Term Sheet for the Implementation of Advanced Satellite Development and Know-How Transfer for the Philippines

1. Introduction

The ***Advanced Satellite Development and Know-How Transfer for the Philippines Project*** under the Space Technology and Application Mastery, Innovation and Advancement (STAMINA4Space) Program aims to further strengthen the Philippines' nascent space technology research, development and innovation activities. It will be done by conceptualizing and designing an Earth Observation small satellite and acquiring the know-how and license to rebuild or innovate on technologies that will aid a sustainable satellite development in the Philippines.

The project is being co-implemented by the Department of Science and Technology – Advanced Science and Technology Institute (DOST-ASTI) and the University of the Philippines Diliman (UPD). Specifically for DOST-ASTI, it will complement the agency's mandate on undertaking research to strengthen and modernize science and technology infrastructure, allowing the agency to expand its operations and open opportunities for value-adding on its earth observation data products that can provide supplementary aid to improve the inventory, assessment, monitoring, and other development planning activities related to various stakeholders in the Philippines. The operational satellite system shall provide data on a regular basis for the **following applications**, among others:

1. Coastal habitat mapping, assessment, and monitoring
2. Aquaculture monitoring
3. Water quality monitoring
4. Forestry management
5. Wide area Disaster Damage assessment
6. Land use and land cover change mapping
7. Agriculture mapping
8. Crop monitoring and mapping
9. Ship and aircraft detection and tracking
10. Monitoring evolution of infrastructures and public spaces during crisis
11. Situational awareness during crisis

2. Purpose

This document serves to detail the specifications for the implementation of the project necessary to provide DOST-ASTI and UPD with the required services needed to undertake the small satellite conceptualization and design, training, access to the IP, project management, and documentation requirements of the project. It is primarily composed of the **Statement of Work (SOW)** describing the work required from the Contractor by

fulfillment of specifications and provisions for the satellite development and the training program. Other information relevant to the ground station and the tender are also included.

3. Definitions

Throughout this document, the following conventions apply:

a) the word “will” and the present tense indicate a statement of fact or intention;
b) the word “shall” indicates a mandatory requirement;
c) the word “should” indicates a preferred alternative, but not mandatory; and
d) the word “may” indicates an optional feature.

“**Bidder**” refers to an individual or group who will submit a proposal for evaluation;
“Contractor” refers to the winning Contractor
“**Project**” refers to the Advanced Satellite Development and Know-How Transfer for the Philippines Project under the Space Technology and Application Mastery, Innovation and Advancement (STAMINA4Space) Program;
“**End-user**” refers to the DOST-ASTI and UPD, who are co-implementing agencies of the project;
“**Filipino Engineers**” refer to the group of engineers selected by the End-user to undertake the satellite development and training activities relevant to the implementation of the project alongside the Contractor. “Filipino Engineers” may also be referred to as “**trainees**”;
“**Trainees**” refer to all other involved theoretical training participants that have been nominated by the End-user, including the Filipino Engineers; and
“**Training**” refers to the theoretical and practical training delivered by the Contractor for the Filipino Engineers during the design phase of the satellite. Also referred to as Know-how Transfer and Training or KHTT

Abbreviations and acronyms used in the document are enumerated with their meanings in Annex A.

4. Additional Bidder Qualifications

The Bidder shall provide documentation of having a proven track record in satellite manufacturing and delivering know-how transfer programs. The documentation shall include the following:

a. completion of at least 3 training programs for small satellite development in the last decade;
b. production of at least one microsatellite in the past 3 years;

5. Statement of Work

5.1 Satellite design

The Contractor shall commit to provide a preliminary design of an operational low-earth orbit (LEO) satellite with a medium-resolution multispectral optical imager as primary payload, and automatic identification system (AIS) and automatic dependent surveillance-broadcast (ADS-B) receivers as secondary payloads. The minimum specifications of the satellite platform and payloads are given in section 6. The Contractor shall deliver pertinent documentations and files on:

a. design of the satellite platform and payload complying to the minimum specification given in subsections 6.2-6.3;
b. mission analyses and proposed solutions relevant to meeting the performance requirements described in subsection 6.4 that shall be delivered pre-launch during the following phase/s if the project;
c. mission analyses and proposed solutions relevant to meeting the operational requirements described in subsection 6.5 that shall be delivered during the following phase/s of the project ;
d. potential commercial users of its data outside the Philippines; and
e. initial plans for the launch integration and commissioning of the satellite.

Documentation deliverables are provided in subsection 12.5 with corresponding descriptions in Annex B. The Contractor, in anticipation of a follow through activities after the contract, shall ensure that the results of the work until PDR are picked up in subsequent phase/s of the project and updated where applicable, so that the technical specifications of the mission are met.

5.2 Training Program

The Contractor shall conduct a training program for a pool of Filipino Engineers to develop their expertise and experience in space systems, equipping them with in-depth specialist skills in disciplines and technologies needed to deliver an advanced satellite platform and a constellation of earth observation satellites. The training program shall also facilitate the transfer of all required theoretical knowledge, skills and hands-on experience by allowing the full integration and co-location of the Filipino engineers with its project team. The theoretical courses shall be delivered remotely, which will accommodate up to thirty trainees. The rest of the training program shall be conducted at the premises of the Contractor and shall be participated in by thirteen Filipino engineers. Further details and minimum specifications of the Training Program are stated in Section 7 of this document.

5.3 Consultation Services

The Contractor shall provide consultation services in the following areas to the End-user to support in the further development of the Philippines as a space nation, enabling progression along the identified roadmap to establish both facilities and capability in country:

a. Satellite data product and Mission planning
b. Assembly, Integration and Testing (AIT) Facility Set-up
c. Ground receiving stations (GRS) facility set-up and Assessment of GRS locations

Description of consultation deliverables are discussed in section 8.

6. Satellite Development

6.1 Mission requirements

The Contractor shall provide a design concept along with a training and licensing package for a 100-150 kilogram satellite platform that can accommodate a medium-resolution

multispectral optical imager with the specifications described below. Moreover, the design concept shall include provisions for propulsion, advanced core avionics with in-flight software update capability, near-real time data turnaround, an AIS payload for ship tracking and an ADS-B for aircraft tracking, among others.

Within six (6) months, the PDR shall be completed to determine the preliminary mission and satellite design specifications along with the preliminary concept of operations (CONOPS). The PDR shall present analysis that will serve as an early proof that the design concept can meet the target unit and system level specifications described in this section. This initial analysis shall include, but should not be limited to, satellite structural analysis, satellite thermal analysis, satellite system budgets and satellite computer-aided design (CAD) model. The Contractor shall also provide complete and more comprehensive specifications for the satellite upon request of the End-user to verify that the Contractor's proposed system, satellite and payloads meet the specifications as stated in this section.

