TECHNICAL SPECIFICATIONS DOCUMENT FOR SERVICE CONTRACT FOR PROVISION OF SATELLITE DATA REGARDING EARTH OBSERVATION AND INTEGRATION AND OPERATION OF AN IN-ORBIT TECH DEMONSTRATOR (IOD), BASED ON A LOW-EARTH ORBIT SATELLITE MISSION (EXP. IEEC/61/2023)

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1 Purpose of the Contract

The present contract's purpose is the provision of satellite services according to the needs identified by the IEEC and defined in the second and third clauses of these specifications. The provision of these services shall supply data, experiments and experience to the Catalan ecosystem, including industry, research centers, and Catalan Government bodies and departments.

The provision of the identified services shall be carried out through the supply of at least three satellites:

- **Main mission**: low-Earth-orbit satellite, hereinafter GENEO-02, designed, integrated and operated by the successful bidder in accordance with the second and third clauses of this document.
- **Complementary missions**: the successful bidder shall be in a position to provide the necessary additional Earth observation data to satisfy the acquisition and delivery of "base" and "emergency" data (clause §3.3) with similar features to GENEO-02 according to the description in clause §3.7. To achieve these requirements, the successful bidder is expected to have at their disposal at least two low-Earth-orbit satellites.

The services to be supplied are as follows:

- **Design, integration and satellite mission management service:** provision of the necessary service to manage the whole life cycle of a satellite mission (GENEO-02) in line with the requirements described in this document.
- **"Base" data acquisition and delivery service:** supply of satellite data from the main and complementary missions (GENEO-02 and two additional satellites, or the equivalent to achieve the number of revisits and coverage required), with the characteristics described in clause §3, on Catalan territory (32,108km^2), acquiring the maximum amount of data available, with maximum priority for the IEEC.
- **Emergency data acquisition and delivery service:** quick supply of data from the satellites providing the acquisition and delivery service of "base" data in line with the applicable service level agreement (§6.2) on Catalan territory (32,108km^2) and adjacent areas up to 100 km, acquiring the requested data with the quality and availability required and with maximum priority for the IEEC.
- **Service for the design, integration, operation and use of a secondary payload for IoT:** provision of the service for the design, integration, operation and use of payload for Internet of Things (IoT) on board GENEO-02.
- **Service for the integration and operation of an IOD payload**: provision of the service for the integration and operation of an In-Orbit Demonstrator (IOD) payload as a technology demonstrator on board GENEO-02.
- **Engineering support service in data processing:** provision of engineering support service (in line with description §2.6) in the data processing chain from raw data to L2A, following the established definitions and criteria (clause §3.8).

2 Definition of services

2.1 Design, integration and satellite mission management service

The design, integration and satellite mission management service includes all those engineering activities related to the achievement of the services entrusted to the successful bidder. Through this service, the successful bidder shall guarantee that all other services may run satisfactorily and in line with the IEEC's needs. This service includes the following tasks:

- Design of GENEO-02 mission following the requirements described by the IEEC through an iterative design process; phases 0 to C according to ECSS-M-ST-10C.
- Management of purchases, stock and availability of necessary test infrastructure.
- Verification, integration and qualification; phase D according to ECSS-M-ST-10C.
- Launch and commissioning.
- Nominal operations, preventive and corrective maintenance operations, and contingency operations on the satellite and its payloads; phase E according to ECSS-M-ST-10C.
- Management of the end of the satellite's life cycle; phase F according to ECSS-M-ST-10C.
- Processing satellite registration and coordination necessary for the use of the radio-electric spectrum for each of the bands used by the satellite.
- Supplementary activities necessary to complete the entrusted tasks derived from the requirements described by the IEEC, such as maintenance of ground control software, integration of communication antennas, execution of compatibility tests. In this sense, the contractor shall be obliged to carry out all the supplementary tasks required by the IEEC through the contract manager for its correct execution.

2.2 "Base" data acquisition services

The successful bidder shall supply the following services with regard to the acquisition of "base" data, following the specifications of clauses §3 and §4 of this Technical Specifications Document (TSD):

- Acquisition of multispectral data on the region of interest defined in clause §3.2.
- Collection of planning and data acquisition requests.
- Planning proposal to optimize data availability.
- Processing of data up to L2A.
- Delivery of acquired raw data, intermediate products and data derived from the processing of data to L2A and associated metadata.
- Storage and custody of data obtained and processed, as well as associated metadata.
- Maintenance of operational condition of GENEO-02 satellite's platform and the instrumentation used, as well as the execution of geometric and radiometric calibration on Earth and in orbit.

2.3 "Emergency" data acquisition service

The successful bidder shall supply the following services with regard to the acquisition of "emergency" data, in line with the specifications of clauses §3 and §4 of this TSD:

- Acquisition of multispectral data on the region of interest defined in clause §3.2.
- Collection of planning and data acquisition requests.
- Processing of data up to L2A.
- Delivery of acquired raw data, intermediate products and data derived from the processing of data to L2A and associated metadata.
- Storage and custody of data obtained and processed, as well as associated metadata.

The service for the acquisition of emergency data shall be activated at the request and behest of the IEEC. The contractor shall be obliged to activate the service, as set forth in these specifications. The goal of the emergency data acquisition service is to obtain data in short time in situations considered exceptional in the region of interest, such as: monitoring natural catastrophes such as fires, floods, storms, landslides, earthquakes or similar events, monitoring catastrophes relating to human action such as large waste spillage or major accidents, or any other activation required by Civil Protection.

The IEEC only expects to request this service from the successful bidder rarely and for specific events. The forecast is for up to 25 captures per year. Should this number not be reached, the remainder shall be transferred to the following year.

2.4 Service for the design, integration, operation and data supply for a secondary payload for IoT

The service for the design, integration and operation of a secondary payload for IoT, on board GENEO-02, includes the following activities:

- Definition of the architecture, operation and services according to the needs identified by the IEEC
- Supply of ground communication terminals
- Operation and maintenance of the secondary payload and the ground terminals
- Supply of auxiliary systems for the preparation and monitoring of the IoT service: development kit and visualization service.

2.5 Service for the integration and operation of an IOD payload

The service for the integration and operation of a payload for IOD, on board GENEO-02, include the following activities:

- Participation in the analysis of payloads proposed for the selection of the IOD (call for proposals to be made by the IEEC).
- Analysis of requirements and needs of the IOD for its integration, verification and testing.
- Production of associated documentation, specifically the Interface Control Document (ICD) with the satellite platform and the Mission Control System (MCS) used by the successful bidder.
- Inclusion of the IOD in the Concept of Operations of the main and secondary payload.
- Supply of a simulator of the On-Board Computer (OBC) representing the platform's hardware and software platform interfaces, alongside a user manual.
- Mechanical and electrical integration, and support to the functional validation of the IOD into the satellite platform.
- Coordination and execution of commissioning activities.
- Operation and maintenance of interfaces during the IOD's operational phase.
- Coordination with the supplier of the IOD payload during all phases of the mission.

2.6 Engineering support service in data processing

The engineering support service in data processing includes the following activity:

- Design, adaptation and development of raw to L2A data processing flows, according to the applicable definitions.
- Maintenance of the processing chain during the full length of the contract.

- Functional and technical support in the processing chain under IEEC's responsibility in order to ensure the proper functioning of the whole processing chain.
- Evolving and adaptive maintenance of the raw to L2A data processing chain.

3 Definition of technical solution and requirements

3.1 General description

The solution which is the subject of this service contract is set up by the IEEC as a dedicated satellite mission (GENEO-02), complemented by the equivalent to two satellite missions with similar on-board payloads dedicated to Earth Observation (complementary missions). The bidder shall propose a technical solution that offers the equivalent features made up by GENEO-02 and the corresponding complementary missions, justifying the suitability of the proposed solution.

The obtention of complementary satellites' data may be carried out through the use of satellites owned by the bidder or provided by a third party. In any case, the bidder must be able to meet the operational requirements established in these specifications. In no case shall data already openly available for free (for example, from the Copernicus programme or any other programme of a similar nature) be accepted.

Figure 1 shows the high-level preliminary architecture of the technical solution identified by the IEEC. The bidder shall propose a preliminary architecture adjusted to the proposed solution in order to satisfy the service requirements to be iterated during the contract's design phase milestones.

