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PIANO NAZIONALE
DI RIPRESA E RESILIENZA



INAF
Istituto Nazionale
di Astronomia

Statement of Work

"SETUP OLOGRAFICO PER LA REALIZZAZIONE DI VPHG DI GRANDI DIMENSIONI"

CIG: A034AE8768, CUP: C33C22000640006

PNRR-STILES IR0000034

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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 Astronomico di Brera (INAF-OABrera) is the contracting authority for this project.
- **Contractor.** The company or other economic operator that signs with INAF the contract for this project.
- **Technical requirements.** Requirements that define the characteristics and technical specifications 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

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

1.2 Purpose of the document

This document describes and specifies the subject of the contract and deliverables for the purchasing of “**Setup olografico per la realizzazione di VPHG di grandi dimensioni**” in the framework of project Strengthening the PNRR – Italian leadership in ELT and SKA (STILES) IR0000034, CUP: C33C22000640006. The technical and optional requirements for the system are described in the document: “Holographic set-up Technical Specifications” (AD1) 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

The aim of this activity is the realization of a holographic facility for the writing of very large size Volume Phase Holographic Gratings (VPHGs) suitable for ELT instrumentation.

VPHGs are dispersing elements used in modern astronomical spectrographs and they have become the reference technology for high quality and high performance dispersing elements. They are obtained by making an interference pattern between two collimated laser beams with a certain defined angle. The size of the VPHG is limited by the size of the collimated beams. Spectrographs for ELTs scale with the size of the telescope; therefore, larger and larger VPHGs are required and there is a lack of worldwide manufacturers as pointed out by both European and American astronomical agencies. At the Astronomical Observatory of Brera, we developed in the last 10 years an important expertise in the design, manufacturing and characterization of VPHGs for astronomical spectrographs. Now, we have the capability of producing VPHGs up to 180 mm in diameter with a controlled diffraction efficiency and wavefront distortion. Such size fits the spectrographs for medium and small spectrographs, but not enough for the future requests.

The activity starts with the design of the holographic setup and the refurbishment of the laboratory for accommodating the writing setup and other supporting setups (substrates handling and VPHG characterization). The holographic machine is based on off-axis parabolic mirrors and the target diameter of the clear aperture is 450 mm combined with flat mirrors having a clear aperture of more than 500 mm in diameter according to a detailed analysis involving the astronomical requests, the costs and stability of the system. This holographic setup will be mounted in a dedicated laboratory. A custom-made cover will be developed to make the system stable during the holographic exposure. In parallel, the ancillary setups will be implemented/improved. In particular, the characterization setup (already available) for the measurement of the grating efficiency across the clear aperture in the UV-Vis-NIR spectral range, the line density and fringe alignment.

The reliability of the holographic setup will be evaluated, in particular the fringe stability and accuracy, the quality of the wavefront and the laser stability.

At the same time, a smaller size holographic setup, already available, will be requalified and it will work in parallel to the big one for smaller size VPHGs (<150 mm in diameter).

The validation of the full holographic laboratory consists in the writing and characterization of VPHGs. The specifications of VPHGs for ELT, in particular the cross-dispersers of ANDES and the gratings for MOSAIC are considered.

ART. 3 SUBJECT OF THE CONTRACT

This SoW applies to the supply of a holographic setup for the production of large size VPHGs. The setup will be hosted in a brand new dedicated laboratory. The holographic setup to be procured consists in some well-defined components that are here reported:

- 2 Off-Axis Parabolic Mirrors (OAPM) mounted on proper optomechanics;
- 2 identical Flat Mirrors (FM) mounted on proper optomechanics;
- 2 Motorized Rotary Stages sized to be mounted below the optomechanics of the FMs to set the rotation angle;
- 2 Motorized Rotary Stages for the substrate/sample movement. One stage is mandatory, the other stage is optional;
- Optical Bench with an "H shape" where the optics are mounted;
- High power narrowband stabilized laser system emitting in the red.

The scheme of the setup is reported in figure 1.

