INAF
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Title

Statement of Work for the Design and Manufacturing of Main Structures and AIV tools for the MORFEO Instrument of the ELT

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Change Log

Date	Affected Section	Change / Reason / Remarks
15/10/2025	–	First draft (v. 01D1)
xx/xx/2025		Second draft (v 01D2)

Art. 1 Definitions and purpose of the document

1.1 Definitions

- **AIV tools.** Throughout this document the term refers to all items to be supplied as shown in AD2: **Handling Tools**, custom-designed for the safe installation, removal, and positioning of MORFEO's opto-mechanical subsystems, and **Support Equipment,** auxiliary structures (ladders, platforms, rails) that enable access, facilitate integration and maintenance in constrained environments.
- **Bidder.** Any company or other economic operator that submits an offer for the present Call.
- **BIH.** Bologna Integration Hall. The INAF integration site in Europe.
- **Contracting Authority.** INAF - Osservatorio Astronomico di Capodimonte (INAF-OACN) is the contracting authority for this project.
- **Contractor.** The company or other economic operator that signs with INAF the contract for this project.
- **ESO.** The European Southern Observatory (ESO) is an intergovernmental science and technology organisation 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.
- **Functional requirements**. Requirements that indicate the purpose and function of the supply.
- **ESO IAA.** ELT Integration and Assembly Area situated at Cerro Armazones, Chile.
- **Main Structure.** In this document, in the "Disciplinare" and in the Draft Contract the term 'Main Structure' as specified in Art. 3 includes all the items to be supplied as shown in AD1 section 3.2.
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- **On-site**. Throughout this document, "INAF On-site" refers to the INAF integration hall (Bologna, Italy) and "Chile On-site" refers to the ELT Integration site (Armazones IAA in Chile)"
- **Quality and Performance requirements**. Requirements that define what performance and level of service the supply must have.
- **SLA.** Service Level Agreement.
- **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** indicate an optional, desired requirement
- **Will** indicates a circumstance expected to happen

1.2 Purpose of the document

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 Technical Specification document (AD1 and AD2) that is an integral part of this Statement of Work, while the contractual and financial aspects are described in the documents "Disciplinare di Gara" and drafted in "Schema di Contratto".

Art. 2 Background, context and vision

MORFEO (formerly known as MAORY) 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 arcmin^2) 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, Canada and Ireland (also referred to as "the Consortium" in the following), together with ESO. INAF, as the leading institute, is responsible for all the major procurements and for the integration of the instrument that will take place at the Bologna Integration Hall located beside INAF OAS Institute in Bologna, Via Gobetti 93/3, Italy.

2.1 Timeline of MORFEO project (Phases and Reviews)

Preliminary Design Phase

During this phase the conceptual design of MORFEO, originally produced during the Phase A Study, is developed into a preliminary design for the fulfilment of the requirements defined in the MORFEO Technical Specification.

Preliminary Design Review (PDR)

The purpose of this review is to scrutinise the compatibility of the preliminary design with the Technical Specification and its applicable documents. During the PDR the overall instrument, the cost, schedule and risks associated with the development of MORFEO as well as the status of the interface design documents shall be reviewed. The PDR shall take place when the hardware development specifications and the software top level design documents and their corresponding verification / test plans are available. The MORFEO PDR took place in two distinct phases: April 2021 and July 2021. The formal conclusion of the PDR occurred in February 2023.

Final Design Phase

In this phase MORFEO is designed down to the level of components. The manufacturing drawings must be available at the end of this phase.

Final Design Review (FDR)

The purpose of this review is to ensure that the detailed hardware and software design solutions as reflected in the submitted drawing set, the interface design documents and other relevant documents satisfy the requirements established by the Technical Specification (AD1) and its applicable documents. The review shall also demonstrate that the instrument can be successfully integrated into the observatory. There is the possibility of having earlier FDR for critical components.

The **Main Structure** and **AIV tools** are critical components of the MORFEO system since their design and implementation require a significant time and effort and can influence the overall schedule.

Manufacture, Assembly, Integration and Test (MAIT) Phase

The MORFEO MAIT phase comprises two main sub-phases:

1. The subsystem MAIT, including the construction/procurement of the pieces composing the subsystem, the assembly and integration of such pieces and the test of the integrated subsystem as a stand-alone unit at the factory.
2. The system AIT, that involves the assembly and integration of the various subsystems in order to compose the full system and the test of the integrated MORFEO system at the INAF Integration Site.

Preliminary Acceptance in Europe (PAE)

Once MORFEO has been assembled, aligned and all sub-system tests performed in the Consortium's Integration Facility, the system acceptance tests foreseen in the PAE test Plan shall be performed. During the PAE the Consortium shall demonstrate to ESO the conformity of the instrument performance with the technical specifications and its applicable documents.

After the successful completion, ESO will grant Preliminary Acceptance (Europe) and authorise the shipment of MORFEO to the final observatory location. The PAE meeting should be held at the place where the instrument is located.

The Preliminary Acceptance in Europe (PAE) is scheduled for December 2030; however, the date remains subject to change.

Transport and Incoming Inspection Phase

After passing the PAE, the Consortium has to pack MORFEO in a manner suitable for road and air or sea transport. The transport will be organised by the Consortium, if not specified otherwise.

Once arrived at the Chile location the material is inspected to verify that it hasn't received any damage during the transport.

Installation and Commissioning Phase

The MORFEO system will be assembled, integrated and tested in the Integration and Assembly Area at the telescope and then moved to the Nasmyth platform and commissioned.

Provisional Acceptance (Chile) (PAC)

The PAC has the objective to demonstrate that the instrument meets the requirements of the Technical Specifications and its applicable documents, and that all tasks described in this SoW have been satisfactorily fulfilled.

The PAC is planned for September 2032 and is followed by a 2-year guarantee period.

Art. 3 Subject of the contract

The **Main Structure** includes the following assemblies:

- Main Support Structure: the structure that holds all the payloads except what is mounted directly on Nasmyth or on MICADO
- CU selector: the mechanism that switches between observing and calibration modes
- Enclosures: the thermal cover installed onto the Main Support Structure and the one mounted onto MICADO
- MAOMIC thermal duct: the thermal tube and its supporting structure that thermally connect MORFEO and MICADO.

The **AIV tools** encompass both Handling Tools (HTs) and Support Equipment (SEq):

- Handling Tools are custom-designed devices used to safely install, remove, and precisely position MORFEO's delicate opto-mechanical subsystems on the Main Support Structure (MSS) across different integration sites (BIH, IAA, Nasmyth).
- Support Equipment includes auxiliary tools and structures — such as ladders, platforms, extension rails, and access systems — that facilitate installation,

maintenance, and safe operator access within constrained integration environments.

This SoW applies to the **Main Structure** and **AIV tools** of MORFEO and will cover:

- their design phase
- their MAIT phase which includes the manufacturing, assembly, integration and test at the company premises.
- the testing of MORFEO integration procedures with optical dummies delivered by the consortium at the company premises, and AIV tools that are subject of this tender.
- their delivery and integration at the INAFintegration site (Bologna, Italy).
- their dismounting, packing and shipping to the Chile integration site
- the integration in Chile of the Main Structure.

The Kick Off Meeting shall mark the official start of project activities. The Kick Off Meeting shall take place within 30 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 4.3.

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

3.1 Applicable Documents

The following applicable documents (AD) of the exact issue shown form a part of this document to the extent described herein. In the event of conflict between the documents referenced herein and the contents of this document, the contents of this document are the superseding requirement.

- AD1 E-MAO-PM0-INA-SPE-004_01 Main Structure Technical Specifications
- AD2 E-MAO-SM0-INA-SPE-001_01 Handling tools and Support Equipment
- AD3 SAF-GEN-MAN-3444_5 Safety Conformity Assessment Procedure
- AD4 FEM Analysis Strategy and Verification Plan

3.2 Reference Documents

- RD1. E-MAO-000-00-00-00-00-INA-MOD-001_02 MAORY System Model

3.3 Definition of Project Items

This project concerns the Main Structure of MORFEO and all the related documentation, as specified in the following sections.

The Contractor shall procure and deliver the items specified in Section 3.2 of AD1 and section 4 of AD2 .

Art. 4 Contractual Phases, acceptance procedure, deliverables, timeline and milestones

4.1 Contractual Phases

The project shall comprise the following phases:

Phase 1 (firm phase)

Subphase 1.1 - Design:

- Design and performance analysis of Main Structure and AIV tools towards Technical specifications provided by Consortium. It is important to note that interface technical specifications (both towards Main structure and Handling tools) at the time of the contract signature have a 15 % margin of confidence level. The consortium reserves the right to modify those interfaces within the margin defined above within the first 4 months from the KOM.
- Support the definition of the various MORFEO integration, Alignment, Maintenance procedures.
- Delivery of the expected documentation (full list and timeline specified in Section 4.4 and 4.5).

Subphase 1.2 - Final Design Review:

- Final Design Review

Phase 2 (conditional phase)

Subphase 2.1 - Procurement, Manufacturing and Assembly:

- Procurement and/or construction of the elements needed to build the Main Structure and the AIV tools
- Delivery of the expected documentation (full list and timeline specified in Section 4.4 and 4.5).

