room (IC104). All Interface IFXX#XX are described in AD 7. The laser beams are carried from the storage room (inside the enclosure) to the VLTI lab using optical fibers.*

5 PRIMET Safety

5.1 List of possible hazards

Table 1 lists the possible hazards following the classification given in AD 1 appendix C3.

However only a subset is applicable to PRIMET as indicated in Table 1.

PRIMET is considered free from mechanical hazards. There is no sharp edge and no injury or damage can occur by unwanted activation of any motors. PRIMET has no moving parts.

All PRIMET components are rigidly attached to optical tables and secured against Eathquakes. The tables themselves (storage room, VLTI lab) are bolted to the ground or equipped with Earthquake Restraints.

The electronic cabinets located in the storage room will be secured with steel cables fixed to the ceiling, as it is currently done for other instruments.

The PRIMET control electronics follows the rules of AD 3. It is using VLT standard components (LCU crate, boards, cables etc...) or commercial components with CE marking. All cables are protected, properly secured and relayed through cable trays. It follows the same approach as for any other VLTI Instrument already installed at Paranal. No electrical safety issue is identified. Fiber connectors are all standard industrial FC/PC or FC/APC. All fibers cable are routed inside special conduct (protection against mechanical damage).

During operation, no significant heat is produced inside the VLTI lab (only about 16 W produced by all 8 quadcells). The heat produced inside the storage room is properly absorbed by the cooling system (see AD 7). All PRIMET temperature controlled components (I2 cell at 70 deg; SHG oven at 50 deg and laser driver) are protected by insulation material (no skin burning possible) and are also protected against over heating. All cables are halogen free and fire resistant. No thermal hazard is identified.

PRIMET is considered free from Hazard Generated by Materials and Substances. Only the heat exchangers of the electronics cabinets (ESO standard) are connected to cooling fluids provided by the Paranal Service Connection Points.

The impact if Human error will be minimized by allowing access and operation of PRIMET only to trained people who will also follow the ESO & Paranal safety regulation. Failure of power supply or control system will not cause any hazard.

The PRIMET infrared laser source represents the major source of potential hazard. Section 5.2 details the origin of the hazard as well as the associated safety equipment to be installed.

Table 1 Hazard List

Hazards List	**Applicability to PRIMET**
Mechanical Hazards	NO
Electrical Hazards	NO
Thermal Hazards	NO
Hazard generated by Noise	NO
Hazard due to Vibration	NO
Hazard generated by Radiation	**YES**
Hazard Generated by Materials and Substances: Cooling Liquid	NO

Table 1 Hazard List

Hazard generated by Neglecting Ergonomic Principles	NO
Human Errors	**YES**
Hazards in conjunction with the deployment environment	NO
Combination of Hazards	NO
Unexpected Start-up	NO
Lack of opportunity to Stop/ Shut down in Optimum Position	NO
Variation in Rotational Speed	NO
Failure of Power Supplies	NO
Failure of Control System	NO
Errors of Fitting or Faulty Assembly	NO
Breakage during operation	NO
Falling or ejected Objects and Liquids	NO
Loss of Stability/ toppling over of machine	NO
Slipping, Tripping, Falling of persons	NO

5.2 Laser Hazards and Safety Interlock system

5.2.1 Introduction

Laser safety is part of the ESO general safety regulations documented in AD 2. This document defines the laser classification as well as the necessary controls (engineering, administrative, etc.) associated to their safe operation.

5.2.2 PRIMET Laser source and specification for eye protection

PRIMET operates **one of** the following Infrared laser (wavelength=1319 nm). Both laser have a fiber output which confines the laser beam.

1/ Innolight laser (see AD 8)

According to its documentation, this laser complies with the Federal Register 21 CFR 1040.10 Laser Safety Standard. and is CE marked.The maximum power at the output of its pigtailed fiber is 340 mW (λ=1319 nm)

2/ Also a spare laser is available in case of failure of the Innolight laser. The spare laser is a **Lightwave laser 125** (see AD 9). It is Class IIIb defined by the Federal register 21CFR 1040.10 and conforms to EN60825-1:1994. Standard for safe use of lasers defined in ANSIZ136.1. This Laser is CE marked and the maximum power at the output of its pigtailed fiber is 210 mW (λ=1319 nm)

Both lasers corresponds to a **class IIIb** defined in AD 2.

Radiation in this class is very likely to be dangerous. For a continuous wave laser the maximum output into the eye must not exceed 500mW. The radiation can be a hazard to the eye or skin. However, viewing of the diffuse reflection is safe.

Both lasers have an interlock input.

Based on AD 2, the following actions will be implemented:

- The laser beam will be enclosed as much as possible
- Signs and labels will be posted adequately
- Controlled laser area will be defined, with access control and interlock triggering
- Warning system will be implemented to notify when the laser is operated
- The laser will only be operated by trained people
- eyewear protectors will be available

Definition of the Eye protection level:

The method described in RD 1 p.32 is used to define the Eye protection level.

