

Term of Reference (TOR) and Specifications
for the procurement of equipment for Satellite Assembly,
Integration and Testing Facility
Geo-Informatics and Space Technology Development Agency
(Public Organization)
Ministry of Science and Technology

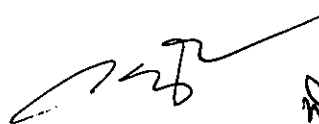
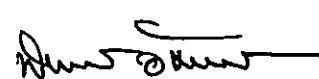



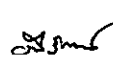


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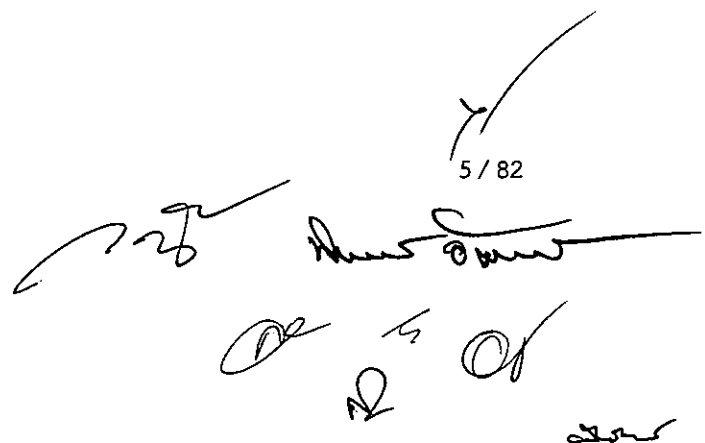
Ministry of Science and Technology

1. Background

According to the Cabinet meeting dated March 14, 2017, the Cabinet approved the implementation of the Earth Observation Satellite System for national development or THEOS-2 and assigned the Geo-informatics and Space Technology Development Agency (Public Organization): GISTDA as the responsible entity for the project. One of the mission of the project is to develop the infrastructure in preparation for the project which consists of a satellite assembly, integration and testing (AIT) building and the equipment for satellite assembly and testing in order to support the development of components, assembly, integration and testing of the satellite especially for small satellites in Thailand.

Hence, GISTDA wishes to procure equipment for satellite assembly and testing to be used for the design, assembly and testing of satellite systems including research and development of components used in satellite systems as well as using the facility for advanced research and development in the area of aeronautics and astronautics. Therefore, GISTDA is proceeding to procure the equipment for satellite assembly and testing to improve the capability and efficiency in research, development and innovation and the development of human resources in aerospace research and development sector into the aerospace and aerospace market at the national and international level.

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Definition

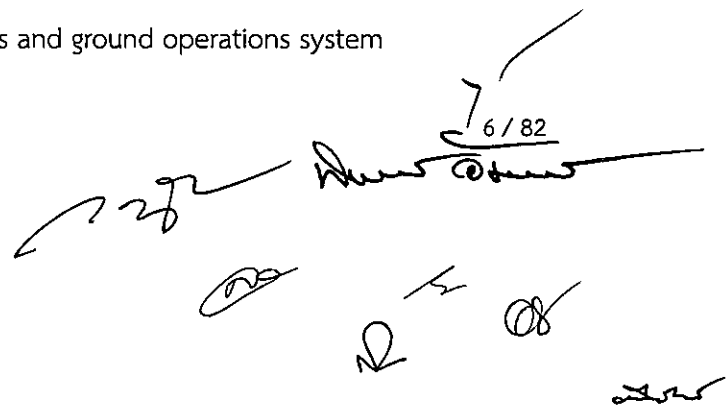
GEVS	refers to <i>General Environmental Verification Specification</i>
CE	refers to <i>Conformité Européene</i>
CSA	refers to <i>Canadian Standards Association</i>
IEC	refers to <i>International Electrotechnical Commission</i>
ISO	refers to <i>International Organization for Standardization</i>
FS	refers to <i>Federal Standard for Cleanliness Classification Levels</i>
ASTM	refers to <i>American Society for Testing and Materials</i>
ANSI	refers to <i>American National Standards Institute</i>
IEEE	refers to <i>Institute of Electrical and Electronics Engineers</i>
TISI	refers to <i>Thai Industrial Standards Institute</i>
Clean Room	refers to a room with controlled amount and size of particles, temperature and air pressure

2. Objectives

In order to ensure that the development of satellite systems to be effective meet international standards, GISTDA needs to possess the equipment and the laboratory which can support the development, assembly, integration and testing of satellite systems. Hence, GISTDA has defined the following objectives for the procurement of the satellite AIT equipment as follows:

- 2.1 Procurement and installation of equipment for assembly, integration, and testing of satellite systems.
- 2.2 Procurement and installation of equipment for research and development of components and parts for satellite systems and ground operations system

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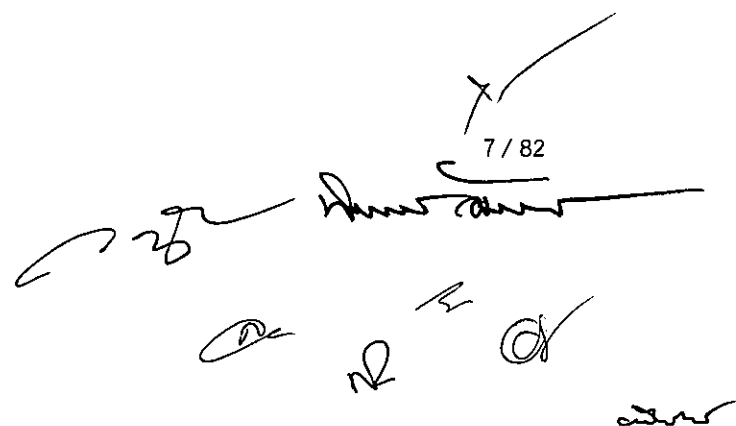