6.2 Satellite platform specification

A mechanical structure excluding the separation system shall accommodate all the subsystems and the payload of the satellite. A platform that should be compatible with future missions will be proposed by the Contractor. Majority of the sub-systems shall be built and designed in the Contractor's facilities. At the minimum, the satellite component and unit level performance shall be able to meet the minimum specifications stated in this section:

6.2.1. On-Board Data Handling (OBDH) Subsystem

The OBDH subsystem consists of the On-Board Computers (OBC) and the on-board Controller Area Network (CAN). The OBC shall be capable of management of satellite operations including the execution of telecommands and monitoring of the satellite subsystem telemetry. The OBC shall also provide telemetry data including, but not limited to, those listed in table 1. These data and a real-time subset of these shall be downloadable to the mission operators during ground contact. This shall also be responsible for the autonomous control of the spacecraft platform and payloads. The OBC will run a set of software designed to execute payload and platform operations, maintain the attitude of the satellite, monitor critical telemetry and monitor satellite safety. The OBC software shall routinely record log files of software activities such as, but not limited to, telecommands received from the ground segment, execution of telecommands and system status. These shall be downloadable for the analysis of the status and health of the satellite. The CAN enables the control of the main modules of the spacecraft that are connected to the OBC. The minimum requirements for the OBC and CAN are shown in table 2.

Table 1. Minimum downloadable telemetry data to be recorded by OBC

Downloadable telemetry data*
1. Sensor and focal plane temperature
2. Date and time of image acquisition
3. Sun and sensor viewing angles (in quaternion values at the time of capture)
4. Satellite estimate of the center latitude and longitude of the acquired image or Global Positioning System (GPS) data of the satellite
5. Battery levels of the satellite

6.	Full telemetry data of the visible acquisition or download - time when the cameras are turned on - Imager electronics voltage consumption - Imager electronics temperature
7.	Storage memory and image ID
8.	Attitude telemetry
9.	Voltage consumption of all platform modules
10.	Temperature of all critical modules

* Data pertinent to image processing shall be included in the image metadata and shall be downloaded simultaneously with the image.

Table 2. OBDH subsystem components and minimum requirements

Qty	Component	Parameter	Required value
2	OBC	processor speed	60MHz
		main memory	256 Mbytes
2	CAN bus	Line rate	388 Kbit/s

6.2.2. Attitude and Orbit Control Subsystem (AOCS)

An AOCS shall ensure platform stability and pointing accuracy. There will be an interface integrated to the OBC which will provide telemetry and telecommand interface to the connected units. This interface will also provide and control power to the sun sensors and magnetometer. A suite of attitude actuators consisting of reaction wheels and magnetorquer rods will enable precise and active control of the attitude. The attitude data will be provided with high accuracy by a suite of attitude sensors consisting of sun sensors, magnetometers, gyros and star trackers. The AOCS shall also consist of a GPS receiver for the accurate determination of spacecraft position and velocity. It shall also provide the precise reference time for all systems on-board. A summary of quantity and requirements of the components are as follows.

Table 3. Suite components and minimum requirements of the AOCS

Qty	Component	Parameter	Required Value*
1	Interface module	-	-
4	sun sensors*	Field of View	±58±2 degrees on axis, ±66±2 degrees diagonal
		Accuracy	0.5 degrees 3σ (with calibration), 3.5 degrees (without calibration)
3	magnetorquer rods	Magnetic moment capability	5 Am^2

4	microsatellite reaction wheels	Maximum Torque	11 mNm
		Range	0-5000 RPM
		Max. angular momentum	0.42 Nms
2	GPS Receiver	3D Position accuracy	10 m (value at 2σ)
		3D velocity accuracy	0.015 m/s (value at 2σ)
		Time accuracy	<1 microseconds
2	magnetometer	Field Measurement range	±120μT
		Accuracy	< ±1% of the measured value
2	star tracker data processing unit*	Space-time noise on XY / Z	7.5 / 48 arcsec 1σ
		Bias (worst case)	0.017 deg
		Low Frequency spatial (FOV) error XY / Z @ 3σ	9 / 51 arcsec
		High Frequency spatial (Pixel) error XY / Z @3σ	6.6 / 37 arcsec
		Temporal Noise on XY / Z @ 3σ	11 / 69 arcsec
		Time from lost-in-space (typical)	<4s
		Slew rate in Acquisition	0.3 deg/s
		Slew rate in Tracking	Up to 3 deg/s
		Full Moon in the Field-of-View	No Performance degradation
2	star tracker camera head unit	Field of View	30deg
		Baffle Sun Exclusion Angle	35deg
		Baffle Earth Exclusion Angle	22deg
8	gyros	Bias instability Accuracy	0.34deg/h 0.15 deg/sqrt(hr)

**If any of the units mentioned above are procured from a third party supplier, then the Contractor shall procure based on those requirements, though will not be required to individually verify the specifications at unit level.*

6.2.3. Satellite power system

The satellite shall have a solar array configuration consisting of two fixed body-mounted panels and one fixed deployable panel, all panels composed of AZUR3G30 solar cell assemblies. The system shall utilize a lithium-ion battery for the storage of the power generated by the solar panels. The power generated by the solar panels will be regulated by the Battery Charge Module (BCM). This module will also be responsible for managing the charging of the battery. A Power Distribution Module shall also be responsible for the conditioning and distribution of power to the satellite subsystems. A Hold-Down Release Mechanism (HDRM) shall be responsible for the restraint during launch and deployment of solar panels upon activation during post-launch. Actuators involved shall be non-explosive. The proposed satellite power system shall consist the following components:

Table 4. Power system components and minimum requirements

Qty	Component	Parameter	Required value
2	Fixed solar panels (+/- X)	Efficiency	28.9 % at 28 °C
1	Deployable solar panel (+Y)	Solar cells	AZUR3G30
		Maximum capacity*	approximately 113.9 W at beginning- of-life (BOL) approximately 82.2 W at end-of-life (EOL)
1	Lithium ion battery	Configuration	3 parallel strings with 8 cells in series (8S3P)
		Total battery capacity	13.5 Ah
		Battery cell energy	16Wh per cell
		Battery voltage range	32.8 - 24 V
		Total battery energy	384 Wh
		Mass	3.8 kg
1	Battery charge module (BCM)	Number of battery charge regulators	6
		Nominal power input channel	150 W
1	Power distribution module (PDM)	-	-
2	Activation switches	-	-

**Values based on best case temperature of -40°C and worst case temperature of +70°C and may vary depending on the mission start date*

6.2.4. S-Band Telemetry, Tracking and Command (TTC) Subsystem

The TTC subsystem transmitter and receiver avionics shall consist of a low-rate S-band receiver and transmitter, and shall be integrated into the OBC. The S-band receiver and transmitter shall interface to the S-band patch antenna and the S-band monopole antenna outside of the spacecraft. The following table gives the summary of requirements for the TTC subsystem:

Table 5. TTC components and minimum requirements

Qty.	Component	Parameter	Required value
2	S-band uplink receiver	Data rate	19.2 Kbps
2	S-band downlink transmitter	Data rate	38.4 Kbps
4	S-band patch antenna	-	-
2	S-band monopole antenna	-	-

The satellite shall be able to store up to seven (7)-days worth of scheduled commands that can be replaced, updated or deleted up until the start of a payload or downlinking task, i.e., before the spacecraft implements the first telecommand for setting up payload data acquisition or download.

6.2.5. Overall platform specification

The satellite shall be designed to provide structural, electrical and mechanical support for all subsystems. The required system features needed for the successful fulfillment of applications mentioned in section 1 are given in table 6. The initial orbit and mass will be presented during the PDR.