- *Determine the minimum laser beam diameter to which a person might be exposed under reasonably foreseeable circumstances*: The worst case occurs when an operator looks directly at the tip of the fiber pigtailed laser. The minimum laser beam diameter corresponds to the size of the eye pupil, i.e. d=0.7mm
- *Calculate the cross-sectional area of the beam at this point*: $a=\pi.d^2/4=3.85e^{-5}$ m^2
- *Calculate the average power density at this point by dividing the average power of the laser by the beam area*: For this, we take the maximum power level of P=0.35 W which leads to a density of $D=0.35/\ 3.85e^{-5}$ $=9.1\ e^3$ $W/m^2 < 1e^4$ W/m^2
- *Look-up the required L number from table B1 in EN207*: the required minimum L number is **L3** (see Fig. 4):

EN207 – Classification and Specifications of filters and eye protection against Laser

Scale number	Max spectral transmittance At Laser Wavelength	Maximum power (E) and/or energy (H) density in the wavelength range								
		180nm to 315nm			>315nm to 1400nm			>1400nm to 1000 microns		
		D W/m^2	I,R J/m^2	M W/m^2	D W/m^2	I,R J/m^2	M J/m^2	D W/m^2	I,R J/m^2	M W/m^2
L1	10^{-1}	10^{-2}	$3x10^{2}$	$3x10^{11}$	10^{2}	$5x10^{-2}$	$1.5x10^{-3}$	10^{4}	10^{3}	10^{12}
L2	10^{-2}	10^{-1}	$3x10^{3}$	$3x10^{12}$	10^{3}	$5x10^{-1}$	$1.5x10^{-2}$	10^{5}	10^{4}	10^{13}
L3	10^{-3}	1	$3x10^{4}$	$3x10^{13}$	10^{4}	5	0.15	10^{6}	10^{5}	10^{14}
L4	10^{-4}	10	$3x10^{5}$	$3x10^{14}$	10^{5}	50	1.5	10^{7}	10^{6}	10^{15}
L5	10^{-5}	10^{2}	$3x10^{6}$	$3x10^{15}$	10^{6}	$5x10^{2}$	15	10^{8}	10^{7}	10^{16}
L6	10^{-6}	10^{3}	$3x10^{7}$	$3x10^{16}$	10^{7}	$5x10^{3}$	$1.5x10^{2}$	10^{9}	10^{8}	10^{17}
L7	10^{-7}	10^{4}	$3x10^{8}$	$3x10^{17}$	10^{8}	$5x10^{4}$	$1.5x10^{3}$	10^{10}	10^{9}	10^{18}
L8	10^{-8}	10^{5}	$3x10^{9}$	$3x10^{18}$	10^{9}	$5x10^{5}$	$1.5x10^{4}$	10^{11}	10^{10}	10^{19}
L9	10^{-9}	10^{6}	$3x10^{10}$	$3x10^{19}$	10^{10}	$5x10^{6}$	$1.5x10^{5}$	10^{12}	10^{11}	10^{20}
L10	10^{-10}	10^{7}	$3x10^{11}$	$3x10^{20}$	10^{11}	$5x10^{7}$	$1.5x10^{6}$	10^{13}	10^{12}	10^{21}

Figure 4 *EN207, classification and specifications of filters and eye protection against Laser*

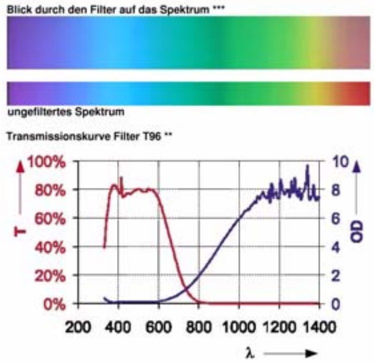
Selected Laser Protection goggles

The protection goggles purchased for PRIMET are model "Protector (L-08)" and "All Star (L-02K)" with T96 filters, from LaserVision (www.lvg.com). These goggles are specified L5, i.e much better than the minimum required (L3). The Optical density is > 6 at 1319 nm. The glasses will be available in dedicated boxed at the entrance of all places where operators are potentially in contact with the laser:

- Storage room
- VLTI laboratory
- All Coude rooms

- Inside each AT

Filter	T96
	Vollschutz
Farbe	hellgrau
Filtermaterial	Beschichtung auf Mineralglas
Filter-Technologie	Absorptionsfilter
Zertifizierung	DIN GS
VLT (ca.)	75 %
Visuelle Helligkeit	sehr gut
Farbsicht	hervorragend
Filterdicke	ca. 3 mm *



