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All.h) Statement of Work (S.O.W) - E-MAO-000-INA-SOW-003 v.01

*Document Number* E-MAO-000-INA-SOW-003\_01

*Title* **Statement of Work for the Design and Manufacturing of the Deformable Mirrors for the MORFEO Instrument of the ELT**

*Type of tender* Open procedure pursuant to art. 60 of Legislative Decree April 18, 2016, n. 50, and successive modifications and integrations



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## Art. 1 Definitions and purpose of the document

### 1.1 Definitions

- **Bidder.** Any company or other economic operator that submits an offer for the present Call.
- **Contracting Authority.** INAF - Osservatorio di astrofisica e scienza dello spazio di Bologna (INAF-OAS) is the contracting authority for this project.
- **Contractor.** The company or other economic operator that signs with INAF the contract for this project.
- **DM.** In this document, in the “Disciplinare” and in the Draft Contract, the term “DM” includes all the items to be supplied for each of the deformable mirror subsystems as shown in AD1, Section 3.2. The term “DM”, if not differently specified, corresponds to the term “DMAMS” used in AD1.
- **DM1.** It is the first of the two Deformable Mirrors that constitute the object of this Statement of Work.
- **DM2.** It is the second of the two Deformable Mirrors that constitute the object of this Statement of Work.
- **FDR.** Final Design Review
- **Functional requirements.** Requirements that indicate the purpose and function of the supply.
- **Optional Requirements.** Requirements that are not mandatory for the acceptance of the proposal but can give additional points in the evaluation.
- **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** indicates an optional, desired requirement
- **Will** indicates a circumstance expected to happen



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## 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, see section 3.1) 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 ( $\sim 1 \text{ arcmin}^2$ ) 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 and Ireland, 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 which the fulfilment of the requirements defined in the MORFEO Technical Specification.



## **Preliminary Design Review (PDR)**

The purpose of this review is to scrutinize 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 is foreseen by the end of 2022.

## **Final Design Phase**

In this phase MORFEO is designed down to the level of components. The major 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 DMs 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 MAIT phase comprises two main 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.
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.

## **Preliminary Acceptance in Europe (PAE)**



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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 observatory. The PAE meeting should be held at the place where the instrument is located.

The PAE is planned for December 2028.

### **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.

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 2030 and is followed by a 2-year guarantee period.

### **Art. 3 Subject of the contract**

This SoW applies to the delivery of **2 (two) adaptive deformable mirrors systems** (DMs, which include the deformable mirrors and everything needed with them as indicated in section 1.1.) needed by MORFEO and will cover:

- the design phase,



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- the manufacturing phase, which includes the assembly, integration and test (MAIT) at the company premises
- the delivery and integration at the Bologna Integration Hall in Europe
- support to the installation in Chile.

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 Kick Off Meeting with the selected contractor, the project shall follow the timeline indicated in Section 4.2.

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 Technical Specifications for the Design and Manufacturing of the Deformable Mirrors for the MORFEO Instrument of the ELT E-MAO-000-INA-SPE-001\_01
- AD2 ESO Safety - Safety Conformity Assessment Procedure SAF-GEN-MAN-3444\_4

### 3.2 Reference Documents

Not Applicable.

### 3.3 Definition of Project Items

This project concerns the Post Focal Deformable Mirrors (DM as defined in Section 1.1) of MORFEO and all the related documentation, as specified in the following sections.



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

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

#### 4.1 Contractual Phases

The project shall comprise the following phases:

##### DM1 Phase 1 (firm phase)

- Design and performance analysis of DM1
- Procurement of elements necessary for the construction of DM1 which require long production times (list to be proposed by the contractor and to be approved by INAF at contract signature)

##### DM2 Phase 1 (firm phase)

- Design and performance analysis of DM2
- Procurement of elements necessary for the construction of DM2 which require long production times (list to be proposed by the contractor and to be approved by INAF at contract signature)

##### DM1 Phase 2 (conditional phase)

- Procurement and/or construction of the elements needed to build DM1 and their Assembly
- Transfer of Ownership of the complete set of components of DM1
- Integration and Factory Test of DM1
- Delivery to Bologna Integration Hall, On-site Test and commissioning of DM1
- 40 hours of training to INAF personnel and, if requested, to ESO personnel

##### DM2 Phase 2 (conditional phase)



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- Procurement and/or construction of the elements needed to build DM2 and their Assembly
- Transfer of Ownership of the complete set of components of DM2
- Integration and Factory Test of DM2
- Delivery to Bologna Integration Hall, On-site Test and commissioning of DM2
- 40 hours of training to INAF personnel and, if requested, to ESO personnel

For each DM the transition between Phase 1 and the (optional and not granted) Phase 2 will be subject to internal and external conditions:

INAF accepts the Final Design for that DM upon review and joint recommendation by the MORFEO Consortium and ESO

#### **4.2 Acceptance procedure**

For both DM1 and DM2 the acceptance procedures shall be as follows:

##### **Phase 1**

The acceptance of the Final Design will be done by evaluating the requested documents, as specified in Section 4.3.

The acceptance of the (optional) Start of Early Procurement will be done by evaluating the procurement documentation and verifying the execution of the proper agreed procedure.

##### **Phase 2**

For Phase 2 there will be two separate acceptance procedures.

The first acceptance procedure consists in the verification that all components of a DM are present at the Contractor premises and have the required characteristics. After this first acceptance the Integration of the DM can start.

The second acceptance process for the physical equipment (DM1, DM2) will be carried out through structured test sessions. These test sessions will verify that the DM fulfils all the technical specifications. The test sessions will be executed at the Factory premises and, later, at the INAF Integration site.