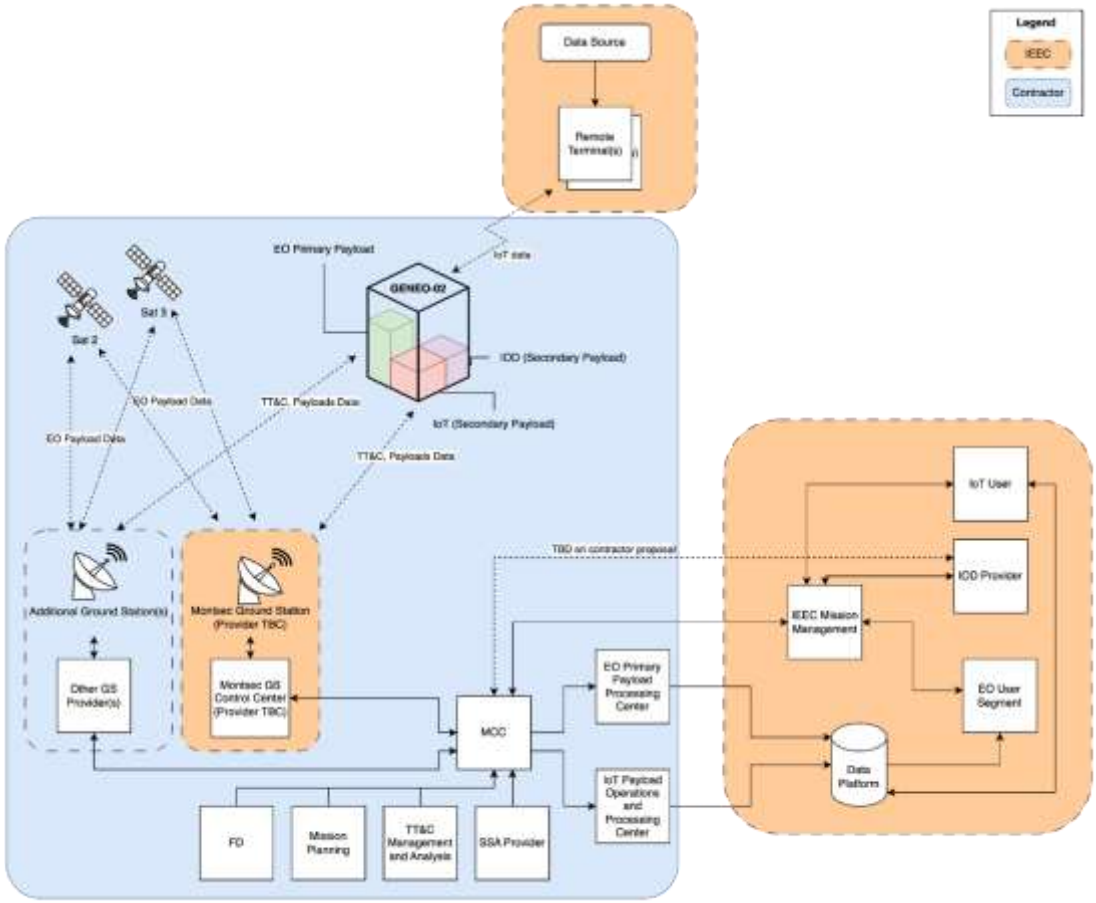

Figure 1. Proposed preliminary architecture

In order to obtain the data on base and emergency data services, the instruments must be in low Earth orbit (LEO). With the objective of reducing the risk to the instruments, the minimum requirements to be met by the main mission (GENEO-02) that will embark the payloads, have been defined.

The complementary missions must be compatible with the criteria and requirements established by clause §3.7 on "complementary satellite data".

3.2 Region of interest

3.2.1 General region of interest

The general region of interest is defined as the area of the Earth on which the successful bidder shall provide data within the framework of base and emergency data acquisition services. The general regions of interest for each service are:

- Base data acquisition service: Catalan territory (32,108km^2).
- Emergency data acquisition service: Catalan territory (32,108km^2) and adjacent areas 100km away from the border.

3.2.2 Region of interest applicable to the commissioning phase and in-orbit calibration campaigns

During the commissioning phase and during the construction of the processing chain, the successful bidder shall provide images without zone restrictions in order to maximize opportunities to acquire data and proceed to its validation. That is to say, during the commissioning phase, Catalan territory shall not be considered the sole region of interest; instead, priority shall be given according to the needs of technical teams for the validation of the processing chain. This provision shall also be applicable during the nominal operations phase during periodic in-orbit calibrations or during the execution of activities relating to the main payload that require the availability of large amounts of data.

3.3 Recurrence in Data Acquisition

Recurrence in data acquisition is measured as follows:

- **Revisit period:** time between two image acquisitions above the region of interest taking into account the admissible roll angle interval (between +15° and -15° off nadir). Only descending revisits in local daytime shall be counted.
  - Note: in order to maximize the chance to acquire data on different days, a maximum of two revisits a day shall be counted for the revisit period goal (i.e., if there were three acquisitions on the same day, the interval between the second and third acquisition would not be taken into account to calculate the revisit period goal).
- **Total coverage of a region:** time necessary to complete the acquisition on all the points within said region.

To calculate recurrence in data acquisition, the availability of a total of 3 satellites located in Sun-Synchronous Orbit (SSO) at an orbital altitude of 550 km with similar orbital characteristics to those required by GENEO-02 and a certain tolerance for the distribution of its orbital planes has been taken into account.

Recurrence requirements in data acquisition for the "base" service are as follows:

Parameter	Requirement

Revisit period over region of interest	Equal or higher than 30 hours and lower than 50 hours
Total coverage of the region of interest	Equal or higher than 20 days and lower than 30 days

Table 1. Requirements for recurrence in data acquisition for the “base” service

The recurrence requirements may be subject to improvement by bidders. The improvements that are offered in relation to the recurrence requirements must be recorded in the electronic file / envelope C. IF THE IMPROVEMENT IS RECORDED IN THE TECHNICAL REPORT OF THE ELECTRONIC FILE / ENVELOPE B THE OFFER WILL BE EXCLUDED FROM THE TENDER.

3.4 Orbital parameters

The main mission satellite must comply with the following orbital parameters, measured at the end of the mission launch (milestone 6):

Parameter	Requirement
Orbit type	Sun-synchronous Orbit (SSO)
Eccentricity	≤0.0025
Orbital altitude	≥540km
Situation of descending node in local time	10h30 local solar time +-30 min

Table 2: Requirements applicable to orbital parameters

The successful bidder shall justify that final orbital parameters ensure a satellite life cycle during the full length of the service in accordance with the main payload characteristics and applicable data quality requirements.

3.5 Space segment

3.5.1 Platform

In order to meet requirements, the solution is expected to propose a platform with an equivalent volume of between 12U and 16U, 1U being a unit according to the CubeSat standard (cubesat.org). The bidder may suggest other kinds of configurations that ensure the provision of services and must explain how requirements are met in their technical report.

The platform’s minimum technical requirements are as follow:

- **Pointing capacity:**

Parameter	Requirement
Cross track-off pointing	Minimum between -15º and +15º
Pointing accuracy at 3 sigmas (σ) error	< 0.5º

Pointing knowledge at 3σ error	< 2 arc minutes
Stability accuracy	< 0.005 deg/s
Agility	> 1º/s

Table 3. Requirements applicable to pointing capacity

- **On-board storage capacity:** capable of storing four 400km strips for all bands.
- **Communications:** the satellite shall use communication S-band and X-band, specifically:
  - S-Band shall be used as the main band for TT&C operations (to uplink commands, downlink telemetry data, including IOD data, to update software on board, etc.). Additionally, the S-band shall be used to downlink data from the IoT secondary payload, and this communication chain may be the same as the one used for TT&C operations as long as the bidder demonstrates sufficient link budget to achieve all other communications.
  - X-band shall be used as the main band to downlink data from the main payload dedicated to Earth observation.