Table 6. Summary of Satellite Platform Minimum Specifications

Parameter	Value
Reference Orbit	600 km Sun-synchronous ~10:30 LTAN
Launch Mass	100-150 kg
Primary payload	medium-resolution multispectral imager
Geolocation error	<=250 m
Pointing accuracy	0.07 degrees (1σ)
Platform off-pointing	±45 degrees
Simultaneous imaging and downlink	Yes

6.2.6. Satellite Launch Vehicle

The satellite platform shall support the installation on a satellite launch vehicle and allow the installation of a suitable separation system. The final launch procedure is to be determined with the launch provider who will be selected at the later stages of the satellite development.

6.3 Payload chain specification

The satellite platform shall have flexibility and capability to carry a multispectral imager as its main payload and allow complementary data acquisition with its secondary payloads. The optimal settings and automatically set parameters shall be reported by the Contractor at PDR and agreed with the End-user in accordance with the preliminary Concept of Operations (CONOPS).

6.3.1 Multispectral imager payload

The primary multispectral imaging payload shall satisfy the minimum payload specifications in table 7. In-orbit signal-to-noise ratio (SNR) and the Modulation Transfer Function (MTF) minimum requirements in table 8 shall be presented at PDR. The Contractor shall offer flexibility on final band selection in the mission design phase and ensure comparable SNR and MTF values when changes are made to the bandwidths indicated in table 8. Narrowing down to particular band windows (620, 665 and 708) shall also yield the indicated SNR and MTF values.

Table 7. Multispectral Imaging payload minimum specifications

Parameter	Value
Imager type	Complementary metal-oxide semiconductor (CMOS)
Imaging method	Pushbroom with time delay integration (TDI)
Pixel size	5.5 µm
Pixel depth	At least 12 bits
Swath width	~120 km at 600km altitude at nadir
Number of bands available	9
Band edge tolerance	± 4 nm
Band edge slope	0.008
Equivalent Ground sample distance (GSD)	5 m at 600 km altitude at nadir
Binning	2x2, 4x4
Maximum TDI lines for all bands imaged	200
Operational temperature range	TBD
Survival temperature range	-20 to +50 ℃
Secondary payload	Automatic Identification System (AIS) and Automatic Dependent Surveillance-Broadcast (ADS-B)

Table 8. Multispectral imaging payload bandwidth specifications with corresponding minimum SNR and MTF requirements

Band	Wavelength (nm)	Binning	SNR*	MTF**(%)
Aerosol/Coastal Blue	433-453	4x4	171	3
Blue	458-523	none	166	10
Green	535-585	none	150	5
Red	630-680	none	142	5
Red Edge-1	690-720	none	86	5
Red Edge-2	727-753	none	69	5
Red Edge-2	769-797	none	65	5
NIR-1	777-907	none	136	5
NIR-2	845-885	none	52	5

**Assuming 10:30 LTAN at 45-degrees North at mid-summer 30% albedo, and assuming TDI of 32 for all bands except Aerosol at 16.*

***For TDI of 32 for all bands and on optical axis at nadir and at Nyquist, except Aerosol and Blue which are at half-Nyquist.*

6.3.2 Automatic Identification System (AIS) Receiver

The satellite shall have an AIS receiver as one of the secondary payloads to support maritime applications. The day in the life scenario defining how the secondary unit will be used shall be agreed with the End-user by PDR in order to verify the system design.

Table 9. AIS minimum specifications

Parameter	**Value**
Channel Frequencies	161.975 MHz, 162.025 MHz
Channel selection	Default to be specified by End-user
Channel Bandwidth	25 kHz
Data Output	Digitised AIS channel as baseband IQ samples or demodulated AIS messages
Data Output Interface	LVDS
Noise Figure	5 dB
Power Interface	28V DC unregulated

Command/Telemetry Interface	CAN
RF Input Connector	Subminiature version A (SMA)

The AIS is designed to receive signals which are compliant to the International Telecommunication Union (ITU) as indicated in ITU-R M.1371. For readability, an .xml file shall be provided where the binary AIS data have been converted to ASCII following the NMEA 0183 format.

6.3.3 Automatic Dependent Surveillance-Broadcast (ADS-B) Receiver

The satellite shall have an ADS-B receiver as one of the secondary payloads to support aeronautical applications. The day in the life scenario defining how the secondary unit will be used shall be agreed with the End-user by PDR in order to verify the system design.

Table 10. ADS-B minimum specifications

Parameter	Value
Channel Frequencies	1090 MHz
Channel Bandwidth	2.6 MHz
Data Output	Demodulated ADS-B messages in binary format
Data Output Interface	LVDS
Noise Figure	5 dB
Power Interface	28V DC unregulated
Command/Telemetry Interface	CAN
RF Input Connector	SMA

6.3.4 Payload data handling unit (PDHU) and Payload Downlink

The PDHU is responsible for uploading settings to the payload and for recording, managing and storing its data. This unit also implements compression necessary for data download. The temporary storage of payload data and the downlink shall have the following specifications:

Table 11. PDHU and payload downlink specifications

Parameter	Minimum Value
On-board data storage capacity at the beginning of life	500 GB
Compression algorithm	JPEG-LS Lossless compression
Over-the-air transmission rate	400 Mbps at X-band

Effective transmission rate	360 Mbps at X-band
Broadcast mode	Automatic repeat request (ARQ) or non-ARQ

6.4 Performance requirements

The Contractor shall report solutions to the following performance requirements to be met pre-launch. This shall be verified by design or analysis during the design phase. A preliminary report of all pertinent files, softwares, content, formats and sizes, including corresponding export restrictions, shall be provided during the PDR.

6.4.1 Imaging Capacity and Daily Throughput

Simulation results showing the imaging capacity and daily throughput shall be provided by the Contractor (table 12). Inputs to the simulation are the required satellite specifications and the locations of local ground stations. Also included in the report are binning parameters, number of bands captured and the access times needed for the download of a given throughput during (1) download-dedicated pass and (2) simultaneous imaging and download pass.

Table 12. Minimum performance requirements for imaging

Performance Parameter	Value
Imaging Capacity	
Average Access time (based on one ground station based in Davao)	~26 minutes
Average Revisit time at nadir*	7-89 days
Average Revisit time* (off-pointing at 10 degrees)	6-9 days
Daily throughput	38 GB
Equivalent daily area imaged	123,000 km^2
Equivalent daily strip length	1,018 km
Equivalent imaging time	147 s

*This is an average revisit time based on the reference orbit of 600km SSO LTAN 10:30:00. This revisit time may change over lifetime if orbit is not maintained and will also depend on the final injected orbit. Further analysis to refine this value will be performed during the design phase of the mission.

6.4.2 Simultaneous Imaging and Download of Primary and Secondary payload data

The satellite system shall allow simultaneous image and data capture of the multispectral imager and secondary payloads to enable data from all three (3) payloads to be captured for the same target area in the same time frame. The primary payload data shall be able to be captured and downloaded in a single pass.

6.4.3. Near-real time data turnaround

For the primary payload, the satellite shall be capable of simultaneous imaging in nine (9) bands and download for payload data. Files shall be created in the PDHU during image capture and will be able to be downloaded as soon as they are closed, enabling this near-real time data download or downlink.

