URSC-WO-Testing-2024

Statement of Work

Outsourcing of HILS & OILS Realization, Testing and Analysis for Spacecraft Control System Applications

STATEMENT OF WORK

U.R. RAO SATELLITE CENTRE
VIMANAPURA POST BANGALORE - 560017

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Acronyms:

AMS	-	Angular Motion Simulator
AOCE	-	Attitude & Orbit Control Electronics
AOCS	-	Attitude & Orbit Control System
CDDG	-	Control Dynamics Design Group
DMSS	-	Dynamic Multifield Star Simulator
EID	-	Electrical Interconnection Definition
EIU	-	Electrical Interconnection Unit
ESD	-	Electro Static Discharge
FDIR	-	Fault Detection, Isolation and Reconfiguration
FEP	-	Front End Processor
FM	-	Flight Model
FPGA	-	Field Programmable Gate Array
HILS	-	Hardware-In-Loop-Simulation
HTS	-	Harness Test System
IPC	-	Industrial Personal Computer
INS	-	Indian Nano Satellites

ISRO	-	Indian Space Research Organisation
ISITE	-	ISRO Satellite Integration and Testing Establishment
ICD	-	Interface Control Document
IVV	-	Independent Verification and Validation
MTC	-	Magnetic Torquer Coil
NCR	-	Non-Conformance Report
NGCS	-	Navigation, Guidance and Control System
OBC	-	On-board Computer
OILS	-	Onboard Computer-In-Loop-Simulation
PRT	-	Peer Review Team
QA	-	Quality Assurance
QC	-	Quality Control
QM	-	Qualification Model
SDD	-	Software Design Document
SGRP	-	Secondary Ground Reference Point
SM	-	Simulation Model
SoW	-	Statement of Work

SRC	-	Standing Review Committee
SRS	-	Software Requirements Specifications
SUT	-	System Under Test
TC	-	Telecommand
TM	-	Telemetry
TRC	-	Test Results Review Committee
TRRC	-	Test Readiness Review Committee
URSC	-	U. R. RAO Satellite Centre

1.0 Introduction

U R Rao Satellite Centre (URSC) at Bengaluru is responsible for building satellite systems for scientific, technological and other specific applications of national importance.

Independent verification and validation (IVV) and testing of on-board Attitude and Orbit Control Systems (AOCS) & Navigation, Guidance and Control System (NGCS) performance through Autonomous simulations, Hardware-In-Loop-Simulation (HILS) and Onboard Computer-In-Loop-Simulations (OILS) testing is required for every project.

Launch manifesto is planned to be achieved with the support from technically competitive Service Provider with proven experience and skill sets in mission critical and safety critical testing of spacecraft control system.

This document describes the Scope of work with brief descriptions and quantum of HILS and OILS test activities, skill sets requirement, estimation of technical services in terms of milestone activities, general precautions / work instructions for reference to the technically competitive Service Providers.

1.1. Need

Multiple test beds need to be realized for Human Space Programme apart from several other missions to be realized simultaneously in a short time for both HILS and OILS Test beds at URSC. The facility needs to meet the requirement of integrated simulators and plethora of associated testing activities. In addition, emphasis is given for Research and Development activities as a part of Technology Development Programme.

Hence it is planned to carry out the testing of above-mentioned missions through external Service Providers, familiar in testing flight subsystems with expertise on control systems spacecraft dynamics, Simulation tools like MATLAB Simulink, System Engineering and Electronics. To meet this requirement, outsourcing of this testing activity is planned to be established with multiple **(limited to a maximum of two)** Service Providers, who agree and comply with the terms and conditions.

2.0 Service Provider Pre-requisites

Service Provider shall fulfil the below mentioned requirements to be eligible for Testing of various Attitude and Orbit Control System (AOCS) / Navigation and Guidance

Control System (NGCS) related Flight and Simulation hardware and software under this work order:

2.1 General

2.1.1 The Service Provider's company should be an established firm for testing of avionics/aerospace Packages. The registration details of the company shall be provided.