The platform's interfaces with the payloads must meet the following requirements:

- Platform services:

Parameter	Requirement
Format and management of telecommands (TCs)	Direct TCs for the payloads must be sent to the platform in an encapsulated format allowing the management of all of data and time up to the payload. The platform has to be capable of sending TCs to the payloads as a direct (asynchronous) TC and as part of a list of time-tagged TCs. TCs must, at least, be acknowledged by the payloads, and this acknowledgement must be downlinked to Earth by the platform as telemetry (TM).
Format and management of telemetry (TM)	Payload TM, whether housekeeping or containing end-user data, must be sent to Earth using an encapsulation format allowing the management of time, verification of the completeness of data, verification of the consistency of the TM data flow and allow its automatic decoding on Earth with the support of a database. The platform must be capable of managing payload TM in real time, which must be sent to the Earth in real time during visibility periods. The platform must be capable of managing recorded payload TM, which must be sent to the Earth during visibility periods.
Housekeeping (HK) TM	A dedicated TC must allow a change in the sampling and downlinking rate of any HK TM.
Time distribution and management	The platform must maintain an on-board time (OBT) which is synchronised with Earth time, and it must relay it periodically to the payloads. The platform must allow the option of synchronising payload time with platform time as an additional service. Precision must be 1 ms or better.
File transfer	The platform must allow file transfer through uplink and downlink between Earth and the payloads, in a manner which is robust with regard to space-Earth losses and on-board communications.
Memory check	The platform must implement a memory check that allows the verification of the integrity of a binary code within any non-volatile memory.
Monitoring and Failure Detection, Isolation and Recovery (FDIR)	The platform must implement a configurable monitoring and FDIR service enabling the management of payload TM parameters monitoring and the running of automatic payload-level recovery actions through scripts on the platform's memory.

On-board software maintenance	The platform must implement an on-board software upgrade service allowing updates of different versions of all the software on board (e.g., default version, current version and new version) through file transfers. This requirement also applies to updatable FPGAs.
File system check	The platform must implement a file system check enabling the performance of checks and repairs of any file in the on-board storage memory system.

Table 4. Requirements applicable to platform services

3.5.2 Main payload

The main payload's minimum requirements are:

Parameter	Requirement
Swath	> 14km at 500km orbital altitude. Proposals with lower swath are going to be considered. If this is the case, the compliance with all requirements and provision of services as stated in this document need to be technically justified in the bid technical report.
Resolution	Less than 3m of Ground Sampling Distance (GSD) at the resulting orbital height (target orbit > 540 km), in the VNIR range
Spectral bands	Minimum 7 spectral bands in the range 400nm to 1000nm with the following characteristics: • Blue: band centred around 490nm ± 15nm • Green: band centred around 560nm ± 15nm • Red: band centred around 665nm ± 15nm • Near infra-red: band centred around 842nm ± 30nm • Additional bands: minimum 3 additional bands (see table 6).
Multispectral radiometric resolution	At least 12bit per pixel
Signal-to-Noise Ratio (SNR)	All bands must have a minimum SNR above 20~~dB~~
Strip length	A strip must allow the acquisition of an image of up to 400km in length
Data compression	A lossless data compression method shall be used in order to minimise the use of bandwidth in X-band

Table 5. Minimum requirements of main payload

Additionally, the availability of the characteristics listed on Table 6 shall be assessed in line with the Specific Administrative Clauses as an assessment criterion.

Parameter	Assessment
Spectrality of three additional spectral bands	Coincidence or similarity of additional spectral bands (according to Table 5) with red-edge bands, aerosols or water vapour from Sentinel 2A satellite.
Signal-to-Noise Ratio (SNR)	All bands must have a SNR above 35~~dB~~.
Analysis of the availability of additional spectral bands	• Availability of a band or bands in the SWIR spectrum inside the 1000nm to 1700nm range. • The assessment will consist on the analysis of its complementarity with respect to the SWIR bands of Sentinel-2, the number of bands offered within the range, its/their resolution, the associated SNR to each band and its/their availability in the complementary missions.

Table 6. Additional value characteristics of the main payload

3.5.3 Internet of Things (IoT) secondary payload

GENEO-02 satellite shall include a secondary payload dedicated to the provision of services to Internet of Things (IoT) applications.

During GENEO-02 satellite's operations phase the IEEC shall operate a data collection service in order to bolster the fusion thereof with Earth observation data. Data collected through sensors operated in the region shall contribute to enriching the catalogue of ground truth data.

Taking this into account, the bidder must propose a technical service solution that enables the operation of terminals for communication with GENEO-02 through IoT technology. The architecture must be proposed by the bidder in the bid technical report (envelope B), which must meet the following requirements:

- **Wireless communication**: should a commercial frequency band be used, it must be licensed or in the process of being licensed by the bidder.
- **Packet Error Rate (PER)**: < 30% for each individual terminal and connection opportunity
- **Minimum number of simultaneously operating terminals:** 30
- **Minimum number of bytes per terminal per day:** 192 bytes

The proposed architecture shall later be iterated for the MDR, PDR and CDR milestones.

The assessment of this technical solution that bidders must explain in the technical report (envelope B) shall be carried out in line with criteria and rating established in the Specific Administrative Clauses that govern the tender.

3.5.4 In-orbit demonstrator (IOD) payload

An in-orbit demonstrator (IOD) payload shall be taken on board GENEO-02 satellite, and it shall be integrated into the platform and operated by the successful bidder for the whole duration of the mission. This IOD payload shall have as its goal the demonstration of in-orbit capacities. The technical team responsible for the IOD shall be referred to as the IOD Supplier.

The typology and technical characteristics of the IOD payload to be integrated by the successful bidder shall be indicated by the IEEC before milestone 1 (MDR) after a prior selection by the IEEC of the IOD payload proposal in accordance with the appropriate procedure to be carried out in parallel with this tender. The successful bidder in this tender shall participate in the assessment of the different IOD proposals within the framework of the IEEC public tender and therefore in the selection of the winning proposal, which shall be integrated into the satellite in the terms established in the tender.

The successful bidder shall meet the boundary conditions set forth in Table 7 for the integration of the IOD. The selection procedure of the IOD payload carried out by the IEEC shall be based on this tender.

Parameter	Requirement
Volume	Maximum volume 2U, including protuberances
Mass per CubeSat unit	Mass per CubeSat unit within the range [1, 1.33] kg/U
Power consumption	In OFF mode: 0W In Standby mode: <3W In Nominal Operation mode: <6W on average (8W peak power) In Processing/Analysing/Intensive Computing mode: 8W peak power, during a certain period of time
Hardware interfaces	CAN/Serial Port
Data Protocol/Communication	The protocol between the IOD and the satellite platform must be CSP (CubeSat Space Protocol)

Table 7. IOD boundary conditions

3.5.5 Launch vehicle

The successful bidder shall propose the launch vehicle, which must be expressly accepted by the IEEC through a favorable report of IEEC's contract manager and by resolution of the contracting body. The successful bidder shall produce a contract or commitment by the satellite launching company as a requisite to achieve the FRR milestone.

The launch vehicle must meet the following minimum requirements:

The launch vehicle used to put the satellite into orbit must have a solid record of success in similar launch-into-orbit operations during the past 3 years. The vehicle shall be understood to have a solid record of success when 90% of the satellites it launched in the past three years reached orbit.

In order to prove this requirement, the successful bidder must attach to the contract or to the commitment with the launching company, a list of the latter's solid record over the last three years, indicating missions and their result.

Should the bidder choose to contract a deployer or orbit transfer service after the launch, the chosen provider is required to have a solid record of success for satellites of similar characteristics in the past two years. A solid record of success shall be understood to have been attained when 90% of the satellites launched in the past 2 years reached orbit.

In the case of a deployer, in order to prove this requirement, within the FRR milestone framework, the successful bidder must attach to the contract or to the commitment with the launching company, a list of the latter's solid record over the last 2 years, indicating missions and their result.

During the tender phase, the bidder must explain in the proposal's technical report (envelope B) the options foreseen for the launch vehicle and/or deployer or orbit transfer service taking into account the experience requirements in place.

3.5.6 Operation and autonomy

The successful bidder shall present as part of the technical report (envelope B) an operations plan that describes the way in which satellite GENEO-02 shall operate. The description of operations shall include the system with which image acquisition in regions of interest are acquired, as well as the operation of the secondary and the IOD payloads. Furthermore, the additional satellites' data provision operation to complete the required services shall be described.

The bidder shall explain in their technical report the use of methods to maintain the orbit or lengthen the satellite's natural life cycle, such as for example the use of propulsion, if necessary. This justification shall include the description of the technical solution, the operational concept, the operation's implications for the main payload and the mission's impact and risks.

The mentioned operations plan shall be assessed in accordance with the Specific Administrative Clauses.

3.6 Ground Segment

3.6.1 Ground Stations for Communications

In order to guarantee the service, the successful bidder must have one or more ground stations. In this regard, the tasks related to the integration, maintenance, evolution and compatibility of the Ground Segment are the responsibility of the successful bidder.