Subphase 2.2 - Integration and Test:

- Integration and Factory Test of the Main Structure and the AIV tools

- Testing of MORFEO Integration procedures with optical dummies delivered by the consortium (TBC)
- Delivery to INAF Integration Site of the Main Structure and the AIV tools

Subphase 2.3 - On-site integration and commissioning

- On-site integration, On-site Acceptance Test and commissioning of the Main Structure and AIV tools at INAF Integration Site
- Delivery of the expected documentation (full list and timeline specified in Section 4.4 and 4.5).

The start of Phase 2 (conditional and not guaranteed) shall be subject to internal and external conditions:

- INAF accepts the Final Design for the Main Structure and the AIV tools upon review and implementation of the joint recommendations by the MORFEO Consortium and ESO.

Phase 3 (conditional phase)

Subphase 3.1 - On-site Disassembly, Packing and Shipping to Chile

- Dismounting at the INAF Integration site
- Packing and Shipping to Chile Integration Site.

Subphase 3.2 - Chile Integration and Commissioning

- Integration and commissioning of the Main structure at the ELT Integration site in Chile.

The start of Phase 3 is subject to successful completion of the Preliminary Acceptance in Europe (PAE) conducted in collaboration with ESO.

4.2 Acceptance procedure

The acceptance procedure shall be as follows:

Phase 1

INAF will approve the Final Design by evaluating the corresponding documents (full list and timeline specified in Section 4.4 and 4.5) and will declare it successfully closed after the successful implementation of all the relevant actions coming from the FDR.

Phase 2

For Phase 2 there shall be a review and three separate acceptance procedures.

Integration Readiness Review: 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 person responsible and the success criteria for all activities are clear.

Factory Acceptance: acceptance procedure for the physical equipment (Main Structure and AIV tools) shall be carried out through structured test sessions. The procedure shall start with the verification that all the expected items (See AD1 section 3.2 and AD2 section 4) are present and in working conditions. Then specific test sessions shall verify that the Main Structure and the AIV tools fulfil all the technical specifications. The test sessions will be executed at the Factory premises and will include the integration of the payloads delivered by the consortium to test all the Main Structure performances including MORFEO Integration procedures.

INAF On-site Acceptance (also referred to as "commissioning in Europe"): it comprises the integration and the execution of the On-Site Test and the correction of any non-compliance until the Main Structure and the AIV tools fulfil all the technical requirements. This acceptance phase ends under the condition that all the Requests for Waivers for the Main Structure and the AIV tools are closed and all agreed changes are implemented.

Phase 3

Chile On-site Acceptance (also referred to as "commissioning in Chile"): it comprises the dismounting, packing, shipping and integration of the Main Structure and AIV tools at the ELT site Chile. The scope of the final verification is limited to confirming that the integration has been correctly executed, without repeating the full performance verification carried out during the INAF On-site Acceptance.

4.3 Timeline and Milestones

In the following figure the high-level project schedule is reported, under the form of Gantt chart and under tabular form.

The date of the Kick Off Meeting of Phase 1 shall be decided at the time of the contract signature (T0) and must in any case take place within 30 days from the date of the contract signature.

The start of Phase 2 (T1) shall happen when all Action Items arising from Main Structure' FDR are closed, and in any case only after formal approval to proceed from INAF.

In the following schedules we have assumed, as the maximum reference time, a T1=T0+23. Please note that while this represents the upper limit, T1 may occur earlier.

All the dates of milestones are to be considered tentative and will be confirmed at project start, except for the following ones that are fixed:

- Main Structure and AIV tools delivery of Final Design documentation
- Main Structure and AIV tools On-site Acceptance (End of Phase 2)

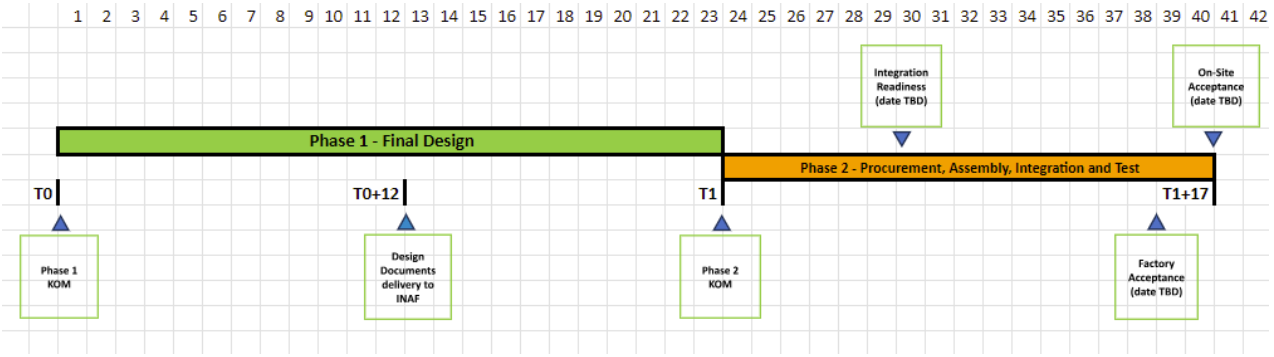

Figure 1 - Project schedule of Phase 1 and 2 of the Main Structure and AIV tools in graphical form (Units are in Months)

Phase 1 (T0 start of activities TBD)			
Activity/Milestone	**Start**	**Stop**	**Description**
Subphase 1.1 - Design			
Contract Signature	T0		Contract signature. Kick-Off Meeting to be arranged within one month from contract signature
Kick Off Meeting (KOM)	T0+1		The main objectives of the Kick-Off Meeting is to confirm mutual understanding of the scope of work specified herein, including its applicable specifications. The documents supporting the Kick-Off Meeting shall be submitted to INAF one week before the KOM, for review.
Main Structure Interfaces finalisation	T0	T0+1(4)	The objective of this activity is to ensure that all the interfaces are closed. As stated above the consortium reserves the right to update the interface pending on the feedback of final design of various subsystems.
Design	T0	T0+12	The objective of this activity is to carry out the final design and analysis of the Main Structure and AIV tools, in order to be ready to start Phase 2.
Delivery of Final Design documentation	**T0+12**		All the documentation of Final Design of the Main Structure and AIV tools is delivered to INAF.
Subphase 1.2 - Final Design Review			
Final Design Review (FDR)	T0+12	T0+K	The purpose of this review, that closes Phase 1, is to ensure that the detailed design solutions as

			reflected in the submitted drawing set, the interface design documents and other relevant documents satisfy the requirements established by the Technical Specifications (AD1 and AD2). The joint Final Design review meeting with ESO is expected 6 weeks after the delivery of the documentation. The FDR is considered successfully closed after the successful implementation of all the relevant actions. The FDR closure is a condition for the start of Phase 2. The value of K is TBD, though is expected to be 19 months at most.

Table 1 - Project schedule of the Main Structure and the AIV tools for Phase 1 in tabular form (Shifts in Months)

The reviews reported in Table 1 are detailed in the following:

- **FDR – Final Design Review**

In this review the final design of the Main Structure and the AIV tools is verified. Phase 2 cannot start until the FDR has been successfully accepted.

ESO will participate in this review as a reviewer and as joint approving authority.

Phase 2			
Activity/Milestone	**Start**	**Stop**	**Description**
Subphase 2.1 - Procurement, Manufacturing and Assembly			
Kick Off Meeting for Phase 2	T1		The objective of this Meeting is to verify the presence of all conditions to start Phase 2. The procurement of all elements can start after this meeting.

Procurement, Manufacturing and Assembly	T1	T1+N	This activity has the objective to manufacture all the elements according to the Main Structure and AIV tools subsystem list (See AD1 Section 3.2 and AD2 Section 5). (The value of "N" shall be proposed by the bidder)
Subphase 2.2 - Integration and test			
Integration Readiness Review (IRR)	T1+ Q-14 days	T1+Q	The purpose of this activity is to verify that the elements of the integration phase (plans, 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)
Integration	T1+ Q	T1+M	The objective of this activity is to integrate the Main Structure and the AIV tools at the Contractor's premises and to prepare the Main Structure and AIV tools for the Factory Acceptance. (The value of "M" shall be proposed by the bidder)
Factory Acceptance Readiness Review (FARR)	T1+M		At this milestone the Main Structure and the AIV tools, fully integrated, shall be ready for the execution of Factory Acceptance Test. (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 Main Structure and the AIV tools are working according to their specifications at Contractor's premises (The value of "F" shall be proposed by the bidder)
Factory Acceptance Review (FAR)	T1+15		This milestone marks the positive acceptance of the Main Structure and AIV tools at the Contractor's premises and the consequent authorisation to ship them to the INAF facility for MORFEO Integration. A Test and Inspection report is signed by both INAF and the Contractor. (The value of "F" shall be proposed by the bidder)
Subphase 2.3 - On-site Integration and Commissioning			

On-site Integration Readiness Review (OIRR)	T1+G		The purpose of this activity is to verify that the elements of the on-site integration (plans, tools, procedures and resources) are clearly identified. The positive conclusion of this review is the condition for the start of on-site integration. (The value of "G" shall be proposed by the bidder)
On-Site Integration and Commissioning	T1+ G	T1+H	The objective of this activity is to integrate the Main Structure and the AIV tools at the INAF premises and to prepare the Main Structure for the On-Site Acceptance. (The value of "H" shall be proposed by the bidder)
On-Site Acceptance Readiness Review (OARR)	T1+H		Following the transport and integration of the Main Structure and AIV tools at the INAF facility, this milestone confirms their readiness for the execution of the Acceptance Test.
On-Site Acceptance Test	T1+ 17-1 4 days	T1+17	During this activity INAF reserves the possibility to carry out selected tests on the Main Structure and the AIV tools to verify the fulfilment of its specifications at INAF premises.
On-Site Acceptance Review (End of Phase 2)	**T1+17**		This milestone marks the positive conclusion of the Test and commissioning at INAF premises and the consequent final acceptance by INAF. A Test and Inspection report is signed by both INAF and the Contractor.