2.1.2 The company profile, workforce ,experience and the past executed works should match the requirements for carrying out the activity. For this,

- Details of the testing of similar avionics for spacecraft sub-system, aerospace sub-systems related to Control electronics, Sensor, Actuator activity, the time taken to execute the order and the Principals for whom the work was carried out should be provided.
- Final order is subject to the verification of Service Provider's credentials as per URSC norms

Service Provider should abide with URSC General Terms and Conditions.

2.2 Technical

The Service Provider bidding for this work order shall have the following:

2.2.1 Knowledge in spacecraft/Aerospace/industrial control system.

2.2.2 Ability to understand technical specifications.

2.2.3 Experience in Testing of Aerospace/Avionics software and hardware

2.2.4 Knowledge in quality and reliability standards.

2.2.5 Skills in test performance analysis.

2.2.6 Preparation of test reports and documentation.

Compliance and Evaluation plan for the above General and Technical conditions are provided in Table 16:

2.3 Terms and Definitions

a) U.R. Rao Satellite Centre [URSC], HAL Airport Road, Vimanapura Post, Bengaluru – 560017 and

ISRO Satellite Integration & Test Establishment [ISITE], Karthik Nagar, Doddanekkundi, Marathahalli Outer Ring Road, Bengaluru – 560 037

are prime Service locations. The Service Provider should provide support at other centres of ISRO and at places where the test bed (OILS / HILS) facility will be commissioned and tested within India.

b) The term URSC, U.R. Rao Satellite Centre, is Service Receiver.

c) The vendor to whom the Work Order is awarded, is Service Provider.

d) The term Parties shall mean Service Receiver and Service Provider.

e) The term Work Order shall mean, this order is for Test Bed Establishment, Interfacing of AOCS elements, OILS/HILS open/closed loop Test Execution and related documentation activities as defined by the responsibilities in this SoW.

3. Pre Bid activities & Bid Submission:

A Pre-Bid meeting will be held at U R Rao Satellite Centre, HAL Airport Road, Vimanapura post, Bengaluru – 560017, to have better understanding of Statement of Work, to clarify doubts, if any, related to technical activities, terms and conditions.

The work involved in this test service support activities are very sophisticated, critical, specific and challenging, demanding special skill set with precision and accuracy. Hence, it is highly suggested and encourages Service Providers to participate in the pre-bid meeting to clarify on the technical activities and its intricacies, working environment as well as associated terms and conditions. Hence, any offer from Service Provider with prior exposure or experience in similar aerospace simulation and testing related activities or any offer from the Service Provider with clarity on our technical activities will be mandatory. It is recommended for Service Providers to attend pre-bid meeting to understand the nature and scope of work.

The bid shall have two separate components and contain the following components:

PART-I: Technical Bid: Technical compliance against compliance matrix (Table:14) to be provided in response to statement of work (SoW). No price details should be revealed in the Technical bid.

PART-II: Price Bid: Price Bid should be quoted with cost information. The price bid shall be a separate component of the bid and should not be a part of technical bid.

Price Bid should be for the completion of activities of Type 1 for HILS and OILS as follows. Further details are explained in following parts of SoW.

The format for Quote from Service Provider for complete testing is provided in section 19.

4. Statement of Work

The statement of work comprises of nature of work and the responsibilities of the Service Provider in connection with realization of test bed and testing of Attitude and Orbit Control System (AOCS) / Navigation and Guidance Control System (NGCS) performance and related activities at URSC/ISITE, Bangalore.

This indent is common for HILS and OILS testing. The Service Provider is expected to provide service for both HILS and OILS, at URSC, ISITE, other ISRO units and at any other place, wherever HILS/OILS test bed is commissioned and tested. The following section gives a brief introduction on HILS and OILS testing activities.

4.1 HILS Test Introduction:

The major responsibility of HILS Division is to validate onboard implementation of Control Algorithms, Logics and interfaces of NGCE/AOCE/OBC/Any Controller Under Test along with flight sensors and actuators in a closed loop dynamic environment.

- The HILS test bed is realized by integrated test system providing three Axis rates to Rate Sensor depicting the on-orbit motion of spacecraft using 3-axis Angular Motion Simulator (AMS).