The successful bidder must present a plan for the use of the ground stations within the mission concept of operations, with the aim of minimizing data delivery times in the event of an emergency. This plan will form part of the technical report (envelope B) of this tender and will be iterated with the successful bidder in the execution of the contract, within the framework of milestones 1 (MDR), milestone 2 (PDR), milestone 3 (CDR) and milestone 4 (FRR).

3.6.2 Integration of the future S-band and X-band telecommunications station (Montsec Ground Station) in the Ground Segment of the mission

The IEEC manages the Montsec Observatory (OdM), a scientific facility located in Sant Esteve de la Sarga (Lleida), where space-related activities are carried out: astronomical observatory, environmental and meteorological measurement station, base for different telecommunications services, among others.

At present, the corresponding administrative procedures have been initiated so that these activities may also include those associated with a satellite communication and calibration station. This new service offered by the OdM will include, in a first phase, the construction of an S-band and X-band telecommunications antenna for satellites.

The IEEC is therefore expected to have signed, prior to the start of the LEOP Phase (Launch Early Operations Phase) of the contract, a contract with a provider of satellite communication stations (ground stations) that will equip the Montsec Observatory facilities (location: Longitude: 00° 43' 46" E; Latitude: 42° 03' 05" N; Altitude: 1570 m a.s.l.) with an S-band (uplink and downlink) and X-band (downlink only) telecommunications station, hereinafter the "Montsec Ground Station".

Once the Montsec Ground Station is operational, the successful bidder must integrate it into the ground segment used for the operations of the main mission satellite (GENEO-02) by signing the corresponding agreement with the station manager.

The IEEC will contribute to the costs derived from the integration and compatibility tests of the elements involved in the communication chain (equipment on board the satellite, mission and station control centers and Montsec Ground Station) that are necessary to ensure operations (TT&C and data downlinking of primary and secondary payloads). The contribution will be limited to the amount established for this concept in the Specific Administrative Clauses of this tender.

The costs derived from the use will not be the subject of this contract and therefore do not form part of the tender budget and will be borne by the successful bidder, who will be responsible for agreeing them directly with the owner of the Montsec Ground Station.

The successful bidder must modify the plan for the use of ground stations to include the use of the Montsec Ground Station within the Mission Concept of Operations document, with the aim of maximizing the use of the Montsec Ground Station for the basic service, as well as to minimize data delivery times in the case of an Emergency.

From the beginning of the use of the Montsec Ground Station and after Milestone 6 (CRR), the successful bidder must update the use plan for the aforementioned station on a weekly basis so that it reports on both the fulfilment of the weekly plan corresponding to the previous week and, also, on the planning for the coming week.

3.6.3 IoT Ground Segment

The IoT ground segment will be made up of communication terminals, a display system and a platform for data collection for subsequent exploitation.

An IoT terminal is defined as the set of devices and accessories required for two-way communication with the satellite, typically: a transmitting antenna, a receiving antenna (if different), the modem device that establishes the IoT link, connectors and cables, the protective packaging and, if necessary for its operation, the SIM card. These terminals must meet the following requirements:

- Direct communication with the satellite.
- RS-232 standard serial communication port for connecting auxiliary external sensors.
- Minimum level of protection of IP54.
- The electronic components of a terminal (the board) may not exceed 250x250mm in surface area.
- Terminals must have a low consumption mode of less than 0.033W and an active mode that does not exceed 3W nominal and 5W peak.
- Terminal documentation must contain, at least: a system design, an interfaces document, a software library, a user and installation manual to ensure that the IEEC can be autonomous in the deployment of the terminals.

The successful bidder must supply the IEEC with 10 IoT communication terminals for an initial deployment of the service, which must be active at the start of the Nominal Operations Phase. The IEEC may order the supply of additional terminals, bearing the costs incurred.

The successful bidder will additionally provide:

- A development kit for the preparation and maintenance of the IoT chain by the IEEC, between Milestones 3 (CDR) and 4 (FRR) comprising, at least, a ground terminal identical to those provided for the service and a satellite IoT service capacity simulator.
- An automatic display system of network performance parameters such as: availability, transmitted and sent packets.

3.6.4 Planning of Payload Operations

The bidder must propose an operations planning process for each payload that guarantees traceability and meets the specifications defined for each payload.

a. Planning of Main Payload Operations

For the main payload of GENEO-02 and complementary satellites in service, the process must have a planning tool or system (hereinafter, planning system) accessible 24/7 by the IEEC and that it is of the GIS-web type or equivalent. This system must allow the IEEC to plan acquisitions for the region of interest.

The operations planning system must show users the following variables, so that the user can modify them and choose the final configuration of the acquisition:

- Windows of opportunity available for execution
- Visualization of lighting conditions
- Estimated data delivery time, for each window of opportunity
- Roll angle, for each window of opportunity
- Planning proposal to optimize the acquisition of data on the region of interest.

The planning tool or system must allow the following:

- Entering new requests
- Editing existing requests, with the following margin:
  - Cancelling existing requests
  - Querying the execution status of existing requests
  - Linking a request with the data obtained from it for all levels of processing.

The planning process must allow the entry and editing of requests with the following margins:

- "Base" case: up to 18 hours before the acquisition opportunity
- "Emergency" case: up to 12 hours before the acquisition opportunity

The successful bidder must report, through the system and email:

- Confirmation of the request for operations
- Estimated data delivery time
- Confirmation of execution
- Confirmation of the time of availability of the data associated with the operation, for each of the levels of processing

The successful bidder must provide documentation and training on the process and system to the IEEC.

The successful bidder will be responsible for maintaining the process and the planning system throughout the duration of the contract. Both the successful bidder and the IEEC may propose improvements or changes in the process and the operations planning system that must be agreed between the two parties. The introduction of improvements or changes is included as part of the contract.

b. Planning of Secondary Payload Operations (IoT)

The bidder will propose a preliminary process for planning the routine operations, configuration and maintenance of the payload and the IoT service elements, which will be used as a starting point for iterations during the contractual milestones.

This process must guarantee that any scheduled unavailability of the service is communicated at least 7 days in advance.

c. Planning of IOD secondary payload Operations

The successful bidder will agree with the IOD supplier on the operations planning process. This process must guarantee that the successful bidder, as the operator of the payload, has all the elements necessary to carry out the activities and that the IOD supplier has all the data necessary for the in-orbit exploitation of its demonstrator.

3.6.5 Data exchange interfaces with users

For each of the payloads, the successful bidder will establish a permanent data exchange interface that will be documented and maintained throughout the duration of the contract. The costs associated with any data exchange or transfer must be assumed by the successful bidder.

a. Data interface relating to the main payload, complementary missions and the IoT secondary payload

Data from the main payload, the complementary missions, the IoT secondary payload, and the intermediate and resulting products of the processing chain associated with each case will be transferred by the successful bidder, together with supporting files such as associated metadata, to the servers indicated by the IEEC through an API (Application Programming Interface) by using a standard protocol agreed with the IEEC.

The frequency of data exchange must be defined by the bidder for each of the services in order to satisfy the service level agreements and requirements associated with each of the services. It is estimated that at least one exchange of data will occur per day.

b. Data interface relating to the IOD secondary payload

The successful bidder will agree with the IOD supplier on the data transfer method, both uplink and downlink.

The successful bidder must provide data from the platform telemetry, such as temperature, power consumption, position and attitude sensor readings, to the IOD supplier if these are necessary for the evaluation of the demonstrator's operation.

3.6.6 Custody and availability of data

The history of all the data produced and the data obtained must be available to the IEEC through a service accessible through a graphical interface which can be displayed through a browser.

Prior to the end of the contract, the successful bidder will agree with the IEEC the method to transfer stored data if necessary, at no additional cost to the IEEC, which will be carried out using the standard transfer protocol indicated by the IEEC, such as HTTPS or SFTP.

3.7 Complementary satellite data

In order to complement the base and emergency data acquisition services and satisfy the data acquisition recurrence requirements according to clause §3.3, the successful bidder must undertake complementary missions. The satellites of the complementary missions (a minimum of two satellites are deemed necessary) will have to carry payloads that provide similar data to the payload of the main mission, to be processed and combined together with the main mission data. For this purpose, the following similarity criteria are defined in Table 8.