Schutzstufe	unverstärkte Fassung			verstärkte Fassung				
Fassung	VISION	ECO	PROTECTOR	GOLD LINE	VISION	ECO	PROTECTOR	SHIELD
Artikelnummer	005.T0096.00	007.T0096.00	008.T0096.00	-	015.T0096.00	017.T0096.00	018.T0096.00	-
DIR 850-900	L2	L2	L2	-	L2	L2	L2	-
DIR >900-950	L3	L3	L3	-	L3	L3	L3	-
DIR >950-1030	L4	L4	L4	-	L4	L4	L4	-
D >1030-1400	L5	L4	L5	-	L5	L5	L5	-
IR >1030-1400	L5	L5	L5	-	L5	L5	L5	-
DIR >1400-2200	L2	L2	L2	-	L4	L4	L4	-
DIR 2400-2800	L2	L2	L2	-	L3	L3	L3	-
DIR >2800-3200	L2	L2	L2	-	L4	L4	L4	-
DI>3200-10600	L2	L2	L2	-	L5	L5	L5	-
DI>10600-11000	L2	-	L2	-	-	-	L5	-

Figure 5 *Filter T96 used on the safety Glasses purchased for the PRIMA Metrology:Protector (L-08) with T96 filter;All Star (L-02K) with T96 filter from LaserVision (www.lvg.com); Aufbewahrungsbehälter Augenschutz;Ref: 111-0021 from http://de.vwr.com/app/catalog/Product?article_number=111-0021*

Figure 6 *laser goggles for PRIMET; left: Protector (L-08); right: All Star (L-02K)*

5.2.3 PRIMET laser beam propagation and power levels

The PRIMET laser head is located inside an opaque metallic enclosure where part of the laser beam propagates in free space (beam diameter 2 mm, max power=340x0.25=85 mW) for frequency stabilization purpose. The rest of the beam is split in 4 and leave the enclosure through 4 optical fibers towards the VLTI lab.

Inside the VLTI lab the 4 x beams are collimated into 1 mm diameter beams, are superposed to the stellar beams and propagates in free space along the VLTI optical train towards the Star separator of the telescopes (UTs or AT's).

Each beam has a maximum power of 50 mW (whereas the power required during operation is only about 10 mW).

For the UT's, the beams propagates in free space inside the Coude room where they are retroreflected back to the VLTI laboratory and detected. However, less than half of the power is reflected by M9 and propagates through the VLT optical train up to the primary mirror of the UT (straylight). For the AT's, the beams are confined inside the AT optical train.

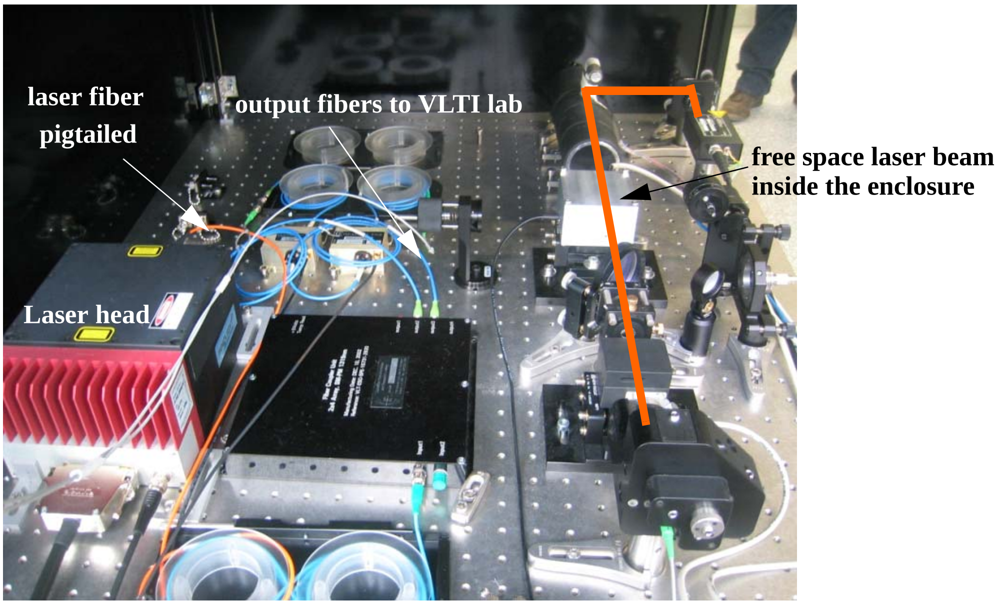


Figure 7 *View of the laser head and of the laser frequency stabilization system inside its enclosure. Inside the enclosure, part of the laser beam propagates in free space (beam diameter <2 mm, max power=340x0.25=85 mW. The laser beams leaving the enclosure are contained in optical fibers.*

Table 2 *Laser beam propagation*

Location	Max. free space Laser power	Beam diameter
Storage Room	85 mW	2 mm
VLTI laboratory	50 mW	1 mm
VLTI Tunnel and light ducts	50 mW	4 mm
Coude AT's/ UT's	50 mW	4 mm

