**Statement of Work for Opto-Mech elements Manufacturing**

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# Introduction

## Purpose

This document describes and specifies the subject of the contract and the relative milestones and deliverables. The technical requirements for the system are described in the MORFEO LGS WFS Optical Specifications (AD1) that are an integral part of this Statement of Work.

## Scope

MORFEO is a post-focal adaptive optics module that forms part of the first light instrument suite for ELT, the ESO Extremely Large Telescope (39m diameter) currently under construction. The main function of MORFEO is to relay the light beam from the ELT focal plane to the client instruments while compensating the effects of the atmospheric turbulence and other disturbances affecting the wavefront from the scientific sources of interest. MORFEO enables high angular resolution observations in the near infrared over a large field of view (~1 arcmin2) by real time compensation of the wavefront distortions due to atmospheric turbulence. Wavefront sensing is performed by laser and natural guide stars while the wavefront compensation is performed by adaptive deformable mirrors in MORFEO which work together with the telescope's adaptive and tip tilt mirrors M4 and M5 respectively.

MORFEO is being designed and built by a consortium of partners in Italy, France (CNRS-IPAG), Canada and Ireland, together with ESO. IPAG the Institute for Planetary sciences and Astrophysics of Grenoble (IPAG) is responsible for delivering the LGSWFS module described in the AD1.

## Definitions

**Bidder.** Any company or other economic operator that submits an offer for the present Call.

**Contracting Authority.** CNRS - IPAG Institute for Planetary sciences and Astrophysics of Grenoble is the contracting authority for this project.

**Contractor.** The company or other economic operator that signs with IPAG the contract for this project.

**ESO.** The European Southern Observatory (ESO) is an intergovernmental science and technology organization in astronomy. It is the commissioning party or MORFEO, a first-generation instrument of ELT, the Extremely Large Telescope under construction in Chile. ESO is entitled to participate, as a reviewer, to the Final Design Review.

**Factory.** Throughout this document, “Factory” refers to the contractor premises, where the first acceptance test is carried out.

**On-site**. Throughout this document, “On-site” refers to the IPAG integration hall.

**SoW.**  Statement of Work

**Technical requirements**. Requirements that define the characteristics and technical specifications of the supply.

In this document and in all other documents of the Call the following convention applies:

* **Shall** indicates a mandatory requirement
* **Should** indicates an optional, desired requirement
* **Will** indicates a circumstance expected to happen

# Subject of the contract

This SoW applies to the procurement and delivery of the optical elements and their housing of the following subsystems:

1. Collimator (3 lenses, 2 mirrors and Narrow Band Pass Filter)
2. LDM optical relay (6 lenses)
3. Calibration Unit (2 doublets, the pupil mask plate and the folding mirror)

as specified in AD1, and listed in section 3.3 hereafter, needed by LGSWFS Module of the MORFEO Instrument.

LGS WFS needs 6 copies of each of the following subsystems: collimator, LDM optical relay and calibration unit plus 1 spare of the collimator and of the LDM and one optical spare of the calibration unit, as described in sections 3.3.2 and 3.3.3.

This SoW will cover:

* The manufacturing phase which includes the tests at the company premises
* The delivery at the integration hall in Europe (Grenoble, France).
* The documentation as specified in the following sections

The Kick Off Meeting shall mark the official start of project activities. The Kick Off Meeting shall take place within 14 days from contract signature.

Assuming as T0 the date of the contract signature with the selected contractor, the project shall follow the timeline indicated in Section 3.2.

In the following the Applicable Documents for this supply are listed.

## Applicable Documents

The following applicable documents form a part of the present document to the extent specified herein. In the event of conflict between applicable documents and the content of the present document, the content of the present document shall be taken as superseding.

1. E-MAO-PL0-IPA-SPE-104\_01D3 LGS WFS Optics Specifications
2. E-MAO-PL0-IPA-CMX-101\_01D1
3. DWG

# Contract, acceptance procedure, deliverables, timeline and milestones

It is expected that the bidder analyzes the specifications in AD1 for all the optical elements. Alternative solutions can be proposed by the bidder if they cannot be compliant with the specified specifications. IPAG will approve the final specifications by evaluating the corresponding documents.