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The On-site Acceptance (also referred to as “commissioning”) comprises the execution of the On-Site Test and the correction of any non-compliance until the DM fulfils all the technical requirements.

The final acceptance is reached under the condition that all the waivers for both DMs are closed and all agreed changes are implemented.

### 4.3 Timeline and Milestones

In the following 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 (T0) will be decided at the time of the contract signature and must in any case take place within 30 days from the date of the contract signature.

The start of Phase 2 (T1) will happen when all Action Items arisen from DMs' FDR are closed.

In the following schedules we have assumed, as a tentative reference,  $T1=T0+18$ . However T1 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:

- the date of DM2 Transfer of Ownership (DM2 Integration Readiness), that is constrained by the rules of the National Fund for Recovery and Resilience (PNRR, the European programme managed by the Italian Research Ministry that funds the DM2); this date is fixed to 30th June 2025, unless possible shifts according to PNRR rules;
- the end of DM1 Phase 2 and of DM2 Phase 2 with respect to T1 ( $T1+35$  for DM2 and  $T1+39$  for DM1)

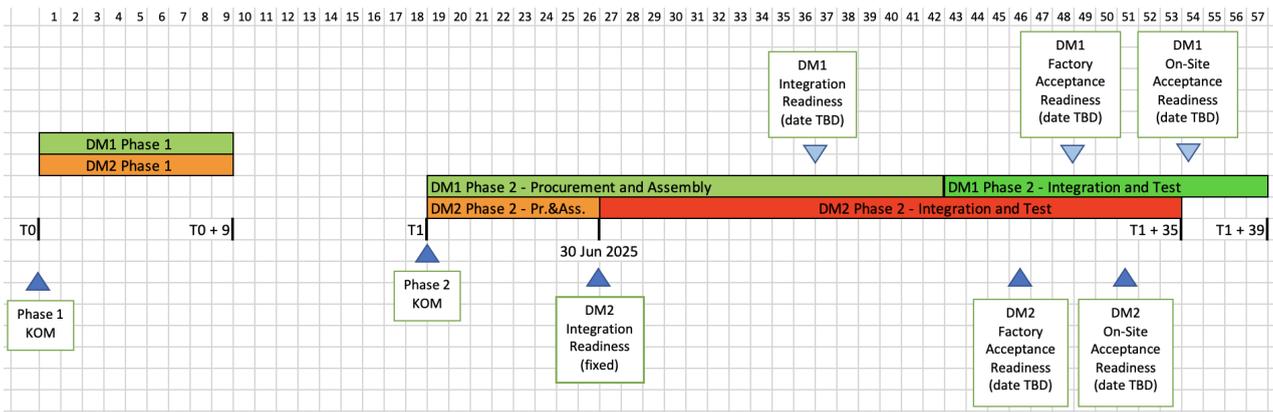


Figure 1 - Project schedule of DM1 and DM2 in graphical form (Units are in Months)

Phase 1 (T0 start of activities TBD)				
Activity/Milestone	Start	Stop	Description	
DM1/DM2 Kick Off Meeting (KOM)	T0	T0	The main objectives of the Kick-Off Meeting are 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.	
DM1/DM2 Design	T0	T0+9	The objective of this activity is to carry out the final design of the DM, in order to be ready to start the Phase 2.	
DM1/DM2 early procurements FDR	T0+2,5	T0+3	This milestone has the objective of reviewing the documentation and design of Long-Lead Items (if needed), to assess their maturity and to formally authorise the start of such early procurements.	
DM1/DM2 start of early procurements (if needed)	T0+3	T0+9	The objective of this activity is to procure all the elements that require a long time to be built and that could impact the overall schedule if	



			<p>their construction is not started in Phase 1.</p> <p>This activity can start only after the positive conclusion of the DM1/DM2 early procurement FDR.</p>
DM1/DM2 Final Design Review (FDR)	T0+9		<p>The purpose of this review, that closes Phase 1, 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).</p> <p>The FDR is considered successfully closed after the successful implementation of all the relevant actions.</p>

*Table 1 - Project schedule of DM1 and DM2 for Phase 1 in tabular form (Shifts in Months)*

<b>DM1 Phase 2</b>			
<b>Activity/Milestone</b>	<b>Start</b>	<b>Stop</b>	<b>Description</b>
DM1 Kick Off Meeting for Phase 2	T1		<p>The objective of this Meeting is to verify the presence of all conditions to start Phase 2.</p> <p>The procurement of all non-LLI elements can start after the successful conclusion of this meeting.</p>



DM1 Procurement of elements (Completion of Early Procurements and of other Procurements) and Assembly	T1	T1+N -14 days	<p>This activity has the objective to complete all the procurements and to assemble these elements according to the first level decomposition of the DM (See AD1, Section 3.2).</p> <p>At the end of this activity the first-level elements of the DM will be ready for Integration.</p>
DM1 Integration Readiness Test	T1+N-1 4 days	T1+N	<p>The purpose of this activity is to verify that the elements composing the DM are present, comply with their specifications and are ready to be integrated.</p>
DM1 Integration Readiness verified. Transfer of Ownership	T1+N (To be proposed by the bidder)		<p>The positive conclusion of the previous testing activity is the condition for the transfer of ownership of the DM to INAF.</p>
DM1 Integration	T1+N	T1+M (To be proposed by the bidder)	<p>The objective of this activity is to integrate the DM at the Contractor's premises and to prepare the DM for the Factory Acceptance.</p>
DM1 Factory Acceptance Readiness	T1+M (To be proposed by the bidder)		<p>At this milestone the DM, fully integrated, shall be ready for the execution of Factory Acceptance Test.</p>



