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1. Specification

1.1 Identification

The present document is the purchase specification for a low-medium altitude blimp to be used as prototype within the SANCHO programme. The prototype is so-called SAMBA. Whereas SANCHO is an operational remote sensing aerostatic platform for wildfire monitoring and security applications, SAMBA is to provide a test platform for many of the technologies involved.

SANCHO is promoted by a consortium of Spanish companies led by INSA. INSA (www.insa.es) is a public organisation fully owned by the Spanish Institute for Aerospace Research (INTA, www.inta.es). Other relevant members are ISDEFE (www.isdefe.es), EGMASA (www.egmasa.es) and TRAGSA (www.tragsa.es).

In order to speed up the SANCHO research programme, a medium altitude prototype is to be acquired from existing manufacturers. This specification contains information on the relevant blimp technologies to be met by the SAMBA prototype, including:

- Requirements to the aerodynamic and structural design of the platform
- Requirements to the platform performance
- Quality assurance and test provisions
- Target price and delivery conditions

1.2 Programme Overview

The SANCHO programme (Aerostatic System for Navigation, Communications and Observations Tools) pursues the development of medium and high altitude aerostats for security, fire surveillance and telecommunications applications, as well as the testing of aerial navigation and other technologies.

Today, a low altitude (20-m/ 65 ft) blimp prototype is being already operated, but the project development requires a larger platform which allows new and more ambitious experiments. The new SAMBA blimp shall provide a first glance of what high altitude platforms will be capable of, at a reasonable cost.

The main system applications are shown:

- Identification, measurement and monitoring of potential sources of forest fire
- Identification and mapping of infrastructures (roads, urban areas...)
- Surveillance of human activity
- Local meteorology and micro-meteorology
- Other remote sensing applications
- Communications relay (e.g. UMTS repeater)

On the other hand, SAMBA must serve as a workbench for internal developments as remote sensing instruments, navigation algorithms and communication equipment. Thus, some internal interfaces are fixed to allow the future attachment of new pieces of hardware.

1.3 Document Overview

1.3.1 Conflicts

This document supersedes any other conflicting requirement that may appear in former documents or informal communications.

1.3.2 Requirement Weighting Factors

The requirements stated in this specification are not of equal importance or weight. The following two paragraphs define the weighting factors incorporated in this specification.

a. ***Shall*** designates the most important weighting level; that is, mandatory. Any deviations from these contractually imposed mandatory requirements require the approval of the payload responsible.

b. ***Should*** designates requirements requested that are not mandatory.

2 Applicable Documents

The present document is self-contained with respect to the low-medium altitude blimp features.

2.3 List of Acronyms

BOL Beginning Of Life
DM Development Model
EOL End of Life
ESD Electro-Static-Discharge
GCS Ground Control System
FM Flight Model
FOV Field Of View
GIS Geographical Information System
ICD Interface Control Document
LOS line of Sight
MLI Multi Layer Insulation
SAMBA Sistema Aerostático Medio
SM Safety Margin
UTC Current Time
TBC To Be Confirmed
TBD To Be Defined

3 Blimp Requirements

3.1 Definition

3.1.1 Blimp Description

Â *SAMBA3.1.1-1 Blimp Description*

The system required is a low-medium altitude blimp or a pressurised non-rigid airship (presumably a conventional design). The requirement design will be refereed to the blimp parts including the control flight system and each of its internal interfaces. The payload and mission data communications are not considered in the present document since, in principle, they are not part of the platform.

The blimp shall be an unmanned aerostatic platform which must keep its shape thanks to the pressure of the lifting gas (Helium) inside the envelope. To provide the lifting and control capacity under any working conditions, at least two (bow and stern) internal air bags will be deflated or inflated to maintain the pressure difference. Operational conditions are fixed about an altitude over 1500 m (5000 ft).

3.1.2 Main SAMBA Elements

3.1.2.1 Envelope

SAMBA **shall** be shaped by an optimal envelope, which is one of the main blimp elements. It holds the helium gas and it shall be made of a durable, airtight, and lightweight fabric. For the envelope design, items as the structural philosophy, the aeroelastic effects and the operation under bad weather conditions **should** be considered.

Â *SAMBA3.1.2.1-1 Envelope requirements*

The envelope **should** consist of an outer translucent white multi-layer laminate, a fabric base, and a clear inner laminate. The envelope **shall** be heat sealed together as gores.

The outer laminate and the translucent white heal seal tape covering the seams, **shall** protect the fabric and seam tape respectively from structurally damaging UV radiation from the sun.

Â *SAMBA3.1.2.1-2 Envelope material requirements*

Material ideal for use in pressurised non-rigid airship envelopes **should** have the following properties:

- High strength. This property will determine the maximum possible size of the envelope.
- Minimum weight to minimise the global system weight.
- Resistance to environmental degradation through temperature, humidity and ultraviolet light.
- High tear resistance to give damage tolerance.
- Low permeability to minimise helium loss, which could increase the operational cost
- Optimal joining techniques.
- Low creep to ensure that the envelope shape is maintained throughout its life.

