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VERY LARGE TELESCOPE

MACAO-VLTI
List of Deliverables

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1.0	03/01/01	All	First issue
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List of Acronyms

ADn	Applicable Document No. n
AIV	Assembly, Integration and Verification
AO	Adaptive Optics
AoC	Award of Contract
ARE	Acceptance Review Europe
ARC	Acceptance Review Chile
CTC	Cabinet Thermal Control
DM	Deformable Mirror
ESO	European Southern Observatory
FDR	Final Design Review
FOV	Field of View
HD	Hardware Deliveries
I/F	Interface
ICA	Instrument Control Software
ISS	Interferometer Software Superviser
LAN	Local Area Network
LB	Laser Bench
LCU	Local Control Unit
MLE	Maximum Likely Earthquake
OPD	Optical Path Difference
OS	Observing Software
PAC	Provisional Acceptance Chile
PDR	Preliminary Design Review
PS	Power Supply
RDn	Reference Document No. n
RTC	Real-Time Computer
RTCS	Real-Time Computer Software
SCP	Service Connection Point
SOW	Statement of Work
SW	Software
TBC	To Be Confirmed
TBD	To Be Defined
TTM	Tip Tilt Mount
UPS	Uninterruptible Power Supply
UT	Unit Telescope
VLT	Very Large Telescope
VLTI	Very Large Telescope Interferometer
VLTISS	Very Large Telescope Interferometer Supervisory Software

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WFS	Wave Front Sensor
WS	WorkStation

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1. SCOPE

This document presents an exhaustive list of all deliverables (down to a certain detail level) of the system called MACAO-VLTI. One of these systems is developed for each VLT UT's so that there are four (4) identical copies of this system. Where this is not the case, it will be specifically stated.

This list will allow to identify clearly the components of MACAO-VLTI developed and/or provided by the AO department and the ones developed and/or provided by the VLTI group.

2. APPLICABLE & REFERENCE DOCUMENTS

The following documents shown form part of the MACAO-VLTI design to the extend specified herein. In the event of a conflict between the documents referenced herein and the content of this document, the content of the present document prevails.

2.1. APPLICABLE DOCUMENTS & REFERENCE DOCUMENTS

AD1	Top-Level Requirements For MACAO-VLTI	VLT-SPE-ESO-15600-2082	v1.2	8.03.2001
AD2	MACAO VLTI Technical Specifications	VLT-SPE-ESO-15600-2245	v1.1	9.03.00
AD3	MACAO-VLTI Verification Matrix	VLT-LIS-ESO-15600-2332	v2.0	14.03.01
AD4	MACAO –VLTI Interface Control Document	VLT-ICD-ESO-15600-2057(previously issued as VLT-ICD-ESO-11640-2057)	v2.0	5 Feb 2001
AD5	MACAO-VLTI Management Plan	VLT-PLA-ESO-15600-1742	v1.2	12Feb.01
AD6	MACAO VLTI Draft Maintenance Plan	VLT-PLA-ESO-15600-2521	v1.0	Date: 9.03.00
AD7	MACAO-VLTI Detailed Hazards Analysis	VLT-TRE-ESO-15600-2466	v1.1	9.03.01
AD8	MACAO-VLTI System Overview	VLT-TRE-ESO-15600-2251	v1.2	15-02-2001
AD9	MACAO-VLTI System Design Analysis	VLT-TRE-ESO-15600-2067	v2.1	02.02.01
AD10	MACAO-VLTI Detailed mechanical design and Analysis report of the Coude AO facilities	VLT-TRE-ESO-15600-2274	v2.0	12.03.01
AD11	MACAO VLTI Electronics – Overview	VLT-TRE-ESO-15600-2268	v2.0	6-Mar-2001