6.4.4 Data Products

Image processing software shall be supplied in follow-on phase contract to produce the following image products:

a. A single georeferenced image product containing the blue, green, and red spectral bands, at 5m sampling.
b. Separate georeferenced image products for each of the other spectral bands at 5m sampling, except the coastal blue which will be at 20m sampling.
c. File format in public domain metadata standard (e.g. GeoTIFF, or other more compressed formats NetCDF, HDF, HDF5 or HDF-EOS)

6.4.5 Redundancy

The satellite shall be dual redundant in the avionics, AOCS system and payload chain with graceful degradation in the imager and reaction wheels. The quality of the captured images and performance of the satellite shall not deteriorate upon use of the backup components. The AIS and ADS-B payloads and the propulsion system shall be single string.

6.4.6 Orbital Maneuvers using Propulsion system

The satellite shall include a propulsion system that can be used to perform orbital maneuvers including:

a) Orbit injection correction
b) Altitude Maintenance
c) Collision Avoidance

A delta-v analysis will be performed to assess the orbit maintenance strategy, the preliminary results of which will be presented at PDR.

6.4.7 Pre-flight calibration

A pre-flight radiometric calibration report shall include the relative spectral response of each band, estimated out-of-band values, non-uniformity corrections, among others shall be provided in the following phase. These data shall be given for varying gain, exposure time and TDI lines. A preliminary report on initial calibration plan shall be presented at PDR. The report on the implementation of the calibration and its results shall be completed at the following phases.

6.5 Operational requirements

The Contractor shall report solutions to the following operational requirements to be delivered pre-launch. This shall be reported by the design or analysis during the design phase.

6.5.1 Payload Tasking

For the mission objectives determined by the End-user, the Contractor shall be responsible for confirming the feasibility of perceived tasking requests, recommending de-conflicting protocols and formulating corresponding tasks to the satellite. These shall be reported to the End-user during the mission design phase and presented as part of the PDR data package.

6.5.2 Ground Station Requirements

The Contractor shall conduct an assessment of all ground stations in the Philippines that the End-user intends to utilize within the Philippines and ensure that these ground stations will be compatible for communication, uplink and downlink with the satellite. This assessment may be done remotely using available information or may be on-site if an inspection is deemed to be appropriate by the Contractor. Should the ground stations be found incompatible due to software and hardware deficiencies and datedness, the Contractor shall inform the End-user of all hardware and software updates and their corresponding costs. An assessment of the potential ground receiving station (GRS) locations for backup reception or backup nodes shall be conducted to allow data downlink during emergencies.

6.5.3 Mission Operations

The Contractor shall recommend a workflow for mission planning and image processing during the design phase until PDR. It is envisaged that the mission planning and image processing should include the following considerations:

Table 13. Software and GUI requirements

Software/GUI	Functionality
Collection Planning System	-centralized planning engine which receives, consolidates and prioritizes imaging requests -capable of assessing the feasibility of requests within the capabilities and the normal operating envelope of the spacecraft -allows updating the progress of requests
Scheduler	-facilitates scheduling of imaging tasks, and ground and space segment calibrations. -enables satellite to maintain on-board schedule of tasks for up to 7 days
Data processor	-automatically decompresses and enables processing to georeferenced and co-registered images
Catalogue System	-allows inventory, retrieval and downloading of stored images via graphical interface. -provided metadata shall include quick-looks, date of capture, file sizes and geographical area viewing -enables search by location and processing levels
Flight Dynamics System	-tools to plan and schedule propulsion firings -converts downloaded GPS files into TLE's (orbital information) for use in the general ground segment

6.5.4 Design life

The Contractor shall ensure that the proposed satellite will fulfill its intended mission for at least five (5) years. In addition, the satellite shall have a mechanism to de-orbit within twenty-five (25) years from the end of its operational life if required. This shall be verified by analysis during the design phase.

The Contractor shall submit documentation to ensure that previously designed satellites have reached and/or exceeded their designed lifespan.

7. Training Program

7.1 Program structure

As a whole, the Contractor's proposed training program shall provide for a holistic approach consisting of theory, technical complementary courses, personnel development, and practical hands-on training in mission design, subsystem design, and manufacturing. The primary language of instruction and communication for the duration of the program shall be English. The program structure will have solutions for a remote training set-up for the theoretical component and the Qualification Status Review that would cater to the Filipino Engineers and the additional Trainees nominated by the End-user. While the remaining

activities under the Preliminary Design Review (PDR) shall be done on-site at the Contractor's facilities for hands-on training and mentoring.

The following topics shall be covered for the duration of the program:

a. Mission analysis and design
b. Subsystem design, (power, propulsion, AOCS software and hardware, data handling, flight software, radio frequency (RF), structure)
c. Project management
d. Quality Control
e. Documentation control

The following courses will be included in the following phase/s of the project:

a. Subsystem design (build and test)
b. Manufacture process and test practices
c. Procurement and kitting

The Contractor's program shall feature academic and theoretical courses as well as practical and interactive workshops to provide the team with a robust preparation for the on-the-job training. This shall include access to the Contractor's facilities and all necessary training components including, but not limited to, software and hardware supplies, documentation, manuals, and source codes. The training program shall use the same or flight equivalent software, firmware and hardware components to be utilized during the manufacture of the actual procured satellite and its local operation. These shall then be compounded by a series of hands-on training, especially in terms of executing the mission planning and design phase requirements of the project. The Contractor shall also provide lectures and activities to ensure knowledge in project management methods and quality management reports. A schedule of activities shall be delivered upon kick-off and shall be updated and communicated with the End-users throughout the duration of the contract.

7.1.1 Remote training

The Contractor shall ensure that the theoretical training is to be completed on a remote setup, wherein the training recipients are participants nominated by the End-user, including and not limited to the selected Filipino Engineers. All online meetings and reviews related to the theoretical part of the training shall involve the nominated personnel of the End-user.

7.1.2 On-site training

The Filipino Engineers shall only be expected to work at most for 7.5 hours a day from Monday to Friday similar to the working hours set by the Contractor for its regular employees. This shall coincide with the working or operating hours in the company's facilities. They shall also be allowed to take holiday leaves provided it is formally requested from authorized representatives of the Contractor and the End-user, except for emergency cases wherein no formal requests shall be required. The Filipino Engineers shall be subject to fair and just working conditions as provided by national work laws and policies. If necessary, the End-user may provide monthly payslips as deemed required by the Contractor.

The Contractor and the Filipino Engineers are encouraged to engage in joint scientific papers and presentations at international conferences.

7.2 Research team

The project shall involve a total of thirty (30) trainees who will attend the remote training consisting of the theoretical part. Thirteen (13) of which are the Filipino Engineers who shall participate full-time and hand-on in the Contractor's training program. The following functions listed below shall be performed, at a minimum, by the Filipino Engineers for the duration of the program:

a. Project Management
b. System Engineer
c. Thermal, Radiation, and Propulsion Engineer
d. Payload (Optomechanics) Engineer
e. Payload (Optics/ Optoelectronics) Engineer
f. Mechanical Design Engineer
g. Mechanical Analysis Engineer
h. Power Engineer
i. RF S/X-Band Engineer
j. On-board Data Handling Hardware Engineer
k. Flight and TT&C Software Engineer
l. AOCS System, Software, and Equipment Engineer
m. AOCS Hardware and GPS Engineer

The Contractor shall assist the End-user with the selection of the Filipino Engineers to determine potential capability and suitability for each technical discipline. The Contractor shall provide profile expectations, role specifications and technical set of questions if deemed necessary. The End-user reserves the right to have the final decision on the selection process. During the training program, the End-user reserves the right to revise, remove, or re-assign roles and responsibilities upon mutual agreement with the Contractor. Furthermore, the End-user shall notify the Contractor should there be changes to the Filipino Engineers in cases of resignation or disaffiliation from UP, DOST-ASTI, or the Philippine Space Agency (PhilSA).