- OBC and other actuators like wheels and MTC are placed on the working table. Rate sensor and optical sensors are mounted on AMS. Star sensor is mounted in front of "Dynamics Multi field star simulator" (DMSS).
- All the sensors are provided with stimuli using respective simulators (Earth simulator/Sun simulator/star simulator). All actuator data are captured using FPGA based cards housed in an Industrial PC (IPC).
- Spacecraft Control Dynamics is simulated using Industrial PC (IPC) or Work station (WS) in which drive information is computed based on the acquired actuating torque and AMS is driven.
- Sensors mounted on AMS gives instantaneous attitude information to OBC which computes error information and actuators are actuated by OBC which is captured in IPC/WS. Based on torque, Spacecraft Dynamics simulation computes next instantaneous position and rate, thus closing the loop.
- Control parameters like coasting rate, firing pattern, convergence time and processed error will be verified by means of Telemetry and dynamics real time data and plots.

Carrying out HILS Test can be broadly classified as (1) Test Bed Realization and (2) Test Execution as depicted in Fig 1 and Fig 2.

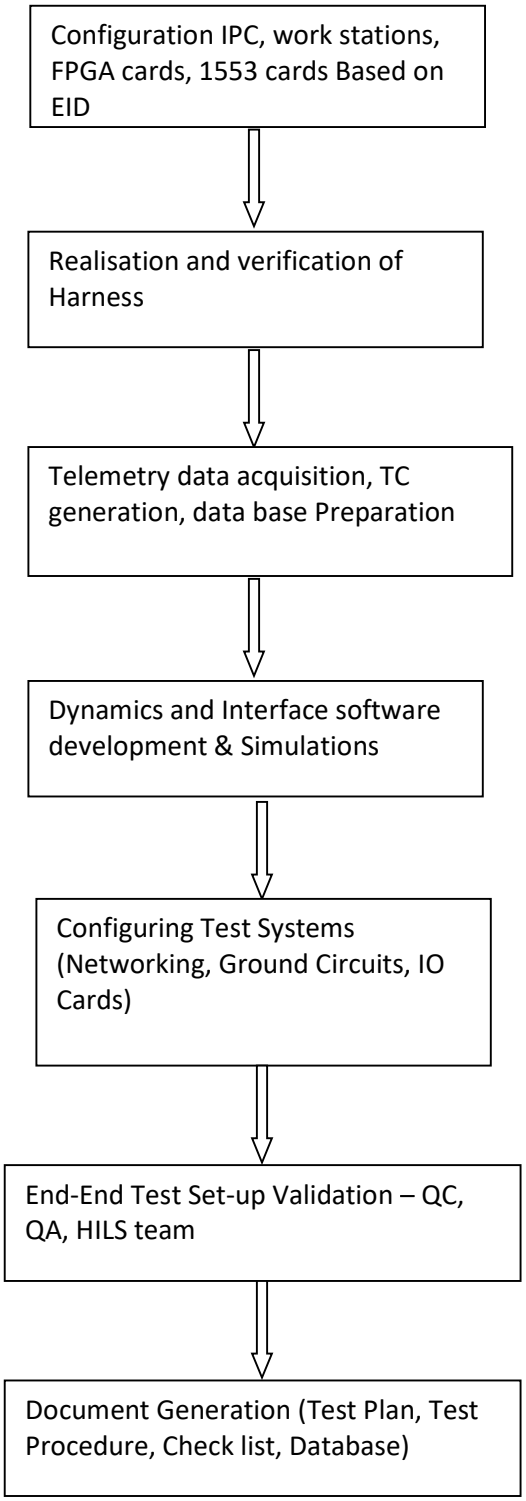
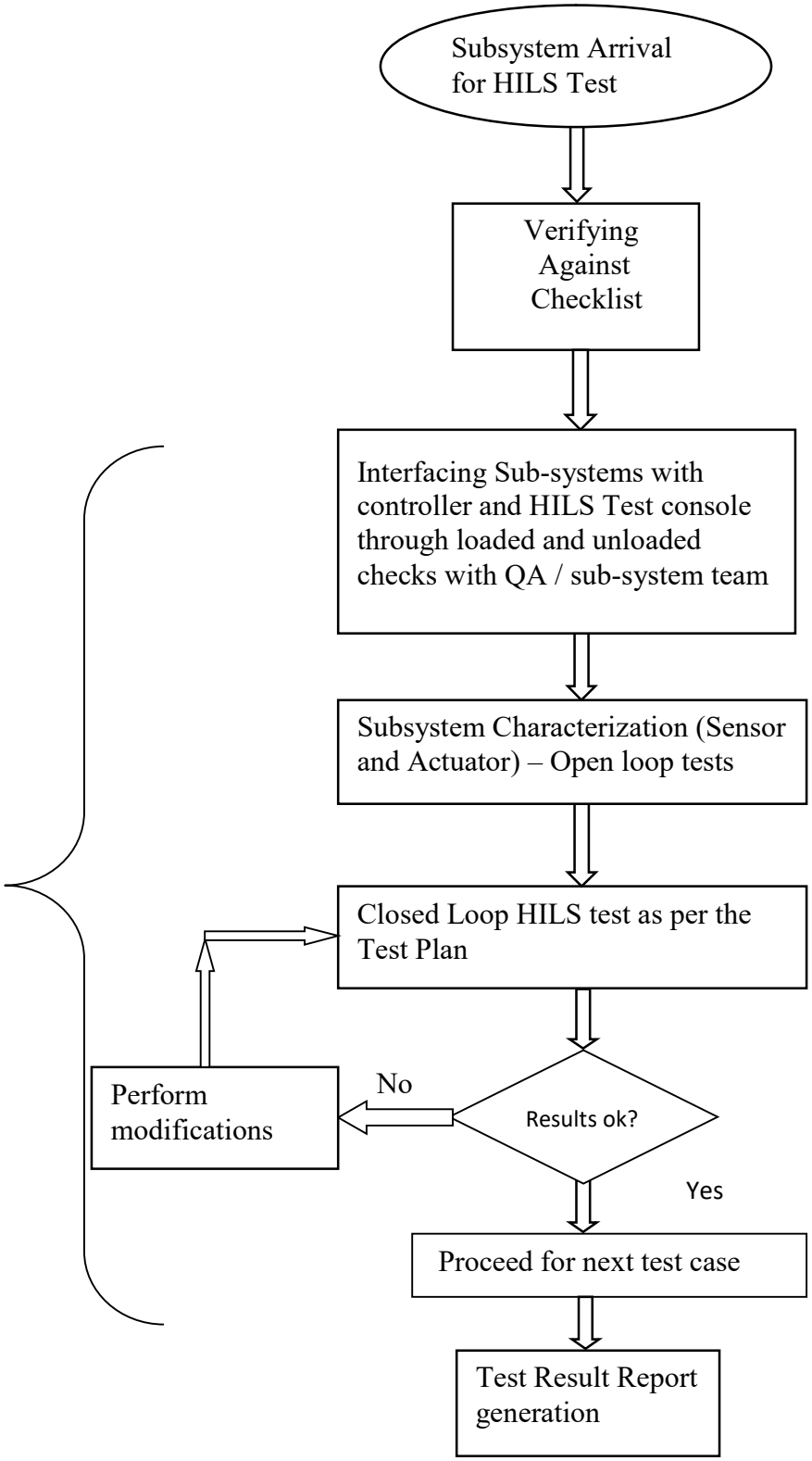


Figure 1: HILS Test Bed Realization



Multiple mounting configurations will be involved as per project requirement and the process to be repeated

Figure 2: HILS Test Execution

4.2 HILS Activities:

HILS test bed involves interfacing of Flight Hardware elements such as OBC, Sensors and Actuators and evaluate the performance of closed loop dynamics control. To test and validate AOCS/NGCS performance, 3 activities are identified. The activities are HILS Test bed realization (Harness realization, test systems with computing platforms, Verification and Validation with QC and QA teams, Database generation/Entry, Documentation), Interfacing AOCS elements, Open loop checks, Closed loop testing, Performance Analysis and Documentation.