2.3 Procurement and installation of equipment and tools in support of the operations and security of the laboratory.

3. Eligibility of Bidders.

- 3.1 Bidders must have a profession relating to the trade of items as specified in this e-bidding.
- 3.2 Bidders may proceed in the e-bidding process as one of the following:
 - 3.2.1 Bidders shall be a single legal entity.
 - 3.2.2 Bidders shall be a joint venture or a consortium and must demonstrate the purpose of the joint venture or the consortium and the obligation to share responsibility in the work as required by GISTDA and must submit the joint venture agreement or consortium agreement with the proposal.
- 3.3 Bidders shall not be enlisted in the abandoners' list of the Thai Government Agencies and the State Enterprises.
- 3.4 Bidders shall not be juristic persons who have the special privilege or immunity with which to refuse being taken to Thai court, or if they have, such privilege or immunity must be waived by the order of such Bidders' Government. The government of the bidder has the right to waive such immunity.
- 3.5 Bidders shall not be a jointly interested bidder with other bidders, Service Provider / Facilitator or shall not be a person who undertakes and acts as a "Obstruction of Fair Price Competition" in this bid invitation.
- 3.6 Entity entering into the agreement must not be an entity that does not provide income-expense accounting or have provided an incorrect income-expense accounting
- 3.7 Bidders who enter the contract in e- Government Procurement: e-GP shall register themselves for e-GP in the Thai Government Procurement Center's Website of the Comptroller General's Department.

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- 3.8 Bidders must receive/provide payment via bank account, except if the total amount of each payment does not exceed THB 30,000.00 (Thirty Thousand Baht Only), which, then, can be paid in cash.
- 3.9 The bidders must have delivered a Clean Room installation work or Vibration Test Equipment or Thermal Vacuum Chamber Equipment or Mass Properties Measurement Equipment or similar work, whose contract must be not less than 10,000,000 Baht (Ten Million Baht) directly (not sub-contract) with a government or private entity and at least 1 contract must have been fully executed. Bidders must provide a certified copy of the completed said contract and a certified copy of the certificate of completion along with the bid documents.
- 3.10 The bidder must have at least 1 electrical engineer, 1 Mechanical engineer and 1 civil engineer who has been certified by the council of engineers by the Engineer Act 1999, with the minimum qualification of Professional Engineer They shall be the supervising engineers for the installation and testing of all the systems. Bidders must submit all certified copies of the certification engineering license as part of the technical proposal.

4. Bid Requirement

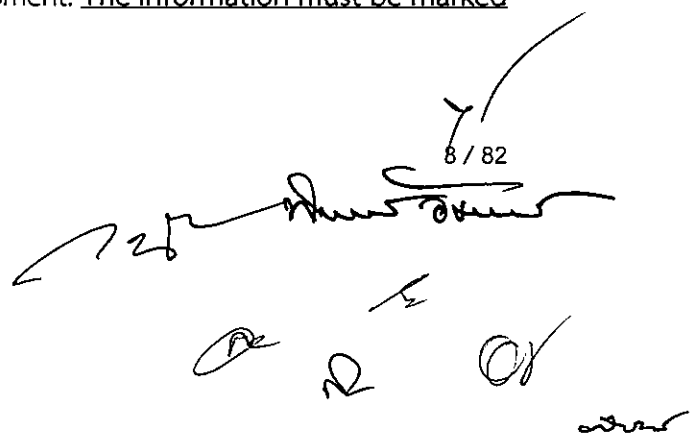
4.1 General requirements

4.1.1 The bidder must submit a technical proposal consisting of:

4.1.1.1 The bidder must set up a Compliance Table showing the compliance between the requirements of GISTDA and the bidder's proposal clearly stating which items fulfill which requirement.

4.1.1.2 The bidder must submit a technical proposal, documents providing catalog or brochure with detailed technical specifications including the origin of the proposed equipment. The information must be marked

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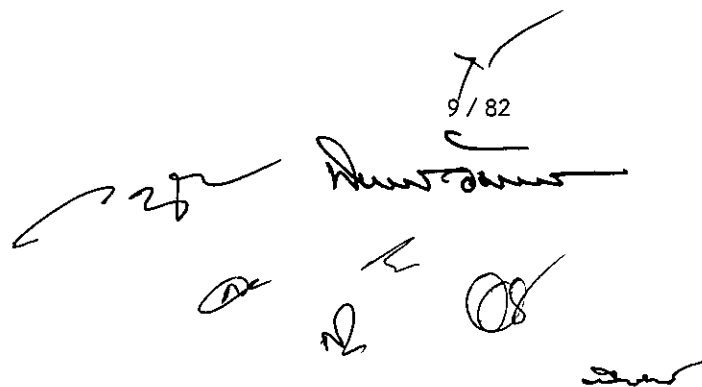


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clearly and refer to the specific bid requirement for the consideration of the committee.

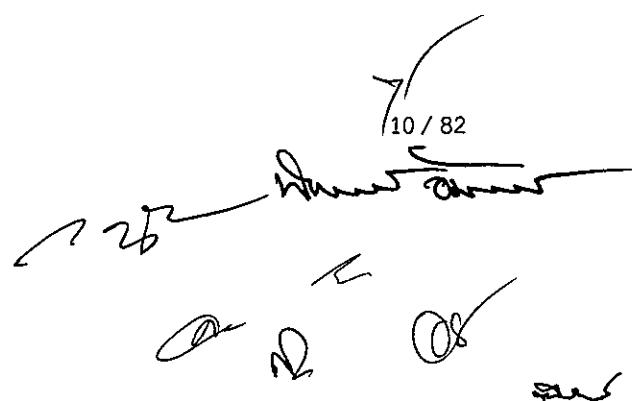
- 4.1.1.3 The bidder must submit an Implementation Plan which is in line with the delivery period.
 - 4.1.1.4 The bidder must submit an Installation Procedure with detailed steps in the implementation of the Clean Room system, the Air Shower system, Vibration Test Equipment, Thermal Vacuum Chamber Equipment, Foundation Isolator and Mass Properties Measurement Equipment at the least.
 - 4.1.1.5 The bidder must estimate the electricity consumption of each assembly integration and test equipment, measuring devices, Clean Room systems, etc. that shall be delivered and installed.
 - 4.1.1.6 The bidder shall submit a single line diagram for the electrical work and the design of the electrical installation to support electrical load for all the equipment. The electrical system design must be done by an electrical engineer who has been certified by the Council of Engineers, with the minimum qualification of Professional Engineer
 - 4.1.1.7 The bidder must submit a training plan for the operations and maintenances of each equipment at the place of delivery (Onsite Training). The training for each equipment must be given to no less than 5 employees.
 - 4.1.1.8 The bidder must sign and seal/stamp (if any) all bid documents including the technical proposal, bid support documents, term of reference, etc. which shall be legally binding.
- 4.1.2 All delivered equipment and accessories must be new, never used. If GISTDA request of additional documents, the contractor must be able to show the documentation that can verify the origin and unused condition of the equipment.