5.2.4 Protection against laser hazards

Table 3 Definition of the protection foreseen against laser hazards

Location	Protection foreseen
Storage Room	**Controlled laser area** with key-pad access control. At the entrance door: Safety goggles available Flashing light when the laser in ON On the enclosure: Warning labels. The enclosure cannot be removed without tools.
VLTI laboratory	**Controlled laser area** with key-pad access control. At the entrance door: Safety goggles available Flashing light when the laser in ON Interlock on the entrance door The entrance door is the only access the VLTI laboratory and the VLTI tunnel. The interlock can be overridden for several seconds using a pin code (both inside and outside the lab). A buzzer is available outside the lab to request opening of the door. A push button (+key) allows triggering and locking the interlock
VLTI Tunnel	Only accessible through the VLTI laboratory which makes the VLTI tunnel a Controlled laser area (with key-pad access control)
Coude room UT's	**Controlled laser area** with key-pad access control At the entrance door (single access): Safety goggles available Flashing light when the laser in ON Interlock on the entrance door The interlock can be overridden for several seconds using a pin code (both inside and outside the lab). A buzzer is available outside the lab to request opening the door. A push button (+key) allows triggering and locking the interlock
Auxiliary telescope	At the entrance door (single access): Warning labels Safety goggles available
Auxiliary telescope pit (when no telescope is installed)	Warning labels on the pit cover “do not remove “bi-lingual, english/spanish
Nasmyth platform	Warning labels. Lock-out button available in the UT lock-out station

Any personnel with authorized access to the VLT area concerned by the PRIMET laser shall be trained by the Paranal Safety officer in coordination with the supervisors responsible for the area. (VLTI storage room and laboratory, VLTI tunnel, UT coude room, AT,UT Coude and azimuth/nasmyth platform).

Any operation using the PRIMET laser shall be performed in coordination with the VLT/VLTI managers.

During the Assembly, Integration and Verification phase of PRIMET, the Paranal safety officer will receive an extensive training related to the maintenance and operation of PRIMET.

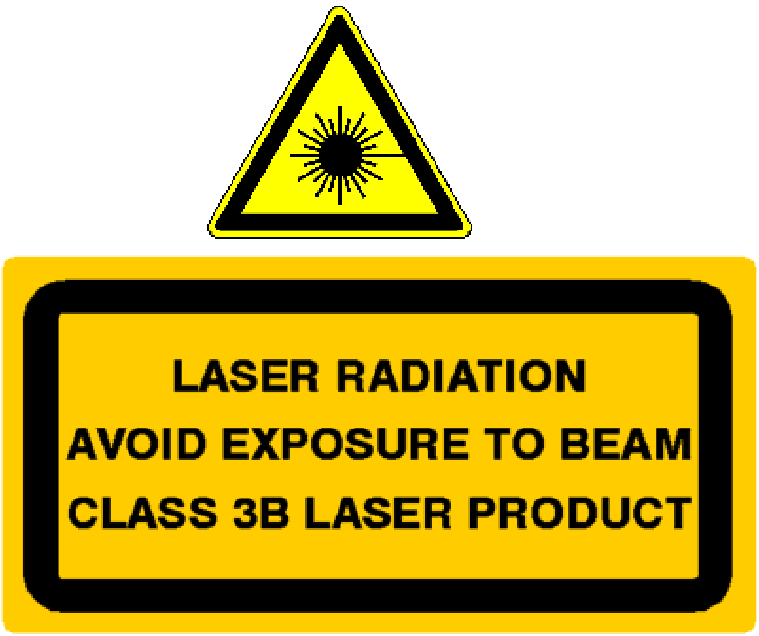


Figure 8 Warning signs

5.2.5 Laser Interlock system based on safety PLC's

All "**Controlled laser area**" defined Table 3 will be controlled by a Siemens safety PLC system. The system consists of decentralized periphery modules with I/O connections (Simatic ET200S), connected in a star network to a CPU (S7-317F). The CPU will control the interlock input of the laser driver. The system operates with Profinet distributed via multimode fibers.

Each ET200S will guaranty access control and lock-out as described in the following figures.

The status of the laser (ON or OFF) will be indicated by a light at the entrance of all Controlled laser area. Access will be granted by typing the right code on a key-pad. The interlock is then overridden for some seconds (delay adjustable) to allow access to authorized people even if the laser is ON. Similarly, when going out of these areas without triggering the laser interlock, a lock-out button must be pressed to override the interlock for some seconds. If someone enters the lab/storage&coude rooms without entering the code (non-authorized persons), the interlock will be triggered and the laser goes OFF, or if it was already OFF, it cannot be switched ON without resetting manually the interlock. This configuration is compatible with daily operation in the lab/storage&coude rooms with authorized personnel. By default, the laser will always be off during day-time unless PRIMA engineering activities must be carried out.