Table-1 HILS Activities:

Activity No	Nature of work	Flow Chart Reference
1	Test bed Realization	Refer Fig-1 HILS Test Preparation
2	AOCS Interface and Open loop checks	Refer Fig-2 HILS Test Execution
3	HILS Closed loop Testing and Performance Analysis	Refer Fig-2 HILS Test Execution

Documentation is the parallel activity where each activity will be followed by document generation.
Eg: HILS Closed Loop Testing followed by Test Report generation

4.3 Details of each HILS Activity:

Required Infrastructure, Hardware and Software for Test bed realization activity will be provided by URSC.

4.3.1 Test bed Realization: (Activity-1)

a) **Harness Realization:** Study of EID, identifying the needed connections, realization of EIU with different type of crimp connectors, sensor harness and power harness as per project requirements will be carried out by Service Provider with the support of URSC Engineers. Service Provider should participate in evaluating harness along with QC and QA team.

b) **Integration of Test Systems:** Test bed consists of industrial PCs/Workstations,

1553 cards, data acquisition cards, sensor simulation, Telemetry acquisition, Telecommand generation and power supplies. Installation of necessary software and hardware for test bed to be carried out by Service Provider.

c) Service Provider should carry out integration of above computing elements with ESD precautions in place. Test bed configuration and hardware will be provided by URSC.

d) **Verification of test bed:** Test bed verification/evaluation needs to be carried out by Service Provider along with QA as per Test procedures. Evaluation of the test set-up includes verification of all Power lines, load signals,Telecommand generation, Telemetry acquisition, 1553 Bus Monitor functionality, sensor simulation and data acquisition.

e) **Documentation:** Harness Test System Output verification report, Test Procedure documents for interface, open loop tests and Review presentation are to be generated by Service Provider based on requirement documents. Results logging in prescribed format, control system performance analysis, result review report can be generated and submitted to URSC for clearance.

f) **Accountability:** Recording and reporting any observation/deviation in test results, analysis of the same from the specified values in HILS AOCS observation report. Providing the updated information to focal person about all activities related to test system and any updates.

g) **Checklist Generation and Clearance:** HILS checklist documents for each sub-system will be updated by Service Provider which has to be reviewed and cleared by HILS engineers. Each sub-system arriving for test should be verified against this checklist. The checklist document needs to be filled with the information of sub-system ID, date of reception, date of handing-over, Package model, T&E completion by Service Provider.

4.3.2 AOCS Interface and Open loop checks (Activity-2)

Following activities are required to be performed by Service Provider:

- To check all harness/buffers that are used for interfacing AOCS elements
- Pin scanning of all connectors of HILS to ensure “safe to mate” condition.
- Ensure power (Live and Return signals), SGRPs are reaching at the expected connections
- Ensure isolation of Raw bus Live and Return
- Impedance measurement for all load connections
- Verification of Tele-commands
- To interface AOCS elements as per the user manual interface document in association with URSC engineers along with QA and record the results.
- Verification of TM health parameters of the interfaced sub-system
- Performing open loop checks like sensor characterization and actuator data acquisition as per the procedures mentioned in HILS checklist.
- Sensor characterization consists of Noise measurement, Calibration and Polarity verification of Gyro, Sun, Star and Earth sensors.
- Sensor Misalignment computation, up-linking of misalignment values and verification of sensor outputs after up-linking misalignment values.
- Ground circuits used in the test set-up have to be evaluated for their functionality by giving simulated inputs.

While performing the above checks the Service Provider should verify for all input and output signals as per the user interface document provided by sub-system team**.** Any anomaly noticed should be discussed with URSC engineers. Testing needs to be proceeded only after obtaining the necessary clearances from URSC engineers, URSC.

4.3.3 HILS Closed loop Testing (Activity-3)

- Test plan document covering the nominal and non-nominal conditions will be provided by URSC.

- Preparation of test procedures, telecommand file, telemetry page display and database for various test cases are to be carried out by Service Provider in consultation with URSC engineers.
- Service Provider has to carry out closed loop tests for various control modes of AOCS as per the test plan document and verify the test results in real time for compliance of control specifications.
- Service Provider has to record any Observations or Non-conformances, AOCS performance deviations observed during testing.
- Detailed study, analysis, debug, troubleshoot and close-outs of observations has to be consolidated & prepared and presented to review committee by Service Provider with support of URSC engineers.
- Periodic Backup of all files on completion of all planned tests – Source codes, Input files, data bases, Dynamics test results, Telecommand files, Telemetry extracted parameters, MIL STD 1553 data logs, MIL STD 1553 data extractions have to carried out by Service Provider.