Parameter	Similarity criteria
Swath	> 14km at 500km orbital altitude. Proposals with lower swath are going to be considered. If this is the case, the compliance with all requirements and provision of services as stated in this document need to be technically justified in the bid technical report.
Resolution	Less than 5m of Ground Sampling Distance (GSD) at the resulting orbital height in the VNIR range
Spectral bands	Minimum of 7 spectral bands in the range of 400nm to 1000nm with the following characteristics: • Blue, Green, Red, Near Infra-red: coincidence of the centre of spectral bands with respect to those of the main payload GENEO-02 • Additional bands: minimum 3 additional bands
Capture type	Descending capture with LTDN at 10:30 ± 60 minutes local solar time

Table 8. Selection criteria for complementary mission data

3.8 Processing, Formatting and Delivery of data relating to Earth Observation

The data acquired for the base and emergency data acquisition services must be processed for use in the construction of datasets and products. In order to facilitate coordination between the technical teams, the applicable definitions and the minimum results of this process are provided below.

3.8.1 Applicable definitions

The nomenclature defined for the types of data files according to their processing status is as follows:

- **Raw level data:** data from telemetry with embedded information. The format and content will depend on the selected instrument, for example a binary file.
- **Edited or L0 level data:** data corrected for telemetry errors, communication or other artifacts. Tagged in time and with the necessary metadata for subsequent processes.
- **Calibrated or L1 level data:** L0 level data time-referenced and annotated with auxiliary information, calibrated radiometrically (Top-Of-Atmosphere or TOA reflectance) and geometrically, georeferenced and/or geometrically rectified. The format must be GEOTIFF. Different sublevels are defined within L1, generated internally in the processing chain. The by-products of interest to the IEEC are:
    - **L1A:** reconstructed instrument data, time-referenced and accompanied by auxiliary information (synchronized platform position and attitude data related to the image reference band, as well as the angles corresponding to each effective pixel in the band with respect to the principal point of the focal plane), including the geometric and radiometric calibration coefficients of the sensor. If necessary, the image lines will be reprocessed in order to achieve a good geometric registration between all the bands of the image. The delivery format will therefore be a single multiband image.
    - **L1C**: Based on the L1A level data, the sensor pointing model has been refined to the desired accuracy and this correction has been applied to the image pixels so that the resulting image can now be overlaid on a map. The reference system for images at L1C level and below is: DATUM: WGS84 and PROJECTION: UTM31 North.
- **Measurement or L2 level data:** Data generated from the L1 level (Top-Of-Atmosphere or TOA) over Catalonia and transformed to generate derived geophysical variables. The format must be GEOTIFF.

Using the usual conventions of the remote sensing data processing industry, the product defined in the framework of this document is analogous to L2A, where a process of atmospheric correction has been applied to the L1C level image to obtain reflectance values (Bottom-Of-Atmosphere or BOA).

- **Metadata:** data necessary to be able to perform data processing. These will be compatible with the ISO 19115 standard, with the INSPIRE profile, and arranged in XML format.

3.8.2 Data processing

The provisional processing chain defined by the IEEC, once the data is received at the mission control center and has been decompressed, is as follows:

a. Under the responsibility of the successful bidder:

1. Receipt of the RAW file.
2. Creation of the associated metadata file. From here, each level of processing will incorporate a metadata file that will include the relevant metadata from the previous level and will add new ones, ensuring the traceability and reproducibility of the processes carried out to reach that level.
3. L0 product
4. L1A product
5. L1C product
6. L2A product
7. Transfer of products and associated metadata to the destination platform communicated by the IEEC

b. Under the responsibility of the IEEC, or the delegated entity:

8. Generation of datasets
9. Other higher-level processed products that may be derived from it

In the technical report (envelope B) the bidder must describe the processing chain used, in line with the terminology provided.

3.8.3 Requirements associated with the data

The bidder must justify that the data processing flow complies, for each of the intermediate products, with the criteria described in Table 9. To this end, the bidder must detail the process used in the technical report submitted in envelope B of the tender in order to guarantee the results by means of the applicable justification. The justification to be provided by the successful bidder during the course of the contract must also be indicated.

These criteria apply both to the GENEO-02 data and to the complementary missions, although the instrument calibration reports will only be requested for GENEO-02.

Applicability	Minimum criteria	Justification to be included in the report (envelope B) by the bidder	Justification during the contract by the successful bidder
Radiometric calibration in the laboratory	Process of calibrating the radiance measured by the sensor using a calibrated light source and a detailed procedure that ensures at least the response to the linear range of the instrument. Absolute radiometric accuracy: relative error < 8% each band	Radiometric calibration report or certificate of a sensor similar to the one proposed, stating the result thereof and the traceability of the reference light source used	Radiometric calibration report or certificate of the payload on board GENEO-02 to be delivered at Milestone 4 (FRR)
Geometric calibration in the laboratory	Calibration process of the optics and focal plane determining the coordinates of the principal point, the value of the calibrated focal point and, at least, the coefficients of radial distortion for each band. The a posteriori error on the adjusted parameters will be smaller than 0.2 pixels for the coordinates of the principal point and less than 0.5% for the calibrated focal point. The residuals on the coordinates of the points used will be less than 0.5 pixels.	Calibration report or certificate of a sensor similar to the one proposed, stating the procedure used and the result thereof	Geometric calibration report or certificate of the payload on board GENEO-02 to be delivered at Milestone 4 (FRR)
L0	Image completeness in all bands Synchronization between image and orbit	Justification of the process used in the report	Annual justification report specifying the quality of the L0 processing
L1A	Correlation between all bands of the same spatial resolution (single multiband image archive file) < 1 pixel RMS over well-measured points distributed over the image. Identification and selection of a reference band to associate the geometric metadata external to the image (time synchronization, platform position and pointing). The content of each band will be digital values with the relative calibration applied while the radiance conversion values for each band will be in the XML header for use in subsequent processes.	Justification of the process used in the report	Delivery of the technical specifications document of the data processing at the FRR, which must be updated periodically when there are changes.

L1C	Incorporation of a refinement of the geometric pointing model using a DTM (Digital Terrain Model) of a resolution that allows an RMS geometric error no greater than 1.5 times the pixel size, taking as reference distinguishable well-measured control points in the territory. At the radiometric level, the image will contain TOA reflectance values appropriately quantized so as not to lose radiometric resolution. *As an example, since the reflectance values are between 0 and 1 a quantization factor of 10000 can be applied (multiply the actual reflectance value by 10000 and convert it to an integer) in order to write an image of 16 bits per pixel and keep four significant digits of the original value.*	Justification of the process used in the report with details on: • The process of fine-tuning the geometric model and statistical data quality at image and terrain level. • The TOA reflectance calculation model from the calibrated radiance	Delivery of the technical specifications document of the data processing at the FRR, which must be updated periodically when there are changes.
L2A	The image will contain BOA reflectance values and it must be demonstrated that the relative error of the retrieval of surface reflectance (SR) in the different bands is smaller than 20% in measurements provided by the calibration center for the day and time on which the satellite passes, over calibration zones appropriately instrumented for the estimation of the atmospheric parameters required for the proposed correction process.	Justification of the process used in the report	Delivery of the technical specifications document of the data processing at the FRR, which must be updated periodically when there are changes.

Table 9. Minimum criteria applicable to the processing chain and justification thereof

3.8.4 Delivery of data

The data in L1A, L1C and L2A format will be delivered through the data interface defined according to clause §3.6.5 and in the terms indicated by the Service Level Agreements (§6) based on their acquisition.

Additionally, the IEEC may require the transfer of data in RAW and L0 processing levels for studies related to image quality or scientific research.

3.9 Product Assurance and Quality Control

The successful bidder will be responsible for the Product Assurance and Quality Control process in accordance with the following requirements.

3.9.1 Risk Management

The successful bidder will be responsible for continuously assessing the risks during the course of all phases of the project, recording them in the form of a Risk Register, along with the assessment and the corresponding mitigation actions that it must communicate to the IEEC following ECSS-M-ST-80C guidelines. This communication will be made at each of the milestones as well as at the time any risks categorized as severe (high or very high according to the applicable standard) are identified. The successful bidder is responsible for properly addressing these risks and planning specific actions to mitigate them.