DM1 Acceptance Test	Factory	T1+ M	TBD	This activity has the objective to verify that the DM is working according to its specifications at Contractor's premises
DM1 Acceptance	Factory	TBD		This milestone marks the positive acceptance of the DM at the Contractor's premises and the consequent authorisation to move it to the INAF facility for MORFEO Integration.
DM1 Acceptance Readiness	On-Site	T1+P (To be proposed by the bidder)		After the transport of the DM to INAF facility and after its integration the DM is ready for the execution of the Acceptance Test.
DM1 Acceptance Test	On-Site	T1+ P	TBD	This activity has the objective to verify that the DM continues to work according to its specifications at INAF premises.
DM1 Acceptance	On-Site	TBD		This milestone marks the positive conclusion of the Test and commissioning at INAF premises and the consequent final acceptance by INAF.
DM1 End of Phase 2		<b>T1+39</b>		

Table 2 - Project schedule of DM1 Phase 2 in tabular form (Shifts in Months)

DM2 Phase 2			
Activity/Milestone	Start	Stop	Description



DM2 Kick Off Meeting for Phase 2	T1		<p>The objective of this Meeting is to verify the presence of all conditions to start Phase 2.</p> <p>The procurement of all non-LLI elements can start after the successful conclusion of this meeting.</p>
DM2 Procurement of elements (Completion of Early Procurements and of other Procurements) and Assembly	T1	16th June 2025	<p>This activity has the objective to complete all the procurements and to assemble these elements according to the first level decomposition of the DM (See AD1, Section 3.2).</p> <p>At the end of this activity the first-level elements of the DM will be ready for Integration.</p>
DM2 Integration Readiness Test	16th June 2025	30th June 2025	<p>The purpose of this activity is to verify that the elements composing the DM are present, comply with their specifications and are ready to be integrated.</p>
DM2 Integration Readiness verified. Transfer of Ownership	30th June 2025		<p>The positive conclusion of the previous testing activity is the condition for the transfer of ownership of the DM to INAF.</p>
DM2 Integration	30th June 2025	T1+B (To be proposed by the bidder)	<p>The objective of this activity is to integrate the DM at the Contractor's premises and to prepare the DM for the Factory Acceptance.</p>



DM2 Factory Acceptance Readiness	T1+B (To be proposed by the bidder)	At this milestone the DM, fully integrated, shall be ready for the execution of Factory Acceptance Test.	
DM2 Factory Acceptance Test	T1+B	TBD	This activity has the objective to verify that the DM is working according to its specifications at Contractor's premises
DM2 Factory Acceptance	TBD		This milestone marks the positive acceptance of the DM at the Contractor's premises and the consequent authorisation to move it to the INAF facility for MORFEO Integration.
DM2 On-Site Acceptance Readiness	T1+C (To be proposed by the bidder)	After the transport of the DM to INAF facility and after its integration the DM is ready for the execution of the Acceptance Test.	
DM2 On-Site Acceptance Test	T1+C	TBD	This activity has the objective to verify that the DM continues to work according to its specifications at INAF premises.
DM2 On-Site Acceptance	TBD		This milestone marks the positive conclusion of the Test and commissioning at INAF premises and the consequent final acceptance by INAF.
DM2 End of Phase 2	<b>T1+35</b>		

*Table 3 - Project schedule of DM2 Phase 2 in tabular form (Shifts in Months)*

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

- **Integration Readiness Review**

The Integration Readiness Review takes place before starting the integration of a DM.



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The purpose is to ensure that all elements to be integrated (and all auxiliary equipment needed for the Integration) are present at the Contractor premises and are of the expected quality.

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.

After the successful completion of the Integration Readiness Test the ownership of the DM is transferred to INAF and the DM remains at the Contractor's premises for its Integration.

- **FAT – Factory Acceptance Review**

The FAT - Factory Acceptance Review is the process of provisional acceptance that assesses the proper functioning of the system(s) at the contractor's site. All interfaces (including but not limited to SW and RTC) are also verified.

Test procedures, modes and timeline of the FAR of each DM will be defined in detail in the relevant MAIT Plan. The MAIT Plan shall ensure the proper implementation of all requirements contained in the Compliance Matrix.

Once successfully passed the FAR, the system can be transported to the INAF integration site.

During the FAR all technical requirements and interface requirements described in each MAIT plan that are foreseen to be verified by test will be verified. The result of such tests will be documented in the test reports. The tests executed at the factory will 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.

A Test and inspection report (FAR 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.

- **OAR – On-site Acceptance Review**

In this test session, executed at INAF premises or other place indicated by INAF, the whole set of technical requirements and interface requirements is tested, comprising the tests that couldn't be executed during the FAT.



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The tests of the OAR will be executed in an environment much closer to the real operational conditions than the ones of the FAR

Test procedures, modes and timeline of the OAR will be defined in detail in the relevant MAIT Plan.

The contracting authority will verify with its own personnel the compliance of the delivered products with the technical and functional requirements indicated by the contractor at the time of the offer, comparing them with the data sheets associated with each individual product.

The presence of contractor personnel during OAR is required.

A Test and inspection report (OAR 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 Model, Drawing

E -> Equipment

Refer to the table of milestones (Table 2) for delivery dates.

For the definition of "DM1" and "DM2" (and of the elements composing them) refer to AD1, Section 3.2.

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.