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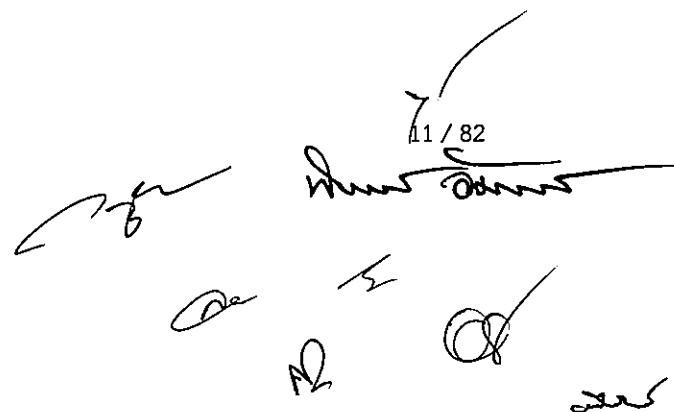
- 4.1.3 The contractor must submit the Certificate of Calibration, issued by either the manufacturers or the ISO/IEC 17025 calibration centers, of the proposed equipment at least for the Thermal Vacuum Chamber Equipment, Vibration Test Equipment, Mass Properties Measurement Equipment and Thermal Cycling Equipment
- 4.1.4 The items delivered to GISTDA, if copyrighted, must be a legal product and have the license needed for GISTDA to use forever without additional cost.
- 4.1.5 The contractor is responsible for all cost with respect to the import and export of all equipment as well as all other costs associated with the work.
- 4.1.6 In the event that any equipment requires a permission or license or registration to import, utilize or possess from any agency, the contractor is responsible in ensuring that all items and processes are in accordance with legal regulations.
- 4.1.7 In case the contractor wishes to store equipment and other tools within GISTDA's premise during the installation period, GISTDA shall not be liable for all loss or damage.
- 4.1.8 The contractor must coordinate with the Site Management officer for site inspection and installation. The equipment and installation must comply with relevant standards and must be installed in the way as specified by the manufacturer of the equipment. the contractor must have qualified technicians and engineers who are specialized in the installation and have the relevant engineering license as supervisor. The contractor is responsible for all installation and related expenses.
- 4.1.9 The contractor shall be liable for all damages incurred in the case the contractor, its employee, representatives or subcontractor's executed with negligence or intention or lack of expertise or lack of action in the implementation of various procedures under the contract which causes the system or equipment or property to be damaged or not in good condition.

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- 4.1.10 In case of any change other than those approved by GISTDA, the contractor must notify and receive approval from GISTDA before proceeding at least 30 days in advance. If the contractor installs any equipment which has not been approved or does not follow the specifications that has been pre-approved, GISTDA reserves the right to temporarily suspend work and to perform correction immediately at the expense of the contractor. Any delay due to such a correction cannot be used as a request for extension of the contract execution or an excuse for the incompleteness of the entire project.
- 4.1.11 The contractor must study the detail and the scope of the Term of Reference including any potential problem, vagueness, discrepancy prior to starting the work. When the contractor starts the work, if there is any conflicts or discrepancies in the production, installation or assembly, and the equipment or system cannot function according to the design specification, the contractor must take corrective action as soon as possible and cannot appeal for any additional time and expenses for the execution of the contract.
- 4.1.12 The contractor can proceed to install, test, deliver deliverables as per the contract during normal working days and time which is Monday to Friday (except public holidays) from 08.00 - 17.00 hrs. In the event that the bidder requires to work beyond the specified days and time, the contractor must present a request in writing, indicating the reasons for the request and the list of employees or subcontractors who shall be performing the work and shall submit the list to the Chairman of the Acceptance Committee for temporary permission.
- 4.1.13 GISTDA does not allow the employees or subcontractors of the contractor to stay overnight in the installation site or in the GISTDA's area. In the event that bidder's employees or subcontractors need to work at night or stay on site to guard any property, the contractor must request so in writing stating the reason and the list of employees or subcontractors to the Chairman of the Acceptance Committee for a temporary permission.

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4.1.14 The contractor shall supervise the contractor's employees or subcontractors to work only in the work area as agreed under the contract. The contractor must ensure that there is no consumption of narcotics, alcohols or gambling or drunken behavior or fighting or any actions which is against the rules and regulations of GISTDA including any action or lack any action that may be defamatory to GISTDA. If such an event occurs, the contractor is responsible and liable for all damages.

4.1.15 The contractor is responsible for the cost of the security, fuel for electrical generator for the period of testing and so on during installation and testing of the deliverable as per the rules and regulations of GISTDA.

4.2 Technical requirements

The Technical Specifications of equipment specified in the TOR is the minimum requirement. The bidder may offer better equipment than specified in the TOR. However, GISTDA reserves the right to deliberate the bidder's proposal and GISTDA's decision is considered final.