For the UT, a laser "lock-out" button will be available to interlock the laser whenever some work has to be performed inside the Nasmyth adapter or inside the Coude structure (e.g operation on the mirrors M4, M5, M6, M7 or M8). This new laser lock-out button will be added to the current Lock-out Station or close to it. It will be physically connected to the ET200S located at the entrance of the coude room inside the "access control electronics box".

A "status display" located in the storage room will show the status of the laser and of all interlocks. This information will also be available on the Prima metrology GUI. If the interlock is triggered, we will know immediately where it has been triggered.

Details about the design and wiring of the interlock system can be found in RD 2 .

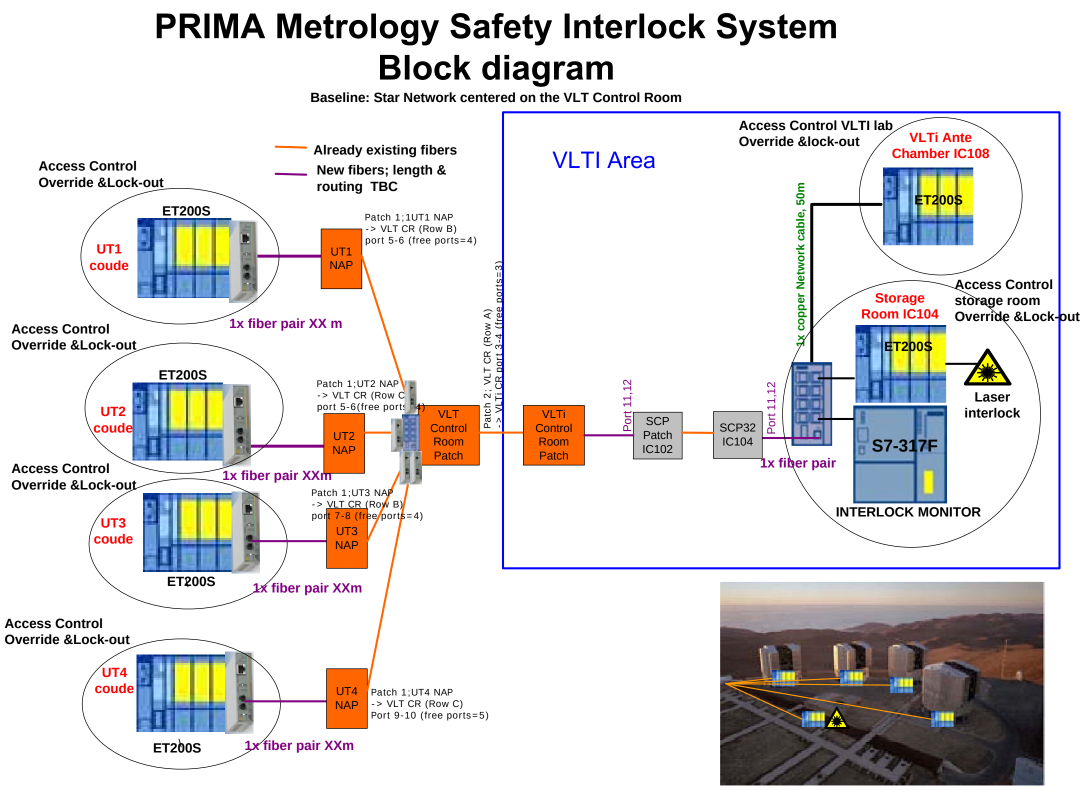


Figure 9 Overview of the layout

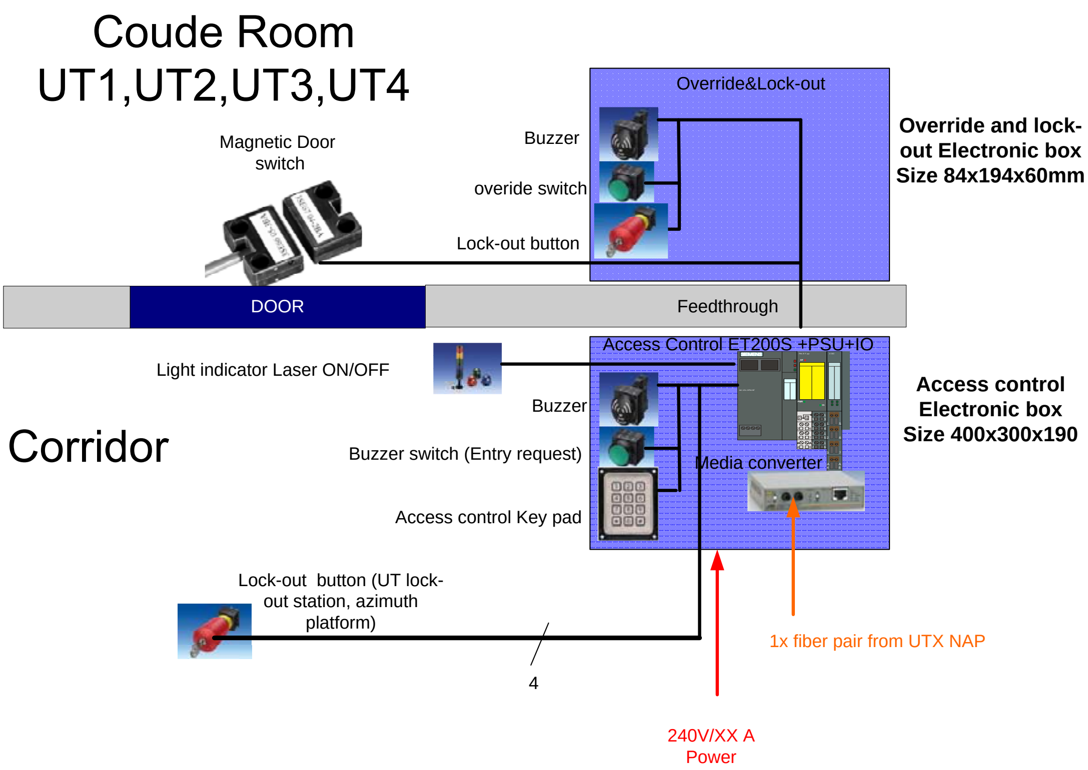


Figure 10 Safety equipment for the UT1,2,3,4 Coude rooms

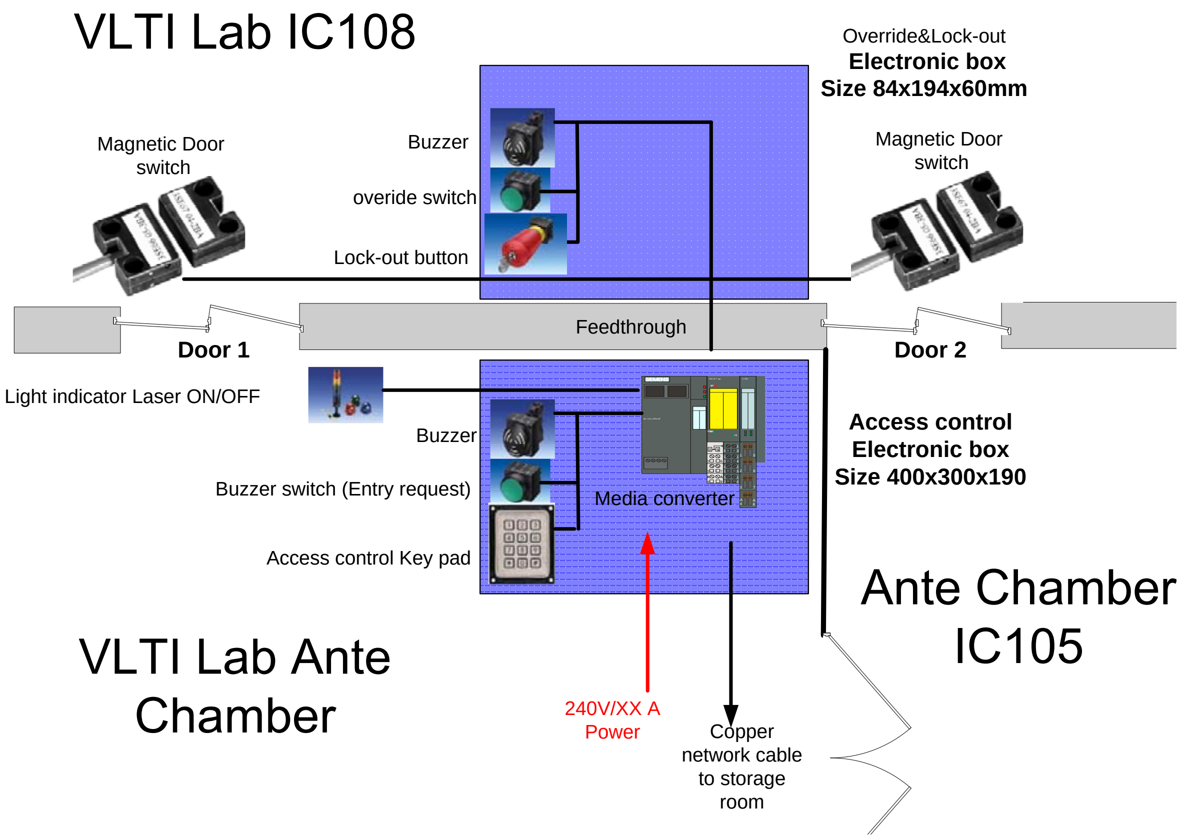


Figure 11 Safety equipment for the accessing the VLTI laboratory (IC108)