3.1.2.2 Nose Cone Battens

SAMBA **shall** be strengthened by the nose cone battens which are the supports that radiate from the tip of the blimp.

Â *SAMBA3.1.2.2-1 Nose cone requirements*

The nose cone **shall** stiffen the front of the blimp so that it is not damaged when it will be moored to the moored mast.

Â *SAMBA3.1.2.2-2 Nose cone battens*

The nose cone **shall** give aerodynamic shape to front part of the blimp maintaining the shape against aerodynamic forces.

3.1.2.3 Ballonets

SAMBA **shall** contain one or more ballonets, or air-filled bag located inside the envelope which serves as a diaphragm between the outside air and the helium.

Â *SAMBA3.1.2.3-1 Ballonets function*

The ballonets **shall** be used to pressurise the hull and to compensate for pressure/volume changes as the airship altitude or temperature changes.

Attitude control is also a possible use of ballonets.

Â *SAMBA3.1.2.3-2 Ballonets number*

SAMBA **should** have the necessary number of ballonets inside the envelope, and attached to it, to ensure correct operation in all the mission phases.

Â *SAMBA3.1.2.3-3 Ballonets material requirements*

Material ideal for use in pressurised non-rigid airship ballonets **should** have the following properties:

- Low permeability to both air and helium to minimise helium contamination or loss.
- Good flexure and abrasion resistance with no increase in permeability.
- Low weight.

3.1.2.4 Gondola

Â *SAMBA3.1.2.4-1 Gondola*

SAMBA **shall** carry a gondola, which is the rigid structure under the envelope to provide physical support for the different subsystems and the mechanical interface among the main operative systems. It **should** also housekeep the mission payloads. It could be divided in several items to meet the structural and thermal requirements to respective elements that are inside that.

3.1.2.5 Propulsion System

Â *SAMBA3.1.2.5-1 Engines*

The blimp **shall** be propelled by at least two engines which should provide the necessary power to meet mission requirements. The engines, located on either sides of the platform, shall be prepared to meet safety and reliability requirements for the unmanned operation.

The engines **should** help to meet the platform control requirements (depending on final design).

Â *SAMBA3.1.2.5-2 Propellers*

Each SAMBA engine **shall** be attached to a propeller which provides final thrust to the platform.

3.1.2.6 Flight control surfaces

SAMBA **should** have the proper flight control surfaces, mounted on the hull, to provide system manoeuvrability.

Innovative designs are allowed provided that the vehicle controllability is proved.

Â *SAMBA3.1.2.6-1 Rudder*

The rudder **should** allow steering the blimp to starboard or port directions (yaw axis).

Â *SAMBA3.1.2.6-2 Elevators*

The elevators **should** allow controlling the angle of ascent or descent (pitch axis) of the blimp.

3.1.2.7 Catenary Curtain and Suspension Cables

Â *SAMBA3.1.2.7-1 Catenary Curtains and Suspension Cables*

SAMBA **should** enclose the necessary catenary curtains inside the envelope, along the length of the blimp, to provide structural stiffness in the vertical direction. They **should** be made or fabric and sewn into the envelope. The proper suspension cables **should** attach the curtains to the gondola.

3.1.2.8 Air Ballonet System

Â *SAMBA3.1.2.8-1 Air Scoops or Active Pumps*

SAMBA **shall** hold an air ballonet system; during flight, air scoops or active pumps **shall** inject air into the ballonets to maintain internal overpressure.

Â *SAMBA3.1.2.8-2 Air Valves*

As well as the air will be added into the ballonets by the air scoops or pumps, to vent the air from these, it **shall** be necessary the location of two valves in each ballonet.

3.1.2.9 Lifting Gas System

Â *SAMBA3.1.2.9-1 Lifting Gas*

The SAMBA lifting gas **shall** be Helium which is a non-flammable, non-toxic and non-irritant gas.

Â *SAMBA3.1.2.9-2 Helium Valve*

Normally, it will not be necessary to remove or add any amount of helium into the envelope; however the envelope **shall** be provided of a helium valve to vent the gas if the helium pressure excesses its maximum safe limit.

Â *SAMBA3.1.2.9-2 Helium Pressure Sensor*

The vehicle **shall** continuously measure temperature and pressure of the lifting gas at the bottom of the envelope, and include them into the telemetry packet.

Â *SAMBA3.1.2.9-2 Helium Emergency Release*

A special valve or mechanism **should** be implemented to allow helium release in case of emergency, commanded remotely.

3.1.2.10 Ground Elements

Â *SAMBA3.1.2.10-1 Mooring Mast*

When SAMBA is grounded, it **shall** keep hold by the nose to a stationary mast or pole erected to the landing area called mooring mast.

Â *SAMBA3.1.2.10-1 Moveable Mooring Mast*

SAMBA **should** be equipped with a moveable mooring mast attached to the proper vehicle to allow mechanical ground transportation of the blimp.

3.1.3 SAMBA Operational Conditions

3.1.3.1 Operational Altitude

Â *SAMBA3.1.3.1-1 Operating Altitude Range*

SAMBA **shall** operate at an altitude range over 0 to 1500 meters (0 to 5000 feet).