The Contractor shall also provide assistance with the Filipino Engineers' visa application. Logistical and administrative support shall also be provided by the Contractor for the temporary relocation of the Filipino Engineers. This shall include, but not limited to, finding suitable accommodation, opening bank accounts, registering with the local health center and police and applying for insurance.

The schedule of contract deliverables shall not be affected by delays in arrival and unavailability of the Filipino Engineers. The Contractor shall ensure both on-site and remote learning training. Specifically, the project kick-off and theoretical training shall be done remotely. The hands-on training and the rest of the training activities shall be done on-site. In preparation for the actual activities related to the mission, a platform for developing essential non-technical skills and for learning necessary tools and theory shall be provided to the Filipino Engineers.

7.3 Training requirements

7.3.1 Training Components

The intensive training program should have the following components and extent:

Table 14. Components of the training program

Item	Component	Extent
1	Exposure and access to the Contractor's company	All levels, including Director of Projects, Group Managing Director and Chairman of the Contractor, shall be accessible to the End-users and Filipino Engineers for consultations or meetings relevant to the project. Filipino Engineers shall be co-located with the Contractor's project team for ease of access to facilities, personnel, and communication. The Filipino Engineers shall receive significant supervision from their mentors and have access to technical departments and at all levels of the Contractor's organization relevant to the accomplishment of expected output. The Filiipino Engineers shall be able to shadow their corresponding mentors through the lifecycle of the project phase.
2	Design	The Filipino Engineers shall have a full involvement in system design and analysis through a combination of formal technical training and hands-on experience. The Filipino Engineers shall also have a full insight into detailed design choices. All trainees shall have access to most design tools with in depth module based training.
3	Mission Analysis	Trainees shall have full involvement in Mission Analysis tasks covering but not limited to following topics: ● Coverage Analysis ● Revisit times and Ground Station Accesses ● Orbit options and tradeoffs (i.e. LTAN drift analysis over lifetime, altitude maintenance requirement, constellation management as may be applicable) ● Launch options ● Data manipulation and processing requirements ● Mission planning capability (i.e. satellite resources, antenna availability) Mission Analysis training targets to enable Trainees to understand various opportunities, constraints, risks, etc. relevant to planning future missions and/or satellite constellations for the PH, including EO and telecommunication satellites. This will serve as input to the long-term (10-year) mission and satellite development plan for the PH.
4	Introduction to Image Analysis	Contractor shall provide a practical short course in satellite imagery processing and typical value-added applications based on other multispectral imagery from Contractor’s satellites and other freely available image sources.

5	Access to Intellectual Property	The Filipino Engineers shall have on-site access at the Contractor's premises to relevant Intellectual Property required to undertake their training, which may include, but not be limited to, source codes, parts lists, schematics, manufacturing drawings, firmware, and executables as required for the execution of the project.
6	Academic Course in Spacecraft Design	Academic short course/s shall be available through a partner university for specialized training on spacecraft system design
7	In-depth training	Training shall be tailored to End-user's requirements. Mentors shall be part of the project team and are readily accessible. The hands-on training shall be co-located within the Contractor's functional engineering team. The Filipino Engineers shall have involvement in the mission planning and design activities of the project in preparation for the assembly, integration, Environmental Verification and Test (EVT) and verification from subsystem to satellite level which would be completed should a further phase of the project be undertaken. The Filipino Engineers shall have on the job training using the flight model hardware where appropriate. The Filipino Engineers shall have specific training on firmware modification for future development in the Philippines. All trainees shall have technical and non-technical exposure to all aspects of a spacecraft life-cycle to develop the key skills that can be directly transferable to future projects. All trainees shall be provided with theory training courses that include topics on Systems Engineering and Subsystems. All trainees shall have access to relevant project information in accordance with contract specifics.
8	Access to facilities and equipment	Filipino Engineers shall be provided with access to facilities and equipment, which are as follows: a. Dedicated IT infrastructure for information transfer and storage b. Office tools, computing facilities and software packages that are necessary for the training c. Same or flight equivalent software, firmware, and hardware components d. Office accommodation e. Facilities that include spacecraft operation center, clean rooms, Assembly, Integration and Test (AIT) hall and thermal chambers, and external test facilities as required for the training

9	Active involvement in project activities	The Filipino Engineers shall be actively involved in meetings and technical discussions as well as project milestone reviews. The trainees shall also be encouraged to contribute to meetings by producing and presenting project review materials as required, with the support of a relevant subsystem engineer or manager from the Contractor. The Filipino Engineers shall also be allowed to provide recommendations in terms of the satellite design, which will be reflected in the Training Progress Evaluation and Project Reviews.
10	Access to specialist software	Filipino Engineers will have access to specialist engineering software to enable them to perform training and tasks during the satellite design activities. Typical software functionalities will include,but not limited to: -Mechanical Engineering simulation software for design & test - General-purpose programming - Reviewing complex schematics & design - Source code design for operating systems - Debris risk assessment analysis - Script engine in support of Linux - Working with files under concurrent version system (CVS) version control directly from Windows Explorer. - C/C++ development for project creation & build for various toolchains - Unified Modeling Language (UML) analysis and design tool for UML, Systems Modeling Language (SysML) & Business Process Modeling Notation(BPMN). Covering software development from requirements gathering through to the analysis stages, design models, testing and maintenance - Calculation of radiation effects on electronic components -Electromagnetic simulation used for reliable electromagnetic analysis, shielding & antenna design/placement - Programming for field-programmable gateway arrays (FPGA's) -Portable Document Format (PDF) Reader - Tracking changes in source code during software development - AIT Harness design & manufacture - Mechanical Engineering simulation for design - Automatic regression testing. - Bug tracking and agile project management. - FPGA & System-on-chip (SoC) design - The operating system, which manages the communication between software and hardware - Matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other language - Mechanical 3D analysis simulator in x-y plane - Providing toolbox for remote networking - Schedule management - Structural analysis & simulation - Space environment and radiation effects on electronic devices - Text and source code editing for use with Microsoft Windows.

		- Building models which can be used to design and de-rate circuits - Programming for creating test scripts and general purpose coding - Bench testing i.e. GPS functional testing - Integration of mechanical analysis with optical analysis - Mechanical & Mechanisms software for capturing vibration test data - Solid modelling computer-aided design and computer-aided engineering - Performing complex orbit analyses of space platforms - Simulation of the thermal behaviour of a spacecraft in orbit - Code editing, debugging, and building code. - Design tool for use in embedded systems. - Comparing files and folders to find differences, code changes and updates - Creating spacecraft log files - Synthesis and analysis of Hardware Description Language (HDL) designs - Model and analysis of optical systems.

7.3.2 Dedicated Training Team

A dedicated training team responsible for the Quality Control of the training program shall be provided by the Contractor. The Contractor should also provide a Training Manager for the duration of the project. The Training Manager is responsible for the training program, the production of training plans by mentors, conducting evaluations, progress monitoring, managing the mentors and all the Filipino Engineers working on the project, administrative and logistical aspects of training and living abroad, and reporting on the Filipino Engineers' performance back to the End-user.