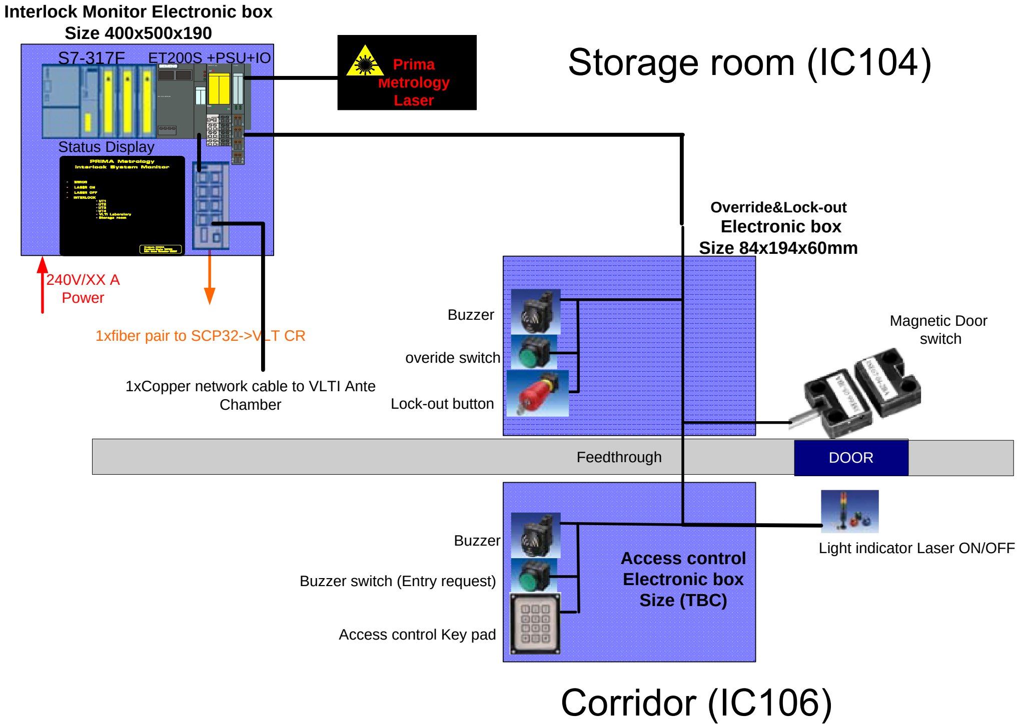


Figure 12 Safety equipment for the accessing the storage room (IC104)

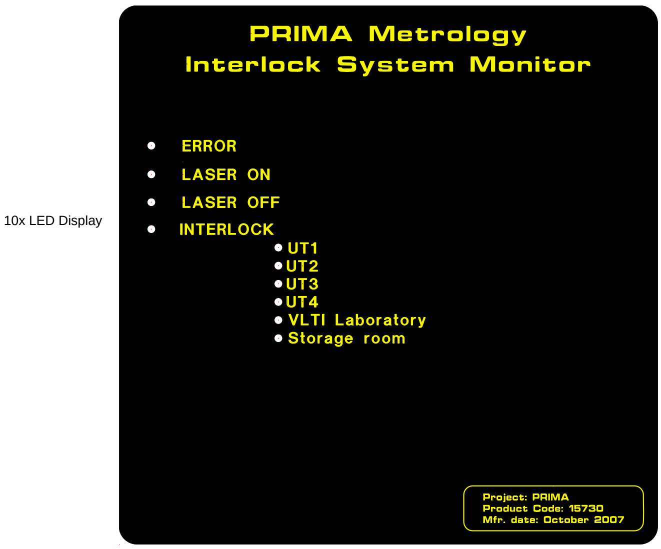


Figure 13 Display of the interlock Status

Figure 14 *Lock-out station located on the azimuth area of each UT where a new lock-out switch will be installed to interlock the laser during work in the Nasmyth adaptor or in the Coude optical train*

5.3 Hazard Identification and Risk Estimation

The identification of the hazardous events and the estimation of the associated risks follows the Method provided in AD 1.

The Hazard Severity Classification, the Hazard Occurrence Frequencies and the Hazard Risk Acceptance / Rejection Matrix are defined in AD 1.

The analysis shows that hazard classification of PRIMET can be ranked Class III -tolerable risk (transport only) and Class IV negligible risk (for all other phase of the project.

Under consideration of all hazards and protective measures, PRIMET can be used without any risk

Table 4 Risk estimation

Phase	**Risk**	**Risk reduction**	**Hazard classification**
Transport	-Hardware damaged	-Special Packing designed for delicate instrumentation including shock recorders.	Marginal-Rare Class III -tolerable risk
Integration	- Laser hazard - Hardware damaged by Human error	-Safety interlock to be integrated first. -Integration performed by trained people following the ESO & Paranal safety regulation	Improbable-Marginal Class IV negligible risk
Commissioning	- Laser hazard - Hardware damaged by Human error	- Safety interlock. - Commissioning performed by trained people following the ESO & Paranal safety regulation	Improbable-Marginal Class IV negligible risk
Operation	-Hardware damaged by Human error	- No access to the Hardware during operation - User manual	Improbable-Marginal Class IV negligible risk
Maintenance	- laser hazard - Hardware damaged by Human error	- Safety interlock -Maintenance performed by trained people following the ESO & Paranal safety regulation	Improbable-Marginal Class IV negligible risk
De-commissioning/Disposal	None	Not applicable	Not applicable

6 PRIMET Reliability

The reliability goal of PRIMET is similar to any other VLTI instrument, i.e typically 12 month MTBF and a lifetime of 10 years (87600 hours).