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AD12	Macao VLTI Electronics APD	VLT-TRE-ESO-15600-2269	v2.0	06-03-01
AD13	MACAO VLTI Electronics - DM Control	VLT-TRE-ESO-15600-2271	v2.0	6-Mar-2001
AD14	MACAO-VLTI Instrument Control Electronics (LCU)	VLT-TRE-ESO-15600-2270	v2.0	5.03.01
AD15	Effect of DM Dynamics on MACAO Performance	VLT-TRE-ESO-11640-2429	v1.0	31/12/2000
AD16	MACAO-VLTI Wavefront Sensor Optics	VLT-TRE-ESO-15600-2273	v2	15-02-2001
AD17	MACAO Lenslet Array Unit Design Report	VLT-TRE-ESO-11640-2451	v1.0	30.01.2001
AD18	MACAO-SoftwareDesign-ICS	VLT-SPE-ESO-15600-2440	v1.0	12/02/2001
AD19	MACAO-VLTI Software Design – OS	VLT-SPE-ESO-15600-2439	v1.0	12-2-2001
AD20	MACAO-VLTI Real-Time Computer Software Design	VLT-SPE-ESO-11640-2352	v1.1	28.02.01
AD21	MACAO-VLTI Software Functional Specs – RTC	VLT-SPE-ESO-15600-2062	v1.2	15.02.01
AD22	Assembly Integration and Tests Plan for MACAO-VLTI	VLT-PLA-ESO-15600-2241	v2.0	14.03.01
AD23	MACAO-VLTI Tip-Tilt-Mirror FEM Analysis	Technical note		7.03.01
AD24	Studies on MACAO Software Specifications: Piston Removal from Bimorph Control (WP1),	ONERA		03/2001
AD25	Optical path difference sensors	ONERA		2001-03-08
AD26	MACAO-VLTI Tip-Tilt Mount Final Design Report	VLT-TRE-ODP-11640-0002	v1.0	22/02/01
AD27	MACAO-VLTI Deformable Mirror Design Report	CILAS		28.02.01
AD28	MACAO APD Counter Module Design Report	VLT-TRE-SHK-11640-0001	v1.0	26.02.01

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3. INTRODUCTION

The MACAO VLTI consists in four (4) AO modules installed at the Coudé focus of each UT. It shall correct the wavefront coming from the telescopes from atmospheric turbulence, before recombination of the beams in the interferometric laboratory of the VLTI.

4. LIST OF DELIVERABLES

4.1. MECHANICAL COMPONENTS DELIVERABLES

4.1.1. X-Y Tables, 4 units (AD10)

This includes all the components allowing the X and Y translation of the whole WFS unit in the Coudé focal plane of the VLT: welded base and frame, linear bearings motors, encoders, brakes and cables to the IC-LCU.

4.1.2. T-Mount, 4 units (AD10)

This is the main opto-mechanical component of MACAO-VLTI and it serves as a holding structure for most of the WFS components of MACAO-VLTI. The "T-Mount" includes the welded frame and the component listed hereafter.

4.1.2.1. Welded Structure

The "T-Mount" welded structure and also the light-tight covers (front and back). It also includes routing for cables and a centralised connecting panel with connections for all motors and encoders, power and fluid distribution.

4.1.2.2. Entrance Shutter

The entrance shutter and the cables to the T-Mount connecting panel.

4.1.2.3. Beam Exchanger slide, beamsplitters & mirrors

This includes the optical mirrors (7 mirrors) and beamsplitters (2 50/50 beamsplitters), the translation stage with cables to the T-Mount connecting panel.

4.1.2.4. Membrane mirror Unit

This unit includes the membrane mirror, the resonant cavity and the loudspeaker to drive it. The whole unit is mounted on, and includes a motorized gimball (tip-tilt). It is also mounted on a focusing stage. Cables to the T-Mount connecting panel are also included.

4.1.2.5. STRAP Neutral Density Filter Wheel

This includes a commercial double-8 filters position wheels, the neutral density filters motor and encoder and cables to the T-Mount connecting panel.

4.1.2.6. WFS Neutral Density Filter Wheel

This includes the 12 filters position wheel, the neutral density filters motor and encoder and cables to the T-Mount connecting panel.

4.1.2.7. Components not delivered

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Here is a list of the optical components *not delivered* by the AO department but necessary to the normal functioning of a complete MACAO-VLTI system. These particular items are provided by the VLTI.

4.1.2.7.1. STRAP

It includes the STRAP head, and cables to the T-Mount connection panel. The VLTI group is responsible for making this component available to AO department (includes also the cables from the T-Mount connection panel to the VLTI-LCU, drive and power electronics).