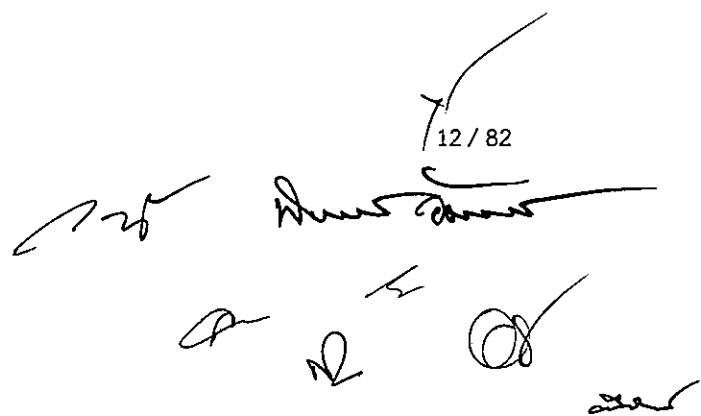
4.2.1 The minimum technical specifications of the equipment for satellite assembly and integration are as described in Appendix A.

4.2.2 The minimum technical specifications of the room design, operational equipment and support tools are as described in Appendix B.

4.2.3 The minimum technical specifications of the tools and hand tools are as described in Appendix C.

4.2.4 The minimum technical specifications of the security and electrical systems are as described in Appendix D.

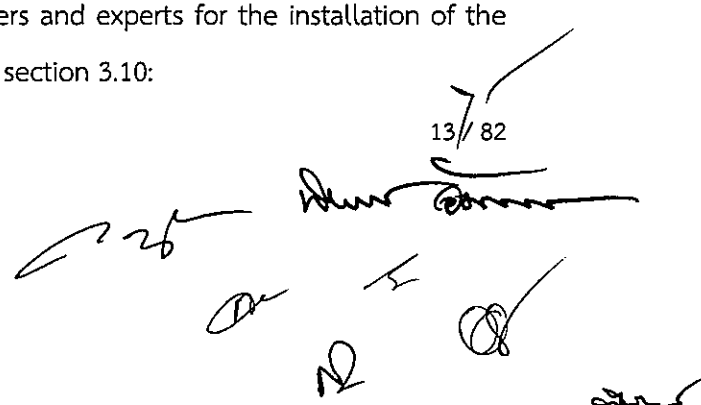
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4.3 Equipment Installation

In order to ensure that equipment and tools as other facilities as described in 4.2 can be used effectively and in accordance to international standards, the bidder must propose an implementation plan, especially for the following equipment:

- 4.3.1 Vibration Test Equipment as specified in Appendix A must be installed in the Clean Room of AIT high bay area as specified in Appendix B, which shall support 5,000 kilograms per square meter in an area of 10 meters wide, 10 meters long and 2.7 meters deep and there must be a mechanism, equipment or material that can insulate the vibration from the Vibration Test Equipment to the building.
- 4.3.2 The Thermal Vacuum Chamber Equipment as specified in Appendix A shall be installed in the Clean Room of AIT high bay area as specified in Appendix B, approximately 15 meters wide and 15 meters long.
- 4.3.3 Mass Properties Measurement Equipment as specified in Appendix A shall be installed in the Clean Room of AIT high bay area as specified in Appendix B, which shall support 5,000 kilograms per square meter in an area of 8 meters wide, 8 meters long and 1.5 meters deep.
- 4.3.4 The Foundation Isolator as specified in Appendix B shall be installed in the Clean Room of AIT high bay area as specified in Appendix B, which are 10 meters wide, 10 meters long and 3 meters deep.
- 4.3.5 Transformers capable of not less than 2,000 KVA, as specified in Appendix D, must be installed outdoors including wiring cable from transformer to MDB and must meet engineering standards and the Provincial Electricity Authority's standard or its equivalent. GISTDA will be responsible for the fees related to the implementation with the Provincial Electricity Authority.
- 4.3.6 Uninterruptible Power Supply (UPS), as specified in Appendix D, must be installed including wiring cable to branch MDB or equipment.
- 4.3.7 The contractor must have the engineers and experts for the installation of the following test equipment according to section 3.10:



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- (1) Class 100000 and Class 100 Clean Room
- (2) Vibration Test Equipment
- (3) Thermal Vacuum Chamber Equipment
- (4) Mass Properties Measurement Equipment
- (5) Foundation Isolator

The contractor also must have electricians for indoor and building work who have received the certification under the Skill Development Promotion Act. B.E. 2545 and its amendment and must submit the list of engineers and their certification from the office of skill standard and test development.

5. Training and Technology Transfer

The contractor must present a training and technology transfer plan with the details as follows

- 5.1 The contractor must prepare a training plan including with training material, test and examinations for the at least the following equipment.
 - 5.1.1 Vibration Test Equipment
 - 5.1.2 Thermal Vacuum Chamber Equipment
 - 5.1.3 Thermal Cycling Equipment
 - 5.1.4 Mass Properties Measurement Equipment
 - 5.1.5 Theodolite, Forklift, IR Thermometer, UPS, CCTV etc.
 - 5.1.6 Clean Room for both Class 100000 and Class 100
- 5.2 The teaching materials must be carefully prepared and must include a manual for the trainees or recipients of the training to assist them to understand the purpose of using the equipment, understand the operation of the equipment, understand the parameter settings and read the parameters of the equipment including understanding the display and reporting of equipment and understand the maintenance procedure.
- 5.3 The maintenance manual must be described in detail, including Preventive maintenance and Corrective maintenance. The Handbook documents should, at least, include the

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daily, weekly, monthly, yearly maintenance templates along with maintenance procedures.

- 5.4 The trainer must train and explain all the procedures carefully thoroughly and teach the operators to operate and maintain the equipment by themselves.
- 5.5 The trainers must conduct tests to measure the understanding of the trainees.