PRIMET will operate under well controlled laboratory conditions at Paranal:

- Temperature range: 15.5 ± 5 °C
- Relative Humidity: 5% to <50%
- Air cleanliness: class 30000.

The maximum duty of PRIMET is considered as 12 hours per nights during its 10 years lifetime, i.e a total of 43800 hours. However, in practice PRIMET will only be used during PRIMA runs which should occur typically by blocks of 10 to 15 days and at most every month. So a more realistic duty is 12hoursx15daysx12monthx10years=21600 hours.

Preventive maintenance will be performed during day-time as well as any necessary replacement of components in case of failure. Any component of PRIMET can be replaced in less than 8 hours (i.e. MTTR<8 hours), including potential re-alignment, provided that a spare unit is available.

The most critical components of PRIMET are located inside the storage room and do not require access to the interferometric laboratory for repair.

Access to the laboratory will be only required if:

- a quadcell detector fails: two spares are available and MTTR< 2 hours
- a fiber transmitting the laser signals is damaged: spares available and already routed, see AD 7. The replacement by a spare fiber is “instantaneous” but it then requires re-alignment as described below.
- the PRIMET optics must be re-aligned: MTTR< 8 hours. During the PRIMET testing in Garching, a re-alignment was only necessary if a major intervention on the FSU optics had occurred. The stability of the PRIMET beam injection/extraction opto-mechanics is such that no re-alignment is necessary at a scale of several months.

The list of components with potential failure are listed below. It includes the PRIMET electronic parts and active components. Excluded are all passive mechanical structures and optics for which no “failure” are expected during the lifetime of PRIMET, considering the above environmental conditions.

Table 5 Component Reliability

Item	MTBF (hours)	Duty at Paranal (hours)	Spares available/Comments
ESO LCU crate	>100000	87600	spares available
ESO standard boards used in PRIMET		87600	
CPU 6100	>320 000	87600	

Table 5 *Component Reliability*

M58 DIO	70 000	87600	
M36 AIO	44 000	87600	
ISER12	-	87600	
VMIVME -3123 (AI)	>63 000	87600	(1 spare)
MPV955 (AO)	>63 000	87600	
High speed digital I/O PMC-HPDI32A-64K	145 000	87600	(1 spare)
Reflective memory VMIPMC-5565-110000	> 400 000	87600	
Phase Meter	-	21600	Custom item. 1 spare Proto manufactured in 2001 still operating without failure Current Phase meter (x2) manufactured in 2005. Only 1 failure reported ("OR" gate replaced)
Laser head	10 000	21600	10000 hours=lifetime of the pump diodes 1 spare
Optical fibers and adaptors	>87600	87600	spares available
Fiber coupler	-	87600	operated since end of 2002 without failure. 1 spare
AOM	-		
Driver	-	21600	1 spare. Operated since 2004 1 failure observed. No failure observed on a similar system since 2001
AOM heads	-	21600	**No Spare (cost reason, TBC)** Operated since 2004 No failure observed on a similar system since 2001
Quadcell (detector head + analog module)	-	21600	Custom 2 spares
Laser frequency stabilization Hard-ware			Operated since mid-2004 without failure
SHG crystal and oven	-	21600	1 spare
EOM and driver	-	21600	

Table 5 Component Reliability

iodine cell	-	21600	2 spares
Lock-in amplifier	-	21600	"standard" electronics
Temperature controller/detector power supply	-	21600	"standard" electronics
detector	-	21600	1 spare

7 PRIMET preventive maintenance

Table 6 PRIMET Preventive maintenance

Item	manpower required	Total time required	Period
Cleaning of the PRIMET optics	1 pers.	2 days	5 years
Check Alignment	1 pers	1/2 day	every PRIMA run or every 2 months
Change/clean fiber adaptors and fibers	1 pers	1/2 hour	every change of Channel A of PRIMA
Run health Check script	1 pers	1/2 day	every PRIMA run or every month
Check Laser Interlock System	2 pers	1/2 day	every year

8 Actions after an Earthquake

After an earthquake of medium intensity (Mercali intensity 4-5) or high intensity (Mercali intensity >5), the hardware located in the storage room and in the VLTI laboratory shall be inspected . This includes in particular:

- Checking that the cooling pipes of the heat exchangers located on each electronic cabinet are OK.
- Checking that the safety Interlock system is operational

In addition, some software scripts dedicated to health checks shall be run.