Table 2 - Project schedule of the Main Structure and the AIV tools in Phase 2 in tabular form (Shifts in Months)

During this phase, intermediate milestones, to be agreed during contract negotiations, will require the supplier to submit reports documenting inspections, tests, and verification against the agreed subset of critical requirements.

The start of Phase 3 (T2) shall happen at the conclusion of the MORFEO Preliminary Acceptance in Europe (PAE), and in any case only after formal approval to proceed from INAF.

In the following schedules we have assumed, as a tentative reference, T2=T0+60. However, T2 could be different from that assumption.

All the dates of milestones are to be considered tentative and will be confirmed at project start, except for the following ones that are fixed:

- Main Structure and AIV tools Chile On-site Acceptance Review (End of Phase 3)

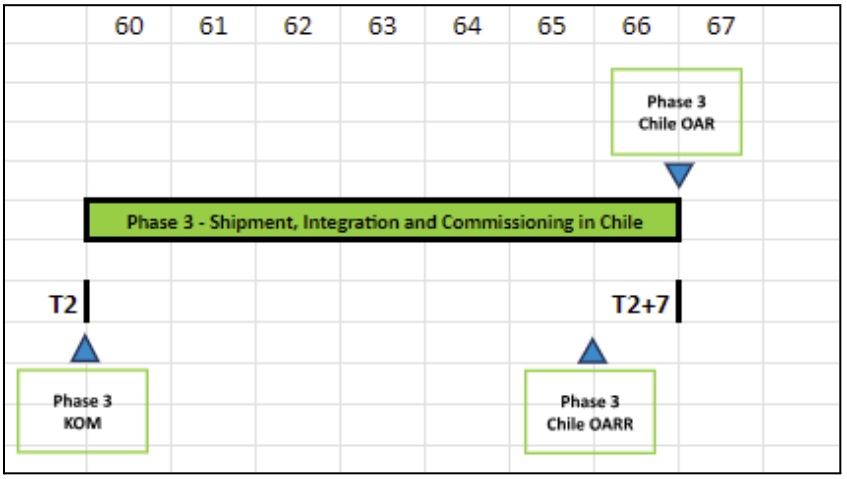

Figure 2 - Project schedule of Phase 3 of the Main Structure and AIV tools in graphical form (Units are in Months)

Phase 3			
Activity/Milestone	**Start**	**Stop**	**Description**
Subphase 3.1 - On-site Disassembly, Packing and Shipping to Chile			
Kick Off Meeting for Phase 3	**T2**		The objective of this Meeting is to verify the presence of all conditions to start Phase 3.
Dismounting, packing and shipping	**T2**	**T2+TBD**	The Main Structure and AIV tools are disassembled at the INAF BIH, then packed and shipped to Chile.
Subphase 3.2 - Chile Integration, Commissioning and Test			
Integration and commissioning	**T2+ L**	**T2+6**	Once the Main Structure and AIV tools are delivered to the site in Chile, they are reassembled at the ELT IAA and recommissioned to verify that the integration has been carried out correctly.

Chile On-Site Acceptance Review (End of Phase 3)	**T2+7**	This milestone marks the positive conclusion of the Integration and commissioning at INAF premises and the consequent final acceptance by INAF.

Table 3 - Project schedule of the Main Structure and the AIV tools in Phase 3 in tabular form (Shifts in Months)

The readiness reviews reported in Table 2 and 3 are detailed in the following:

- **Integration Readiness Review**

The Integration Readiness Review takes place before starting the integration actitivties.

The Integration Readiness Review includes the verification that all the activities to be carried out in the Integration Phase are clearly identified, prioritised and scheduled. The responsibility for each of the activities must be also clearly identified.

- **FARR - Factory Acceptance Readiness Review**

The Factory Acceptance Readiness Review takes place before starting the tests at the Contractor's premises, with the Main Structure and the AIV tools fully integrated and all the required information is gathered in the documentation. FARR assess test objectives, scope, methods and procedures, and safety. FARR is also intended to determine if any changes are required in planning, resources, training, equipment, or timing to successfully proceed with the test.

- **OARR - On-site Acceptance Readiness Review**

The On-site Acceptance Readiness Review takes place before starting the tests at the INAF premises. OARR assess test objectives, scope, methods and procedures, and safety.

OARR is also intended to determine if any changes are required in planning, resources, equipment, or timing to successfully proceed with the test.

During the execution of the OARR the presence of Contractor personnel is required.

The test sessions reported in Table 2 and 3 are detailed in the following:

- **FAT – Factory Acceptance Test**

The FAT - Factory Acceptance Test 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 the Main Structure shall be defined in detail in the relevant Main Structure MAIT Plan by the constructor. The Main Structure

MAIT Plan shall ensure the proper implementation of all requirements contained in the Compliance Matrix.

Optomechanics integration procedures, and Main Structure general operations (motion, alignment, etc…) shall also be validated.

Once successfully passed the FAT, the system can be packed and transported to the INAFintegration site.

During the FAT all technical requirements and interface requirements described in the Main Structure and the AIV tools MAIT plan that are foreseen to be verified by test will be verified by the constructor. The result of such tests shall be documented in the test reports. The tests executed at the factory shall reproduce to the maximum possible extent the real operational conditions.

When needed, simulators and mock-up devices will be used to mimic interfaces and operational conditions. Optomechanics simulators will be provided by the Consortium within T1 + 6

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

A further test campaign will be conducted at the factory premises to test all the MORFEO AIV and maintenance procedures by means of AIV tools and optomechanical dummies provided by the consortium. This activity is detailed in the MORFEO system AIV

- **OAT – On-site Acceptance Test**

In this test session, executed at INAF premises under the responsibility of INAF, and agreed subset of technical requirements and interface requirements are tested.

The tests of the OAT will be executed in an environment much closer to the real operational conditions than the ones of the FAT.

Test procedures, modes and timeline of the OAT will be defined in detail in the relevant Main Structure and AIV tools MAIT Plan.

The contracting authority reserves the possibility to carry out selected tests with its own personnel to verify the compliance of the delivered products with the technical and functional requirements.

During the execution of the OAT, the presence of contractor personnel is required.

A Test and inspection report (OAT version) will be issued at the end of the test session, signed by the appointed INAF responsible and counter-signed by a contractor's representative.

4.4 Deliverables

Types:

D -> Document

M -> 2D/3D CAD, analytical Models

E -> Equipment

Refer to the tables 1, 2, 3, 10 for milestones and Table 11, 12, 13 for delivery dates.

For the definition of Main Structure refer to AD1 Section 3.2.

For the definition of the AIV tools refer to AD2 section 5.

Note that the code used hereby is intended only to enumerate and identify the deliverable items, the proper document numbering will be agreed with the consortium at the contract signature.

PM0 Technical Deliverables (Documents)

Code	**Title**	**Type**	**Description**
PM0-CMX-001	Main Structure Compliance Matrix	D	Compliance Matrix to Requirements. The Compliance Matrix shall, as a minimum: 1. List in a tabular format all requirements that have been identified in the Call documentation, including the interface requirements. 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 NCR. 4. List any reference to NCs, CREs or RF(W/D)s documents. 5. Reference to the location of the verification description within the document datapack Note: the template will be provided by INAF