A dedicated mentor shall be assigned to each Filipino Engineer for each technical discipline. The mentor shall be responsible for the following:

a) Defining and refining the training plan to meet the Filipino Engineer's individual needs as the program progresses

b) Supervising the activities and progress monitoring of the Filipino Engineers

7.3.3 End-User Participation

The End-user and Project shall be allowed to oversee the technical and administrative components of the training program. The Contractor shall ensure that all activities are to be communicated regularly to the End-user through email correspondence and meetings as part of the quality assurance and control. The End-user reserves the right to recommend revisions to the training program upon mutual agreement with the Contractor. Likewise, the End-user shall also perform Quality Control through the feedback of the Filipino Engineers of which shall be shared with the Contractor.

Future consultations with the Contractor will be included in the following phase/s of the project.

7.4 Training program deliverables

The Contractor's training program shall have the following deliverables:

a) Monthly Training Plans – Each report must contain defined learning objectives and activities for each of the thirteen (13) Filipino Engineers. These plans shall be tailored to their individual qualifications, experience, and abilities. These shall also contain methods of assessment to track progress alongside feedback mechanisms, as necessary.

b) Training Progress Evaluation Reports – These contain more detailed description of training tasks and activities for each of the thirteen (13) Filipino Engineers. These shall also contain any general training events that took place. Evaluation shall include progress, achievement, work in progress, upcoming tasks and mentor's or training manager's comments. Any relevant recommendations from the Filipino Engineers will be included as well.

c) Satellite concept design as output of the hands-on training activities, which shall be presented as part of the PDR data package to be delivered.

d) Materials and tools such as training manuals, project documentation, hard copies and electronic copies of course materials and lecture notes for the introductory KHTT courses and general knowledge courses.

e) People trained within the duration of the contract, which shall include the following:

- 30 people trained, inclusive of the 13 Filipino Engineers, for remote training to be conducted within 2 months, covering the theoretical component and activities on QSR.
- 13 FIlipino Engineers trained on hands-on activities for mission planning and preliminary design review to be conducted within 4 months after QSR

f) Certifications for the Filipino Engineers and nominated personnel to confirm that specific skill sets were acquired during the training program.

8. Consultation Services

8.1 Satellite data products and Mission Planning

The Contractor shall prepare and deliver a document at PDR that sets out the multispectral imager, ADS and AIS data formats from the spacecraft required for processing that can then be used by the End-user in developing further data products locally. The Contractor shall also list the software tools that it considers necessary for development of future missions.

Upon delivery of the requirement documents, the Contractor shall provide remote support via a fortnightly telecon (when needed) to questions and queries from the End-user in evaluating information that may be received.

8.2 AIT Facility Set-up

The Contractor shall provide an AIT requirements document by the Qualification Status Review (QSR) that the End-user can use as guidance for any local specification of AIT facilities. This document should include details on the specification and size of such a facility,

as well as the standards required for testing a satellite of similar size to that to be procured as part of this process. The Contractor shall provide a list of tools that are commonly used in such facilities as well as a list of the tools commonly required in such a facility to enable Satellite Integration.

Upon delivery of the requirement document, the Contractor shall provide a reasonable level of remote support via a weekly telecon (when needed) to questions and queries from the End-user in evaluating information that may be received once procurement activities have started locally and in assessing the suitability of any quotations received.

8.3 GRS Facility Set-up and Assessment of GRS Locations

The Contractor shall prepare a Ground Segment Interface Control Document that outlines the ground station requirements (RF performance, frequencies, modulation schemes, coding, interfaces) to allow the End-user to assess existing infrastructure of its suitability to operate and receive Payload and AIS data from the Contractors satellites. The Contractor will need to work with the End-user to assess the existing GRS and provide a list of equipment to upgrade the system as needed.

The Contractor shall provide an infrastructure requirements document to the End-user to allow infrastructure (suitable room area, power, networking, IT infrastructure) to be procured to allow the installation of the Contractors supplied software to allow platform and payload operations to be performed from the local control centre planned to be utilized by the End-user for this mission.

The Contractor shall review up to four (4) DOST identified GRS locations that can be used for back up to the main GRS to assess suitability for backup GRS duties.

Upon delivery of the requirement documents, the Contractor shall provide a reasonable level of remote support via a weekly telecon (when needed) to questions and queries from the End-user in evaluating information that may be received once procurement activities have started locally and in assessing the suitability of any quotations received.

9. Hardware Inclusions

Some hardware shall be procured by the Contractor in preparation for assembly and testing in the following phase/s. These equipment shall remain and be maintained at the Contractor's premises. These include the following:

Table 15. Hardware to be procured during PDR

Item	Equipment	Purpose or Function/s
1	Sun Sensors	Four (4) flight Sun-Sensors in readiness for the following phase/s
2	Optical Electrical Ground Support Equipment	Equipment that supports the imager testing on the ground Includes two computers and two coaxpress frame grabbers

		Used during MTF (measuring the optical performance of the lenses) and optical testing
3	100 TB Data storage device	Support imager testing on the ground during the following phase/s
4	Breadboard of electronics and thermal straps around the imager design	Re-risk the imager design
5	Imager mounting and isolation system	Testing of mounting methods
6	Solar cells	Parts of the deployable and body-mounted panels in readiness for the solar laydown onto the panels for the following phase/s
7	Magnetometers	Two (2) flight anisotropic magnetoresistive (AMR) magnetometers in readiness during the following phase/s

10. Access to Intellectual Property

All intellectual property (IP) owned by the Contractor that is relevant to attaining and reviewing the milestones covered in this contract shall be accessible to the Filipino Engineers and the End-users on site at the Contractor's premises.

11. Licensing Requirements

The Know-How Training & Transfer ("KHTT") License shall consist of the following data and documentation, which shall be included by the Bidder as provisions to be provided at the end of the overall program upon completion of the follow-on phase:

a. Schematics, Board Layout, Gerber Files, and other PCB Fabrication Specifications
b. Drawings,CAD models, and Manufacturing Files
c. Firmware, Software and Application Program executable files
d. Interface Control Documents (ICDs)
e. Build instructions
f. Test instructions
g. Parts lists
h. Bill of Material/s
i. Data Processing Software and Algorithms

To facilitate the transfer of technology and know-how, the Contractor shall commit that they will provide a license to the technology and the IP mentioned above, it being recognized that such license will be provided as part of the future activities. The KHTT license shall grant use of the Contractor owned Intellectual Property Rights (IPR) identified above to DOST-ASTI, the UP Diliman, and the Philippine Space Agency to allow manufacturing of future satellites in the Philippines for their own non-commercial needs. The perpetual license shall permit the Philippine government to reproduce and modify these technologies to enable alternate payloads to be accommodated on the Contractor's platform and adapt to national future missions, with no obligation to pay royalties to the Contractor. The Philippines may request, in the future, the Contractor's support as may be necessary, which the Contractor commits to provide if so requested. Such support shall be in accordance with a future contract to be agreed between the parties.

This condition applies to the future phases of this programme awarded by DOST and/or other Philippine government departments.

This shall form part of the License Agreement between the Contractor and the aforementioned institutions in the Philippines as end-users of the technology and know-how.

12. Payment and Delivery Terms

12.1 Documentation

The Contractor shall provide all necessary documentation, such as but not limited to, reports, minutes of meetings, manuals, among others. These documents shall all be in English.