## DM1 Technical Deliverables (Documents)

Code	Title	Type	Description
PD1-CMX-001	DM1 Compliance Matrix	D	<p>Compliance Matrix to Requirements.</p> <p>The Compliance Matrix shall, as a minimum:</p> <ol style="list-style-type: none"> <li>1. List in a tabular format all requirements that have been identified in the Call documentation, including the interface requirements.</li> <li>2. Recapitulate for each requirement the means of verification adopted (by Design, Analysis, Inspection or Test)</li> <li>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.</li> <li>4. List any reference to NCs, CREs or RF(W/D)s documents.</li> <li>5. Reference to the location of the verification description within the document datapack</li> </ol>
PD1-DER-001	DM1 Design Report	D	<p>Design of the DM.</p> <p>The Design Report shall contain, as a minimum:</p> <ol style="list-style-type: none"> <li>a. Assumptions, such as design constraints, environmental conditions other than specified in technical</li> </ol>



			<p>specification, maintenance concept, access concepts</p> <p>b. Materials used in the design with physical properties as well as chemical behaviour, applicable treatments and their purposes</p> <p>c. Detailed description of the system design, all relevant components subsystems and function with reference to every specified requirement specified</p> <p>d. Any parts of the design that are not closed and problem areas</p> <p>e. all the description required to prove the requirement that has to be verified by design according to CMX</p> <p>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</p> <p>The design shall cover the optical, mechanical, electrical and SW design. The handling tools shall be part of the design.</p>	
PD1-ANR-001	DM1 Report	Analysis	D	<p>Analysis of the system.</p> <p>The Analysis Report, taking into account the actual system design demonstrating that the referred requirement is met, shall contain, as a minimum:</p> <p>a. Requirement analysis</p> <p>b. Functional analysis</p>



				<p>c. Performance analysis</p> <p>d. Interface analysis in operational conditions</p> <p>e. Reliability analysis</p> <p>f. Earthquake analysis</p> <p>g. Further analyses, as appropriate</p> <p>h. all the analysis required to prove the requirement that has to be verified by analysis according to CMX</p>
PD1-SPE-001	DM1 Budget	System	D	<p>Technical/Error Budget</p> <p>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.</p> <p>The Document shall contain the following set of information, as a minimum:</p> <p>1. Purpose of the Document; in this section the purpose of the document shall be identified</p> <p>Scope of the Document; in this section the scope of the document shall be identified</p> <p>2. Applicable Documents; in this section all the documents referred to in the technical budget shall be listed</p> <p>Definition &amp; Convention; in this</p>



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		<p>section all definitions and conventions used in the Document shall be given.</p> <p>3. 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.</p> <p>4. 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.</p> <p>5. 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</p> <p>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.</p> <p>7 Conclusion; the conclusion shall summarize the outcome of the technical budget in terms of</p>
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			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.
PD1-ICD-001	DM1 Interface Control Document	D	<p>The ICD shall list for each interface:</p> <ol style="list-style-type: none"> <li>1. Interface name and reference number</li> <li>2. The items to be interfaced</li> <li>3. The description of the interface</li> <li>4. The verification status of the interface</li> <li>5. Reference to Change Request or Request for Waiver, if applicable</li> <li>6. Status and comments</li> </ol> <p>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.</p>
PD1-PLA-004	DM1 MAIT Plan	D	<p>Manufacturing, Assembly, Integration and Test Plan.</p> <p>The system MAIT plan shall be established for the DM. The MAIT plan shall give detailed definitions, requirements, conditions and constraints of all manufacturing, assembly, integration, alignment and test activities performed in factory.</p> <p>Facilities shall be identified and briefly described. Requirements and</p>



			<p>definitions shall be given for support equipment to cover MAIT phases including handling, transport and storage.</p> <p>The document contains a clear and well detailed verification plan describing the tests to be performed to verify the compliance of the DM to the specifications.</p> <p>It includes SW Test Plan and Procedures.</p>
PD1-DWG-00 1	DM1 Manufacturing Drawings	M	<p>The package shall contain Assembly drawings, parts drawings and manufacturing drawings. "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).</p> <p>The document includes also cables, and cooling pipes routing.</p>
PD1-DWG-00 2	DM1 As Built Drawings	M	<p>Drawings after building.</p> <p>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)</p> <p>The Handling tools shall also be</p>



			included
PD1-MOD-001	DM1 Models	M	<p>3D Models and other technical Models.</p> <p>It includes CAD models, FE models, and any other computational and simulation models.</p> <p>The models shall be delivered according to the product breakdown structure.</p> <p>ESO standards shall be used for the modelling.</p> <p>The Handling tools shall also be included</p>
PD1-LIS-001	DM1 Parts List/Bill of Materials	D	<p>List of parts composing the system.</p> <p>The part list shall contain as minimum:</p> <ol style="list-style-type: none"> <li>1. Title or Identification: Name of the item which is shown in its drawing.</li> <li>2. Part Number. <ol style="list-style-type: none"> <li>a. For standard components (Fasteners) the dimensions and quality shall be provided according to ISO standards. e.g. ISO 4017-M8x20-8.8</li> <li>b. For COTS parts the number shall be complete to enable reordering.</li> </ol> </li> <li>3. Quantity: amount of pieces used in the assembly or subassembly</li> <li>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)</li> </ol>



			<p>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.</p> <p>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.</p> <p>The BoM is a multilevel list of all components contained in a Configuration Item (CI).</p> <p>The BoM shall be delivered in a hierarchical multi-level form.</p> <p>Each sub-assembly shall be listed along with the components that make up that subassembly.</p> <p>An individual part may be listed in the BoM multiple times if it is included in more than one sub-assembly.</p>
PD1-PLA-005	DM1 Development and Verification Plan	D	<p>Development Plan.</p> <p>The Design, Development and Verification Plan shall present the overall instrument design development, validation and verification plan in terms of strategy, organisation and processes. It shall aim to demonstrate how to ensure the compliance of the instrument design and the means to verify it. It shall address the strategy regarding the</p>



			main technical risks, associated foreseen prototype and testing activities and the achievement of the Technology Readiness Levels defined in Annex A as required for the different project phases.
PD1-CIDL-00 1	DM1 CIDL	D	<p>Configuration Item Data List.</p> <p>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.</p> <p>It shall contain as a minimum:</p> <ol style="list-style-type: none"> <li>1. CI identification (part number and serial number (where appropriate))</li> <li>2. List of the technical specifications</li> <li>3. List of the ICDs</li> <li>4. List of the design/analysis reports</li> <li>5. List of the drawings</li> <li>6. Bill of Material (BoM) &amp; Parts List</li> <li>7. List of plans</li> <li>8. List of procedures</li> <li>9. List of manuals</li> <li>10. List of verification documentation</li> <li>11. List of software</li> <li>12. A section called Change Status Report (CSR) which identifies the status of approved CREs and</li> </ol>



