SCENARY 1 – SPACE SYSTEMS

A space mission involves the use of four optical cameras (telescopes) working in combination to create a composite instrument. The aim is to combine the field of view of each unit (20°) to generate an instrument with a total field of view of 60°. The payload concept is therefore based on combining the performance of each camera to create a multi-camera, which allows the observation of very faint stars with an extended field, the spatial resolution is not a critical parameter in this mission.

The telescope is based on a fully dioptric (refractive lens) design, working in a wide range of visible light (400-900 nm). The cameras shall be mounted on a common optical bench, providing structural and thermoelastic stability to ensure that the relative lines of sight (LoS) between each camera do not deviate by more than 0.5°.

Each camera includes a 240mm focal Telescope Optical Unit (TOU), a Focal Plane Assembly (FPA) supporting four large format CCD detectors, the (FEE) unit and the Support Structure. Each camera is equipped with its own passively cooled FPA, consisting of 4 CCDs of 3500 × 3500 pixels each and 20 micron pixels, working in frame transfer mode.

The mechanical enclosure of a complete camera, including Baffle and detector stage, is contained in a cylinder 60 cm in diameter and 110 cm in length. The characterisation of the final performance must be carried out under operating conditions (-80°C).

Please**, respond to 3 (THREE) of the following 4(FOUR) questions:**

1. Based on the current capabilities of the institute, assess a possible contribution to the instrument, identifying the different areas of INTA's knowledge and facilities that would be involved, and identifying which activities would be developed outside INTA with their justification.
2. Define the mission development plan that you would impose on the institution responsible for the delivery of the camera. Define the modelling philosophy that you propose as reasonable to ensure that performance is met, both by units and for the whole system.
3. Define an AIV Plan for all models of a camera, detailing each of the activities in the Plan, identification of necessary facilities at INTA (or need to modify any existing ones), workflow, INTA equipment needed to perform that work.

In the Camera Development Plan, the responsible company has identified several elements that are not initially qualified for this mission, namely:

- The detectors are functional laboratory prototypes, which have not flown on any space mission.

- The refractive lenses of the TOU have been used on another space mission but at an operating temperature of 20ºC.

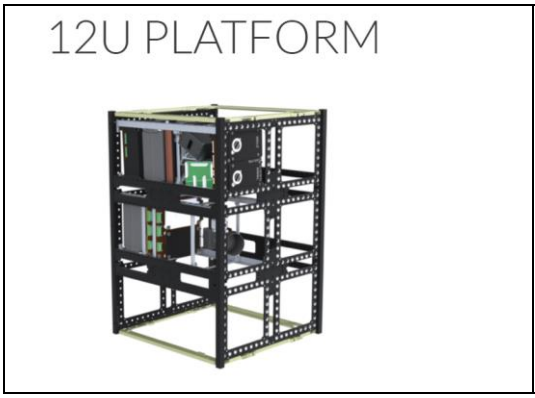
4. Define a Technology Plan for both components, identifying the TRL of these components and identifying the activities needed to achieve TRL 7 in PDR.

SCENARY 2 . SPACE SYSTEMS

It is desired to carry out the integration activities of a space constellation consisting of 10 satellites, 5 with an optical payload requiring ISO-6 cleanliness conditions and 5 with a radar payload requiring ISO-8 cleanliness conditions.

A basic layout of the platform is sketched in the following figures; where the main subsystems TTC, EPS, OBC, ADCS_OBC, GPS and ADCS sensors and actuators are included just for reference. There are 8U frees units for payloads integration in "L" configuration.

The activities related to the payloads are outside the scope of this exercise.