12.2 Reporting Media and Formats

Unless otherwise stated, reports shall be provided in electronic format.

12.3 Severability

The invalidity of any portion of the agreement/contract shall not affect the validity of the remaining portions thereof.

12.4 Currency

The Contractor shall describe all financial bid prices in Philippine Peso.

12.5 Payment and Delivery Terms

Philippine Government terms. Payments shall be inclusive of, but not limited to, all government fees, taxes and other applicable fees and charges. Payment shall be made in Philippine Peso. T0 shall commence within thirty (30) days upon the issuance of the Notice to Proceed, such date to be agreed upon by the End-user and the Contractor.

Table 16. Milestones and payment terms

Milestones and Deliverables	Deliverable Format/Type	% Payment	Date
Project Kick-Off		15%	T0 + 2 weeks
Kick-off Documentation	pdf and ppt		
Project Management work plan	pdf		
Master Schedule	Gantt chart in pdf		
Risk Register	pdf		
Minutes of the Meeting, when applicable	pdf		
Waivers, Deviations and Non-Conformance Reports, when applicable	pdf		

Technical Notes, when applicable	pdf		
Qualification Status Review (QSR)		45%	T0 + 2 months
Master schedule	Gantt chart in pdf		
Action Register	pdf		
Risk Register	pdf		
QSR Documentation	pdf and ppt		
Monthly Project Status Report equivalent to 2 months	pdf		
Minutes of the Meeting, when applicable	pdf		
Waivers, Deviations and Non-Conformance Reports, when applicable	pdf		
Technical Notes, when applicable	pdf		
Remote Training			
At most thirty (30) Filipino Engineers, Scientists and Researchers trained through online lectures and courses	Certifications		
Monthly Training Plan covering 2 months of remote training	pdf		
Training Materials	pdf/ppt		
Consultation Services			
AIT requirements documentation	pdf		
Preliminary Design Review (PDR)		40%	T0 + 6 months
Action Register	pdf		
PDR Data Package	pdf and ppt		
Initial System Verification Plan	pdf		
Satellite Failure Modes Effects and Criticality Analysis (FMECA)	pdf		
Satellite AIT Plan	pdf		
Initial Launch Integration Plan	pdf		

Initial Commissioning Plan	pdf		
List of data users from outside of the Philippines	pdf		
Monthly Project Status Report equivalent to 4 months	pdf		
Minutes of the Meeting, when applicable	pdf		
Waivers, Deviations and Non-Conformance Reports, when applicable	pdf		
Technical Notes, when applicable	pdf		
Hands-on Training			
Thirteen (13) Filipino Engineers trained on site for satellite preliminary design review	Attendance Record , Certifications		
Monthly Training Plan equivalent to 4 months hands-on training	pdf		
Access to thirteen (13) training workstations with specialist software listed in Section 7.3.1 intended for use in training activities, one for each of the Filipino Engineers	Access to workstations with installed software		
Training Materials	pdf/ppt, printed hard copy		
Training Progress Evaluation Report	pdf		
Consultation Services			
Documentation on the multispectral imager, ADS and AIS data formats and processing requirements	pdf		
Ground Segment Interface Control Document	pdf		
Operations Infrastructure Requirements Document	pdf		
Assessment report for up to four (4) end-User identified ground stations	pdf		
Hardware Inclusions			
Sun Sensors	Hardware		
Optical Electrical Ground Support Equipment	Hardware		
100 TB Data storage device	Hardware		
Breadboard of electronics and thermal straps around the imager design	Hardware		

Imager mounting and isolation system	Hardware		
Solar cells	Hardware		
Magnetometers	Hardware		

The above milestones and deliverables shall be regularly coordinated with the End-user. It shall be subject to review and evaluation by Technical Experts to be convened by the End-user, together with partner agencies such as DOST-PCIEERD and the Philippine Space Agency, among others.

13. Other Terms and Conditions

Should there be any discrepancy with any of the technical requirement/s and the Term Sheet, the requirement/s provided for in the latter shall govern.

The milestones and deliverables stated herein shall be transferable to the PhilSA through the DOST-ASTI to continue succeeding activities on satellite development and its eventual launch and operation.

Any other term, condition or provision not stipulated in this document will be covered by a separate agreement as proposed and agreed upon by the End-user and the Contractor.

Annex A: Acronyms and abbreviations

AMR	Anisotropic magnetoresistive	**IP**	Intellectual Property
ARQ	Automatic repeat request	**IT**	Information Technology
AOCS	Attitude and Orbit Control Subsystem	**KHTT**	Know-how transfer and training
AIS	Automatic Identification System	**LEOP**	Launch and Early Operations Phase
ADS-B	Automatic dependent surveillance-broadcast	**LEO**	Low earth orbit
AIT	Assembly, Integration and Test	**LVDS**	Low Voltage Differential Signaling
BCM	Battery Charge Module	**MCC**	Mission Control Center
BCR	Battery charge module	**MTF**	Modulation Transfer Function
BPMN	Business Process Modeling Notation	**OBC**	On-board computer
CMOS	Complementary metal-oxide semiconductor	**OBDH**	On-board data handling
CAD	Computer-aided Design	**OS**	Operating System
CAN	Controller area network	**PCB**	Printed circuit board
CONOPS	Concept of Operations	**PDHU**	Payload data handling unit
CVS	Concurrent version systems	**PDF**	Portable Document Format
DMM	Digital multimeter	**PDM**	Power distribution module

DOST	Department of Science and Technology	**PDR**	Preliminary Design Review
DOST-ASTI	Department of Science and Technology-Advanced Science and Technology Institute	**PFM**	Proto-flight model
DOST-PCIEERD	Philippine Council for Industry, Energy and Emerging Technology Research and Development	**PhilSA**	Philippine Space Agency
EMC	Electromagnetic compatibility	**RF**	Radio frequency
EO	Earth Observation	**RTOS**	Real-time operating system
EVT	Environmental Verification and Test	**SNR**	Signal-to-noise ratio
FPGA	Field-programmable gateway array	**SMA**	Subminiature version A
FOV	Field of view	**SoC**	System-on-chip
GPS	Global positioning system	**SysML**	Systems Modeling Language
GRS	Ground receiving station	**TTC**	Telemetry, Tracking and Command
GSD	Ground sample distance	**TVT**	Thermal vacuum test
HDL	Hardware Description language	**UPD**	University of the Philippines Diliman
HDRM	Hold-Down Release Mechanism	**UML**	Unified modeling language

Annex B: Description of Deliverables

A. Project Kick-off

In this project review, the contractual baseline and the corresponding practical steps forward shall be agreed upon by the Contractor and End-user. To achieve this, it is essential that the Contractor discuss the following:

1. Project Kick-off documentation

This documentation shall present all pertinent information to the project kick-off such as:
-Breakdown of organization, leadership, roles and responsibilities
-Initial concepts of design and operation
-Project milestones and schedule
-Key risks and issues

2. Project Management Work Plan

The project management plan shall include the following:
-Overview of project objectives, scope and lifecycle
-Description of the deliverable items and their corresponding milestones and acceptance criteria
-Compliance approach
-Product assurance
-Identification and management of suppliers, subContractors and stakeholders
-List and schedule of long-lead and critical components
-Management of potential risks and issues
-Key project decisions
-Project control including performance metrics
-Change management
-Resource and facilities management

3. Master Schedule

The master schedule shall be regularly updated and submitted to the End-user at major reviews. This shall also be provided should the End-user request for it after the Contractor implement key changes or decisions to the project.