			<p>RF(W/D)s.</p> <p>All documents shall be recorded in the CIDL as a minimum with their:</p> <ol style="list-style-type: none"> <li>1. Document Title</li> <li>2. Document Number</li> <li>3. Document Version</li> <li>4. Document Status (draft, released, etc.)</li> <li>5. Status Date.</li> </ol>
PD1-TRP-001	Report on DM1 Integration Readiness Test	D	<p>Report on integration readiness of DM.</p> <p>The document shall clearly describe the steps executed to assess integration readiness at the factory and the corresponding detailed results.</p> <p>It has the structure of a Test and Inspection Report.</p> <p>This document shall clearly assess the presence of all the elements and all the conditions needed to start the integration.</p>
PD1-TRP-002	Report on Test and Inspection of DM1	D	<p>Report on Test and Inspection.</p> <p>This document shall include at least the following sections :</p> <ol style="list-style-type: none"> <li>1. Purpose; in this section the purpose of the Test Report explicitly stating the requirements that have been verified, shall be identified</li> <li>2. Scope of the Test Report; in this section the scope of the Test Report</li> </ol>



			<p>shall be identified</p> <p>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.</p> <p>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.</p> <p>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 NCRs shall be provided.</p>
PD1-RRR-001	DM1 Risk Analysis	D	<p>This document shall provide:</p> <ol style="list-style-type: none"> <li>1. Introduction</li> <li>2. Methodology</li> <li>3. The Risk Register.</li> </ol> <p>This document describes the approach to Risk Management, risk classification, ranking and mitigation.</p> <p>The Risk Register shall be kept updated as new risks emerge, change or aren't valid anymore.</p>
PD1-LIS-002	DM1 Spare Parts List	D	<p>The Spare Part List shall contain all the information related to the spare</p>



			<p>parts necessary to operate and maintain the Product.</p> <p>The Spare Part List shall include as a minimum:</p> <ol style="list-style-type: none"> <li>1. Recommended amount of spare parts taking into account the findings of the RAM Analysis and the information provided in the Maintenance Manual</li> <li>2. OEM name and contact details (website, etc.)</li> <li>3. Vendor name and contact details</li> <li>4. Item name</li> <li>5. Type designation</li> <li>6. Dimensions</li> <li>7. Specification</li> <li>8. Delivery times</li> <li>9. Expected lifetime on the shelf</li> <li>10. Any special storage prescription (power up, high altitude influence, etc.)</li> <li>11. Storage conditions.</li> <li>12. Consumables</li> <li>13. Fragile and/or critical parts</li> <li>14. Components or parts with very long delivery time or which are custom-made</li> <li>15. Off-the-shelf/custom-made Products.</li> </ol>
<p>PD1-ANR-002</p>	<p>DM1 document</p> <p>RAMS</p>	<p>D</p>	<p>This document shall contain:</p>



		<p>RAM Analysis, including as a minimum</p> <ol style="list-style-type: none"> <li>1. Description of the System under examination</li> <li>2. Assumptions used in the Analysis</li> <li>3. Methodology used (e.g. Parts Count method as per Military Handbook (MIL-HDBK)-217F)</li> <li>4. Reliability data sources (e.g. Non-electronic Parts Reliability Data (NPRD)-95)</li> <li>5. Prediction of Reliability and Availability based on failure rates</li> <li>6. Optimum preventive replacement time for components in a repairable System.</li> <li>7. Spare parts requirements and production rate, spare parts inventory</li> <li>8. MeanTime Between Failures (MTBF) computation</li> <li>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.</li> </ol> <p>Hazard List and Analysis,</p> <p>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</p>
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			<p>and equipment belonging to the instrument.</p> <p>Hazardous Material List, including as a minimum</p> <ol style="list-style-type: none"> <li>1. Hazardous Materials (HAZMAT) identification</li> <li>2. HAZMAT Categorization</li> <li>3. HAZMAT data tracking</li> </ol> <p>Safety File, collecting all safety relevant documentation applicable to the product.</p> <p>The Handling tools shall also be included</p>
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*Table 4 - Technical documents of DM1*

DM2 Technical Deliverables (Documents)

Code	Title	Type	Description
PD2-CMX-001	DM2 Compliance Matrix	D	Same as DM1.
PD2-DER-001	DM2 Design Report	D	Same as DM1.
PD2-ANR-001	DM2 Analysis Report	D	Same as DM1.
PD2-SPE-00	DM2 System	D	Same as DM1.