Option 1

* The Contractor shall procure and deliver the optical elements listed in 3.3.2 and specified in AD1.
* The contractor shall do the Factory Acceptance test of the optical elements.
* The Contractor shall Deliver the expected documentation (full list specified in Section 3.3).

Option 2

* The Contractor shall procure the optical elements as listed in 3.3.2 and specified in AD1.
* The contractor shall procure the mechanical elements in 3.3.3 and specified in AD1 and AD3.
* The contractor shall do integration and the Factory Acceptance test of the collimator, calibration unit and the LDM optical relay of the LGSWFS Module.
* The Contractor shall Deliver the expected documentation (full list specified in Section 3.3)

## Acceptance procedure

For both optics and mechanics, the acceptance procedures shall be as follows:

*Integration Readiness Review* if option 2: it ensures that the activities to be carried out in the Integration phase are clearly identified, sorted out and scheduled, have assigned resources and the persons responsible and the success criteria for all activities are clear.

*Factory Acceptance: acceptance* procedure for the physical elements shall be carried out through structured test sessions. The procedure shall start with the verification that all the expected items (See AD1, AD2 and AD3) are present and in working conditions. Then specific test sessions shall verify that each optic fulfils all the technical specifications. The test sessions shall be executed at the Factory premises.

## Timeline and Milestones

|  |  |  |  |
| --- | --- | --- | --- |
| Activity/Milestone | Start | End | Description |
| Contract Signature | T0 | | Contract signature. Kick-Off Meeting to be arranged within 14 days from contract signature |
| Kick Off Meeting | T1 = T0+14days | | The main objectives of the Kick-Off Meeting are to confirm mutual understanding of the scope of work specified herein, including its applicable specifications. |
| List of test plates and tools | T0+14days | | The main objective of these lists is to adjust the design according to the tools provided |
| Material certificate of the optical glass | T0+N | | This milestone is to check the conformity of the materials, a positive conclusion from IPAG marks the green light to start the procurements.  (The value of “N” shall be proposed by the bidder) |
| Optical elements procurements | T1 | T1+O | This activity has the objective to procure all the optical elements.  (The value of “O” shall be proposed by the bidder) |
| Mechanical elements procurements  (If Option 2) | T1 | T1+P | This activity has the objective to procure all the mechanical elements.  (The value of “P” shall be proposed by the bidder) |
| Integration Readiness Review  (If Option 2) | T1+  Q-14  days | T1+Q | The purpose of this activity is to verify that the elements of the integration phase (tools, procedures and resources) are clearly identified.  The positive conclusion of this review is the condition for the start of integration.  (The value of “Q” shall be proposed by the bidder) |
| LGSWFS subsystem integrations  (If Option 2) | T1+Q | T1+M | The objective of this activity is to integrate the optical elements in their housing at the Contractor’s premises and to prepare the subsystems for the Factory Acceptance.  (The value of “M” shall be proposed by the bidder) |
| Factory Acceptance test - FAT | T1+M | T1+F | This activity has the objective to verify that the subsystem of the LGSWFS is performing according to its specifications at Contractor’s premises.  (The value of “F” shall be proposed by the bidder) |
| Factory Acceptance Review | T1+F | | This milestone marks the positive acceptance of the optical elements and if option 2: integrated Calibration unit, Collimator and LDM at the Contractor’s premises and the consequent authorization to ship it to the IPAG facility for LGSWFS Integration.  A Test and Inspection report is signed by both IPAG and the Contractor.  (The value of “F” shall be proposed by the bidder) |
| On-Site Acceptance Review | T1 + F + 14days | | This milestone marks the positive conclusion of the Test and commissioning at IPAG premises and the consequent final acceptance by IPAG.  A Test and Inspection report is signed by both IPAG and the Contractor. |

Table 1 – Project schedule

The FAT - Factory Acceptance Test reported in the timeline and milestone is the process of provisional acceptance that assesses the proper functioning of the system(s) at the contractor’s site. All interfaces, maintenance, packing and unpacking procedures are also verified.

Test procedures, modes and timeline of the FAT of each subsystem shall be defined in detail in the relevant verification Plan by the constructor. The verification Plan shall ensure the proper implementation of all requirements contained in the Compliance Matrix.

Once successfully passed the FAT, the system can be transported to the IPAG.

A Test and inspection report (FAT version) shall be issued at the end of the test session, signed by the appointed IPAG responsible and counter-signed by a contractor’s representative.