4.3.4 Documentation (Parallel Activity)

- Following documents shall be made ready under the guidance of URSC engineers. The documents shall be submitted to URSC for review at appropriate time.
  - ✓ Preparation of HILS check list for each AOCS elements that are participating in closed loop dynamics test.
  - ✓ Test procedure document - Service Provider shall prepare the test procedure document containing command files and Telemetry parameters associated with each test case of provided Test plan document.
  - ✓ User Interface Document of sub-system – During interfacing, User Interface document can be logged with all details of observed signal characteristics, current, voltage and command, TM verification.
  - ✓ Command files for executing open loop and closed loop test cases.
  - ✓ Database preparation for TM and TC.

- ✓ Dynamics parameters update.
- ✓ HILS Test report generation.
- ✓ Presentation material for reviews (TRRC, TRC, PRT, SRC).

- Any modification/addition required for any of the above documents based on the inputs/feedback obtained during the testing phase should be implemented by the Service Provider in consultation with focal person.
- Maintenance of movement of AOCS packages , Daily Operations Record (DOR), Non-Conformance Reports (NCRs), test procedure and test results to be logged.
- Service Provider shall compile all simulation test results of various control modes with detailed control performance analysis report, reviewed by URSC engineers and generate HILS test report document on completion of HILS Test.

5. OILS Test Introduction:

The responsibility of OILS Division is to validate onboard implementation of Attitude and Orbit Control System Algorithms, Fault Detection Isolation and Reconfiguration (FDIR) Logics and safety logics of various control modes of NGCE/AOCE/OBC/Any Controller Under Test. OILS test bed provides closed loop testing of spacecraft's attitude and on-orbit control with simulated sensors and actuators.

- ➢ The OILS test bed is realized by integrated test system providing all types of simulation, both hardware and software interfaces, for system under test.
- ➢ The Test systems are 19" rack mounted, having Industrial PCs as Front-End Processors (FEP) housing the hardware required for interfacing with system under test.
- ➢ The Host system provides user interface for commanding and Telemetry, consisting of 1553, TC and TM processing software, plotting and other processing utilities along with the data archival and retrieval software modules.
- ➢ FEP interfaces with Host workstations through dedicated Ethernet link for data transfer.

- The Host and FEP systems, both, are real time systems incorporating the real time control dynamics software computation and interfacing with other software modules
- Sensor simulation consists of simulation of Gyro sensor, star sensor, Earth sensor, Sun sensor and Satellite Position System
- Actuators like Thrusters, LAM and Torquers are simulated as loads. Wheels are simulated using electrical interface simulation.
- OILS Software computes the dynamics of spacecraft based on the torque acquired from actuators driven by controller under test. This information is used to generate sensor stimuli which is acquired by controller thus closing the loop.

The work flow of OILS testing is classified as (1) Test Preparation Activity and (2) Test Execution Activity depicted through Fig 3 and Fig 4.