PM0-DER-001	Main Structure Design Report	D	Design of the Main Structure. The Design Report shall contain, as a minimum: a. Assumptions, such as design constraints, environmental conditions other than specified in technical specification, maintenance concept, access concepts b. Materials used in the design with physical properties as well as chemical behaviour, applicable treatments and their purposes c. Detailed description of the system design, all relevant components subsystems and function with reference to every specified requirement specified d. Any parts of the design that are not closed and problem areas e. all the description required to prove the requirement that has to be verified by design according to CMX f. TRL (according to appendix of the present document) assessment for critical technologies shall be provided, making sure that FDR TRL 6 is achieved for every items The design shall cover the mechanical design.
PM0-ANR-001	Main Structure Analysis Report	D	Analysis of the system. The Analysis Report, taking into account the actual system design demonstrating that the referred requirement is met, shall contain, as a minimum: a. Requirement analysis b. Functional analysis c. Performance analysis d. Interface analysis in operational conditions e. Reliability analysis f. Earthquake analysis g. Further analyses, as appropriate h. all the analysis required to prove the

			requirement that has to be verified by analysis according to CMX The type of analysis, assumptions, boundaries and life phases shall as a minimum cover the content of doc AD4, and in any case will have to be agreed with ESO.
PM0-SPE-001	Main Structure System Budget	D	Technical/Error Budget The Technical/Error Budget shall highlight, at all levels, how a requirement belonging to the Next Higher Assembly (NHA) is broken down into requirements belonging to the Next Lower Assemblies (NLA) which applies to individual elements of the concerned product. The Document shall contain the following set of information, as a minimum: 1.Purpose of the Document; in this section the purpose of the document shall be identified 2. Scope of the Document; in this section the scope of the document shall be identified 3. Applicable Documents; in this section all the documents referred to in the technical budget shall be listed Definition & Convention; in this section all definitions and conventions used in the Document shall be given. 4. General Assumptions; in this section all general assumptions used in elaborating the technical budget shall be given. This includes assumptions on the mode of error combination (linear, quadratic, etc.), assumptions on the load cases (worst case, average case, etc.), approach regarding margins, etc. 5. Operational Conditions; in this section all operational conditions under which the technical budget applies shall be given. This includes the operational mode and the environmental conditions. 6.Contributors/Error Sources; in this section all contributors or error sources

			included in the technical budget shall be identified, described and discussed. Any special assumption made as well as a justification of the allocated value (results of an analysis, test result, comparison with past experience, etc.) shall be given with proper references to relevant documentation 6.Technical Budget; in this section the technical budget shall be presented, for instance in the form of a flow chart or in a tabular format, with clear identification of margins at the relevant level. 8.Conclusion; the conclusion shall summarize the outcome of the technical budget in terms of compliance to the top-level requirement, associated margins, critical component(s) of the technical budget, associated Project risk and specific plan for conforming to the budget allocation and mitigating risks.
PM0-ICD-001	Main Structure Interface Control Document	D	The ICD shall list for each interface: 1. Interface name and reference number 2. The items to be interfaced 3. The description of the interface 4. The verification status of the interface 5. Reference to Change Request or Request for Waiver, if applicable 6. Status and comments For mechanical interfaces, the copies of the drawings of the items to be interfaced shall be attached to the document. The ICD shall be carefully amended with the updated versions of the drawings.
PM0-PLA-004	Main Structure MAIT Plan	D	Manufacturing, Assembly, Integration and Test Plan. The system MAIT plan shall be established for the Main Structure. The MAIT plan shall give detailed definitions, requirements, conditions and constraints of all manufacturing, assembly, integration, alignment and test activities performed in the factory.

			Facilities shall be identified and briefly described. Requirements and definitions shall be given for support equipment to cover MAIT phases including handling, transport and storage. The document contains a clear and well detailed verification plan describing the tests to be performed to verify the compliance of the Main Structure to the specifications. It includes SW Test Plan and Procedures.
PM0-DWG-001	Main Structure Manufacturing Drawings	M	The package shall contain Assembly drawings, parts drawings and manufacturing drawings. The drawing set shall be delivered according to the product breakdown structure (drawings numeration to be discussed and agreed with the consortium). The document also includes cables, and cooling pipes routing.
PM0-DWG-002	Main Structure As Built Drawings	M	Drawings after building. The package shall contain the drawings at all levels of the project, in particular of the as built product. “Drawings” in this context include electronic circuit diagrams. The drawing set shall be delivered according to the product breakdown structure. (drawings numeration to be discussed and agreed with the consortium)
PM0-MOD-001	Main Structure Models	M	3D Models and other technical Models. It includes CAD models, FE models, and any other computational and simulation models. The models shall be delivered according to the product breakdown structure. ESO standards shall be used for the modelling as defined in following applicable documents of AD1: - AD 20 (ESO-192984) - AD 21 (ESO-191462) The complete Assembly CAD model integrated in the Nasmyth model (AD4)

			including the Payloads models delivered by the consortium, shall also be produced, kept updated at and provided for the various review phases. The analysis models assumptions, boundaries and life phases shall as a minimum cover the content of doc AD4, and in any case will have to be agreed with ESO.
PM0-LIS-001	Main Structure Parts List/Bill of Materials	D	List of parts composing the system. The part list shall contain as minimum: 1. Title or Identification: Name of the item which is shown in its drawing. 2. Part Number. a. For standard components (Fasteners) the dimensions and quality shall be provided according to ISO standards. e.g. ISO 4017-M8x20-8.8 b. For COTS parts the number shall be complete to enable reordering. 3. Quantity: amount of pieces used in the assembly or subassembly 4. Original Equipment Manufacturer (OEM) Name: Extra information shall be given to enable the customer to contact the OEM. (This does not have to be in the parts list) In case an alternate component (or more than one) that may substitute a baseline component is available, this shall be listed and the same information as for the original component shall be provided. A clear indication of being an alternate component and for which baseline component shall also be given. For instance a motor of a certain type and make can be used in lieu of the baseline motor, then the alternate motor shall be listed, too. The BoM is a multilevel list of all components contained in a Configuration Item (CI). The BoM shall be delivered in a hierarchical multi-level form. Each sub-assembly shall be listed along

			with the components that make up that subassembly. An individual part may be listed in the BoM multiple times if it is included in more than one sub-assembly.
PM0-CIDL-001	Main Structure CIDL	D	Configuration Item Data List. The Configuration Item Data List (CIDL) shall present the product configuration for a CI at one moment in time of the Project (typically a project milestone) by means of listing the requirements, design/development, manufacturing and operational documentation that are relevant for a CI. It shall contain as a minimum: 1. CI identification (part number and serial number (where appropriate)) 2. List of the technical specifications 3. List of the ICDs 4. List of the design/analysis reports 5. List of the drawings 6. Bill of Material (BoM) & Parts List 7. List of plans 8. List of procedures 9. List of manuals 10. List of verification documentation 11. List of software 12. A section called Change Status Report (CSR) which identifies the status of approved CREs and RF(W/D)s. All documents shall be recorded in the CIDL as a minimum with their: 1. Document Title 2. Document Number 3. Document Version 4. Document Status (draft, released, etc.) 5. Status Date.
PM0-TRP-001	Report on Main	D	Report on integration readiness of the Main

	Structure Integration Readiness Review		Structure. The document shall clearly describe the steps executed to assess integration readiness at the factory and the corresponding detailed results. It has the structure of a Test and Inspection Report. This document shall clearly assess the presence of all the elements and all the conditions needed to start the integration.
PM0-TRP-002	Report on Test and Inspection of the Main Structure	D	Report on Test and Inspection. This document shall include at least the following sections : 1. Purpose; in this section the purpose of the Test Report explicitly stating the requirements that have been verified, shall be identified 2. Scope of the Test Report; in this section the scope of the Test Report shall be identified 3. Applicable and Reference Documents; in this section all the documents applicable to the Test Report shall be listed along with the documents used as reference. 4. 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 summarise the actual versus the nominal ones required. 5. 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.
PM0-RRR-001	Main Structure Risk Analysis	D	This document shall provide: 1. Introduction 2. Methodology

			3. The Risk Register. This document describes the approach to Risk Management, risk classification, ranking and mitigation. The Risk Register shall be kept updated as new risks emerge, change or aren't valid anymore.
PM0-LIS-002	Main Structure Spare Parts List	D	The Spare Part List shall contain all the information related to the spare parts necessary to operate and maintain the Product. The Spare Part List shall include as a minimum: 1. Recommended amount of spare parts taking into account the findings of the RAM Analysis and the information provided in the Maintenance Manual 2. OEM name and contact details (website, etc.) 3. Vendor name and contact details 4. Item name 5. Type designation 6. Dimensions 7. Specification 8. Delivery times 9. Expected lifetime on the shelf 10. Any special storage prescription (power up, high altitude influence, etc.) 11. Storage conditions. 12. Consumables 13. Fragile and/or critical parts 14. Components or parts with very long delivery time or which are custom-made 15. Off-the-shelf/custom-made Products.
PM0-ANR-002	Main Structure RAMS document	D	This document shall contain: RAM Analysis, including as a minimum 1. Description of the System under examination

			2. Assumptions used in the Analysis 3. Methodology used (e.g. Parts Count method as per Military Handbook (MIL-HDBK)-217F) 4. Reliability data sources (e.g. Non-electronic Parts Reliability Data (NPRD)-95) 5. Prediction of Reliability and Availability based on failure rates 6. Optimum preventive replacement time for components in a repairable System. 7. Spare parts requirements and production rate, spare parts inventory 8. MeanTime Between Failures (MTBF) computation 9. Down time of the Product and its availability taking into account the MTBF, Mean Time To Repair (MTTR) and the Time for Preventive Maintenance. 10. FMEA Hazard List and Analysis, which shall identify all hazards arising from the design of the instrument including component failures, critical human errors and hazards resulting from functional relationships between components and equipment belonging to the instrument. Hazardous Material List, including as a minimum 1.Hazardous Materials (HAZMAT) identification 2. HAZMAT Categorization 3. HAZMAT data tracking Safety File, collecting all safety relevant documentation applicable to the product.