## Deliverables

Types:

D -> Document

E -> Equipment

### Technical Deliverables (Documents)

|  |  |  |  |
| --- | --- | --- | --- |
| Code | Title | Type | Description |
|  | Compliance Matrix | D | Compliance Matrix to Requirements.  The Compliance Matrix shall, as a minimum:   1. List in the tabular format in AD4 all requirements that have been identified in the Call documentation. 2. Recapitulate for each requirement the means of verification adopted (by Design, Analysis, Inspection or Test) 3. Provide a statement of compliance and the reference to the document where the compliance is demonstrated or shown. In case of non-compliance (or partial compliance) indicate the pending assessment, possible remarks and the link to the related requirement. |
|  | Report on Test and Inspection | D | Report on Test and Inspection shall include at least:   1. Test Results: in this section the findings of the Test shall be provided. The results shall be processed in such a way that they will be directly comparable with the verification items verified. A comparative table shall summaries the actual versus the nominal ones required.   This report must contain at least the following tests for all the manufactured elements   * Dimensions: Diameter, Thickness, PRISMs angles * Radius of curvature * Roughness * Material certificate of the optical glasses * Coated witness sample report: Transmission, reflection, both in ASCI * Surface quality SFE * Cosmetics: scratch and dig inspection report * WFE and the focal length of the doublets in the Calibration unit   If option 2 and beside the tests defined for option1:   * Measurement of the focal length of the collimator assembly * WFE of the calibration unit, collimator assemblies and of the optical relay. * Magnification of the optical relay.  1. Conclusions; in this section a statement concerning the conformance of the Test results with the requirements specified shall be given. In case of non-compliances, the reference to the related requirements shall be provided and the impact on the final performance and recovery actions shall be discussed. |
|  | Verification Plan |  | The system verification plan shall be established for the calibration unit, collimator and the LDM.  This document contains a clear and well detailed verification plan describing the tests to be performed to verify the compliance of the subsystems to the specifications. |
|  | Cleaning procedure | D | Proceeding describing how to clean the optical elements once on commissioning. |
|  | Non-Conformance Report | D | In case where a non-conformance or discrepancy of any kind is detected during the project execution, the Contractor shall give notice to IPAG by means of a Non-Conformance Report within 1 week after detection. These Reports can refer to any technical, manufacturing, schedule and quality aspect, particularly in cases where a detected non-conformance may lead to a late delivery of products. |

Table – Documents deliverable

### Optical Technical Deliverable (Hardware)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Sub-System | Code | Title | Type | Description |
| 6 copies of Collimator + 1 spare  k=3,4,5,6,7,8, CoLS | TBD | Col\_FM1 | E | Folding mirror 1 inside the collimator  See DWG |
| TBD | CoL\_L1 | E | Lens1 inside the collimator |
| TBD | CoL\_L2 | E | Lens 2 inside the collimator |
| TBD | CoL\_L3 | E | Lens 3 inside the collimator |
| TBD | Col\_FM2 | E | Folding mirror 2 inside the collimator |
| TBD | NBP Filter | E | Narrow Band Pass Filter inside the collimator |
| 6 copies of LDM optical relay + 1 spare  n=3,4,5,6,7,8, LDMS | TBD | LDM\_L1 | E | Lens 1 inside the optical relay of the LDM |
| TBD | LDM\_L2 | E | Lens 2 inside the optical relay of the LDM |
| TBD | LDM\_L3 | E | Lens 3 inside the optical relay of the LDM |
| TBD | LDM\_L4 | E | Lens 4 inside the optical relay of the LDM |
| TBD | LDM\_L5 | E | Lens 5 inside the optical relay of the LDM |
| TBD | LDM\_L6 | E | Lens 6 inside the optical relay of the LDM |
| Calibration unit + 1 spare | TBD | Doublet1(CaL\_L1) | E | Doublet 1 inside the calibration unit |
| TBD | Doublet1(CaL\_L2) | E | Doublet 1 inside the calibration unit |
| TBD | Doublet2(CaL\_L1) | E | Doublet 2 inside the calibration unit |
| TBD | Doublet2(CaL\_L2) | E | Doublet 2 inside the calibration unit |
| TBD | Pupil mask CAL\_PM | E | Pupil mask plate inside the calibration unit |
| TBD | Cal\_Folding mirror CAL\_FM | E | Folding mirror inside the calibration unit |
|  | TBD | Delivery of a coated witness sample for each coating | E | The delivery of a coated witness sample of the same material as the deliverable optical element. |