3.9.2 Quality Assurance and Management

The successful bidder must implement a quality management system in order to:

- Carry out the configuration control of the documentation, hardware and software related to the project.
- Carry out quality control in the different phases of the project and demonstrate fulfilment of the required quality.
- Report non-conformities and anomalies in a systematic and orderly manner and according to the defined Service Level Agreement (§6.3). Non-conformities and anomalies must be classified as critical, non-critical or minor based on the following criteria:
    - Critical: Those that may affect security, the mission objectives, basic system functions or the provision of any of the services.
    - Non-critical: Those that affect a small group without immediately affecting vital processes of the system or the provision of the service, doing so at a non-critical time, but which may have an impact on the following defined requirements:
        - Operational, functional or contractual requirements
        - Reliability
        - Duration of useful life
    - Minor: Those that by definition cannot be classified as critical or non-critical.

The successful bidder will report minor non-conformities during the next review period established according to the contract, milestone or follow-up meeting.

The successful bidder is obliged to enable a software tool available for the IEEC to register and monitor the activities, incidents and anomalies related to the mission, identified/numbered for their subsequent traceability, in order to:

- Monitor those incidents or anomalies/non-conformities that may have an impact on the provision of the different services.
- Extract the necessary information for the calculation and justification of Service Level Agreements (SLA).

3.9.3 Contingency measures

The successful bidder must provide, within the framework of Milestone 3 (CDR), a contingency management plan in case of critical failures in the various actors involved, in order to guarantee the success of the project, following the guidelines of the ECSS-Q-ST-30C standard.

4 Deadlines, phases and monitoring of the provision of services

4.1 Maximum deadline for performance and partial deadlines

The maximum deadline for the performance of this contract is 6 years. Design phases are defined through a V-shaped project management model, adapting the ECSS-M-ST-10C standard. Figure 2 shows, without a time scale, the relationship between the Milestones, Phases and Services applicable to the performance of the contract.

<table>
<tr><td>Milestones</td><td>Contracts enters into force</td><td>MDR</td><td>PDR</td><td>CDR</td><td>FRR</td><td>Launch</td><td>CRR</td><td>Annual milestones of operation review</td><td>ELR</td><td>MCR</td></tr>
<tr><td rowspan="4">Services</td><td colspan="9">Design, integration and satellite mission management service</td></tr>
<tr><td colspan="9">Service for the design, integration and operation for IoT</td></tr>
<tr><td colspan="9">Integration and Operations Service for IOD</td></tr>
<tr><td colspan="9">Engineering support service in data processing</td></tr>
<tr><td>Phases</td><td colspan="5">Design and integration phase</td><td colspan="2">LEOP and commissioning phase</td><td colspan="2">In-orbit operations phase</td><td>End-of life phase</td></tr>
</table>

Figure 2. List of Applicable Milestones, Phases and Services (with no time scale)

Table 10 sets out the partial deadlines related to the milestones defined below according to the following timeline, T0 being the date on which the contract is signed:

Milestone	Name	Deadline
1	Mission Design Review (MDR)	T0 + 2 months
2	Preliminary Design Review (PDR)	T0 + 5 months
3	Critical Design Review (CDR)	T0 + 8 months
4	Flight Readiness Review (FRR)	T0 + 18 months
5	Launch	Milestone 4 + 3 months
6	Commissioning Results Review (CRR) and start of the nominal operations phase	Milestone 5 + 3 months
7	Annual Operations Review 1	Milestone 6 + 1 year
8	Annual Operations Review 2	Milestone 7 + 1 year
9	Annual Operations Review 3	Milestone 8 + 1 year
10	Annual Operations Review 4	Milestone 9 + 1 year
11	End of Life Review (ELR)	At the end of the contract

Table 10. List of contractual Milestones and contract deadlines.

In accordance with Article 29.4 of Law 9/2017, of November 8, on public sector contracts, exceptionally, a contract duration of more than five years is considered necessary given that the recovery period for the investments related to the contract requires it. This is set out in the file report signed by the Director of the Area for the Promotion of the Space Sector (IEEC) relating to the duration of the contract.

4.1.1 Extension

The contract provides for the possibility of extending the contract with regard to the operations phase for 6-monthly periods up to a maximum of 2 additional years, the expected end date of the useful life of the GENEO-02 satellite.

These extensions result from the need to extend the contract due to the return-on-investment period for satellite infrastructure up to the approximate life span observed in similar space missions.

4.2 Phases and monitoring of the provision of services

The contract will be monitored through milestones and follow-up meetings at different intervals according to the applicable phase (see clause §5 PPT) attended by the person responsible for the contract on the part of the awarded company and the specialized staff of the IEEC, either the person responsible for the contract or the person designated by them. The milestones will be held according to the ECSS-S-ST-10-01C standard and will be considered achieved when the successful bidder delivers the associated deliverables and the corresponding reference and applicable documentation detailed in clause 5.1, the two parties accept the minutes of the meeting and agree that there are no open review item discrepancies (RID, according to the applicable standard). In the event that a RID remains open for review at a subsequent milestone, this must be reflected in the minutes of the milestone and may be subject to evaluation for possible contractual penalties.

Both the IEEC and the successful bidder may request the convening of any additional technical meetings that may be necessary for the correct performance of the contract.

In each of the meetings, the successful bidder will deliver the minutes of the meeting and the additional applicable documentation (§5.1):

- Milestones: deliverables and associated reference documentation
- Follow-up meetings: progress report

The successful bidder will monitor the actions that may arise from the meetings throughout the duration of the contract.

4.3 Design and Integration Phase

The design and integration phase starts automatically with the start of the contract and ends with the launch of the GENEO-02 satellite.

During this phase, the successful bidder, based on the proposed technical requirements, is responsible for the design, development, assembly, integration, validation, testing, qualification and processing of the necessary permits and registrations of the satellite (phases A, B, C and D defined according to the ECSS-M-ST-10C standard). This is a phase which requires close coordination between the technical teams of the successful bidder, the IOD supplier and the IEEC.

During this phase, the carrying out of tests relating to the integration of the payloads with the platform and the geometric and radiometric calibration of the main payload must follow the procedures and

organization established in the ECSS-Q-ST-20C standard. These tests must be organized by the successful bidder with specialized IEEC staff in attendance, either the person responsible for the contract or a person designated by them.

4.3.1 IOD integration process

Between the start of the contract and Milestone 1 (MDR) the IEEC and the successful bidder will analyse the samples of interest collected for the secondary payload.

Between Milestone 1 (MDR) and 3 (CDR), the successful bidder will coordinate the activities relating to:

- Construction of the Interface Control Document (ICD) according to the ECSS-E-ST-10-24C standard.
- Inclusion of the IOD in the Mission Concept of Operations of the GENEO-02 mission.
- Communication of the integration timeline of the IOD with the platform.
- Definition of qualification requirements to be met by the IOD supplier in order not to compromise the missions of the main and secondary IoT payloads, such as vibrations, results in TVAC (Thermal Vacuum Chamber) or those related to outgassing.
- Preparation of the plan and the AIV/AIT (Assembly, Integration, Verification and Testing) procedures of the IOD with the satellite platform.
- Development of the other documents and organization of the relevant activities for a correct implementation of the commissioned services.

The deadlines for the delivery of documentation, information and integration requirements must ensure that they are compatible with the IOD design and integration timeline with the GENEO-02 platform.

The successful bidder must temporarily provide the IOD supplier, between milestones 2 (PDR) and 3 (CDR), with a simulator of the On-Board Computer (OBC) selected for the platform, representative of the OBC FM (Flight Model) at the level of the Hardware and Software interfaces, so that the IOD supplier can verify, at its own test site, regardless of the availability of the platform provider (the successful bidder), the proper functioning of the IOD payload in its interfaces with the OBC. The OBC must be accompanied by any additional elements, subsystems and documentation of use that are necessary for its operation by the IOD supplier in such a way that the IOD supplier can use it independently.

The successful bidder will define, before Milestone 3 (CDR), the results derived from qualification tests that the IOD supplier must achieve.

After Milestone 3 (CDR), the IOD supplier will certify compliance with the integration requirements by holding an Integration Readiness Review (IRR). Upon acceptance of the IRR by the IEEC, the successful bidder and the IOD provider, the successful bidder will coordinate and execute the tasks of mechanical and electrical integration, and assembly of the chosen IOD with the satellite platform through the AIV/AIT Plan and Procedures, ensuring compatibility with the ICD.

The IOD supplier must have at least 5 months to develop the demonstrator, once the required documentation and systems have been delivered to the successful bidder.