6. Milestones

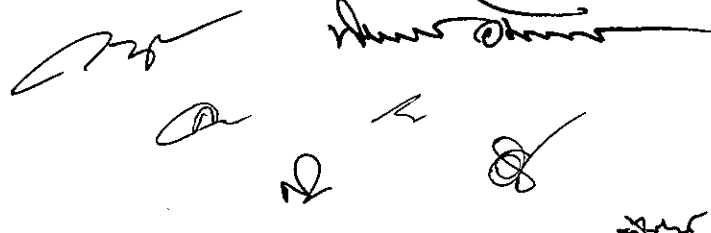
The contractor must comply with the Term of Reference and specifications and must deliver all deliverables within 540 days following the date of signing the contract. The deliverables are divided into 7 milestones as follows:

6.1 Milestone 1: The contractor must deliver 10 copies of the following report in hard copy (printed on paper) and in electronic copy (digital file) within 60 days after signing the contract.

- 6.1.1 System Design Review and Implementation Plan.
- 6.1.2 Technical Proposal, Catalog or Brochure that include all technical specifications including features, brands, models, quantity, etc.
- 6.1.3 Electrical load details of both equipment and Clean Room.
- 6.1.4 Test plan and Acceptance Test procedures for the Factory Test and Onsite Test which must provide test plans and results of the test at the level of unit test, functional test and end-to-end test for at least the following test equipment:

- (1) Vibration Test Equipment
- (2) Thermal Vacuum Chamber Equipment
- (3) Thermal Cycling Equipment
- (4) Mass Properties Measurement Equipment

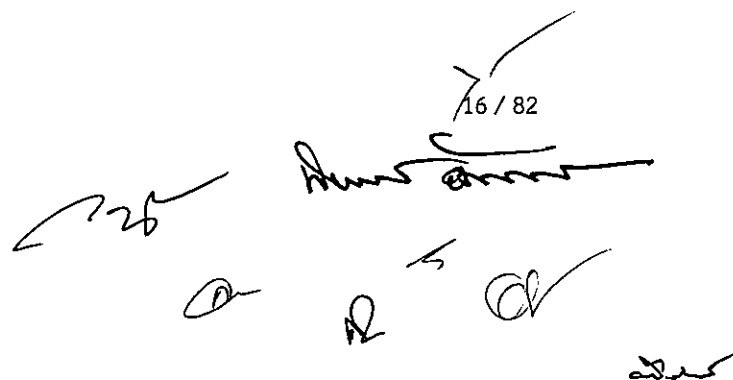
If GISTDA wishes to send a representative to observe the test at the manufacturer's premises (FAT), the contractor shall facilitate the test observation including all liaison, permission, authorization with the



manufacturer of the equipment. (GISTDA shall cover the expense of its representatives visiting the site of the manufacturer)

- 6.1.5 Training plans include training topics, summary of each topic and the training schedule.
- 6.2 Milestone 2: The contractor must deliver, install, test the following items including providing the related manual and training within 150 days following the date of signing the contract:
 - 6.2.1 Hand Tools as specified in Appendix C.
 - 6.2.2 Theodolite as specified in Appendix A
 - 6.2.3 Electrical Transformer as specified in Appendix D.
 - 6.2.4 Foundation Isolator as specified in Appendix B
 - 6.2.5 Furniture, materials/equipment for transportation and storage as specified in Appendix B
 - 6.2.6 UPS as specified in Appendix D
- 6.3 Milestone 3: The contractor must deliver, install, test the following items including providing the related manual and training within 250 days following the date of signing the contract:
 - 6.3.1 Thermal Cycling Equipment as specified in Appendix A
 - 6.3.2 Factory Acceptance Test (FAT) of the Thermal Vacuum Chamber Equipment as specified in Appendix A
 - 6.3.3 Factory Acceptance Test (FAT) of the Mass Properties Measurement Equipment as specified in Appendix A.
 - 6.3.4 Factory Acceptance Test (FAT) for Vibration Test Equipment as specified in Appendix A
- 6.4 Milestone 4: The contractor must deliver, install, test the following items including providing the related manual and training within 360 days following the date of signing the contract:

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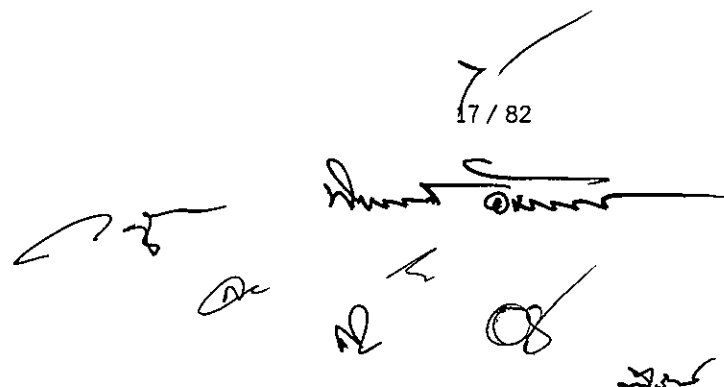
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- 6.4.1 On-Site Acceptance Test (OSAT) of the Vibration Test Equipment as specified in Appendix A
- 6.5 Milestone 5: The contractor must deliver, install, test the following items including providing the related manual and training within 400 days following the date of signing the contract:
 - 6.5.1 On-Site Acceptance Test (OSAT) of the Mass Properties Measurement Equipment as specified in Appendix A
- 6.6 Milestone 6: The contractor must deliver, install, test the following items including providing the related manual and training within 430 days following the date of signing the contract:
 - 6.6.1 On-Site Acceptance Test (OSAT) of the Thermal Vacuum Chamber Equipment as specified in Appendix A
- 6.7 Milestone 7: The contractor must deliver, install, test the following items including providing the related manual and training within 540 days following the date of signing the contract:
 - 6.7.1 Clean Room and its accessories as specified in Appendix B
 - 6.7.2 Installation of CCTV as specified in Appendix D
 - 6.7.3 Any other remaining work according to the TOR such that the delivery is complete, accurate, in full and can be used effectively in all respects with respect to the contract

7. Contract Period

The contractor must deliver all deliverables including the installation and testing of all the equipment and system such that the delivery is complete, accurate, in full and can be used effectively in all respects with respect to the contract as well as complete all the training within 540 days following the date of signing the contract.