Â *SAMBA3.1.3.1-2 Temperature Range*

SAMBA **shall** operate over the altitude range considering the ground temperature in the range -5 to 40ºC (268 to 313 K). The reference temperature in altitude **shall** be estimated considering ISA standard atmosphere conditions corrected to meet the ground temperature.

Â *SAMBA3.1.3.1-3 Pressure Range*

SAMBA **shall** keep its shape, lift and conditions at a pressure range over the operating altitude range considering ISA standard atmosphere pressure conditions corrected with ground temperature.

3.1.3.2 Definition of Atmospheric Conditions

Two reference weather conditions are defined to classify the flight scenarios.

3.1.3.2.1 Nominal Weather Conditions

Â *SAMBA3.1.3.2.1-1 Wind Speed Profile at Nominal Conditions*

Nominal conditions **shall** consider average wind velocities in altitude not less than 14 m/s (50.4 km/h) for 95% of flying time, increasing 15% to account for gusts during 5% of the time.

Â *SAMBA3.1.3.2.1-2 Operating Ground Temperature for Nominal Flight Conditions*

Reference ground temperature for Nominal conditions is 25ºC.(303K).

3.1.3.2.2 Adverse Weather Conditions

Â *SAMBA3.1.3.2.2-1 Wind Speed Profile at Adverse Conditions*

Adverse conditions **shall** consider average wind velocities in altitude not less than 20 m/s (72 km/h) for 95% of flying time, increasing 15% to account for gusts during 5% of the time.

Â *SAMBA3.1.3.2.2-2 Operating Ground Temperature for Adverse Flight Conditions*

Reference ground temperature for Adverse conditions is 40ºC (313K).

3.1.3.3 Conditions of operation

Â *SAMBA3.1.3.3-1 Hovering at Nominal Weather Conditions (C1)*

For the Hover Condition C1, SAMBA **shall** remain in stationary flight whit its optimal operational conditions with the following flight characteristics:

- Hovering speed: 0 m/s
- dh = 0
- Nominal Weather Conditions

Â *SAMBA3.1.3.3-2 Hovering at Adverse Weather Conditions (C2)*

For the Hover Condition C2, SAMBA **shall** remain in stationary flight whit its optimal operational conditions with the following flight characteristics:

- Hovering speed: 0 m/s
- dh = 0
- Adverse Weather Conditions

Â *SAMBA3.1.3.3-3 Cruise at Nominal Weather Conditions (C3)*

For the Cruise Condition C3, SAMBA **shall** be in optimal operational conditions for the following flight characteristics;

- Cruise Speed: not less than 10 m/s (36 km/h)
- dh = 0

- Nominal Weather Conditions

Â *SAMBA3.1.3.3-4 Cruise at Adverse Weather Conditions (C4)*

For the Cruise Condition C4, SAMBA **shall** be in optimal operational conditions for the following flight characteristics;

- Cruise Speed: not less than 5 m/s (18 km/h)
- dh = 0
- Adverse Weather Conditions

Â *SAMBA3.1.3.3-5 Ascent/descent Condidton (C5)*

For the Ascent/descent Condition C5, SAMBA **shall** be in optimal operational conditions for the following flight characteristics;

- Cruise Speed: not specified
- dh = +/- TBD m/s
- Nominal or Adverse Weather Conditions

3.1.4 Top-Level SAMBA Functions

3.1.4.1 Management

Â *SAMBA3.1.4.1-1 Functions Management*

SAMBA **shall** manage its internal activities to meet the functions described in this document.

Â *SAMBA3.1.4.1-2 Request for Diagnose*

SAMBA **should** be prepared to provide a comprehensive housekeeping data pack to be used for diagnose.

The request is typically performed on a daily basis. It shall not exceed 5 min and should be carried out manually. The internal Built-In Test is substituted by an external diagnose for simplicity reasons.

Â *SAMBA3.1.4.1-3 On Board Information*

SAMBA **shall** provide a serial (TBC) data interface to the payload and the communication system (to be sent to the ground control station) with at least the following information:

- Packet time
- Time tagged position
- Time tagged attitude
- Status of electrical system
- Status of Thermal conditioning system
- Status of lifting gas

3.1.4.2 Control System

Â *SAMBA3.1.4.2-1 Range of Radio Control*

Manual radio control **shall** be the primary communication method for SAMBA. This control does not interface with the computer but allows direct operator control of the vehicle and subsystems.

The range of radio control **shall** be 10 km in open field, within frequency regulations in the Spanish territory.

Â *SAMBA3.1.4.2-2 Radio Control Components*

Both transmitter and receiver protocols **shall** be documented to allow future expansion of the system.

Â *SAMBA3.1.4.2-3 Sensors for vehicle control*

SAMBA **shall** be equipped with at least GPS, 3D gyroscopes and Inertial units to help with automatic control.

3.1.5 Modes of Operation

The OFF, Radio Controlled Mode, Unmanned Control, Survival and Maintenance are the common Modes of Operation to all unmanned vehicles.