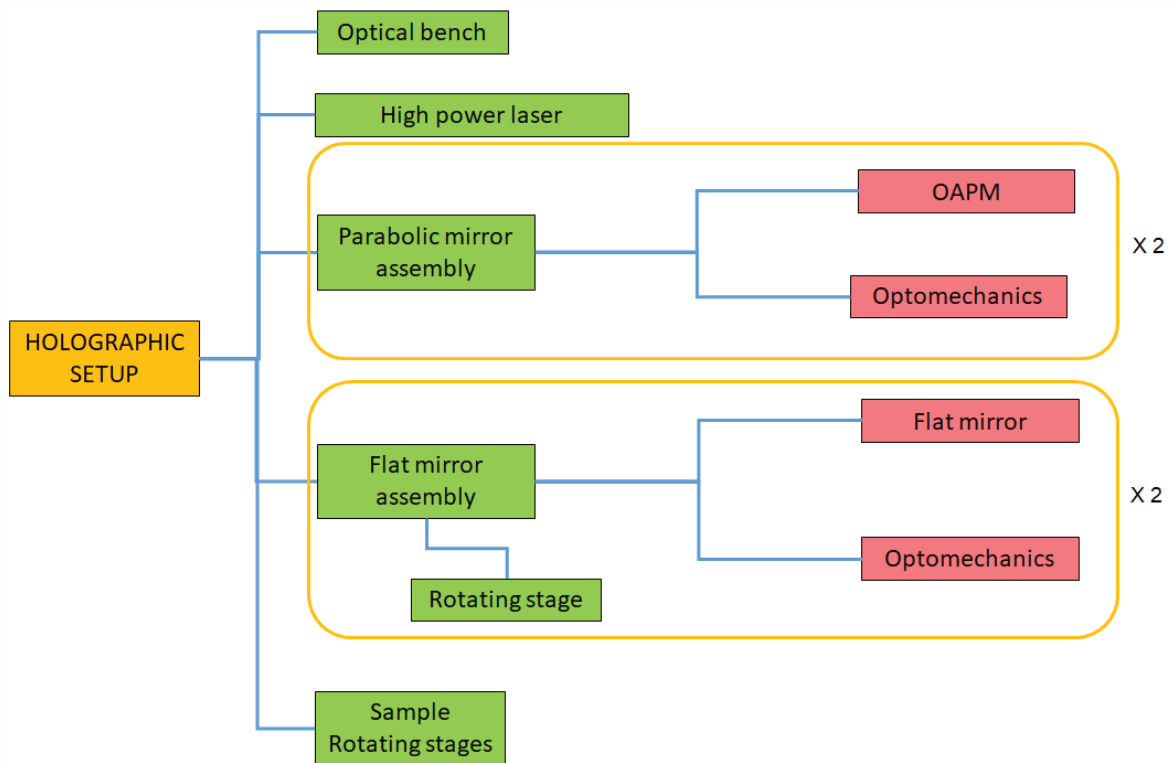


Figure 1. Scheme of the holographic setup with the main components.

The OAPMs will receive the diverging laser light escaping from spatial filters (which are not part of this phase) and they will produce two collimated beams with a clear aperture of 450 mm. These beams are sent to the FMs that are rotated (thanks to the motorized rotating stages) at a certain angle to set the periodicity of the laser interference pattern. In this way, a defined line density will be transfer to the photosensitive layer mounted on a custom mechanical holder that rotates thanks to the sample rotating stage. The clear aperture of the FMs must be larger than that of the OAPM because they receive the collimated laser beam with a certain projection. The laser exposure varies depending on the photosensitive layer and the features of the final grating. In general, it varies from seconds to some minutes. During this period, the interference line pattern must be stable. All these

components will be placed on an optical bench with an “H” shape because the optical must have a certain distance and the central part should be accessible.

The description of the items is reported in Section 2 of AD1 (Holographic set-up Technical Specifications).

In art 4, the details of the schedule, kick-off meeting and deliverables are reported and described.

3.1 Applicable Documents

The following applicable documents (AD) 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 for the Large Dimension VPHGs Laboratory: “Holographic set-up Technical Specifications”.

3.2 Definition of Project Items

The Contractor shall procure and deliver the items listed in section 2 (Setup Description) and fully specified in Section 3 (Specification table) of AD1.

ART. 4 DELIVERABLES AND TIMELINE

4.1 Phase definition

The project shall comprise a single phase, which consists in the following activities:

1. Kick off meeting;
2. Procurement of the different components;
3. Acceptance of all the items and training for the selected ones.

The different activities are here briefly described:

1. Kick-off meeting

The first activity is the kick-off meeting during which a discussion of the procurement based on the signed document will be carried out and the activity starts.

2. Procurement

After that, the procurement of the components will start following the timeline agreed in the contract. Finally, there will be the delivery, acceptance and training of the components.