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The delivery of the deliverables may be delivered across the milestone. However, this is at the approval of the Acceptance Committee taking into consideration compliance with engineering standards.

8. Deliverables

The contractor must deliver and install the deliverables in accordance with List of Deliverables.

9. Place of delivery

Geo-Informatics and Space Technology Development Agency (Public Organization)
88 Moo 9, Thungsukhla, Sriracha, Chonburi.

10. Contract value

The contract value for the procurement of equipment Satellite Assembly, Integration and Testing Facility is Baht 221,403,000 (Two Hundred and Twenty-One Million, Four Hundred and Three Thousand Baht only) including VAT.

The reference price for the procurement of equipment Satellite Assembly, Integration and Testing facility is Baht 221,403,000 (Two Hundred and Twenty-One Million, Four Hundred and Three Thousand Baht only) including VAT.

11. Warranty

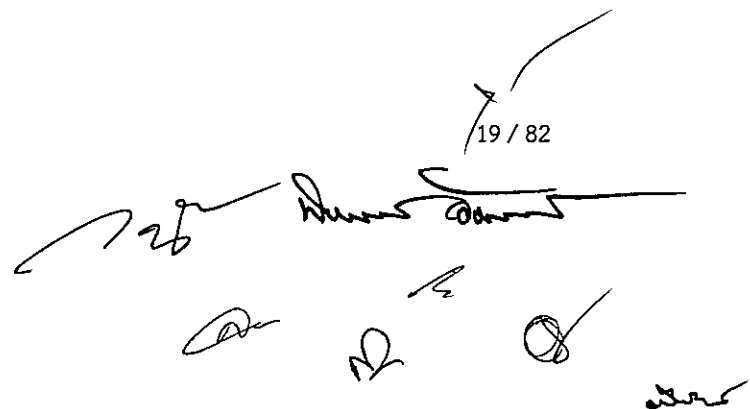
The contractor must guarantee the equipment to be free from defect as well as provide after sales service for at least 1 year after the date of delivery of the final milestone as per the contract. During this period, if any item is found to be damaged or defective or none operational because of normal use, the contractor must repair the item to be in full working condition within 10 working days after the day of reporting the defect without any expense to GISTDA. In the case that the contractor does not comply or does not complete the repair within the stipulated time, GISTDA shall have the right to take any corrective action as deemed appropriate, or contract another party to do it and the contractor shall be responsible for all the cost incurred.

12. Terms of Payment

GISTDA will make the payment in 7 installments according to the following milestones:

- 12.1 The 1st installment is equivalent to 2% of the contract value and shall be paid when the contractor delivers all the document correctly as specified in section 6.1 within 60 days following the date of signing the contract and the acceptance committee has accepted the deliverables.
- 12.2 The 2nd installment is equivalent to 10% of the contract value and shall be paid when the contractor delivers all the work correctly and in full as specified in section 6.2 within 150 days following the date of signing the contract and the acceptance committee has accepted the deliverables.
- 12.3 The 3rd installment is equivalent to 20% of the contract value and shall be paid when the contractor delivers all the work correctly and in full as specified in section 6.3 within 250 days following the date of signing the contract and the acceptance committee has accepted the deliverables.
- 12.4 The 4th installment is equivalent to 15% of the contract value and shall be paid when the contractor delivers all the work correctly and in full as specified in section 6.4 within 360 days following the date of signing the contract and the acceptance committee has accepted the deliverables.
- 12.5 The 5th installment is equivalent to 15% of the contract value and shall be paid when the contractor delivers all the work correctly and in full as specified in section 6.5 within 400 days following the date of signing the contract and the acceptance committee has accepted the deliverables.
- 12.6 The 6th installment is equivalent to 15% of the contract value and shall be paid when the contractor delivers all the work correctly and in full as specified in section 6.6 within 430 days following the date of signing the contract and the acceptance committee has accepted the deliverables.

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12.7 The 7th installment is equivalent to 23% of the contract value and shall be paid when the contractor delivers all the work correctly and in full as specified in section 6.7 within 540 days following the date of signing the contract and the acceptance committee has accepted the deliverables.

13. Penalty

If the contractor is unable to deliver the deliverables, including installations and test, within the time specified in the contract, the contractor shall pay a fine to GISTDA equivalent to is 0.20% (zero point two zero percent) per day of the value of undelivered deliverables not less than 100 Baht per day.

14. Evaluation Criteria

The proposal will be evaluated on a 100 percentage price-performance scoring system with 30% on price and 70% on quality (technical). The scoring criteria is given in Appendix E.

15. Price Confirmation

The bidder must provide a price validity no less than 60 days from the day of final price proposal.

16. Other terms and conditions

- 16.1 If any device, tool, software or deliverables delivered by the contractor violates copyrights or intellectual property of any entity, the contractor shall be responsible for all damages incurred.
- 16.2 All equipment, tools and software delivered must have a lifetime license.
- 16.3 If there is any Software Patch or software update for the equipment delivered within 1 year after the day of the final milestone, the contractor shall update the software/system to the latest version as per the request of GISTDA without any additional cost.

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17. Bid documents

Bid documents are available through the Thai Government Procurement System for Baht 3,000 (Three Thousand Baht only) and must be paid at the bank before the bid document can be downloaded from the Thai Government Procurement system in the process of e-bidding

18. Bid security

The bidder must submit bid security equal of 5% of bidding price at the time of submission of the proposal through Thai Government Procurement system.

19. Performance security

The contractor must furnish to GISTDA a Performance Guarantee in an amount of 5 percent of the total contract price. The Performance Guarantee shall cover all obligations and responsibilities under the contract.