4. Risk Register

Each entry shall be logged with the following details:
-A unique reference number
-Details of the risk item such as origin, dependencies, etc.

-Risk score
-Risk owner
-Risk mitigation steps
-Expected resolution or closure date
-Current status

5. Minutes of the Meeting

-Detailed notes that serves as an official written record of a meeting

6. Waivers, Deviations, and Non-Conformance Reports

-Documents that details non-conformance identified in a quality audit or process review

7. Technical Notes

-Short article that provides a brief description of a specific development, technique or procedure

B. Qualification Status Review (QSR)

This review will present the qualification status of the baselined equipment, establishing its heritage and the expected development paths. Updates on how meeting the system requirements is envisioned shall also be reported. Descriptions of similar items under Project Kick-off apply under QSR.

1. Action Register

-Documentation of the critical tasks, target dates, and ownership responsibilities to review the overall training program

2. QSR Documentation

- includes the design standard, built standard, configuration and qualification status against requirements
- Verify the acceptability of the design specifications and plans with respect to requirements
- Delivered in Microsoft PowerPoint format and will contain the slides presented as part of the Kick-Off review

3. Monthly Project Status Report equivalent to 2 months

- Detailed description of training tasks and activities per person and any general training events that took place. The report shall include progress, achievement, work in progress, upcoming tasks and mentor's/ training manager's comments. Any relevant recommendations from the Filipino Engineers are also included, if any.

C. Remote Training

1. 30 Filipino Engineers, Scientists and Researchers trained through online lectures and courses

- Introductory theory training courses via videoconferencing wherein the training recipients are participants nominated by the End-user, including and not limited to the selected Filipino Engineers.
- Each Filipino Engineer will attend the introductory training modules relevant to their area of specialization
- All online meetings and reviews related to the theoretical part of the training shall involve the nominated personnel of the End-user.
- Certificates are given to the participants after the theoretical training

2. Monthly Training Plan covering remote learning activities

- contains defined learning objectives and activities for the 13 Filipino Engineers
- includes methods of assessment to track progress along feedback mechanisms, as necessary

3. Training Materials

- hard copies and electronic copies of the theoretical lectures
- collection of textbooks or e-books to assist the participants with background reading

D. Preliminary Design Review (PDR)

The purpose of the PDR is to review the status of the preliminary design. The review will include:

- Overview of the mission concept and system design:
- Hardware and Software descriptions
- Block diagrams and layouts of hardware and Software
- Preliminary item ICDs.
- The ability of the solution presented to meet the mission requirements
- Initial requirements verification matrix to demonstrate how system requirements will be verified
- Update on the overall qualification status
- The status of the detailed design activities
- An update of performance budgets

- Status of suppliers and Subcontractors
- Long lead items
- Project schedule and Milestones
- Status of Deliverable Items
- Key risks
- The status of the project Action Item List

Descriptions of similar items under Project Kick-off and QSR apply under PDR.

1. PDR Data Package

- The PDR data pack will be delivered in Microsoft PowerPoint format and will contain the slides presented as part of the PDR review. The slides will address the areas as identified in the PDR definition provided above

2. Initial System Verification Plan

- A document baselined after the comments from the PDR are incorporated
- Plan shall include the following:
- System verification scope, Verification events, Requirements verification, Integration and test flow overview, Environmental test requirements, System testing overview, Integrated Satellite Functional Test Plan, System End-to-End Test, and Additional Regression Tests

3. Satellite Failure Modes Effects and Criticality Analysis (FMECA)

- reliability evaluation/ design technique which examines the potential failure modes within a system and its equipment in order to determine the effects on equipment and system performance
- The Satellite FMECA will contain the following information at preliminary level:
- Qualitative assessment of system reliability, Sub-system interface diagram, Sub-system interface failure modes, Failure modes severity and criticality assessment, System end failure effects and mitigation

4. Initial Satellite AIT Plan

- define plans for assembly, integration, and test of all the equipment deliverable item, which shall include the following:
- Summary of all key AIT facilities, including those of Subcontractors
- Summary of project responsibilities
- Summary of AIT process controls, including non-conformance controls
- Identification of any applicable special process documentation (as required)
- Example AIT Timeline
- AIT Flow Chart showing order of assembly and inspection points
- Description of the activities identified on the Flow Chart

5. Initial Launch Integration Plan

- The purpose is to define plans for the fulfilment of the launch interfacing activities between the launch provider and the Contractor. These plans will start from the Contractor confirming the chosen launcher is compatible with the satellite specification up until shipping for the start of launch campaign. It is also possible that a summary of activities will be provided detailing the launch campaign operational plan.
- The Launch Integration Plan shall include the following:
- Compliance Matrix for confirming the spacecraft is technically compliant with the chosen launcher
- Summary of the Contractor's launch responsibilities
- Description of the launch activities that will be required from Launch Contract signing till shipping to launch site
- Launch Interfacing timeline
- Plan of the meetings expected to be held between the launch provider and the Contractor
- List of deliverable documents that the Contractor will produce during the launch Integration activities
- Launch shipping plan
- Launch site operation plan

6. Initial Commissioning Plan

- The purpose is to capture the planning activities that have taken place with respect to the commissioning phase of the project.
- The initial plan shall include:
- Definition of Commissioning phases
- Identification of resources needed
- Identification of documentation to be produced ready for commissioning
- Initial timeline of activities during commissioning period

Identification of Ramp up activities to be performed during a build and test phase

7. List of potential data users outside the Philippines

- List of public, private or commercial users that may use images taken by the satellite for profit or non-profit purposes.

E. Hands-on Training

1. 13 Filipino Engineers trained on site for satellite preliminary design review equivalent to at least 80 days

- All the Filipino Engineers who have completed the hands-on training shall receive appropriate certifications and are expected to have attendance record during the entire hands-on training program

2. Monthly Training Plan equivalent to 4 months hands-on training

- A document that reflects the evolving progress of each Customer Engineer.
- tailored to the individual Filipino Engineers' qualifications, experience and ability throughout the programme and can therefore be subject to change

3. 13 unit laptops with specialist software listed in Section 7.3.1

- One laptop with installed software intended to be used for the hands-on training activities will be provided for each of the Filipino Engineers, which totals to 13 units
- The laptops are to be provided only for onsite use

4. Training Materials

- hard copies of the relevant lectures for the hands-on training
- collection of textbooks to assist the participants with background reading

5. Training Progress Evaluation Report

- This consists of two (2) assessment milestones in the training programme up to PDR review, each achieved through the preparation of a progress report by the Training Manager and which will be submitted to the End-User for information.
- Each report shall cover the following:
- Progress and achievement of the Filipino Engineers to date - including work that has been covered and how it was assessed
- Work in progress and future work - including a brief description of what work is to be covered and how it will be assessed
- Training Manager's comments - including recommendations for additional study if appropriate and an overview of each Filipino Engineer's performance and progress

F. Consultation Services

Description of the deliverables are in section 8.

G. Hardware inclusions

Description of the deliverables are in section 9.

I hereby certify to comply and deliver all the above requirements.

Name of Company	**:**	_____
Signature of Authorized Representative	**:**	_____
Name of Authorized Representative	**:**	_____
Designation	**:**	_____
Date	**:**	_____