3.1.5.1 OFF Mode (M0)

Â *SAMBA3.1.5.1-1 OFF Mode (M0)*

In the system OFF Mode, no power **shall** be supplied to the SAMBA elements.

3.1.5.2 Pilot Remotely Control or Radio Controlled Mode (M1)

Â *SAMBA3.1.5.2-1 Radio Controlled Mode (M1)*

In the SAMBA Radio Controlled Mode, the vehicle **shall** accept and execute commands and data from the manual radio controller.

Â *SAMBA3.1.5.2-2 Radio Controlled Mode Trouble-shooting*

The SAMBA Radio Controlled Mode **shall** support troubleshooting and configuration parameters update.

3.1.5.3 Unmanned or Autonomous Control Mode (M2)

Â *SAMBA3.1.5.3-1 Autonomous Control Mode (M2)*

The Autonomous Control Mode **shall** allow autonomous flight in C1, C2, C3 and C4 conditions of operation. During flight, all the relevant onboard information shall be downlinked in real time.

A fully documented interface of the flight control system is required in order to allow future expansion and/or replacement of onboard computer unit.

Â *SAMBA3.1.5.3-2 Autonomous Take-off and Climb*

Not required.

Â *SAMBA3.1.5.3-3 Autonomous Descend and Landing*

Not required.

Â *SAMBA3.1.5.3-4 Payload control mode*

A special variety of control mode is that which is driven by the payload processor. After some designated command, manually sent, the vehicle **shall** enter in a mode in which the flight control is led by the payload itself. Upon certain conditions (they can be given by the manufacturer during the design phase) or the reception of manual mode change command, this sub-mode **shall** be abandoned to continue with normal vehicle control mode (autonomous or manual).

3.1.5.4 Survival Mode (M3)

Â *SAMBA3.1.5.4-1 Survival Mode (M3)*

In the Survival Mode, SAMBA **shall** be in minimum operational conditions to ensure safe control and eventual landing, including remote flight control.

Â *SAMBA3.1.5.4-2 Survival Mode Entrance*

A sensor located in the aerostatic platform **shall** accept a command to enter into Survival Mode in the event some critical subsystem enters in an anomalous configuration or operation as determined by the onboard computer. The lost of vehicle control is one of such events.

Â *SAMBA3.1.5.4-3 Survival Mode Recovery*

The recovery from the Survival **shall** require ground intervention. The Survival Mode **shall** transfer to the Radio Controlled Mode for troubleshooting.

3.1.5.5 Ground Handling Mode (M4)

Â *SAMBA3.1.5.5-1 Ground Handling Mode (M4)*

The vehicle **shall** remain in the ground handling mode when it is in contact with the ground handling operators or the mooring mast. In this mode, the system can be switched to OFF Mode and later to Radio Control Mode to start again operations.

3.1.5.6 Maintenance Mode (M5)

Â *SAMBA3.1.5.6-1 Maintenance Mode (M5)*

The system **shall** be into a maintenance mode when ground maintenance operations are required. In this mode the system can be de-mounted to perform checking and upgrades.

3.1.6 Operational and Organisational Concept

Â *SAMBA3.1.6.4-1 Operations of the system*

Special operations are required for the setup, take-off, flight and blimp handling. The manufacturer **shall** provide a complete specification of the operations of the system for all the modes of operation.

Â *SAMBA3.1.6.4-1 Operation Lifetime*

SAMBA **shall** demonstrate to be capable of operating at least for five (5) years with the duty cycle specified in this document.

Â *SAMBA3.1.6.3-2 Duty Cycle*

Campaigns with SAMBA vehicle **shall** be schedule to last for five continuous days. An average of 25 campaigns a year shall be considered.

During the non-operational periods, the system is to be stored, fully inflated, in a hangar.

Â *SAMBA3.1.6.4-3 Operation Autonomy*

The following flight autonomy figures **shall** be demonstrated:

- Condition C1: 10 hours
- Condition C2: 4 hours
- Condition C3: 4 hours
- Condition C4: 2 hours

Â *SAMBA3.1.6.4-4 Maintenance Operations*

Total time of maintenance, including re-fueling operations, **shall** be less than 5% of operating time.

3.1.6.5 Lifting Gas Operational Requirements

Â *SAMBA3.1.6.5-1 Helium Charge Requirements*

The lifting gas **shall** be recharged in the ground infrastructures when this is necessary, without interfere the normal vehicle operations.

Â *SAMBA3.1.6.5-1 Helium loss*

Helium loss **shall** be demonstrated to be below TBD m^3/month. This figure should be minimised.

3.2 SAMBA Characteristics

3.2.1 Performance Characteristics

3.2.1.1 Mission output

3.2.1.1.1 Main mission: Monitoring and Detection of Forest Fires

Â *SAMBA3. 2.1.1.1-1 Main Mission*

The SAMBA main mission **shall** be the monitoring and detection of medium-sized forest fires. During a first stage, tests are to be performed over prescribed burnings. Then, small fires will be targeted.