1	Budget		
PD2-ICD-00 1	DM2 Interface Control Document	D	Same as DM1.
PD2-PLA-00 4	DM2 MAIT Plan	D	Same as DM1.
PD2-DWG-0 01	DM2 Manufacturing Drawings	M	Same as DM1.
PD2-DWG-0 02	DM2 As Built Drawings	M	Same as DM1.
PD2-MOD-0 01	DM2 Models	M	Same as DM1.
PD2-LIS-001	DM2 Parts List/Bill of Materials	D	Same as DM1.
PD2-PLA-00 5	DM2 Development and Verification Plan	D	Same as DM1.
PD2-CIDL-0 01	DM2 CIDL	D	Same as DM1.
PD2-TRP-00 1	Report on DM2 Integration Readiness Test	D	Same as DM1.
PD2-TRP-00 3	Report on Test and Inspection of DM2	D	Same as DM1.
PD2-RRR-00	DM2 Risk Analysis	D	Same as DM1.



1			
PD2-LIS-002	DM2 Spare Parts List	D	Same as DM1.
PD2-ANR-002	DM1 document RAMS	D	Same as DM1

*Table 5 - Technical documents of DM2*

DM1 Technical Deliverables (Hardware)

Code	Title	Type	Description
PD1	DM1	E	DM Adaptive Mirror Subsystem 1, as specified in AD1, Section 3.2.

*Table 6 - Hardware deliverable items of DM1*

DM2 Technical Deliverables (Hardware)

Code	Title	Type	Description
PD2	DM2	E	DM Adaptive Mirror Subsystem 2, as specified in AD1, Section 3.2.

*Table 7 - Hardware deliverable items of DM2*



## DM1 Management Deliverables (Documents)

Code	Title	Type	Description
PD1-PRR-001	Progress Report	D	<p>Description of project status and activities carried out for DM1 in the reporting period (every 2 months)</p> <p>The Progress Report shall summarize on a periodic basis the progress of the Project.</p> <p>The Progress Report shall summarize 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.</p> <p>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.</p> <p>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.</p> <p>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.</p> <ol style="list-style-type: none"> <li>1. Schedule update</li> <li>2. Status List of Change Requests (CREs), RF(W/D)s, Nonconformities and Audits including trends</li> <li>3. Risk Register update</li> <li>4. Overview of major events in the forthcoming period (in particular inspections and tests).</li> </ol>



PD1-LIS-003	Action Item List	D	<p>This document shall list all the actions agreed between the Contractor and INAF.</p> <p>For each ACTION Item it shall contain as a minimum:</p> <ol style="list-style-type: none"> <li>1. The content of the action</li> <li>2. The originator</li> <li>3. The actionee</li> <li>4. The due date and the closure date</li> <li>5. The reference to the documents containing a verifiable basis for the closure of the action.</li> </ol>
PD1-MIN-001	MoM	D	<p>Minute of Meeting, including Action Item List for DM1</p> <p>(prepared by Contractor's personnel and sent 2 days after each meeting).</p>
PD1-SCD-001	DM1 Schedule	D	<p>Project Schedule of DM1.</p> <p>GANTT Charts (in single A4 sheets) of the project with indication of the critical path</p>
PD1-PLA-001	DM1 Project Management Plan	D	<p>Project Management Plan of DM1.</p> <p>This document shall:</p> <ol style="list-style-type: none"> <li>1. Describe the management approach implemented by the Contractor to control the project</li> <li>2. Describe the organizational structure of the project</li> <li>3. Contain an organizational chart which summarizes the organization and the lines of authority including all Contractor partners</li> <li>4. Describe the responsibility and the authority of each function in the organizational charts: job</li> </ol>



			<p>descriptions for the key functions</p> <p>5. Describe the interrelation among the different functions in the organisation</p> <p>6. Contain a list of key personnel including job position, relevant qualification and experience and contact information</p> <p>The Project Management Plan shall also include the project plan:</p> <ol style="list-style-type: none"> <li>1. Master Plan which shall describe the program logic and the main project phases</li> <li>2. Procurement and payment schedule</li> <li>3. Work Breakdown Structure (WBS)</li> <li>4. Work Package (WP) descriptions for the WPs in the WBS containing at least: <ol style="list-style-type: none"> <li>a. WP number according to the WBS</li> <li>b. Title of the WP</li> <li>c. Input to the WP</li> <li>d. Description of the task(s) to be performed</li> <li>e. Output of the WP</li> <li>f. Staff allocated in Full Time Equivalentents</li> <li>g. Responsible WP manager</li> <li>h. Duration of the task</li> <li>i. Milestones</li> <li>j. Start / end dates/ events</li> </ol> </li> </ol>
PD1-PLA-002	DM1 Product Assurance Plan	D	<p>System Product Assurance/Quality Assurance Plan of DM1.</p> <p>The Product Assurance Plan shall describe the Project Product and Quality Assurance organization, methods, tools and Procedures that the Contractor intends to implement for the work</p>



			<p>under Contract both for Software and Hardware. Alternatively the Software part may be covered in a separate dedicated document and reference provided.</p> <p>The document shall contain the following information as a minimum:</p> <ol style="list-style-type: none"> <li>1/ Purpose: Relation to product development</li> <li>2/ Quality Assurance Functions: organization and work tasks</li> <li>3/ Documentation: Control, changes, deliverable and non-deliverable documents that are subject to configuration control</li> <li>4/ Policies, Procedures and Practices: listing all requirements, design implementation, test and documentation</li> <li>5/ Reviews and Audits: Scheduled and non-scheduled</li> </ol> <p>Configuration Management: Means of assuring that adequate procedures and controls are documented and implemented (Unless described in a dedicated document</p> <ol style="list-style-type: none"> <li>6/ Problem Reporting: Processing, tracking and reporting</li> <li>7/ Corrective and Preventive Actions: Processing, tracking and reporting</li> <li>8/ Media Control: Libraries, protection</li> <li>9/ Testing and Inspection: Environment, traceability, sampling methodology</li> </ol>
PD1-PLA-03	DM1 Configuration Management	D	<p>DM1 Configuration Management Plan.</p> <p>The Configuration Management Plan shall describe the Project configuration Management organization, methods, tools and Procedures that</p>