4.1.2.7.2. TCCD

It includes the TCCD head, and cables to the T-Mount connection panel. The VLTI group is responsible for making this component available to AO department (includes also the cables from the T-Mount connection panel to the VLTI-LCU, drive and power electronics).

4.2. CORRECTIVE OPTICS, 4 UNITS

4.2.1. Tip-Tilt Mount (TTM) (AD26)

This includes the mount (gimball, motors, encoders with cables), the TTM front end electronics (FE) and cables to the corrective optics electronics cabinet (on the azimuth platform) (other electronics associated with the TTM will be included in the electronics list).

4.2.2. Deformable Mirror (DM) (AD27)

This includes the bimorph mirror, the mounting ring and its back connecting plate.

4.3. OPTICAL COMPONENTS DELIVERABLES

4.3.1. WFS Beam Expander, 4 units (AD16),

This includes the mechanical housing and the mirrors; spherical mirror, flat mirror, and 2 off-axis parabola.

4.3.2. Micro-Lens array, 4units (AD17)

This includes the 2 micro-lens arrays, the I/F plates to couple the sub-apertures to the optical fibers and the optical fibers themselves.

4.3.3. De-rotator Prism, 4 units

This includes the prism itself but also its mount and the rotating mechanism. The latter contains motor, encoder and cables to the T-Mount connection panel.

4.3.4. TCCD imaging optics, 4 units

4.3.5. Optical components not delivered

Here is a list of the optical components *not delivered* by the AO department but necessary to the normal functioning of a complete MACAO-VLTI system. These particular items are considered part of the Coudé train and are provided by the VLTI.

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4.3.5.1. M9 Dichroic

This includes the optics and its mount.

4.3.5.2. Telecentricity Lens

This includes the optics and its mount.

4.4. ELECTRONICS DELIVERABLES

Note that the VLTI/RTC cabinet and IC-LCU/WFS-XY is a double cabinet (left-side and right-side).

4.4.1. Double Electronics Cabinet, 4 units (AD11, AD14)

This double-cabinet is located on the Coudé platform. We understand by cabinet the structure and all its content. The cabinet itself is composed of walls with adjustable feet, front doors and internal structure. It includes also main power distribution among the various electronic racks. Two main UPS power cables between Coudé platform SCP and the cabinet are also included.

4.4.1.1. Left-Side Cabinet

4.4.1.1.1. RTC Rack

The content of the RTC-LCU is listed in RD1 (p.32).

4.4.1.1.2. VLTI-LCU rack

The content of the VLTI-LCU is listed in RD1 (p.35).

4.4.1.1.3. Heat extraction

This includes a standard ESO heat exchanger CTC, two 1U fan units and 2 cooling fluid pipes with standard connectors linking the cabinet to the Coudé platform SCP.

4.4.1.2. Right-Side Cabinet

4.4.1.2.1. IC-LCU rack

The content of the IC-LCU is listed in RD1 (p.28).

4.4.1.2.2. WFS-XY

The content of this chassis is described in RD1 (p.31).

4.4.1.2.3. Heat extraction

This includes a standard ESO heat exchanger CTC, two 1U fan units and 2 cooling fluid pipes with standard connectors linking the cabinet to the Coudé platform SCP.

4.4.2. Single Electronics Cabinet, 4 units (AD11, AD12)

4.4.2.1. Cabinet

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This cabinet is located on the Coudé platform in close proximity to the WFS box. We understand by cabinet the structure and all its content. The cabinet itself is composed of walls with adjustable feet, front doors and internal structure. It includes also main power distribution among the various electronic racks. Two main UPS power cables between Coudé platform SCP and the cabinet are also included.

4.4.2.2. APD’s

Sixty (60) APD’s are mounted on liquid cooled cold plates (for heat extraction). This cabinet contains also the PS for the APD’s. Water hoses with standard connectors to the Coudé platform SCP are also provided. The optical fibers feeding the APD’s arrive directly from the T-Mount structure located nearby. This rack also contains the APD junction box and line driver. It includes the signal cables from to the APD counter board in the RTC VME rack (see below).