Â *SAMBA3. 2.1.1.1-2 Forest Fire Detection and Monitoring Requirements*

Before a fire starts, SAMBA **shall** be able to make a synthetic rough maps over a large region, however once a fire starts, it **shall** provide detailed information over a small area like;

- Detailed report and mapping for the situation
- Monitoring and tracking of fire front (hot spots)
- Forecasting of fire propagation conditions (fuel status, meteorology...)
- Position of fighting forces

All the applications mentioned **should** be allowed by boarding a dedicated payload which is not part of the vehicle provided by the supplier.

Â *SAMBA3. 2.1.1.1-3 Payload*

The payload **shall** be composed of one or more remote sensing instruments, some conditioning electronics, including interface to the vehicle computers for housekeeping data exchange, and some communication system (apart from the link channel used for flight control).

3.2.1.1.2 Contribution to the Fire Monitoring Performance

Â *SAMBA3.2.1.1.2-1 Contribution to the Fire Monitoring Performance*

SAMBA **shall** be able to provide an agile displacement over the affected areas when a large map is required or a new target selected. The vehicle manoeuvres are described in the operational modes and conditions.

3.2.1.1.3 Contribution to the Other Applications

Â *SAMBA3.2.1.1.3-1 Contribution to Other Applications*

The other applications targeted with the system **shall** be such that do not impose new requirements to the vehicle apart from the ones given in this document.

3.2.2 Physical and Interface Characteristics

3.2.2.1 Mass Properties

Â *SAMBA3.2.2.1-1 Empty Mass*

The supplier **shall** provide detailed information on the vehicle dry mass budget, including position of subsystems to allow calculations of mass centres and moments of inertia.

Â *SAMBA3.2.4.1.1-2 Payload mass*

SAMBA **shall** be able to carry a 100-kg payload in all flight conditions.

3.2.2.2 Mechanical Interface

3.2.2.2.1 Dimensions and Clearances

3.2.2.2.1.1 SAMBA Vehicle Dimensions

The required dimensions of the platform are perhaps the most important global requirement for the system. The system size can have a large influence on other parameters, elements and blimp functions.

Â *SAMBA3.2.2.2.1.1-1 Vehicle Dimensions*

The dimensions of the vehicle **should** be the within the following limits:

Length: 40 m (TBC)

Height: 11.5 m (TBC, limited by current available hangar)

Width: 18 m (TBC)

Â *SAMBA3.2.2.2.1.1-1 Payload Mounting Space*

The vehicle **shall** provide a flat mounting plane for the payload, with good downward clearance and at least 100 cm (along major axis) x 80 cm (along transversal axis) size. Attachment bolts and nuts **should** use European metrics.

The mounting mechanisms need to accommodate manufacturing tolerance, structural, and thermal distortions.

3.2.2.2.1.2 Vehicle Hangar Dimensions

Â *SAMBA3.2.2.2.1.2-1 Hangar*

The blimp **shall** be safeguarded from environmental conditions when it is not being operated inside of the hangar. In addition, all the maintenance and reparation operations **shall** be developed there.

Â *SAMBA3.2.2.5-2 Hangar Dimensions*

The dimensions of the required hangar for normal operation and storage **should** not exceed the following limits:

Length: 45 m (TBC)

Height: 12 m (TBC)

Width: 25 m (TBC)

A hangar with such specifications is currently available.

3.2.2.3 Power Interface

3.2.2.3.1 Vehicle Internal Power

Â *SAMBA3.2.2.3.1 Vehicle Internal Power*

The vehicle power subsystem **shall** be designed to provide the power necessary to the operation including payload consumption.

Â *SAMBA3.2.2.3.2 Compatibility with EMC*

Power distribution components **shall** be compatible with system and subsystem EMC performance requirements.

Â *SAMBA3.2.2.3.3 Payload Average Power Consumption*

Power interface to payload **shall** provide 2KW average power during 55 min/hour (TBC).

Â *SAMBA3.2.2.3.4 Payload Peak Power Consumption*

Power interface to payload **shall** provide 3KW peak power during no more than 5 min/hour (TBC).

Â *SAMBA3.2.2.3.6 Take-off Power*

TBD

3.2.2.3.2 Electrical System Interface Requirements

3.2.2.3.2.1 Electrical Interfaces

Â *SAMBA3.2.2.3.2.1-1 Electrical Interfaces*

The electrical interfaces **shall** include the power and data bus lines.

Â *SAMBA3.2.2.3.2.1-2 Electrical Connectors*

Electrical connectors and batteries **shall** follow European Standards in electrical and electronic equipments.

3.2.2.3.2.2 Power Harnesses

Â *SAMBA3.2.2.3.2.2-1 Electrical connectors*

Electrical connectors **shall** be agreed with the supplier no later than 3 months after contract signature.

3.2.2.3.2.3 Signal Cabling

Â *SAMBA3.2.2.3.2.3-1 Telemetry Connector*

Serial data (TBC) for telemetry exchange between payload and central computer **shall** use a standard DB9 connector (female is at payload side).

3.2.2.4 Thermal Interface

Â *SAMBA3.2.2.4.1-1 Thermal Interface*

The payload **shall** be responsible of their proper environmental protection, including thermal conditioning.