	Plan	<p>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.</p> <p>The Plan shall define as a minimum:</p> <ol style="list-style-type: none"> <li>1. Configuration Management Responsibilities and Authorities</li> <li>2. Responsibilities and Authorities</li> <li>3. Dispositioning authority</li> <li>4. Configuration Management Process</li> <li>5. Configuration Management Planning</li> <li>6. Configuration Identification</li> <li>7. Change Management</li> <li>8. Configuration Status Accounting</li> <li>9. Configuration Audit.</li> </ol> <p>The Configuration Management Plan shall define:</p> <ol style="list-style-type: none"> <li>1. The handling of contractual and technical changes</li> <li>2. The handling of the interfaces internal to the Project</li> <li>3. The handling of the interfaces external to the Project.</li> </ol> <p>The Configuration Management System to be implemented on the basis of the approved Configuration Management Plan shall ensure that:</p> <ol style="list-style-type: none"> <li>1. The manufacturing documentation is in line with the design documentation</li> <li>2. The Product is in line with the manufacturing documentation</li> <li>3. Changes are not implemented without due</li> </ol>
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			<p>Analysis and approval</p> <p>4. Required design, item or component and/or manufacturing changes are properly documented in CREs to be established by the Contractor</p> <p>5. RF(W/D)s and Non-conformities (NC)s are properly handled.</p>
PD1-MAN-001	DM1 Operating Manual	D	<p>Manual for operational use of DM1 including all the operating instructions for the user including installation, packing and unpacking.</p> <p>The Handling tools shall also be included</p>
PD1-MAN-002	DM1 Maintenance Manual	D	<p>The Maintenance Manual shall contain the detailed maintenance Procedures with drawings.</p> <p>It shall contain the maintenance requirements and scheduling for all items included in the supplies of the agreement.</p> <p>All the following types of Maintenance shall be considered and the related maintenance actions shall be provided in a tabular format:</p> <ol style="list-style-type: none"> <li>1. Corrective: <ol style="list-style-type: none"> <li>a. Deferred Maintenance</li> <li>b. Remedial Maintenance</li> <li>c. Shutdown Corrective Maintenance</li> </ol> </li> <li>2. Preventive: <ol style="list-style-type: none"> <li>a. Routine Maintenance</li> <li>b. Running Maintenance</li> </ol> </li> <li>3. Predictive: <ol style="list-style-type: none"> <li>a. Condition-based Predictive Maintenance</li> <li>b. Statistical-based Predictive Maintenance</li> </ol> </li> </ol> <p>Each intervention shall be described with the</p>



			<p>following information, as a minimum:</p> <ol style="list-style-type: none"> <li>1. Item(s) to be maintained.</li> <li>2. Number and qualification of maintenance personnel needed.</li> <li>3. Total time needed to perform the intervention and each phase of the intervention</li> <li>4. Supporting tools and equipment (including access).</li> <li>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)</li> <li>6. Required parts, consumables.</li> <li>7. Safety measures.</li> <li>8. Check after action and start up</li> <li>9. Fault detection</li> <li>10. Fault isolation</li> <li>11. Fault elimination</li> <li>12. Verification of fault elimination</li> <li>13. The recoating procedure shall be included here</li> </ol> <p>The Handling tools shall also be included</p>
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*Table 8 - Management documents of DM1*

DM2 Management Deliverables (Documents)

Code	Title	Type	Description
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PD2-PRR-001	Progress Report	D	Same as DM1.
PD2-LIS-003	Action Item List	D	Same as DM1.
PD2-MIN-001	MoM	D	Same as DM1.
PD2-SCD-001	DM2 Schedule	D	Same as DM1.
PD2-PLA-001	DM2 Project Management Plan	D	Same as DM1.
PD2-PLA-002	DM2 Product Assurance Plan	D	Same as DM1.
PD2-PLA-003	DM2 Configuration Management Plan	D	Same as DM1.
PD2-MAN-001	DM2 Operating Manual	D	Same as DM1.
PD2-MAN-002	DM2 Maintenance Manual	D	Same as DM1.



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*Table 9 - Management documents of DM2*



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#### 4.5 Deliverable timeline

For DM1, the deliverables are expected to be delivered at each milestone according to the following table (I stands for Release Issued, D for Draft, U for Update):

Code	Title	Phase 1			Phase 2		
		KOM	Start of Early proc.	FDR	IR R	FA R	OAR
Technical Docs							



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Code	Title	Phase 1			Phase 2		
		KOM	Start of Early proc.	FDR	IRR	FAR	OAR
PD1-CMX-001	DM1 Compliance Matrix	I	U	U	U	U	U
PD1-DER-001	DM1 Design Report		D <sup>1</sup>	I	(U)	(U)	(U)

<sup>1</sup> The section related to the Early procurement shall be not in draft version. (alternatively a dedicated Early procurement-related Design Report and Analysis Report docs shall be provided)



Code	Title	Phase 1			Phase 2		
		KOM	Start of Early proc	FDR	IRR	FAR	OAR
PD1-ANR-001	DM1 Analysis Report		D <sup>1</sup>	I	(U)	(U)	(U)
PD1-SPE-001	DM1 System Budget		I	(U)	(U)	(U)	(U)
PD1-ICD-001	DM1 Interface Control Document		I	(U)	(U)	(U)	(U)
PD1-PLA-004	DM1 MAIT Plan		D <sup>1</sup>	I	U	U	(U)