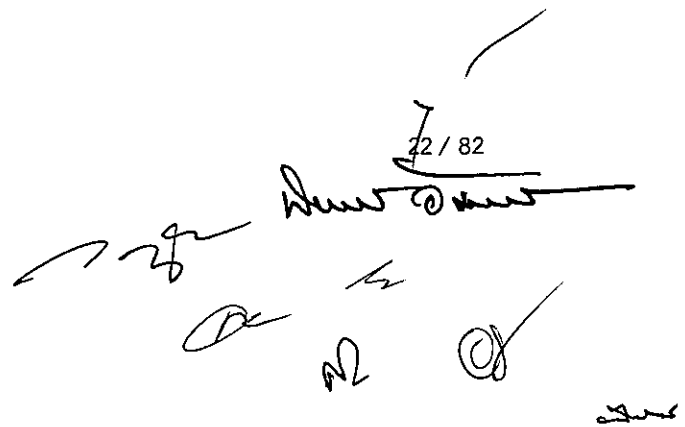
The Performance Guarantee shall be released after the expiry of the specified Maintenance Period or at such later time as the Contractor has discharged all his obligations to GISTDA under the Contract. The Contractor shall maintain the validity of the security accordingly.

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Appendix A.

Technical Specifications – Satellite Assembly, Integration
and Test equipment.

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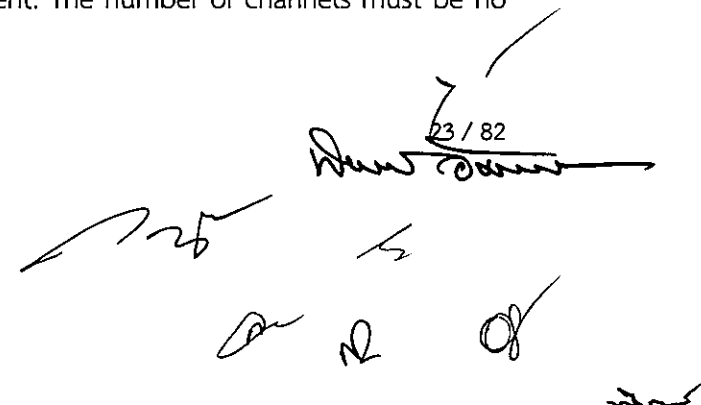
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Appendix A - Technical Specifications – Satellite Assembly, Integration and Test equipment.

1. Vibration Test Equipment (1 set)

- 1.1 Must be able to produce Sine vibration force greater than or equal to 160 kN with an amplitude error not exceeding $\pm 10\%$ and frequency error not exceeding $\pm 2\%$ with reference to the GEVS documentation.
- 1.2 Must be able to produce Random vibration force greater than or equal to 160 kN with RMS error not exceeding $\pm 10\%$ and Acceleration Spectral Density not exceeding $\pm 2\%$ with reference to the GEVS documentation.
- 1.3 Random vibration force delivery must be in accordance with ISO 5344 standard or equivalent.
- 1.4 Shock vibration force must be greater than or equal to 300 kN
- 1.5 Must supports both Vertical and Horizontal Testing
- 1.6 The Maximum Displacement must be greater than or equal to 30 mm (peak-to-peak)
- 1.7 The Maximum load capacity specified for Equipment Under Test (EUT) must greater than or equal to 500 kg.
- 1.8 The equipment must support test with the minimum vibration frequency less than or equal to 5 Hz and maximum vibration frequency more than or equal to 2,000 Hz
- 1.9 The Base plate must be no less than 1.2 meters wide and no less than 1.2 meters long.
Vertical and Horizontal testing performance is as follows.
 - Vertical table vibration frequency must be more than or equal to 1,500 Hz.
 - Horizontal table vibration frequency must be more than or equal to 1,000 Hz.
- 1.10 There must be a control and monitoring system as part of the deliverables. The controller system should be able to configured at least 12 channels.
- 1.11 Sensors for data acquisition must be accelerometer, piezo or better sensors which are suitable for use with Vibration Test Equipment. The number of channels must be no

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less or equal to 80 channels and must have sensors which support 3-axis measurement at least 12 channels at no less than 51 kHz sampling rate.

1.12 The system must be able to support test profile at least according to Table 1 for Random Vibration with reference to the GEVS documentation.

1.13 The Vibration Test Equipment must be manufactured from an ISO 9001 certified factory.

Table 1: Sample Random Vibration Test Equipment

Frequency (Hz)	Acceleration Spectral Density (G ² /Hz)
20	0.0016
20-300	+4dB/oct
300-700	0.06
700-2000	-3dB/oct
2000	0.021
Overall	8.7 Grms

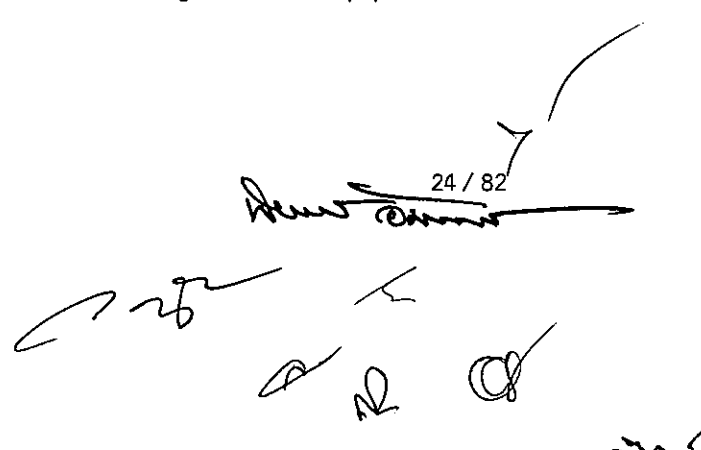
1.14 The equipment must have the Natural frequency detection at any position on equipment under test

1.15 The equipment must have control, protection and automatic cut off system in case of emergency or error and including force overload (Force limiting) and resonance with equipment under test (Notching) for protection damaging at Vibration Test Equipment itself, equipment under test and operator.