3.2.2.5 Structural Interface

Â *SAMBA3.2.2.5-1 Structural loads from the payload*

For the design purposes, payload can be considered as a dead mass attached to the provided mounting plate. The movement of the payload or its elements shall export reaction forces that are negligible with respect to the mass inertial forces.

Â *SAMBA3.2.2.5-3 Mooring Mast Interface*

The supplier **should** select the appropriate interfaces between vehicle and mooring masts, both fixed and portable.

3.2.2.7 Software

TBD

3.2.2.8 Survivability

All the SAMBA interfaces need to be able to survive in the limit environmental conditions that have been defined in the operational temperature range, son no new requirements are listed here..

3.2.2.9 Endurance

Â *SAMBA3.2.2.9-1 Endurance*

All system elements **shall** be designed to operate without critical failures for at least seven (7) years, to ensure the operational lifetime is well covered.

3.2.2.10 Protective Coatings and Finishes

Â *SAMBA3.2.2.10-1 UV coating*

External envelope coating **shall** allow for the operation under sunlight during the whole operational lifetime.

3.2.3 Reliability

Â *WMIR3.2.5-1 Vehicle reliability*

The vehicle design reliability **shall** be proved to be higher than 90% end of nominal lifetime.

3.2.4 Operational Requirements

3.2.4.1 Algorithms

Â *SAMBA3.2.4.2-1 Flight control system algorithms*

On board computer **shall** provide the proper algorithms to allow for operation in the conditions specified in this document.

3.2.4.2 Control of Modes of Operation

The typical transitions among Modes of Operations are shown next;

Â *SAMBA3.2.4.2-1 Switching On*

After the switching on, the aerostatic platform **shall** automatically enter into the Remotely Control Mode (M1).

Â *SAMBA3.2.4.2-2 Command for Mode Change*

The change of Mode of Operation **shall** be controlled under external command, even when Automatic mode is enabled (M2).

Â *SAMBA3.2.4.2-3 Automatic Change of Mode of Operation*

The system itself **shall** command a change in the Mode of Operation whenever some internal condition forces it, always to the Survival Mode (M3).

3.2.4.3 Commanding

Â *SAMBA3.2.4.3-1 Command Line*

The vehicle blimp **shall** execute the external commands received through a serial line, which is also used for telemetry transmission (TBC). These commands shall work only when Automatic Mode (M2) is selected and payload control is on.

The idea is to be able to research on flight control algorithms to better meet the requirements of different final users, without changing the internal vehicle design. In the proposed scheme the payload intelligence can command the actuator of the blimp if the central computer allows it.

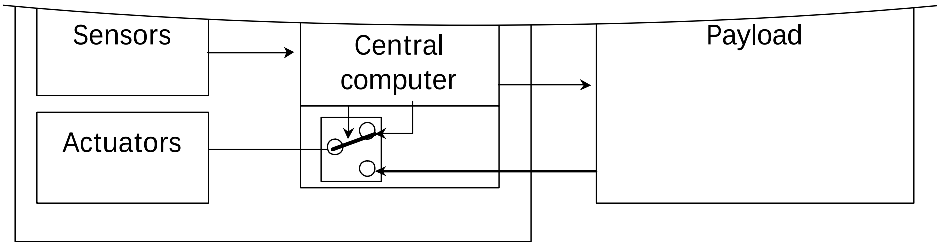

Figure 1: *Logic scheme of the command line driven by the payload*

3.2.4.3.1 Command Execution

Â *SAMBA3.2.4.3.1-1 Master command*

A Master command (TBC) **shall** be designated to change modes of operation. SAMBA **shall** execute the command immediately after their reception and process.

This includes automatic control to payload control.

Â *SAMBA3.2.4.3.1-2 Operational commands*

A number (TBD) of operational commands **shall** allow vehicle operation from ground in all modes.

Â *SAMBA3.2.4.3.1-3 Request for information commands*

A number of commands (TBD) from the payload **shall** allow payload processor to get all the vehicle data provided by sensors, in form of telemetry packets.

Â *SAMBA3.2.4.3.1-4 Action commands*

When in payload control mode within Automatic Mode (M2), action commands (TBD) **shall** allow payload to command all vehicle actuators.

3.3 Operation

3.3.1 Platform Stability

Â *SAMBA3.3.1-1 Platform Stability*

The stability figures during SAMBA operation **shall** be measured and demonstrated to be lower than TBD values.

3.3.2 Safety

Â *SAMBA3.3.2-1 Flight Safety*

SAMBA **shall** be able to perform a safety flight without the minimum risk for the ground crew or other persons, infrastructures and aircrafts that were located in the same flight area.

3.3.3 Security

Â *SAMBA3.3.3-1 Security*

SAMBA and its communications system **should** operate with a minimum of security factors to not allow the intrusion or illegal practise of external agents.

3.3.4 Management

Â *SAMBA3.3.4-1 Easy To Use*

The SAMBA vehicle **shall** be easy to use and operate by the minimum ground crew.

3.4 Design and Construction

3.4.1 Design

Â *SAMBA 3.4.1-1 Design Requirements*

Each part of the SAMBA structure **shall** be suitably protected against deterioration or loss of strength in service due to any cause, including static and dynamic loads, weathering, corrosion and others. A margin budget shall be configured by the supplier during design phase.