3. Acceptance

This step is different from component to component and it is briefly described here:

- Laser: documentation + installation at INAF-Osservatorio Astronomico di Brera, via Bianchi 46, 23807, Merate (LC) with the measurement of maximum power and power stability in 1 hour and training;
- Optical bench: installation at INAF-Osservatorio Astronomico di Brera, via Bianchi 46, 23807, Merate (LC) and manufacturer documentation with dimensions and tests;
- Mounted large optics (FMs, OAPMs): the optics must be mounted on their mechanics. It is required the manufacturer documentation and integrity of the element;
- Rotating stages: manufacturer documentation and integrity of the element.

For specific items, specific phases with proper milestones and deliverables could be proposed by the Contractor.

4.2 Timeline

In this section, the desired GANTT chart is reported in figure 2 considering the maximum allowed windows delivery time of the different items. The final ones, that could be shorted will be reported in the signed contract. The date of the Kick-Off Meeting (T0) will be decided at the time of the contract signature and shall take place within 30 days from the date of the contract signature.

	T0														
ITEM	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15
2 identical Flat Mirrors (FM) mounted on proper optomechanics													TD1 and TD2		
2 Off-Axis Parabolic Mirrors (OAPM) mounted on proper optomechanics;															TD3 and TD4
2 Motorized Rotary Stages sized to be mounted below the FMs													TD6 and TD7		
Motorized Rotary Stages for the substrate movement										TD8 and TD9					
Optical Bench with an "H shape" where the optics are mounted;									TD5						
High power narrowband stabilized laser system emitting in the red										TD10					
M1 starts with the kick-off meeting															

Figure 2 - Project schedule of furniture for Large size VPHG Laboratory in graphical form (Units are in Months). The corresponding Technical Deliverables (TDs) are also reported.

The first step is the kick-off meeting, after that the procurement of the components. The laser shall be delivered before the large optics and the optical table. It will be used on a different setup. There are not specific issues related to the delivery of the sample rotary stage. Concerning the optical bench, it cannot be delivered at any time, since the lab room should be ready to host it.

4.3 Deliverables and milestones

There are technical deliverables (see table 1) that are strictly linked to the different items to be procured. Other deliverables and/or milestone could be defined in accordance to the technical proposal of the Contractor in order to deliver the items of the holographic optical setup with the required performances.

Code	Title	Description
TD1	FM1 assembly	<p>It consists in:</p> <p>Hardware:</p> <ul style="list-style-type: none"> - Delivery of the item, which is the FM mounted on its optomechanics; <p>Documentation:</p> <ul style="list-style-type: none"> - Test report; - Manufacturing assembly drawings including interface description drawings; - Surface map in electronic format; - Operational and maintenance manual; - Declaration of conformity; - Cleaning and handling tools.
TD2	FM2 assembly	<p>It consists in:</p> <p>Hardware:</p> <ul style="list-style-type: none"> - Delivery of the item, which is the FM mounted on its optomechanics; <p>Documentation:</p> <ul style="list-style-type: none"> - Test report; - Manufacturing assembly drawings including interface description drawings; - Surface map in electronic format; - Operational and maintenance manual; - Declaration of conformity; - Cleaning and handling tools.
TD3	OAP 1 assembly	<p>It consists in:</p> <p>Hardware:</p> <ul style="list-style-type: none"> - Delivery of the item, which is the OAPM mounted on

		<p>its optomechanics;</p> <ul style="list-style-type: none"> - Optional: Testing tool (Computer Generated Hologram - CGH) if used. <p>Documentation:</p> <ul style="list-style-type: none"> - Test report; - Manufacturing assembly drawings including interface description drawings; - Surface map in electronic format; - Operational and maintenance manual; - Declaration of conformity; - Cleaning and handling tools.
TD4	OAPM 2	<p>It consists in:</p> <p>Hardware:</p> <ul style="list-style-type: none"> - Delivery of the item, which is the OAPM mounted on its optomechanics; - Optional: Testing tool (Computer Generated Hologram - CGH) if used. <p>Documentation:</p> <ul style="list-style-type: none"> - Test report; - Manufacturing assembly drawings including interface description drawings; - Surface map in electronic format; - Operational and maintenance manual; - Declaration of conformity; - Cleaning and handling tools.
TD5	H-OTB	<p>It consists in:</p> <p>Hardware:</p> <ul style="list-style-type: none"> - Delivery and installation of the Customized "H-shape" Optical Table Bench. <p>Documentation:</p> <ul style="list-style-type: none"> - Test report; - Technical drawings; - Operational and maintenance manual; - Declaration of conformity; - Cleaning and handling tools.