Table 4 - Technical documents of the Main Structure

SM0 Technical Deliverables (Documents)

Code	Title	Type	Description
SM0-CMX-001	AIV tools Compliance Matrix	D	Same as Main Structure
SM0-DER-001	AIV tools Design Report	D	Same as Main Structure
SM0-ANR-001	AIV tools Analysis Report	D	Same as Main Structure
SM0-SPE-001	AIV tools System Budget	D	Same as Main Structure
SM0-ICD-001	AIV tools interface Control Document	D	Same as Main Structure
SM0-PLA-004	AIV tools MAIT Plan	D	Same as Main Structure
SM0-DWG-001	AIV tools Manufacturing Drawings	M	Same as Main Structure
SM0-DWG-002	AIV tools As Built Drawings	M	Same as Main Structure
SM0-MOD-001	AIV tools Models	M	Same as Main Structure
SM0-LIS-001	AIV tools Parts List/Bill of Materials	D	Same as Main Structure
SM0-CIDL-001	AIV tools CIDL	D	Same as Main Structure
SM0-TRP-001	Report on AIV tools Integration Readiness Review	D	Same as Main Structure
SM0-TRP-002	Report on Test and Inspection of AIV tools	D	Same as Main Structure
SM0-RRR-001	AIV tools Risk	D	Same as Main Structure

	Analysis		
SM0-LIS-002	AIV tools Spare Parts List	D	Same as Main Structure
SM0-ANR-002	AIV tools RAMS document	D	Same as Main Structure

Table 5 - Technical documents of the AIV tools

Main Structure Technical Deliverables (Hardware)

Code	**Title**	**Type**	**Description**
PM0	Main Structure	E	Main Structure Subsystem, as specified in AD1, Section 3.2.

Table 6 - Hardware deliverable items of the Main Structure

AIV tools Technical Deliverables (Hardware)

Code	**Title**	**Type**	**Description**
SM0	AIV tools	E	AIV tools, as specified in AD2, Section 5.

Table 7 - Hardware deliverable items of the AIV tools

Main Structure Management Deliverables (Documents)

Code	**Title**	**Type**	**Description**
PM0-PRR-001	Main Structure Progress Report	D	Description of project status and activities carried out for Main Structure in the reporting period (every 2 months) The Progress Report shall summarise

			on a periodic basis the progress of the Project. The Progress Report shall summarise the results achieved in the period and planned for the next period at all levels of the Project and show them against the planned date identified in the Project Schedule highlighting any deviation. It shall also describe the critical issues detected at any level (i.e. technical, programmatic) of the Project during the reporting period and identify the mitigation actions. The progress report shall be accompanied with the Action Item List and the status of all Action Items which shall also be reviewed at each progress meeting. The Progress Reports shall cover a full calendar month and shall be issued not later than 3 (three) working days after the end of the reporting period. 1. Schedule update 2. Status List of Change Requests (CREs), RF(W/D)s, Nonconformities and Audits including trends 3. Risk Register update 4. Overview of major events in the forthcoming period (in particular inspections and tests).
PM0-LIS-001	Main StructureAction Item List	D	This document shall list all the actions agreed between the Contractor and INAF. For each Action Item it shall contain as a minimum: 1. The content of the action 2. The originator 3. The actionee 4. The due date and the closure date 5. The reference to the documents containing a verifiable basis for the closure of the action.

PM0-MIN-001	Main StructureMoM	D	Minute of Meeting, including Action Item List for Main Structure. (prepared by Contractor's personnel and sent 2 days after each meeting).
PM0-SCD-001	Main Structure Schedule	D	Project Schedule of the Main Structure. GANTT Charts (in single A4 sheets) of the project with indication of the critical path
PM0-PLA-001	Main Structure Project Management Plan	D	Project Management Plan of Main Structure. This document shall: 1. Describe the management approach implemented by the Contractor to control the project 2. Describe the organisational structure of the project 3. Contain an organisational chart which summarises the organisation and the lines of authority including all Contractor partners 4. Describe the responsibility and the authority of each function in the organisational charts: job descriptions for the key functions 5. Describe the interrelation among the different functions in the organisation 6. Contain a list of key personnel including job position, relevant qualification and experience and contact information The Project Management Plan shall also include the project plan: 1. Master Plan which shall describe the program logic and the main project phases 2. Procurement and payment schedule 3. Work Breakdown Structure (WBS) 4. Work Package (WP) descriptions for the WPs in the WBS containing at least: a. WP number according to the WBS

			b. Title of the WP c. Input to the WP d. Description of the task(s) to be performed e. Output of the WP f. Staff allocated in Full Time Equivalents g. Responsible WP manager h. Duration of the task i. Milestones j. Start / end dates/ events
PM0-PLA-002	Main Structure Product Assurance Plan	D	System Product Assurance/Quality Assurance Plan of the Main Structure. The Product Assurance Plan shall describe the Project Product and Quality Assurance organisation, methods, tools and Procedures that the Contractor intends to implement for the work under Contract both for Software and Hardware. Alternatively, the Software part may be covered in a separate dedicated document and reference provided. The document shall contain the following information as a minimum: 1/ Purpose: Relation to product development 2/ Quality Assurance Functions: organisation and work tasks 3/ Documentation: Control, changes, deliverable and non-deliverable documents that are subject to configuration control 4/ Policies, Procedures and Practices: listing all requirements, design implementation, test and documentation 5/ Reviews and Audits: Scheduled and non-scheduled Configuration Management: Means of assuring that adequate procedures and

			controls are documented and implemented (Unless described in a dedicated document 6/ Problem Reporting: Processing, tracking and reporting 7/ Corrective and Preventive Actions: Processing, tracking and reporting 8/ Media Control: Libraries, protection 9/ Testing and Inspection: Environment, traceability, sampling methodology
PM0-PLA-003	Main Structure Configuration Management Plan	D	Main Structure Configuration Management Plan. The Configuration Management Plan shall describe the Project configuration Management organisation, methods, tools and Procedures that the Contractor intends to implement for the work under Contract both for Software and Hardware. Alternatively the Software part may be covered in a separate dedicated document and reference provided. The Plan shall define as a minimum: 1. Configuration Management Responsibilities and Authorities 2. Responsibilities and Authorities 3. Dispositioning authority 4. Configuration Management Process 5. Configuration Management Planning 6. Configuration Identification 7. Change Management 8. Configuration Status Accounting 9. Configuration Audit. The Configuration Management Plan shall define: 1. The handling of contractual and technical changes 2. The handling of the interfaces internal to the Project

			3. The handling of the interfaces external to the Project. Configuration Management Plan shall ensure that: 1. The manufacturing documentation is in line with the design documentation 2. The Product is in line with the manufacturing documentation 3. Changes are not implemented without due Analysis and approval 4. Required design, item or component and/or manufacturing changes are properly documented in CREs to be established by the Contractor 5. RF(W/D)s and Nonconformities (NC)s are properly handled.
PM0-MAN-001	Main StructureOperating Manual	D	Manual for operational use of Main Structure including all the operating instructions and safety procedures for the user including installation, packing and unpacking.
PM0-MAN-002	Main StructureMaintenance Manual	D	The Maintenance Manual shall contain the detailed maintenance Procedures with drawings. It shall contain the maintenance requirements and scheduling for all items included in the supplies of the agreement. All the following types of Maintenance shall be considered and the related maintenance actions shall be provided in a tabular format: 1. Corrective: a. Deferred Maintenance b. Remedial Maintenance c. Shutdown Corrective Maintenance 2. Preventive: a. Routine Maintenance b. Running Maintenance

			3. Predictive: a. Condition-based Predictive Maintenance b. Statistical-based Predictive Maintenance Each intervention shall be described with the following information, as a minimum: 1. Item(s) to be maintained. 2. Number and qualification of maintenance personnel needed. 3. Total time needed to perform the intervention and each phase of the intervention 4. Supporting tools and equipment (including access). 5. Step by step procedure, including detection, preparation, location and isolation, disassembly (gaining access), repair or removal, reassembly, realignment/readjustment etc., checkout (Verification of fault elimination) 6. Required parts, consumables. 7. Safety measures. 8. Check after action and start up 9. Fault detection 10. Fault isolation 11. Fault elimination 12. Verification of fault elimination

Table 8 - Management documents of the Main Structure

AIV tools Management Deliverables (Documents)

Code	**Title**	**Type**	**Description**
SM0-PRR-001	AIV tools Progress Report	D	Same as Main Structure

SM0-LIS-001	AIV tools Action Item List	D	Same as Main Structure
SM0-MIN-001	AIV tools MoM	D	Same as Main Structure
SM0-SCD-001	AIV tools Schedule	D	Same as Main Structure
SM0-PLA-001	AIV tools Project Management Plan	D	Same as Main Structure
SM0-PLA-002	AIV tools Product Assurance Plan	D	Same as Main Structure
SM0-PLA-003	AIV tools Configuration Management Plan	D	Same as Main Structure
SM0-MAN-001	AIV tools Operating Manual	D	Same as Main Structure
SM0-MAN-002	AIV tools Maintenance Manual	D	Same as Main Structure

Table 9 - Management documents of the AIV tools

4.5 Deliverable timeline

For Main Structure, the deliverables are expected to be delivered at each milestone according to the following table (I stand for Release Issued, D for Draft, U for Update):

Code	Title	Phase 1		Phase 2			
		KOM	FDR	KOM	IRR	FARR	OARR
Technical Docs							
PM0-CMX-001	Main Structure Compliance Matrix	I	U	(U)	U	U	U
PM0-DER-001	Main Structure Design Report		I	(U)	(U)	(U)	(U)
PM0-ANR-001	Main Structure Analysis Report		I	(U)	(U)	(U)	(U)
PM0-SPE-001	Main Structure System Budget	I	(U)	(U)	(U)	U	U
PM0-ICD-001	Main Structure Interface Control Document		I	(U)	(U)	(U)	(U)