4.3.2 Qualification tests

The successful bidder must pass at least the following qualification tests (QT):

- Physical Properties Test
- Electrical Interface Test
- Functional Test

- Electromagnetic Compatibility Test (EMC)
- Vibration test
- Thermal Test (test in the Thermal Vacuum Chamber, TVAC)

The successful bidder must demonstrate the execution of operational readiness tests (QO) in order to verify the compatibility of the chain within the framework of the FRR milestone.

4.3.3 Monitoring

Monitoring during this phase will be done as follows:

- Follow-up meetings, where the successful bidder will deliver a Progress Report according to the method described in §5.1, with the following minimum frequency:
  - Between the start of the contract and the MDR milestone they will be monthly.
  - Between the MDR and PDR milestones they will be bi-weekly with the IEEC and weekly with the IOD supplier.
  - Between the PDR and FRR milestones they will be weekly.

  The IEEC reserves the right to call additional follow-up or technical meetings as well as to include experts from collaborating entities, who will ascribe the necessary confidentiality. The bidder may propose additional meetings of a technical nature.
- Holding of the following milestones:
  - MDR: Mission Design Review
  - PDR: Preliminary Design Review
  - CDR: Critical Design Review
  - FRR: Flight Readiness Review

  The technical documentation required and method of holding each milestone is detailed in §5.1.

The successful passing of the FRR milestone will imply the acceptance of the status of all the systems involved for all segments of the mission towards the launch.

After the acceptance of the FRR milestone, the successful bidder will coordinate the tasks associated with the transport of the satellite to the launch site and its subsequent integration into the launch vehicle for sending it into orbit.

4.4 LEOP phase and commissioning in orbit

The follow-up meetings, and the delivery of the Progress Report, will be weekly from this phase until the end of the contract.

This phase must follow the procedures and organization established in the ECSS-Q-ST-20C standard and its main objectives will be as follows:

- Stabilize and configure satellite subsystems
- Characterize and guarantee the behavior of instruments in orbit
- Commissioning of the payloads (main, IoT and IOD), according to the instructions of the different suppliers
- Demonstration of compliance with the minimum service requirements for the IoT payload
- Validation campaign of the laboratory calibration of the main payload with real images in orbit and, if deemed necessary, carrying out an in-orbit calibration campaign in order to update it.

4.5 Nominal Operations

The Nominal Operations Phase will have a duration of 4 years from its start date (Milestone 6).

The successful bidder will organize in-orbit calibration campaigns of the payloads according to the specifications of the supplier or suppliers of the instruments, or when the former observes a need to do so due to the degradation of the quality of the data obtained. These calibration campaigns must be organized in such a way as to minimize the impact on data acquisition services.

During this phase, follow-up meetings will be weekly with annual contractual milestones.

4.6 End of the mission

The activities carried out in the end-of-mission phase must ensure that the mission complies with the applicable European Space Agency (ESA) space debris mitigation measures.

5 Conditions for the performance of the service

5.1 Deliverables

The successful bidder, in the periodic follow-up meetings, will deliver a Progress Report. The report will detail the content shown in Table 11 once a month, throughout the duration of the contract.

Document	Content	Frequency
Progress Report	• Activities carried out since the last progress report • Incidents, anomalies and actions • Planned activities until the next follow-up meeting • Follow-up of open actions	Variable, according to the frequency indicated in the description of each phase
	• Activities carried out since the last progress report • Incidents, anomalies and actions • Planned activities until the next follow-up meeting • Calculation of Service Level Agreements • Forecast of achievement of future Milestones • Update of the risk management table • Follow-up of open actions	Monthly

Table 11. Content of the Progress Report

Table 12 shows the deliverables associated with each of the contractual milestones. In the event that a previously delivered document is subject to review or amendment, it must be delivered at the current contractual milestone.

Title of the Document	ECSS reference document	MDR	PDR	CDR	FRR	Launch	CRR	AOR 1	AOR 2	AOR 3	AOR 4	ELR
Project Organization Plan	ECSS-M-ST-10C	X	X	X								
Description of the Mission	ECSS-E-ST-10C	X	X	X								
Mission Requirements	ECSS-E-ST-10-06C	X	X									
Design Iterations (Trade-off)	ECSS-E-ST-10C	X	X	X								
System Concept	ECSS-E-ST-10C	X	X	X								
Systems Engineering Plan	ECSS-E-ST-10C	X	X	X	X							
Mission Requirements Compliance Matrix			X	X	X		X					
Mission Concept of Operations	ECSS-E-ST-10C		X	X	X							
Definition of System Architecture		X	X	X	X							
System Requirements	ECSS-E-ST-10-06C	X	X									
Subsystem Requirements	ECSS-E-ST-10-06C		X	X								
Technical Specifications of the Ground Segment	ECSS-E-ST-70C		X	X								
Technical Budgets Analysis (Mass Budget, Power Budget, Link Budget, Memory and Data Budget, Pointing Budget)	ECSS-E-ST-10C		X	X								
AIV/AIT Plan and Procedures of the IOD with the Satellite Platform and with the mission control system(MCS)	ECSS-E-ST-10-02C (AIV) ECSS-E-ST-10-03C (AIT)		X	X	X							
ICD of the Satellite Platform with the IOD	ECSS-E-ST-10-24C		X	X								
Test Report (AIT/AIV)	ECSS-E-ST-10-03C			X	X		X					
Verification Control Reports	ECSS-E-ST-10-02C		X	X	X							
Contingency plan	ECSS-Q-ST-30C			X	X		X					

Contract or commitment with the satellite launch company					X							
Document of functional specifications of the data processing chain			X	X	X		X					
Document of technical specifications of the data processing chain				X	X		X	X	X	X	X	
Reports justifying the quality of the data and the associated calibration					X		X	X	X	X	X	
Space Debris Mitigation Report			X	X	X							X
Post-Launch Evaluation Report						X	X					
Annual Operations Report								X	X	X	X	

Table 12. List of deliverables for each of the contractual Milestones

5.2 Intellectual Property of the data obtained

5.2.1 Intellectual property of the data obtained from the Main Mission

The intellectual property of the data generated in the overflights over the region of interest of the main mission (low-Earth-orbit satellite GENEO-02, designed, integrated and operated by the successful bidder according to clauses two and three of this document) will be the property of the IEEC and the Government of Catalonia and may be processed and distributed to third parties by the IEEC and the Government of Catalonia if they so agree, under the conditions they establish.

Members of the successful bidder's team who participate in the contract may not disclose information related to it during its duration. If the successful bidder wishes to disseminate or further process data, it must first obtain the approval of the IEEC and the approval of the Government of Catalonia.

5.2.2 Intellectual property of the data obtained from the complementary missions

With regard to complementary missions, whereby the successful bidder provides additional Earth observation data necessary to satisfy the requirements for acquisition and delivery of “base" and "emergency" data, the successful bidder (in the case of data obtained through its own satellites) or third parties (in the case of data obtained by the successful bidder through acquisition from a third party) assigns to the IEEC and the Government of Catalonia the rights to disseminate, process and exploit the images.

5.3 Communication and disclosure

5.3.1 General conditions regarding the communication of the Mission

Any communications associated with the publication of results or technical achievements derived from the fulfilment of the various milestones stipulated in the contract must be coordinated and approved by the IEEC and the Government of Catalonia.

Once the contract has been awarded, the IEEC, the Government of Catalonia and the successful bidder will agree on a communication plan for each phase.

The successful bidder will not be able to make public any audiovisual material (image, video, etc.) generated in relation to the main GENEO-02 mission until it is explicitly authorized to do so by the IEEC and the Government of Catalonia. The successful bidder may distribute images that are not the property of the IEEC, independently and without the need for prior communication/coordination (images from complementary missions). In the case of material owned by the IEEC and the Government of Catalonia (associated with the main mission GENEO-02), the IEEC and the Government of Catalonia will establish the conditions for dissemination by the successful bidder and third parties, where applicable.

5.3.2 Communication materials generated by the successful bidder

With the aim of disseminating the results of the mission, the successful bidder must deliver to the IEEC:

- A 1:1 scale model of the GENEO-02 Main Mission satellite. Delivery deadline: between the PDR and FRR milestones.
- A CAD file in STEP format according to ISO10303 of the satellite in high resolution, which does not include parts that are the exclusive intellectual property of the successful bidder or its suppliers (in this case, the component or components will have to be simulated). Delivery deadline: within the framework of the CDR milestone.

The IEEC may use these deliverables for non-profit promotional purposes, referring to the successful bidder as the author of the GENEO-02 mission design.