4.4.3. Corrective Optics Electronics Cabinet, 4 units (AD11, AD13)

4.4.3.1. Cabinet

This cabinet is located on the azimuth platform. We understand by cabinet the structure and all its content. The cabinet itself is composed of walls with adjustable feet, front doors and internal structure. It includes also main power distribution among the various electronic racks. Two main power cables (normal and UPS) between azimuth platform SCP and the cabinet are also included.

4.4.3.2. TTM Electronics

The TTM electronics is composed of one 3U TTM servo-unit including 2 PS boards (18 V and 15 V), 2 power amplifier boards (X and Y), 2 servo boards (X and Y), one I/F board and one test board. Motor and encoder cables from the SU to the M8 tower are included.

4.4.3.3. DM Electronics

The DM electronics is a 6U VME rack containing a PowerPC board, one I/O board and 4 16-channels amplifier boards. The VME rack also contains a VME PS, and a High Voltage PS as well. Cables from this cabinet to the M8 DM are included.

4.4.3.4. Heat extraction

This includes a standard ESO heat exchanger, at least one 1U fan unit and 2 cooling fluid pipes with standard connectors linking the cabinet to the azimuth platform SCP.

4.5. SPARES

- 1 Beam-Expander Unit*
- 1 De-rotator prism and mount
- Density filters (for MACAO)
- 1 DM
- 1 membrane mirror unit (membrane, loudspeaker, resonant cavity, gimball)
- 4 Micro-Lens arrays*

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- 2 Optical Fiber Bundles (60 fibers) with 60 aperture plate mechanical I/F*
- Beam Switching device 45 deg. Mirrors & Beamsplitters
- XY-Table spares:
  - 1 INLAND motor QT-3103,
  - 1 tachometer INLAND TG-1318,
  - 4 ball bearings SKF type 6201-2RS1,
  - 2 ball bearings SKF type 61901-2RS1,
  - 2 linear actuators SKF type TN2 16x5R,
  - 2 brake actuators FESTO type ADVU 50-10A,
  - 2 Heidenhain LS-106 encoders,
- 60 spare APD modules*
- 1 high voltage driver rack for the DM*
- 1 PowerPC board with 256 MB*
- 2 APD counter boards*
- Standard motor control/amplifier boards
- 1 TTM front end (sensor) box
- 1 spare of all TTM servo-electronic PCB + cables*

*These components are spares for the SINFONI and CRIRES instruments also.

4.6. SOFTWARE DELIVERABLES

The VLTISS *is not a MACAO-VLTI deliverable.* There is no software produced by the AO department that provides coordinated use of two or more MACAO systems.

4.6.1. Instrument Control Software (ICS) (AD18)

4.6.1.1. LCU ICS module

4.6.1.2. ICS Stand-alone GUI

4.6.2. Observing Software (OS) (AD19)

4.6.2.1. Workstation main software

4.6.2.2. Graphical User's interface

4.6.2.3. ICS Workstation server

4.6.3. Real-Time Computer Software (RTCS) (AD20, AD21)

Let's recall that the RTC software has modules running on three (3) separate CPU:

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- The Workstation CPU
- The RTC rack LCU CPU (PowerPC board) (called RTCLCU)
- The RTC rack close loop CPU (PowerPC board) (called RTCCPU)

4.6.3.1. Workstation Softwares

4.6.3.1.1. RTCS Workstation command server

4.6.3.1.2. Workstation engineering interface and GUI

4.6.3.1.3. Workstation Real-Time Display

4.6.3.2. RTCLCU Softwares

4.6.3.2.1. Command Server (running on RTCLCU)

4.6.3.2.2. Loop monitoring module (running on RTCLCU)

4.6.3.3. RTCCPU Softwares

4.6.3.3.1. Command Server (running on RTCCPU)

4.6.3.3.2. RTCS loop-control software (running on RTCCPU)

4.6.3.3.3. Data Stream software

4.7. DOCUMENTATION

- FDR documentation package updated
- Drawing Set as built
- Test procedure document and Test Reports (4) for each unit
- User’s Manual
- Maintenance Manual

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