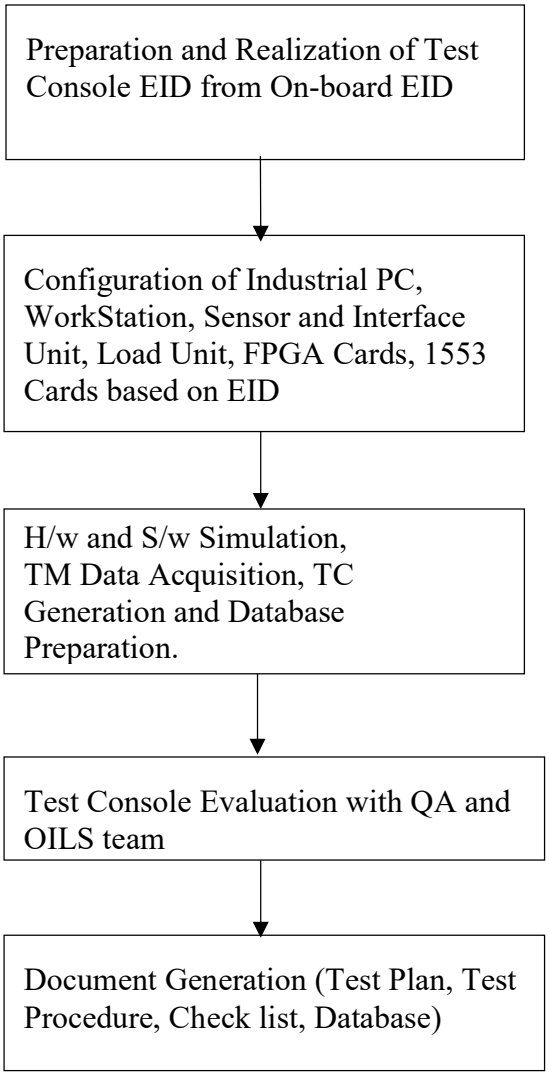


Fig 3: OILS Test Preparation

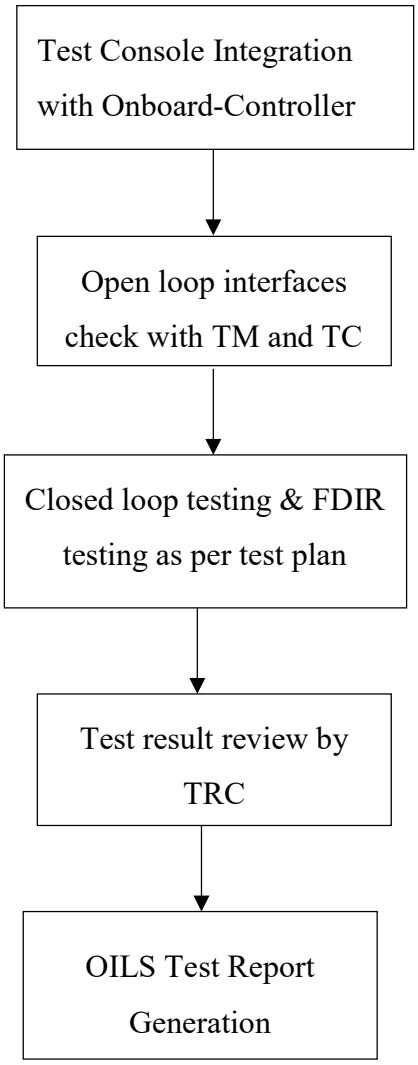


Fig 4: OILS Test Execution

5.1 OILS Activities:

OILS test bed involves testing of AOCS algorithm in Flight Hardware such as OBC/AOCE/NGCE using sensor and actuator simulation. To test and validate the Flight Hardware, 2 activities are identified. The activities can be broadly classified as OILS Test bed realization (Harness realization, integration with computing platforms, Test Console Evaluation with QA teams, Database generation/Entry, Documentation) and OILS Testing

activities (Interfacing AOCE/OBC/NGCE elements, Open loop checks, Closed loop test and Documentation).

Table-2 OILS Activities:

Sl. No	Nature of work	Flow Chart Reference
1	OILS Test System Realization	Refer Fig-3 OILS Test Preparation
2	Integration with Flight package and Testing	Refer Fig-4 OILS Test Execution

Documentation is the parallel activity where each activity will be followed by document generation.

Eg: OILS Closed loop Testing followed by Test Report generation

5.2 Details of each OILS Activity:

5.2.1. OILS Test System Realization (Activity-1)

Required Infrastructure, Hardware and Software for Test bed realization activity will be provided by URSC.

1. **Harness Realization:** Test Console EID has to be prepared by the Service Provider based on Flight OBC EID with guidance from URSC team. Identifying the hardware units, realizing the harness for connecting Sensor Stimuli Unit, Interface unit, Heater & thruster load unit, Interconnection unit are to be carried out by Service Provider. The realized harness shall be verified using HTS along with QA and URSC Engineers.