KEY FEATURES	12U
Bus Mass	10 kg
Max Payload Mass	14 kg
Payload Volume	8 U

SUBSYSTEMS	1
Solar Array Orbit Average Power (OAP) (Orbit Dep)	39.5 - 100 W
Power Bus	3.3V, 5V, 8V, 12V, 18V, 24V up to 2A
Battery Capacity	154 Wh
Determination Error Sun/Eclipse	200 arcsec

SUBSYSTEMS	1
Pointing Error Sun/Eclipse	250 arcsec
Max Slew Rate	10° / s
Position Knowledge (RMS)	3 m
Data Storage	Up to 120 GB
Data Buses	Space Wire, CAN, RS422 and TTL level UART
TMTC Communication	Uplink / Downlink: S-band
High Speed Link (HSL) Communication	Uplink: S-band / Downlink: S-band and X-band
TMTC Data Downlink	Up to 90 kbps
High Speed Link (HSL) Data Downlink (CCSDS Compatible)	From 500 kbps to 6 Mbps (S-band) and up to 225 Mbps (X-band)
High Speed Link (HSL) Data Uplink (CCSDS Compatible)	From 500 kbps to 6 Mbps (S-band)
Propulsion	10 to 300 m/s
Security	AES256 Encryption and Authentication

Please**, respond to 3 (THREE) of the following 4(FOUR) questions:**

1. Define a consignment process for all the platforms elements taking into account the need to maintain them in an environmental condition around 22 +/-5º C of temperature and 45%+/+5% of humidity.
2. For the assembly and integration of the 10 platforms, establish the processes and the flows that you consider most appropriate based on the drawing of the facilities,. Propose improvement initiatives for the facilities, if deemed necessary.
3. Establish an on-board software implementation plan, focusing on the releases required to support both the above validation processes and the operation of the final system.
4. Assuming that is not possible to use a RF link, propose a set-up for the System Validation Tests (SVT) involving the control centre located in another facility and the satellite.

ADDITIONAL INFORMATION

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Principales características de las instalaciones

Main facility characteristics

Regarding facilitiues for thermal Balance/Thermal Vaccuum tests, INTA has the following facilities with their main technical characteristics:

Thermal Vaccuum testing facilities

Name	Width	Height	Length	Min. T	Max. T	Min. Vac.	Max. Spec. weith
TVC-04	4 m	4 m	4 m	-180ºC	+160ºC	10-4 Pa	2000 kg
TVC-01	Diam. 1,3 m		1,5 m	-150ºC	+150ºC	10-4 Pa	250 kg
TVC-02	Diam. 0,8 m		1 m	-150ºC	+150ºC	10-4 Pa	20 kg

Additionally, INTA have a thermal balance and thermal vacuum testing, providing up to 25 power lines (20 lines 300 W each, 5 lines 1500 W each) and 80 thermocouple channels, with the following main features:
Up to three thermocouples per channel (monitor or control); Manual heater temperature and PID control modes; Automatic Report Generation; Heater short circuit, open circuit and temperature protection; PLC controlled sequential power up; Emergency local and remote stop; Real time, acoustic and visual alarms.

Additional climatic testing equipment to carry out test of temperature/humidity/altitude, fast cycling and thermal shocks with the following main characteristics:

Test	Main Characteristics
Temperature and Temperature/Humidity	Maximum dimensions : 1000 mm x 1000 mm x 1500 mm T. range: - 80 ° C to + 180 ° C; RH%: 10% to 95 %
	Maximum dimensions : 5600 mm x 3000 mm x 3000 mm T. range: - 60 ° C to + 110 ° C; RH%: 10% to 95 %
Temperature and Temperature/Humidity	Maximum useful dimensions: 1000 mm x 1000 mm x 1500 mm (2 chambers of different sizes) T. range: - 70 ºC to + 130 ºC; RH%: 10 % to 95 % Altitude: from 1013 mbar to 5 mbar
Fast Cycling (> 2ºC/min)	Maximum useful dimensions: 1500 mm x 1500 mm x 1500 mm (2 chambers of different size) Temperature range:- 180 ºC to + 180 ºC Maximum temperature change rate: 20 ºC/min
Thermal Shocks	Thermal shock chambers on air • Usable dimensions: 470 mm x 650 mm x 600 mm • Temperature range: -80 ºC to 220 ºC

In the same way, in order to check thermoelastic deformations in space systems under vacuum thermal cycling conditions performed in space simulators, INTA owns the next capability in combination with TVC-04:

Additional testing capabilities

Photogrammetry Testing	Thermoelastic deformations calculations by means of photogrammetry tests. Uncertainty: ±25µm, NIST traceability.