Code	Title	Phase 1		Phase 2			
		KOM	FDR	KOM	IRR	FARR	OARR
PM0-PLA-004	Main Structure MAIT Plan		I	(U)	U	U	(U)
PM0-DWG-001	Main Structure Manufacturing Drawings		I	(U)	(U)	(U)	(U)
PM0-DWG-002	Main Structure As Built Drawings				I	U	(U)
PM0-MOD-001	Main Structure Models	D	I	(U)	(U)	(U)	(U)
PM0-LIS-001	Main StructureParts List/Bill of Materials		I	(U)	U	(U)	(U)
PM0-CIDL-001	Main Structure CIDL	I	U	(U)	(U)	(U)	(U)
PM0-TRP-001	Report on Main Structure Integration Readiness				I		
PM0-TRP-002	Report on Test and Inspection					1[1]	2[2]

[1] Issued at the end of FAT
[2] Issued at the end of OAT

Code	Title	Phase 1		Phase 2			
		KOM	FDR	KOM	IRR	FARR	OARR
	of Main Structure						
PM0-RRR-001	Main Structure Risk Analysis	I	U	(U)	U	U	U
PM0-LIS-002	Main Structure Spare Parts List		I	(U)	U	(U)	(U)
PM0-ANR-002	Main Structure RAMS documents		I	(U)	U	(U)	(U)
HW							
PM0	Main Structure				P	I	U

Table 10 - Technical Deliverable expected at each milestone for the Main Structure

Code	Title	Phase 1		Phase 2			
		KOM	FDR	KOM	IRR	FARR	OARR
Management Docs							
PM0-PRR-001	Main Structure Progress Report	At regular interval					
PM0-LIS-003	Main Structure Action Item List	At regular interval					
PM0-MIN-001	Main Structure MoM	At each meeting					
PM0-SCD-001	Main Structure Schedule	I	U	U	U	U	(U)
PM0-PLA-001	Main Structure Project Management Plan	I	U	U	U	U	(U)
PM0-PLA-002	Main Structure Product Assurance Plan	I	U	U	U	U	(U)
PM0-PLA-003	Main Structure Configuration Management Plan	I	U	U	U	U	(U)
PM0-MAN-001	Main Structure Operating Manual		D		I	U	(U)

Code	Title	Phase 1		Phase 2			
		KOM	FDR	KOM	IRR	FARR	OARR
PM0-MAN-002	Main Structure Maintenance Manual		D		I	U	(U)

Table 11 - Management Deliverables expected at each milestone for the Main Structure

For AIV tools, the deliverables are expected to be delivered at each milestone according to the following table (I stand for Release Issued, D for Draft, U for Update):

Code	Title	Phase 1		Phase 2			
		KOM	FDR	KOM	IRR	FARR	OARR
Technical Docs							
SM0-CMX-001	AIV tools Compliance Matrix	I	U	(U)	U	U	U
SM0-DER-001	AIV tools Design Report		I	(U)	(U)	(U)	(U)
SM0-ANR-001	AIV tools Analysis Report		I	(U)	(U)	(U)	(U)

Code	Title	Phase 1		Phase 2			
		KOM	FDR	KOM	IRR	FARR	OARR
SM0-SPE-001	AIV tools System Budget	I	(U)	(U)	(U)	U	U
SM0-ICD-001	AIV tools Interface Control Document		I	(U)	(U)	(U)	(U)
SM0-PLA-004	AIV tools MAIT Plan		I	(U)	U	U	(U)
SM0-DWG-001	AIV tools Manufacturing Drawings		I	(U)	(U)	(U)	(U)
SM0-DWG-002	AIV tools As Built Drawings				I	U	(U)
SM0-MOD-001	AIV tools Models		I	(U)	(U)	(U)	(U)
SM0-LIS-001	AIV toolsParts List/Bill of Materials		I	(U)	U	(U)	(U)
SM0-CIDL-001	AIV tools CIDL	I	U	(U)	(U)	(U)	(U)
SM0-TRP-001	Report on AIV tools Integration Readiness				I		

Code	Title	Phase 1		Phase 2			
		KOM	FDR	KOM	IRR	FARR	OARR
SM0-TRP-002	Report on Test and Inspection of AIV tools					1[3]	2[4]
SM0-RRR-001	AIV tools Risk Analysis	I	U	(U)	U	U	U
SM0-LIS-002	AIV tools Spare Parts List		I	(U)	U	(U)	(U)
SM0-ANR-002	AIV tools RAMS documents		I	(U)	U	(U)	(U)
HW							
SM0	AIV tools				P	I	U

Table 12 - Technical Deliverable expected at each milestone for the AIV tools

[3] Issued at the end of FAT. These reports can also be required at intermediate milestones agreed during contract negotiation.
[4] Issued at the end of OAT

Code	Title	Phase 1		Phase 2			
		KOM	FDR	KOM	IRR	FARR	OARR
Management Docs							
SM0-PRR-001	AIV tools Progress Report	At regular interval					
SM0-LIS-003	AIV tools Action Item List	At regular interval					
SM0-MIN-001	AIV tools MoM	At each meeting					
SM0-SCD-001	AIV tools Schedule	I	U	U	U	U	(U)
SM0-PLA-001	AIV tools Project Management Plan	I	U	U	U	U	(U)
SM0-PLA-002	AIV tools Product Assurance Plan	I	U	U	U	U	(U)
SM0-PLA-003	AIV tools Configuration Management Plan	I	U	U	U	U	(U)
SM0-MAN-001	AIV tools Operating Manual		D		I	U	(U)

Code	Title	Phase 1		Phase 2			
		KOM	FDR	KOM	IRR	FARR	OARR
SM0-MAN-002	AIV tools Maintenance Manual		D		I	U	(U)

Table 13 - Management Deliverables expected at each milestone for the AIV tools

4.6 Meetings

We describe in the following the location and the objectives of the main project meetings.
The descriptions apply to the Main Structure and the AIV tools.
ESO is fully entitled to attend any of the meetings described below.

Kick-off meetings

Location:

The Kick-off meetings (both for Phase 1 and for Phase 2) shall take place at INAF premises (Italy, exact location TBD).

Objectives:

The purpose of the meetings is to verify the presence and adequacy of all the foreseen documentation and to assess the preparedness of the company to start the activities foreseen in the phase.

Process:

The Contractor sends to INAF all the requested documentation 2 weeks (10 working days) before the meeting.

During the meeting the documents are commented on and discussed. Actions can be taken in order to correct errors, insert missing information or improve the quality of the documents.

Approval conditions:

The meeting is considered successfully completed if:

- all the KOM documentation is delivered on time and has the expected level of completeness and quality;
- the project team is ready and adequate for the work to be started;
- all critical actions taken during the review are successfully closed.

Reviews

Location:

Reviews may take place alternatively at the Contractor's premises, at INAF premises or by teleconference.

Objectives:

The purpose of Reviews is to formally assess the preparation of the expected deliverable items, at the level of completeness foreseen at that stage of the project. The Reviews are identified as such in Table 1, 2 and 3.

Agenda items of Reviews shall include but not necessarily be limited to

1. Presentation of the deliverables due for that Review and discussion of RIXs;
2. Status of pending Action Items;

3. Outcome of the Review
4. Recommendations;

Process:

The Contractor sends to INAF all the requested documentation with due advance with respect to the meeting date (in any case not less than 2 weeks (10 working days).

INAF representatives read the documentation and prepare comments and indications under the form of RIXs (Review Item Comments or Discrepancies), During the meeting the RIXs are discussed and closed, as much as possible. Actions can be taken in order to correct non-compliances, insert missing information or improve the quality of the documents.

Approval conditions:

Reviews are considered successfully completed if:

- all the deliverable items have the expected level of completeness and quality;
- all critical actions taken during the review are successfully closed.

The Contractor's personnel shall attend, if invited, MORFEO reviews with ESO (not strictly related to this project), at ESO premises or at INAF premises. The costs of these missions will be in charge of the contractor for up to 4 travels (2 days for 2 persons).

ESO is allowed to send representatives to attend any project milestone meetings, factory and on-site acceptance testing.

The Factory Acceptance Test will take place at the Contractor's premises.

The On-Site Acceptance Test will take place at the INAF premises.

Progress Meetings

Location:

Progress meetings may take place alternatively at the Contractor's premises, at INAF premises or by teleconference.

Objectives:

The purpose of these meetings is to assess the preparation of the expected deliverable items as defined in Table 4 to 9, i.e. the deliverables foreseen for the next Review (Table 10 to 13) at the level of completeness foreseen at that stage of the project.

Progress Meetings are normally held every month. More frequent Progress Meetings can be requested by INAF.

Agenda items shall include but not necessarily be limited to

1. Status of the Action Items List;
2. Progress over the reporting period ;

3. Activities for the next period;
4. Changes to status of compliance, configuration changes (if any);
5. Updated schedule.

Process:

The Contractor sends to INAF all the requested documentation as defined in Tables 4, 5, 8 and 9 with due advance with respect to the meeting date (in any case not less than 2 weeks (10 working days)).

Approval conditions:

Progress Meetings are informative meetings and no specific approval conditions are foreseen.