3.4.2 Materials

TBD by the supplier.

3.4.3 Strength and Stiffness Requirements

Â *SAMBA 3.4.3-1 Qualification Load factor*

The parts/constituents of the blimp **shall** withstand without any degradation of performance a factor 1.25 (qualification factor) with respect to the flight limit load.

The flight limit loads are the maximum levels predictably experienced in the involved part's service life.

Â *SAMBA 3.4.3-2 Safety margins*

A safety margin budget **shall** be configured by the supplier during design phase, not having figures lower than 1.25 with respect to flight limit and 1.75 with respect to ultimate limits.

Estimation of the above loads, allowable and experienced a like, **shall** include the analysis uncertainties, in the local load application points, joined, fastened or other assemblies and geometrical or manufacturing discontinuities.

3.4.4 Access

Â *SAMBA 3.4.4-1 Subsystem access*

No vehicle element **should** be an obstacle to the access, revision or reparation of other subsystem if it is not absolutely mandatory.

3.5 Documentation

Â *SAMBA3.5-1 Documentation*

All the SAMBA system **shall** be supplied with the following documentation:

- System design report (including drawings)
- System performance report (including fine definition of the flight control algorithms)
- Payload Interface Control Documents (including physical an logical interfaces)
- Comprehensive User manual, including operational and maintenance requirements

4 Quality Assurance and Testing Provisions

4.1 Quality Assurance

Â *SAMBA4.1-1 Quality Assurance Approach*

The manufacturer of SAMBA blimp **shall** be responsible of the quality assurance

4.2 Testing

The tests included in this specification are generally regarded as the most critical and the ones having the highest cost impact and schedule impact. Functional and environmental exposure tests are considered.

4.2.1 Location of Testing

Â *SAMBA4.2.1-1 Location of Testing*

The tests, during the design and construction process, **shall** be executed in those points in which some criticality has been introduced, trying to minimise the redundancy of tests over the different parts.

4.2.2 Physical Models

Â *SAMBA4.2.2-1 Physical Model*

A single SAMBA model **shall** be constructed, tested and delivered.

4.2.3 Mathematical Model Requirements

Â *SAMBA4.2.3-1 Mathematical Model Requirements*

The design of the SAMBA Mathematical Model **should** assure all the requirements given in the present document.

4.2.4 Structural Analyses

TBD

4.2.5 Test Types to develop

Â *SAMBA4.2.5-1 Development tests*

The supplier **shall** present, together with the design, a test plan to be developed. The test plan **shall** include al least one gas loss test, membrane strength test, flight control test, payload requirement test and final commissioning test.

Â *SAMBA4.2.5-1 Payload tests*

The system **shall** prove fulfilment of requirements relative to the payload, both mechanical and logical.

Â *SAMBA4.2.5-2 Commissioning test*

Final commissioning tests **shall** be developed in Spain at the delivery of the vehicle. It **shall** last for two weeks and include checks of most of the operational requirements given in this document.

4.2.10 SAMBA Test Requirement Compliance Matrix

Â *WMIR4.2.10-1 SAMBA Test Requirement Compliance Matrix*

The supplier **shall** configure and maintain a compliance matrix to prove fulfilment of the requirements given in this document. The matrix **shall** be delivered at proposal time, end of design phase and final system delivery.

The three column matrix **shall** contain requirement reference, degree of fulfilment and prove of the fulfilment.

4.3 Training

Â *SAMBA4.3-1 Training*

A training practical course **shall** be given by the supplier, just after the commissioning test, including real flights for at least two weeks.

5 Terms and Conditions of Purchase

5.1 Scope of application

The system manufacturer is subject to the Terms and Conditions of Purchase given in this document.

The proposals **shall** thus be bound by these terms and conditions and the manufacturer sales detailed sale conditions **shall** not include any clause against them. Moreover, in case of conflict between the Terms and Conditions stated in this document and the Manufacturer Sale Conditions, the Terms and Conditions stated in this document **shall** prevail. Unilateral declarations, notations and references to general terms and conditions of purchase shown on invoices, delivery notes or other documents issued by manufacturer shall be ineffective.

5.2 Offers

Â *SAMBA5.2-1 Public Question Period*

The manufacturer can request from INSA all the necessary information during the period of preparation of the proposal, preferably through email correspondence, to Jesús Gonzalo (jgonzalo@insa.org, mail subject SAMBA).

Â *SAMBA5.2-2 Offer deadline*

The Manufacturer **shall** present his offer within the time specified in the letter of invitation to offer issued together with this document. Requests for extensions to the deadline **should** be made in writing to INSA.

Â *SAMBA5.2-3 Offer Requirements*

The Manufacturer **shall** adjust quantities and condition exactly to the requirements written in this document, and **shall** specifically indicate any deviation in the appropriate record of the requirement matrix.

Â *SAMBA5.2-4 Offer Periods and Conditions*

The manufacturer **shall** be bound to his offer at least 30 days after INSA has received the offer.