1.16 The equipment must have a cooling system by water cooled or air or equivalent system.

1.17 The equipment must be able to be installed in an area of 10 meters in length, 10 meters in width and 2.7 meters in depth with the floor load of 5,000 kg / sq. m. The working area shall be level with the adjacent surface according to Figure 1 and the depth shall be no more than 2.7 m. The installation of the Vibration Test Equipment must be done to ensure there is no vibration to the building when the equipment is in use.

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- 1.18 The electrical wiring and control cables must be routed to the control room or designated office for the Vibration Test Equipment simulation and the wiring must be routed neatly and should not create an obstacle to the working of the equipment or the people in the AIT center.
- 1.19 There must be warning sticker or label or sign which are clearly visible all around the equipment to increase caution while near or operating the equipment.



Figure 1: Example of Vibration Test Equipment installation*

2. Thermal Vacuum Chamber Equipment (1 set)

- 2.1 The diameter of the internal space for testing must be more than or equal to 2.2 meters and the depth of the test area must be more than or equal to 1.5 meters. (Cylinder)
- 2.2 The lowest Test temperature must be lower or equal to $-150\text{ }^{\circ}\text{C}$
- 2.3 The highest test temperature must be higher than or equal to $+150\text{ }^{\circ}\text{C}$
- 2.4 The Temperature Ramping Rate must be greater than or equal to $2.0\text{ }^{\circ}\text{C} / \text{min}$.
- 2.5 The Cool Down Rate must be greater than or equal to $2.0\text{ }^{\circ}\text{C} / \text{min}$.
- 2.6 The Vacuum pressure must be less than or equal to 10^{-6} mbar
- 2.7 The Chiller system must be available to support 2.2-2.5
- 2.8 The equipment must have a Liquid Nitrogen System (LN_2)

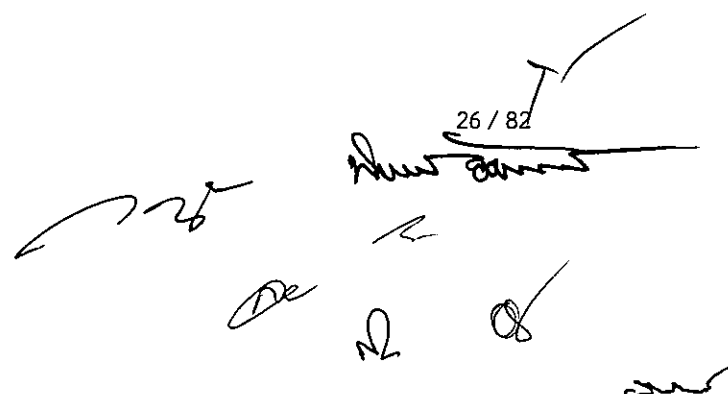
* (Figure is used for installation and physical characteristics reference only. There is no affiliation to the product.)

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- 2.9 There is a glass for IR box to inspect the Equipment under Test while testing.
- 2.10 The delivery must include Installation of the computer and program for monitoring and control.
- 2.11 There must be more than 128 channels of data acquisition and display in real time with Thermocouple type T
- 2.12 The equipment must have an automatic cut off in case of emergency or error.
- 2.13 The equipment must be able to be installed in a room of 15 meters in width and 15 meters in length.
- 2.14 The installation shall be carried out in such a way that the door of the equipment which is the entry point of the test piece must be in the Clean Room area and the other part of the test equipment must be integrated into the wall of the room as shown in Figure 2.
- 2.15 The equipment must have accessories for supporting the transportation of Equipment Under Test to the Thermal Vacuum Chamber Equipment such as a wheel system or sliding rail system, etc. The accessories must have capability to support Equipment Under Test of 500kg at least.

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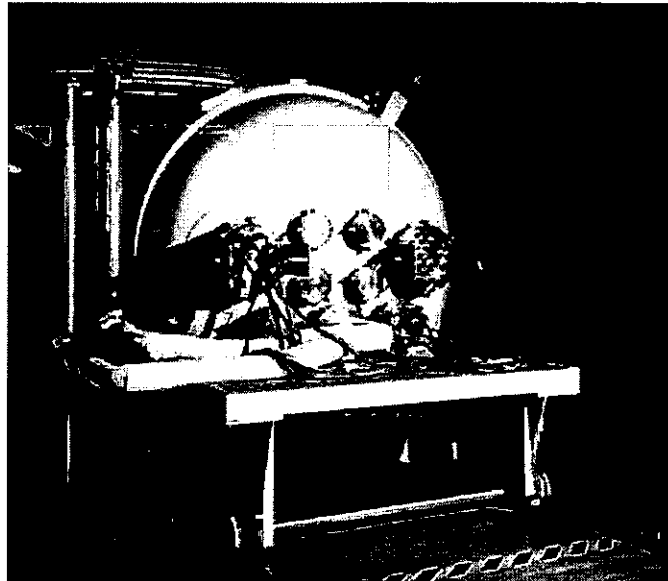


Figure 2: Example of Vacuum Test Chamber Installation*

3. Thermal Cycling Equipment (1 set)

- 3.1 The test area must have the length be greater than or equal to 1.5 m, the width be more than or equal to 1.5 m and the depth be more than or equal to 1.5 m.
- 3.2 The lowest test temperature must be less than or equal to $-70\text{ }^{\circ}\text{C}$
- 3.3 The highest test temperature must be more than or equal to $+150\text{ }^{\circ}\text{C}$
- 3.4 The humidity in the chamber must be in the range of 20 - 98% RH
- 3.5 The average of Heating up rate must be greater than or equal to $3\text{ }^{\circ}\text{C} / \text{min}$, as specified by IEC 60068-3-5 as shown in figure 3.
- 3.6 The average of Cool down rate must be greater than or equal to $1.5\text{ }^{\circ}\text{C} / \text{min}$ as specified by IEC 60068-3-5 as shown in figure 3.

* (Figure is used for installation and physical characteristics reference only. There is no affiliation to the product.)

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