Additional meetings may be requested either by INAF or the Contractor. With due notice to the Contractor, INAF reserves the right to invite Third Parties to meetings to facilitate information exchange. Third Parties can include, for example, INAF personnel not directly involved in the project, members of the MORFEO consortium, external experts in technical or management/administrative matters.

For each meeting the requester shall propose an agenda in electronic form and shall compile and distribute any presentation given at the meeting.

INAF may request, with at least 15 days in advance, access to the integration laboratories and support to make extra measurements directly on the units.

Access to laboratories may be requested at any time during Phase 2, whenever deemed necessary by INAF.

The best time slot will be agreed into a reasonable amount of time.

Art. 5 Supporting Tasks

5.1 Project Management

The Contractor shall implement a centralised Project Management System and will nominate a Project Manager.

The Contractor's Project Management Office shall coordinate and control the project resources, all technical and commercial activities, and manage all activities required to successfully complete the Contract.

The Contractor's Project Manager shall be the principal point of contact and have full authority to deal with all matters related to the contract, including but not limited to technical matters.

The Contractor shall implement a product-oriented Work Breakdown Structure starting from the activities described in this document. The Work Packages shall be clearly identified, with appointed Work Package Managers, Work Package input / output, milestones and timelines.

The Contractor shall implement a Master Plan based on the Work Breakdown Structure. The Master Plan shall be updated or reconfirmed with each Progress Report.

In addition to the Master Plan the Contractor shall establish a detailed planning, including detailed networks, dependencies, bar charts, milestones, resource allocation, etc..

The detailed schedule shall integrate the activities of all subcontractors involved in the project (if any).

Progress reports shall provide a brief account of the progress of the work done by the Contractor, encompassing all aspects within the reporting period..

Progress Reports shall be communicated to the INAF point of contact in electronic format (e.g. as email attachment). Progress Reports shall include the draft agenda of the next progress meeting.

The Contractor's Project Management System (procedures, personnel, documents and tools) shall be described in the Project Management Plan (see description of deliverable items).

Management deviations, impacting project scope/quality, time or cost, shall be reported to INAF, as change request or request for waiver for approval. Once approved by INAF and by the Contractor, the change will be formalised in a contract amendment. If the change comprises schedule shift or other variations that would imply penalties, such penalties can be waived by mutual agreement in the updated contract.

Technical deviations, that do not have impacts on scope/quality, time or cost, may be proposed by both parties and discussed in the first available Progress Meeting (or in a dedicated Meeting in case of urgency). Once agreed by INAF and by the Contractor, these deviations will become part of the technical baseline and shall be reported in detail in the project documentation.

5.2 Configuration Management

To make sure proper Configuration Management is implemented, the Contractor shall have in place a sound and effective Configuration Management System.

This means that any element to be developed in the project shall comply with the configuration control requirements and principles stated in the following.

- "Item" is any physical or non-physical component of inventory, single pieces, assemblies, software code or similar that will make part of the product.

- Every configured product item shall have a unique identifier that shall be used to manage (document, retrieve, identify) and to reference the configuration item.

- As a minimum, all configuration items delivered by the Contractor or referenced by a document delivered by the Contractor shall be the subject of the Configuration Management System.

- The Contractor shall provide information (e.g. as part of the Configuration Management Plan), on how the item numbering system works.
- The contractor shall provide evidence that their numbering system is capable of providing unique numbers across all their contracts for the foreseeable future.
- The item number shall only contain the following characters: Modern alphabet, ciphers, space, underscore, hyphen-minus and dot.
- Configuration items with the same identifier shall be interchangeable. I.e. if the specification, or criteria, for Form, Fit and Function of a particular item are met, then the item may generally be considered interchangeable with other items with the same requirements. If not, it needs a new dedicated identifier.
- Items shall be identified and where possible marked by the items unique reference and serial number to provide traceability and configuration control.
- The Configuration Item List (CIL) shall contain all product elements that will be under configuration control. This list is applicable for both hardware and software elements.
- For each configuration item the contractor shall provide a Configuration Item Data List (CIDL) containing all documents relevant to such configured item. As such, the CIDL shall list all applicable requirements and specification documents, drawings, analyses, models, test reports, bill of materials, lists, etc.. The CIDL shall be updated and delivered with each progress report. The 'as-built' version of the CIDL shall be delivered at delivery of the product/item.

The Contractor's Configuration Management System applied in the execution of the specific Contract shall fulfil, as a minimum all requirements, principles and applicable documents contained in this SOW.

The Configuration Management Plan shall be produced by the Contractor and shall define the Configuration Management procedures and the Configuration Management System that is used in the execution of this contract.

The Configuration Management Plan may use company-wide or standard documents but shall detail how such procedures will be used in the execution of the specific Contract.

5.3 Product Assurance

The general approach concerning the fulfilment of all specified PA requirements (including quality assurance, RAMS, Configuration Management, and Software Product Assurance) shall be described in the Product Assurance Plan. The detailed tasks to be performed during

the individual project phases shall be included as all other project activities in the project planning.

If the contractor is not ISO9001 certified, under request of the MORFEO PA manager it shall provide evidence that the production and service provision proceed under controlled conditions, thus assuring that manufacturing and procurement processes are under adequate control and monitoring

In addition to the specified safety requirements foreseen by ISO9001 and where not explicitly stated otherwise, the Contractor shall comply with all relevant National safety laws and legislation applicable to the design, development, manufacturing, installation and operation of the contracted item.

Art. 6 Commercial guarantee and technical assistance

A standard warranty of 2 years after the final acceptance of the Main Structure and the AIV tools shall be provided by the Contractor.

The extension of the warranty beyond the 2 years will be considered a useful plus and will give additional points in the proposal evaluation.

The baseline for the warranty shall be the change/repair of the defective piece.

The Contractor responsibilities shall cover all costs related to shipment and repair of the defective piece and to travel of the personnel necessary in case of change/repair on-site. This applies to any location in Europe.

INAF will be responsible for dismounting and remounting the Main Structure and the AIV tools ..

When a defect is reported, INAF will give formal notice of the issue to the Contractor

specifying if change/repair is needed on site.

The Contractor is released from its financial obligations, only where an improper use of the product is proven. In such cases the Contractor shall anyway provide technical support upon specific agreement with INAF.

It shall be possible to re-manufacture a deliverable item or some of its components for a duration of 15 years.

- **After-sales technical assistance to be provided.**
  1) *times for replacement of defective products / spare parts.* The defective component must be replaced within 60 calendar days from its reception at the Contractor site or form the defect notification in case of on-site

replacement.

2) *mode that will be used to notify the malfunction*. The contracting authority will communicate the malfunction to the contractor using an agreed e-mail address.

3) *charges for replacement of spare / malfunctioning parts*. During the warranty period the replacement of the non-functioning product shall be borne by the contractor including the collection of the defective part and of the delivery of the replacement part. The replacement operation shall be conducted by Contractor's personnel or, as a second choice, by the contracting authority remotely assisted by the contractor.

Art. 7.1 Delivery to Europe

With delivery to Europe it is considered the packing and shipment from contractor premises to INAFIntegration site (INAF, Bologna).

- **Transport insurance policy.** Insurance on transport is mandatory and shall be paid by the Contractor.
- **Packing 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.

  For details on Main Structure packing requirements and AIV tools, refer to AD1 Section 6.

- **Responsibilities and support.**

  Delivery at final destination 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.

  Logistic support shall be provided by INAF according to plans and requirements set in the Design and in the AIT Phases, and document as specified in Table 4, 5, 8 and 9.

Where INAF manpower is required to support delivery tasks, the Contractor shall provide all necessary manuals and instructions for such manpower to safely perform its tasks according to requirements.

- **Location and delivery times.**

  The Main Structure and the AIV tools must be delivered to the following locations:

  - Bologna Integration Hall, at CNR Research Area - Via Piero Gobetti, 101, 40129 Bologna BO;

  Alternate delivery locations must be agreed with due advance.

  Detailed information will be provided at the time of shipping.

- **Shipping methods.**

  In accordance with the terms **INCOTERMS DDP** - *Delivered Duty Paid*. In the DDP mode the contractor covers all costs and risks of the shipment and of import/export.

- **Method of unloading goods.**

  Unloading will be on the ground floor, by the courier appointed by the Contractor.

  Personnel of the Contractor shall oversee the unloading and perform the unloading inspection to check that no damage was done during the transportation (data logger, shock witnesses, etc.).

Art. 7.2 Delivery at Chile

With delivery to Chile it is considered the packing and shipment from INAF Integration site (INAF, Bologna) to Chile Integration site.

- **Transport insurance policy.** Insurance on transport is mandatory and shall be paid by the Contractor.
- **Packing method**. Care and responsibility of the contractor shall be to choose high quality external materials, rigid and in good conditions. The boxes mentioned in Art 7.1 shall be reusable. 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.

For details on Main Structure and AIV tools packing requirements, refer to AD1 Section 6.

- **Responsibilities and support.**

  Delivery at final destination 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.

  Logistic support shall be provided by INAF/ESO according to plans and requirements set in the Design and in the AIT Phases, and document as specified in Table 4, 5, 8 and 9.

  Where INAF manpower is required to support delivery tasks, the Contractor shall provide all necessary manuals and instructions for such manpower to safely perform its tasks according to requirements.