Â *SAMBA5.2-5 Offer Evaluation*

The evaluation **shall** be done by INSA attending to the following topics:

- Previous experience of the manufacturer (series production preferred)
- Maturity of the proposal
- Performance shown at pre-design
- Price
- Proposals for improvements or joint developments with INSA

5.3 Orders

INSA reserves its right not to place an order to any of the manufacturers responding to this call.

Â *SAMBA5.3-1 Order Requirements*

Orders **shall** be binding only if placed in writing. Any change made orally or by phone **shall** be binding only if confirmed in writing.

5.3.1 Confirmation of Order

Â *SAMBA5.3.1-1 Confirmation of Order*

Any order INSA has placed **shall** be confirmed immediately, without exception, in writing. If INSA does not receive the confirmation within ten calendar days after the order date - not counting mailing time - (in case of shorter delivery time the day following the placement of the order) a contract having the contents indicated in the order will become effective, unless INSA cancels the order placed in writing. Any deviation from the order **shall** be expressly stated in the confirmation of order and accepted in writing by INSA.

Â *SAMBA5.3.1-2 Confirmation Contents*

If the order does not state prices and other conditions (e.g. delivery period), the manufacturer **shall** provide this information in the confirmation of order. INSA may revoke the order within ten days if it disagrees with the contents of the confirmation of order.

5.4 Delivery

5.4.1 Delivery Dates, Periods and Place

The Manufacturer is obliged to comply with the agreed dates and periods of delivery.

Â *SAMBA5.4.1-1 Period for design delivery*

The delivery period is at maximum ten (10) calendar weeks from contract signature between the parties. This time includes trips, meetings and associated delays.

Â *SAMBA5.4.1-2 Delivery Period for system delivery*

The delivery period is at maximum eight (8) calendar months from written approval of design by INSA. This time includes trips, meetings, authorisations, custom formalities and associated delays.

Â *SAMBA5.4.1-3 Delivery Place*

The delivery place shall be Spain in TBC location, accessible by road and commercial regular airplane.

5.4.2 Delay in Delivery

Â *SAMBA5.4.2-1 Delay*

If a date or period of delivery or a part delivery is not complied with, INSA may rescind the contract either immediately or by granting a grace period of 15 days or insist upon performance of the contract.

Any delivery contrary to the terms of the contract shall be deemed a delay in delivery.

Â *SAMBA5.4.2-2 Penalty*

Irrespective of his fault, the manufacturer **shall** pay to INSA a penalty of 0.5% per commenced calendar day of any delay in delivery –no more than fifteen per cent of the total price- in case of a delay in delivery in whole or in a part or delivery contrary to the terms of the contract.

5.4.3 Unsatisfactory design

Â *SAMBA5.4.3-1 Unsatisfactory design*

In case INSA considers that the proposed design is not satisfactory due to low performance or high technological risk, INSA reserves its right not to proceed with the construction phase, with no additional obligations to INSA. Should this occur, the advanced payment already satisfied would be the absolute maximum value of the work provided, subject to the adequate fulfilment of the manufacturer obligations concerning the design phase as per the contract.

5.5 Cost

Â *SAMBA5.5-1 Prices Requirements*

The prices of the system and its parts **shall** be fixed prices, in Euros or American dollars, including system, transportation, commissioning tests, taxes and export/import fares.

Â *SAMBA5.5-2 Target price*

The target price is 350.000 Euros. Manufacturers **should** never exceed more than 10% this ceiling price.

5.6 Payment Plan

Â *SAMBA5.5-2 Payment Plan*

The payment plan is:

- Advanced payment: 10%
- Design accepted and authorisation to start development: 40%
- Mid term review of development: 20%
- Successful delivery and commissioning tests: 15%

5.7 Guarantee

Â *SAMBA5.7-1 Guarantee Period*

The guarantee period **should** be one-year at least, however any defects that become evident not until when the blimp is used in accordance with its intended purpose **shall** be subjected to a two-year warranty period.

Â *SAMBA5.7-2 Defects*

In case of any defect, without setting a deadline, the manufacturer **shall** apply a price reduction or remove of the defect through repair or delivery the goods.

5.8 Confidentiality

Â *SAMBA5.8-1 Confidentiality*

The parties undertake to treat as business secrets all non-obvious commercial and technical matters they become aware of in the course of the business relationship and to assign this secrecy obligation also to their employees. This obligation **shall** be valid for an indefinite term and survive the end of the business relationship.

Â *SAMBA5.8-2 Intellectual and Documents Property*

All information or material of any kind made available or financed by INSA to carry out the order are covered by the secrecy obligation, they will remain the property of INSA and **shall** be immediately returned to INSA after termination of the business relationship.

Except with the INSA written consent, the documents, materials and tools made available **shall** not be reproduced, published or otherwise made available to third parties.

5.9 Other Conditions

Â *SAMBA5.9-1 Control and Supervision*

INSA **shall** visit the process of vehicle construction in the manufacturer facilities at least for two times during the manufacturing time.

Â *SAMBA5.9-2 Control and Supervision*

INSA **shall** have free access to the progress data and test results carried out during the manufacturing process.