The successful bidder must participate during the mission in international events or workshops to disseminate the activities carried out as part of the mission.

The IEEC and the Generalitat de Catalunya will provide to the successful bidder the name to be used for the registration of the GENEO-02 mission satellite in sufficient time and form and no later than contractual milestone 4 (FRR). This name may be previously agreed upon with the successful tenderer and will always be used for communication purposes.

The successful bidder must also provide the IEEC with images and videos of the launch of the satellite of the main mission GENEO-02, which the IEEC will be able to broadcast on its own communication channels. Likewise, if the launcher provides them, the successful bidder must provide images and videos of the insertion into orbit of the satellite, which the IEEC may also broadcast.

6 Service Level Agreements. Infringements and Penalties

The following service level agreements (SLAs) are established, to which the successful bidder will be bound in order to ensure a high-quality service based on an objective assessment regarding any possible incidents that may occur in the performance of the contract and therefore including the operations phase (data acquisition). Table 13 summarizes the service level agreements and the phase to which they apply.

SLA code	Name	Phase of application
SLA-GENEO-01-A/B	Data delivery - Base Case	In-orbit Operations phase
SLA-GENEO-02-A/B	Delivery of data - Emergency Case	In-orbit Operations phase
SLA-GENEO-03	Notification of incidents	The entire duration of the contract
SLA-GENEO-04-A/B	Recurrence in Data Acquisition	In-orbit Operations phase
SLA-GENEO-05	Rate of Achievement of IoT data exchange	In-orbit Operations phase

Table 13. Summary of Service Level Agreements

The successful bidder must propose a monitoring tool that allows the IEEC to extract the information necessary to verify compliance with the SLAs. The successful bidder will be responsible for justifying the achievement of the SLAs during the monthly deliveries of the progress reports.

Definitions applicable to the calculation of Service Level Agreements:

- Time of data acquisition: time in which data capture is carried out with regard to the main payload.
- Working hours: Monday to Friday from 8 am to 6 pm.

When imposing the penalties contemplated in this clause, the IEEC will take into consideration whether the failure to achieve the required quality level in each case is the result of GENEO-02 anomalies that cannot be attributed to the successful bidder due to force majeure or whether they are due to the latter's fault or negligence. In cases of force majeure, the contractor will be exempt from liability.

In each case, the successful bidder must duly justify the reason why the required service level indicator has not been met.

The penalties accumulated and imposed by the IEEC on the successful bidder will in no case exceed the ceiling of 20% of the value of the next milestone for milestones 7, 8 and 9, 15% for milestone 10 and 10% for the additional milestones in case of contract extensions. If this ceiling is reached, the IEEC will have the option of imposing the penalty or terminating the contract.

6.1 Data delivery - Base Case

Code	Name	Description	Frequency of calculation	Penalty applicable
SLA-GENEO-01-A	Delivery of L1A data - Base Case	The average delivery time of L1A data and the corresponding auxiliary files (metadata) between the moment of data capture until the reception at the servers designated by the IEEC must be less than 12 working hours for the L1A data in 95% of cases.	Monthly	Penalty of 0.5% of the amount to be paid in the next contractual milestone for every 2% deviation from the target. *For example: in the first year of operations, the calculation of this agreed indicator exceeds 95% in all but two months. In the first month of non-compliance, the figure of 94% is achieved and in the second, 89%. Therefore, a penalty of 2% will be applied on the amount to be paid by the IEEC in Milestone 7.*
SLA-GENEO-01-B	Delivery of L1C and L2A data - Base Case	The average delivery time of L1C and L2A data between the moment of delivery of the L1A data until the reception at the platform designated by the IEEC of the L1C and L2A data must be less than 12 working hours for L1C and L2A data in 95% of cases.	Monthly	Penalty of 0.5% of the amount to be paid in the next contractual milestone for every 2% deviation from the target. *For example: in the first year of operations, the calculation of this agreed indicator exceeds 95% in all but two months. In the first month of non-compliance, the figure of 94% is achieved and in the second, 89%. Therefore, a penalty of 2% will be applied on the amount to be paid by the IEEC in Milestone 7.*

Table 14. Service Level Agreements applicable to the delivery of data in the Base case

6.2 Delivery of data - Emergency case

Code	Name	Description	Frequency of calculation	Penalty applicable
SLA-GENEO-02-A	Delivery of L1A data - Emergency Case	The average delivery time of L1A data and the corresponding auxiliary files (metadata) between the moment of acquisition until the reception at the platform designated by the IEEC must be less than 6 calendar hours for L1A data in 95% of cases. It will be considered 100% if there were no relevant requests in the emergency case.	Monthly	Penalty of 0.5% of the amount to be paid in the next contractual milestone for every 2% deviation from the target. *For example: in the first year of operations, the calculation of this agreed indicator exceeds 95% in all but two months. In the first month of non-compliance, the figure of 94% is achieved and in the second, 89%. Therefore, a penalty of 2% will be applied on the amount to be paid by the IEEC in Milestone 7.*
SLA-GENEO-02-B	Delivery of L1C and L2A data - Emergency Case	The average delivery time of L1C and L2A data between the moment of delivery of the L1A data until the reception at the platform designated by the IEEC of the L1C and L2A data must be less than 24 working hours for L1A data in 95% of cases. It will be considered 100% if there were no relevant requests in the emergency case.	Monthly	Penalty of 0.5% of the amount to be paid in the next contractual milestone for every 2% deviation from the target. *For example: in the first year of operations, the calculation of this agreed indicator exceeds 95% in all but two months. In the first month of non-compliance, the figure of 94% is achieved and in the second, 89%. Therefore, a penalty of 2% will be applied on the amount to be paid by the IEEC in Milestone 7.*

Table 15. Service Level Agreements applicable to the delivery of data in the Emergency case

6.3 Reporting of incidents, non-conformities and anomalies

Code	Name	Description	Frequency of calculation	Penalty applicable
SLA-GENEO-03	Reporting of incidents, non-conformities and anomalies	The time between the identification and reporting of incidents, non-conformities and anomalies to the IEEC must not exceed: • 1 working day, for those classified as critical (see clause 3.9.4) • 1 calendar week, for those classified as non-critical for 98% of incidents, non-conformities and anomalies.	Monthly	Penalty of 0.5% of the amount to be paid in the next contractual milestone for every 2% deviation from the target. *For example: in the first year of operations, the calculation of this agreed indicator exceeds 95% in all but two months. In the first month of non-compliance, the figure of 94% is achieved and in the second, 89%. Therefore, a penalty of 2% will be applied on the amount to be paid by the IEEC in Milestone 7.*

Table 16. Service Level Agreements applicable to the reporting of incidents, non-conformities and anomalies

6.4 Recurrence in Data Acquisition

Code	Name	Description	Frequency of calculation	Penalty applicable
SLA-GENEO-04-A	Revisit period over region of interest	The revisit period according to the definition applicable in the TSD must be less than 50 hours, taking 14 consecutive calendar days as the calculation period.	Bi-monthly	Penalty of 1% of the amount to be paid in the next contractual milestone for every 4% deviation from the target. *For example: in the first year of operations, the target is not reached in two fortnightly periods. In the first of them, the calculated revisit period is 52 hours and in the second it is 60 hours. Therefore, a penalty of 3% will be applied on the amount to be paid by the IEEC in Milestone 7.*

SLA-GENEO-04-B	Total coverage of the region of interest	The number of calendar months in which total coverage of the region of interest is obtained must be equal to 12.	Annual	Penalty of 1% of the amount to be paid in the next contractual milestone for each month in which the target could not be reached.

Table 17. Service Level Agreements applicable to recurrence in data acquisition

6.5 Rate of Achievement of IoT data exchange

Code	Name	Description	Frequency of calculation	Penalty applicable
SLA-GENEO-05	Individual Packet Error Rate	The Packet Error Rate (PER) for each terminal must be less than 30% for each connection opportunity. The PER of each terminal will be calculated, monthly, as follows: $$PER(\%) = \sum_{i=0}^{n} \frac{Number\ of\ Packets\ received\ from\ N\ at\ the\ IEEC\ server}{Number\ of\ Packets\ sent\ by\ N}$$ Where: i is a connection opportunity for the terminal n is the total number of connection opportunities for the terminal	Monthly	Penalty of 0.3% of the amount to be paid in the next contractual milestone for every 5% deviation for each terminal from the target.

Table 18. Service Level Agreements applicable to IoT data exchange

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