- **Location and delivery times.**

  The Main Structure and the AIV tools must be delivered to the following locations:

  - ELT Integration site at Cerro Armazones, Chile

  Alternate delivery locations must be agreed with due advance.

  Detailed information will be provided at the time of shipping.

- **Shipping methods.**

  In accordance with the terms **INCOTERMS DPU** - *Delivered at Place Unloaded.* The contractor delivers and unloads the goods at the named destination, while the contracting authority is responsible for import clearance, duties, and taxes.

- **Method of unloading goods.**

  Unloading will be on the ground floor, by the courier appointed by the Contractor.

  The coordination of the activity is in charge to INAF/ESO.

  Personnel of the Contractor shall oversee the unloading and perform the unloading inspection to check that no damage was done during the transportation (data logger, shock witnesses, etc.).

Art. 8 General Conditions

8.1 Quality System

The Contractor shall implement a quality system based on the ISO 9001 standard.

The certification of the Contractor with ISO 9001 standard is considered a plus. Alternatively, the Contractor should be able to demonstrate the existence and the use of an equivalent internal quality system.

More specifically the Contractor shall demonstrate the existence and use processes ensuring the final quality of the product by means of:

- Contractual management and validation
- Documentary management
- Manufacturing management
- Personnel Safety
- Production controls and calibration of the associated measuring tools

8.2 Audits

INAF is authorised to perform audits at the Contractor premises during all the duration of the contract in order to validate and evaluate the contractor quality system, as well as the progress of the contract execution.

INAF will inform the contractor of its intention to perform an audit for a given date at least 15 days in advance. The contractor shall answer to this request by an acceptance of the proposed date or by an alternative proposition of date(s) within more or less than 10 days from the initial proposed date.

8.3 Personnel Safety

The contractor shall respect all Italian laws and regulations relative to personnel safety and working conditions. The Contractor is fully liable for the safety of its personnel.

The contractor shall formally notify to INAF before implementation any use of known or potential harmful material (including, but not limited to, radioactive, bio-hazardous, chemically dangerous materials) during the manufacturing process or included in the delivered product. In that case, an official acceptance from INAF of this (these) material(s) is mandatory prior to its implementation.

The contractor shall formally notify to INAF of all potential risk or danger linked with the use or the handling of its products. In that case, safety measures shall be transmitted to INAF and accepted before any delivery.

8.4 Traceability

The contractor shall ensure the traceability and the recording of the product's main components, materials or sub-contracted operations. The rules and conventions for the

tracing components and elements of the system will be detailed in the relevant documentation produced by the contractor (Parts List/ Bill of Materials and CIDL).

The list of these items shall be agreed with INAF before manufacturing. For each delivered product and for each of the identified item the following information shall be available:

- Item manufacturer or sub-contractor
- Identification number
- Batch or serial number
- Manufacturing or service date

8.5 Documentation

All deliverable documents produced during the project shall be written in English language and will be transmitted under electronic format.

Applicable associated file formats are:

- Word, Excel and PDF under ISO A4 size for textual documents
- PDF, Autocad DWG, Inventor IDW under ISO A0 to A4 size for drawings
- Zemax ZMX for optical design files
- STEP, IGES, Inventor IAM and IPT for 3D models

Other formats must be agreed between the Contractor and INAF.

Templates for Change Request, Request for Waiver and Discrepancy Note will be provided and will be applicable.

All internal or deliverable documentation related to the present Statement of Work associated contract shall be archived and recoverable during the duration of 15 years after the end of the manufacturing phase.

The contractor is responsible for verifying all documentation made available by INAF for the contract execution including the present Statement of Work and its applicable documents. The contractor shall give notice to INAF of any errors, discrepancy or missing information in this documentation. The contractor shall not modify documents made available by INAF. In case of errors, discrepancy or missing information, the correct information will be provided by INAF.

8.6 Confidentiality

Both parties undertake to ensure confidentiality of information communicated by the terms of the present contract and not to publish it, divulge it to third parties (apart from ESO) for use it for any other purpose than those stated in the present contract, and the parties agree to do so for the entire duration of the contract and for a period of five years following expiry or termination of the contract. Confidential information must be sent only by registered letter with recorded delivery.

Art. 9 Modification Management

9.1 Change Request

During contract execution, the Contractor and INAF can propose modifications to the contract. Such proposals shall be addressed to the other party by means of a formal change request.

This change request shall include detailed motivation and explanation of the proposed change. It will identify clearly all the documents and products impacted by the change. When issued by the Contractor, it shall also include all potential impacts positive or negative in terms of quality, performance, schedule and cost. When issued by INAF, this information will be given by the Contractor in reply to the change request.

Each Change Request shall be identified by a unique identifier, which shall be used in all subsequent correspondence.

Provided the input is complete, the receiving party shall respond (change approved or rejected) to any such Change Request within 4 weeks of its receipt, or in the case of complex changes inform the other party on the expected completion date within 2 weeks of its receipt. If the input is not complete, the receiving part shall ask for the missing information within two weeks.

If the change of scope is significant an amendment of contract conditions may be agreed.

INAF will provide a template for Change Request at Kick Off Meeting.

9.2 Request for Waiver

A request for waiver is an official request from the Contractor to INAF to release or use a non-compliant product. A request for waiver is limited to specific individual products or limited in time before repair. If this limitation does not apply, a change request shall be issued.

A request for waiver shall include detailed motivation and explanation of the waiver requested. It will identify clearly all the products impacted and if relevant the foreseen date of repair. It shall also include all potential impacts positive or negative in terms of quality, performance, schedule and cost. INAF will pronounce the acceptance decision of the request within 4 weeks after reception of the completed request. If the change of scope is significant an amendment of contract conditions may be agreed.

INAF will provide a template for Request for Waiver at Kick Off Meeting.

9.3 Non-Conformances

In case where a non-conformance or discrepancy of any kind is detected during the project execution, the Contractor shall give notice to INAF 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.

9.4 Contract Amendment

In case of a contract amendment consecutive to a change or a waiver, the financial conditions revision will be based on the cost breakdown given at the contract signature.

Art. 10 Obligations of the contractor

- **Appointment and duties of the Contract Manager.** The Contractor shall indicate its own Contract Manager with whom the Contracting Authority will be able to interact, for contractual matters, until the issue of the certificate of conformity (test certificate) of the supply.
- **Appointment and duties of the Project Manager of the supply.** The Contractor shall indicate its own project manager of the supply that will ensure the effective and timely completion of the contract. The Contractor's Project Manager, supported by other internal personnel, as needed, shall coordinate and control the project resources and manage all activities required to successfully complete the Contract. The project manager shall implement a more detailed, product-oriented, Work Breakdown Structure based on the Work Breakdown Structure described in this document. Work Packages shall be clearly identified, with appointed Work Package Managers, Work Package input / output, milestones and timelines.
- **Appointment and duties of the Technical Manager of the supply.** The contractor shall indicate its own Technical Manager of the supply with which the contracting authority will be able to interact, for technical matters, until the issuing of the certificate of conformity of the supply. The figures of Contract Manager, Project Manager and Technical Manager of the supply may coincide.

Appendix A Technological Readiness Level definition (TRL)

TRL	Technology Readiness	Description
1	Basic principles observed and reported	Lowest level of technology readiness. Scientific research begins to be translated into applied research and development. Example might include paper studies of a technology's basic properties.
2	Technology concept and/or application formulated	Invention begins. Once basic principles are observed, practical applications can be invented. The application is speculative and there is no proof or detailed analysis to support the assumption. Examples are still limited to paper studies.
3	Analytical and experimental critical function and/or characteristic proof of concept	Active research and development is initiated. This includes analytical studies and laboratory studies to physically validate analytical predictions of separate elements of the technology. Examples include components that are not yet integrated or representative.
4	Component and/or breadboard validation in laboratory environment	Basic technological components are integrated to establish that the pieces will work together. This is relatively "low fidelity" compared to the eventual system. Examples include integration of 'ad hoc' hardware in a laboratory.
5	Component and/or breadboard validation in relevant environment	Fidelity of breadboard technology increases significantly. The basic technological components are integrated with reasonably realistic supporting elements so that the technology can be tested in a simulated environment. Examples include 'high fidelity' laboratory integration of components.
6	System/subsystem model or prototype demonstration in a relevant environment	Representative model or prototype system, which is well beyond the breadboard tested for TRL 5, is tested in a relevant environment. Represents a major step up in a technology's demonstrated readiness. An example is the testing of a prototype in a high fidelity laboratory environment or in simulated operational environment.
7	System prototype demonstration in an operational environment	Prototype near or at planned operational system. Represents a major step up from TRL 6, requiring the demonstration of an actual system prototype in an operational environment. Examples include testing the prototype in an observatory environment.
8	Actual system completed and qualified through test and demonstration	Technology has been proven to work in its final form and under expected conditions. In almost all cases, this TRL represents the end of true system development. Examples include developmental test and evaluation of the system to determine if it meets design specifications.
9	Actual system proven through successful mission operations	Actual application of the technology in its final form and under mission conditions, such as those encountered in operational test and evaluation. In almost all cases, this is the end of the last "bug fixing" aspects of true system development. Examples include using the system under operational mission conditions.