INSTITUTO NACIONAL DE TÉCNICA AEROESPACIAL

Carretera de Ajalvir, s/n
28850 Torrejón de Ardoz
(Madrid-España)
Contacto: Área de Ensayos Ambientales
ensayos.ambientales@inta.es
Telf.: 91.520.21.28 /21.25 • http://www.inta.es/qtriDep

@INTAESPAÑA
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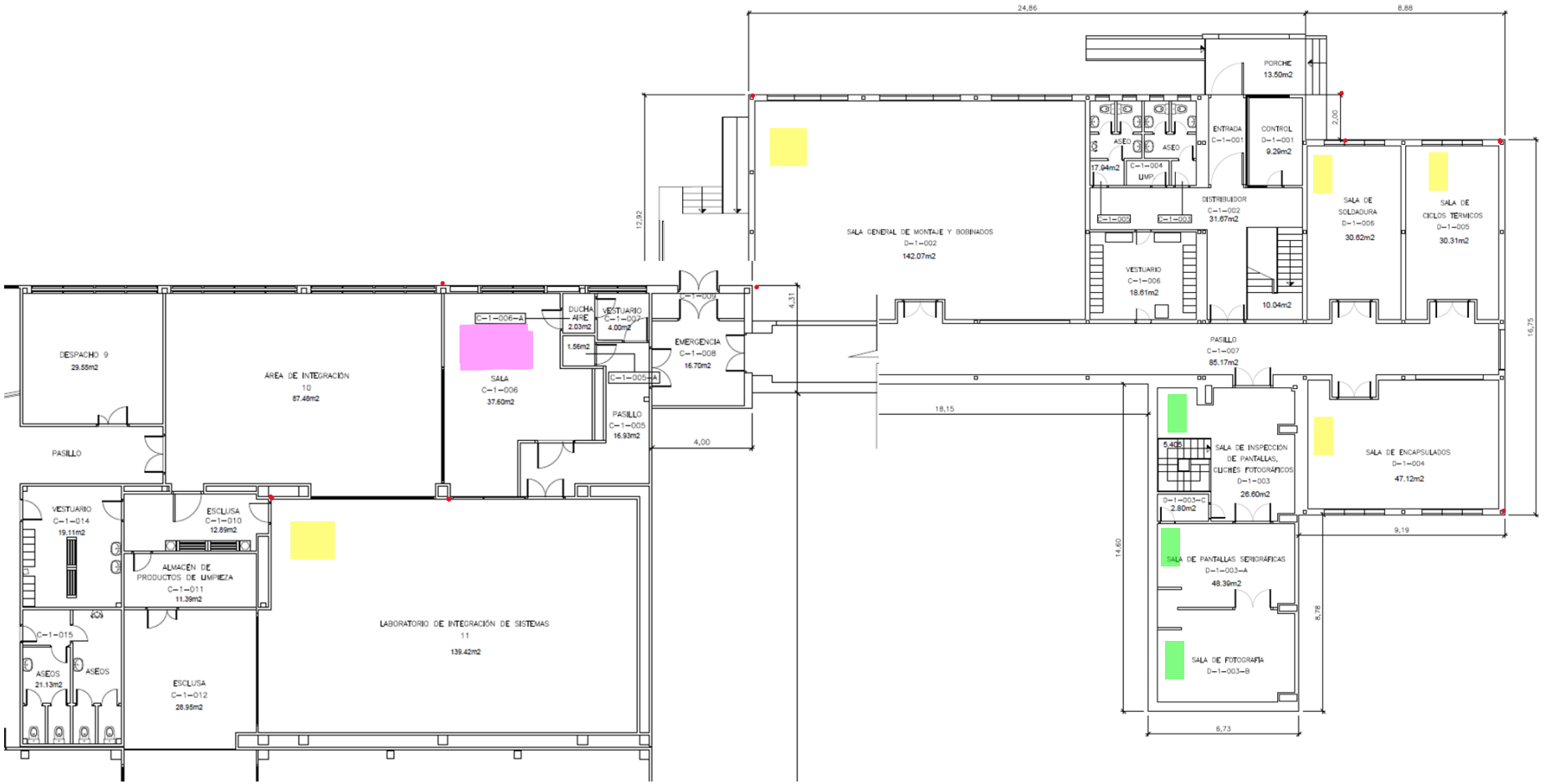

Sala Iso-6 / Salas protección planetaria

Salas ISO-8