Table 3 – Optical Hardware deliverables

### Mechanical technical Deliverables (Hardware) - If Option 2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Sub-System | Code | Title | Type |  |
| Collimator Housing | TBD | Collimator Support | H | Collimator Support |
| TBD | L1 spacer | H | Collimator spacer 1 |
| TBD | L2 spacer | H | Collimator spacer 2 |
| TBD | L3 spacer | H | Collimator spacer 3 |
| TBD | L1 L2 L3 fixing | H | L1 L2 L3 fixing |
| TBD | L3 collimator Adjustment spacer | H | L3 collimator Adjustment spacer |
| TBD | Spring | H |  |
| TBD | Spring Spacer | H |  |
| LDM optical relay Housing | TBD | lenses 1-2 spacer | H |  |
| TBD | lenses 2-3 spacer | H |  |
| TBD | lenses 3-4 spacer | H |  |
| TBD | lenses 4-5 spacer | H |  |
| TBD | lenses centering | H |  |
| TBD | spring for optics RL2-RL5 | H |  |
| TBD | spring spacer | H |  |
| TBD | M3 x 6 screw 6 | H |  |
| TBD | M3 x 12 screw 6 | H |  |
| TBD | spring for optics RL1 | H |  |
| TBD | spring fixing | H |  |
| TBD | pin for the field stop position | H |  |
| TBD | LDM-L6 support | H |  |
| TBD | LDM-L6 fixing | H |  |
| TBD | LDM-L6 spring | H |  |
| TBD | LDM-L6 spacer | H |  |
| Calibration housing | TBD | Doublet 1 Support | H |  |
| TBD | Spacer | H |  |
| TBD | Spring | H |  |
| TBD | M3/10 screw | H |  |
| TBD | Doublet 1 fixing | H |  |
| TBD | M4/10 screw | H |  |
| TBD | CL1 spacer | H |  |
| TBD | Optical tube 2 | H |  |
| TBD | Optical tube 1 | H |  |
| TBD | Folding mirror support | H |  |
| TBD | Folding mirror fixing | H |  |
| TBD | pupil mask support | H |  |
| TBD | pupil mask fixing | H |  |
| TBD | M3/8 screw | H |  |
| TBD | M3/10 screw | H |  |
| TBD | Doublet 2 Support | H |  |
|  |  |  |  |

Table – Mechanical Hardware deliverables

### Mechanical technical Deliverables (Documents) - If Option 2

|  |  |  |  |
| --- | --- | --- | --- |
| Code | Title | Type | Description |
|  | Material certificate | D |  |
|  | Coating certificate | D |  |
|  | Dimensional and tolerance control | D |  |

Table – Mechanical Documents deliverable

# Delivery

* **Transport insurance policy.** Insurance on transport is mandatory andshall be paid by the Contractor.
* **Packing and Transport method**. Care and responsibility of the contractor shall be to choose high quality external materials, rigid and in good conditions. The boxes must be new and must not have been used beforehand. The size of the boxes shall be based on the final size of the products, avoiding semi-empty packages. The packing must guarantee the maximum safety of the goods by the transport company. Care shall be taken of the internal packaging, which provides protection for the goods during transport and during delivery. The internal packaging must be able to protect the product from shocks and vibrations. All possible openings shall be sealed, using high quality resistive products. The contractor shall insert on the outer edges of the box plastic or cardboard protectors that distribute the pressure evenly and avoid damage to the outer casing.

Transport shall be carried out with means (trucks, trains, ships, air freight) that guarantee the absorption of vibrations and bumps, in order not to cause damages to the transported goods. Transport means shall also ensure that the products are kept within the acceptable range of temperature and humidity. Transport means (and their drivers) must be certified for the transport of fragile goods.

* **Responsibilities, Location and delivery times**

Delivery at IPAG premises shall be under the responsibility of the Contractor, who shall give at least two weeks advance notice of the Estimated Time of Arrival of the concerned item.

The optical elements must be delivered to the following locations:

* 414 rue de la piscine, Domaine universitaire, 38400 Saint martin

d'hères, France

**\*\*\* End of document \*\*\***