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Code	Title	Phase 1			Phase 2		
		KOM	Start of Early proc	FDR	IR R	FA R	OAR
PD1-DWG-001	DM1 Manufacturing Drawings		I <sup>2</sup>	I <sup>3</sup>	(U)	(U)	(U)
PD1-DWG-002	DM1 As Built Drawings				I	U	(U)
PD1-MOD-001	DM1 Models		I <sup>2</sup>	I <sup>3</sup>	(U)	(U)	(U)

<sup>2</sup>Issued the early procurement-related ones, drafted the others

<sup>3</sup>All the drawings/models that were drafted for the early procurement



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Code	Title	Phase 1			Phase 2		
		KOM	Start of Early proc	FDR	IR R	FA R	OAR
PD1-LIS-001	DM1 Parts List/Bill of Materials		I	U	U	(U)	
PD1-PLA-005	DM1 Development and Verification Plan	I	(U)	U	(U)		
PD1-CIDL-001	DM1 CIDL	I	U	U	(U)	(U)	(U)
PD1-TRP-001	Report on DM1				I		



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Code	Title	Phase 1			Phase 2		
		KOM	Start of Early proc	FDR	IRR	FAR	OAR
	Integration Readiness						
PD1-TRP-002	Report on Test and Inspection of DM1					I (FAR version)	I (OAR version)
PD1-RRR-001	DM1 Risk Analysis	I	U	U	U	U	U



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Code	Title	Phase 1			Phase 2		
		KOM	Start of Early proc	FDR	IR R	FA R	OAR
PD1-LIS-002	DM1 Spare Parts List		I	U	U	(U)	(U)
PD1-ANR-002	DM1 RAMS documents		I	U	U	(U)	(U)
<b>HW</b>							
PD1	DM1				P	I	U
<b>Management</b>							



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Code	Title	Phase 1			Phase 2		
		KOM	Start of Early proc	FDR	IR R	FA R	OAR
<b>Docs</b>							
PD1-PRR-001	Progress Report	At regular intervals					
PD1-LIS-003	Action Item List	At regular intervals					
PD1-MIN-001	MoM	At each meeting					
PD1-SCD-00	DM1 Schedule	I	(U)	U	U	U	(U)



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Code	Title	Phase 1			Phase 2		
		KOM	Start of Early proc	FDR	IR R	FA R	OAR
1							
PD1-PLA-001	DM1 Project Management Plan	I	(U)	U	U	U	(U)
PD1-PLA-002	DM1 Product Assurance Plan	I	(U)	U	U	U	(U)
PD1-PLA-003	DM1 Configuration Management Plan	I	(U)	U	U	U	(U)



Code	Title	Phase 1			Phase 2		
		KOM	Start of Early proc	FDR	IR R	FA R	OAR
PD1-MAN-001	DM1 Operating Manual			D	I	U	(U)
PD1-MAN-002	DM1 Maintenance Manual			D	I	U	(U)

The table above applies also to DM2 deliverables, considering the relative milestones.

*Table 10 - Deliverable items expected at each milestone for DM1 and DM2*



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## 4.6 Meetings

We describe in the following the location and the objectives of the main project meetings.

The descriptions apply to both the first and the second DM.

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.



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## 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 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 to the contractor for up to 4 travels (2 days for 2 persons).

ESO is allowed to send representatives to attend any project milestone meeting.

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:



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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) at the level of completeness foreseen at that stage of the project.

Progress Meetings are normally held every 2 months. 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 to 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.



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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..



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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



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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 proceeds 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 DMs shall be provided by the Contractor.

An option for 5 additional years of warranty shall be included in the proposal.

The extension of the warranty beyond the 2+5 years will be considered a useful plus and will give additional points in the proposal evaluation.

The baseline for the warranty shall be the repair on-site of the defective piece.

The Contractor responsibilities will cover all costs consecutive to shipment of equipment and personnel travel necessary in case of on-site repair. This applies from any location, especially from Italy, Germany or Chile where the instrument will operate.

If this is not possible, the Contractor will be responsible (and cover the expenses) for the pick-up, the change or repair and the shipment back of the product that showed defective in use. In this case INAF will be responsible for dismounting the defective product from the instrument and making it available for pick-up in its original transport container. INAF will be responsible for the remounting of the changed or repaired part on the instrument.

The Contractor responsibilities extend as well to all costs related to the shipment back and forth of the defective product for factory repair or product exchange, if this is the case.



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When a defect is reported, INAF will give formal notice of the defect to the Contractor specifying if there is the need

- for a change/repair at the operating location, or
- for the defective product sent to the Contractor (and the corresponding working product sent back to INAF..)

The Contractor is released from its financial obligations, only where a mis-utilisation (i.e. not compliant with its specifications) of the product is proven. In such cases the Contractor shall anyway provide technical support upon specific agreement with INAF.

All manufacturing tools and equipment shall be kept in usable condition for a duration of 15 years. Generally speaking, it shall be possible to re-manufacture a deliverable item or some of its components without important additional delivery time or cost with regards to the initial production.

- **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 the notification in case of on-site replacement. If the defective component is shipped to the Contractor, the repaired or replaced component must arrive at Integration site (Bologna) or at the operational site (Chile) in 30 solar days from its reception at the Contractor site,
- 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 will be borne by the contractor both for the collection of the defective part and for the delivery of the replacement part. The replacement operation in the DMs will be conducted by Contractor's personnel or, as a second choice, by the contracting authority remotely assisted by the contractor.

## Art. 7 Delivery

- **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



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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, airplanes) 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 packing requirements, refer to AD1, Section 5.6

- **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 3 and Table 4.

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 DMs 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.



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Detailed information will be provided at the time of shipping

- **Shipping methods.**

Shipment will be done 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.

The coordination and the responsibility of unloading is in charge to INAF.

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



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## 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 any 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 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 or 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.



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## 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.