TD6	M-RS 1	<p>It consists in:</p> <p>Hardware:</p> <ul style="list-style-type: none"> - Delivery of the Motorized Rotary Stage for FM 1. <p>Documentation:</p> <ul style="list-style-type: none"> - Test report; - Assembly technical drawings including interface drawings; - Operational and maintenance manual; - Declaration of conformity; - Cleaning and handling tools.
TD7	M-RS 2	<p>It consists in:</p> <p>Hardware:</p> <ul style="list-style-type: none"> - Delivery of the Motorized Rotary Stage for FM 2. <p>Documentation:</p> <ul style="list-style-type: none"> - Test report; - Assembly technical drawings including interface drawings; - Operational and maintenance manual; - Declaration of conformity; - Cleaning and handling tools.
TD8	M-RS sample 1	<p>It consists in:</p> <p>Hardware:</p> <ul style="list-style-type: none"> - Delivery of the Motorized Rotary Stage for the sample holder. <p>Documentation:</p> <ul style="list-style-type: none"> - Test report; - Assembly technical drawings including interface drawings; - Operational and maintenance manual; - Declaration of conformity; <p>Cleaning and handling tools.</p>
TD9	M-RS sample 2 (optional)	<p>It consists in:</p> <p>Hardware:</p>

		<ul style="list-style-type: none"> - Delivery of the optional Motorized Rotary Stage for the sample holder. <p>Documentation:</p> <ul style="list-style-type: none"> - Test report; - Assembly technical drawings including interface drawings; - Operational and maintenance manual; - Declaration of conformity; <p>Cleaning and handling tools.</p>
TD10	LASER	<p>It consists in:</p> <p>Hardware:</p> <ul style="list-style-type: none"> - Delivery of the high power red laser. <p>Documentation:</p> <ul style="list-style-type: none"> - Test report; - Operational and maintenance manual; - Declaration of conformity; - Cleaning and handling tools. <p>On site tests</p> <p>Training</p>

Table 1 – Technical deliverable items

The Deliverables are related to the components delivery that are part of the holographic setup. Consequently, the deliverable timeline shall follow the delivery timelines of the items.

4.4 Meetings

The only mandatory meeting for this supply is the Kick-off meeting. Other meetings will be organized in agreement with the Contractor when necessary to deliver the holographic set-up with the required performances.

Location:

The Kick-off meeting should take place at INAF – Osservatorio Astronomico di Brera premises (Italy, exact location TBD).

Objectives:

Start the contract.

ART. 5 COMMERCIAL GUARANTEE AND TECHNICAL ASSISTANCE

A standard warranty of one year after the final acceptance of the Items shall be provided by the Contractor. An option for additional years of warranty should be included in the proposal for all the items or for some specific ones and will be evaluated.

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.

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.

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;
- 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.

- **assistance to be provided.**

- 1) *times for replacement of defective products / spare parts.* The defective component should 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 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.

ART. 6 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 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 other details on packing requirements, refer to AD1, Section 3.

- **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. 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 time.**
The Supplies must be delivered to the following locations:
INAF – Osservatorio Astronomico di Brera, Via Emilio Bianchi, 43, 23807, Merate (LC).
Alternate delivery locations must be agreed with due advance. Detailed information will be provided at the time of shipping.
The delivery time of the items shall follow the timeline reported in the GANTT (Figure 1) and they should not be delivered in advance. The possibility to have a deferred delivery, upon request, will be considered a plus of the contract, especially for the optical table.
- **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. The coordination and the responsibility of unloading is in charge to the Contractor. Personnel of both INAF and 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.).

For specific items and if necessary, a site inspection before the shipping and installation will be organized. Moreover, for the optical table that has a large size and weight, a specific plan will be agreed with the Contractor based on the technical proposal.

ART. 7 GENERAL CONDITIONS

7.1 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.

7.2 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.

7.3 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.

7.4 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
- XYZ, FITS or DAT for the surface map.

Other formats must be agreed between the Contractor and INAF.

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.

7.5 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 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. Confidential information must be sent only by registered letter with recorded delivery.

ART. 8 MODIFICATION MANAGEMENT

8.1 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.

8.2 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.

8.3 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.

8.4 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. 9 OBLIGATIONS OF THE CONTRACTOR

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. Moreover, 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 and Technical Manager of the supply may coincide.

Attachment: AD1 - Holographic set-up Technical Specifications