Test set up Integration: Service Provider has to integrate with all required resources such as Industrial PCs, 1553 cards, data acquisition cards, Power supplies, Stimuli & Interface units with interconnection unit in 19” Rack with ESD precautions in place. All hardware will be provided by URSC, URSC.

2. Test Console Evaluation:

Following activities are required to be performed by Service Provider before interfacing to controller:

- To check all harness that are used for interfacing AOCE/OBC/NGCE.
- Pin scanning of all connectors to ensure “safe to mate” condition.
- Ensure power(Live and Return signals), SGRPs are reaching at the expected connections
- Isolation checks and Impedance measurement for all load connections to be carried out.
- All test console –simulations (sensors and actuators) to be verified in open loop with test console command and console telemetry.
- 1553 Remote Terminal simulations to be validated through bus monitor
- To coordinate with engineers of OILS team, QA and record the results.

While performing the above checks the Service Provider should check for all input and output signals as per the user interface document provided by URSC**.** Any anomaly noticed should be discussed with URSC engineers. Testing needs to be proceeded only after obtaining the necessary clearances from URSC.

3. Documentation: Test Console Simulation Document having details of simulation interfaces (console Telemetry and Telecommand) are to be generated by Service Provider. This will be reviewed and cleared by URSC Engineers.

5.2.2 Integration with Flight package and Testing (Activity-2):

Following activities are required to be performed by Service Provider:

· Flight Package (OBC/AOCE/NGCE) isolation checks and clearance for package connection along with QA and OILS Engineer.

· Testing of flight packages involves both open loop and closed loop testing.

a) Open Loop Testing:

· Test console connection with SM/FM OBC/AOCE/SUT and powering ON in the presence of QA and subsystem.

- Testing of sensors and actuators simulations including FDIR simulations in open loop using 1553 bus monitor and Onboard TM.
- Verification of TC and TM health parameters of OBC/AOCE/SUT.

b) Closed Loop Testing (OILS)

- Test plan document covering the nominal and non-nominal conditions, FDIR tests will be prepared by URSC and given to Service Provider.
- Service Provider shall prepare the test procedures for various test cases in consultation with URSC engineers.
- Service Provider shall carry out the closed loop tests for various control modes of AOCS, FDIR, Safe mode logics and all associated on-board logics for AOCS validation as per the test plan document. Service Provider has to verify the test results in real-time for compliance of control specifications.
- Service Provider shall record any Observations or Non-conformances, AOCS performance deviations observed during testing.
- Detailed study, analysis, debug, troubleshoot and close-outs of observations has to be prepared and presented to review committee by Service Provider with support of URSC engineers.
- Periodic Backup of all files (Source Files, TM TC Databases, Plots, Test Results) and on completion of all planned tests by Service Provider.

While performing the above checks the Service Provider should verify for all input and output results. Any anomaly noticed should be discussed with URSC engineers. Testing needs to be proceeded only after obtaining the necessary clearances from URSC,URSC.

5.2.3 Documentation (Parallel Activity)

- Following documents shall be made ready under the guidance of URSC engineers. The documents shall be submitted to URSC for review at appropriate time.
  - ✓ Preparation of OILS check list for each simulation requirement and validation
  - ✓ Test console Evaluation document – results of passive, active and load checks

- ✓ Test procedure document - Service Provider shall compile and consolidate the test procedures as a single document. Inputs for preparing test procedures will be provided by URSC.
- ✓ Database preparation for TM and TC
- ✓ Dynamics input database
- ✓ OILS Test report generation - Service Provider shall compile all simulation test results of various control modes, including FDIR, Safety Logics with detailed controls performance analysis, reviewed by URSC engineers

- Any modification/addition required for any of the above documents based on the inputs/feedback obtained during the testing phase should be implemented by the Service Provider in consultation with URSC Engineer.
- Maintenance of movement of OBC/AOCE packages , Daily Operations Record (DOR), Non-Conformance Reports (NCRs), test procedure and test results.

6.0 Support for Review Process: (for both HILS and OILS)

The following reviews have to be supported by Service Provider with appropriate presentations and documents of both HILS and OILS.

6.1 Test Readiness Review (TRRC):

This review is held by TRR Committee which has respective Division Heads as members along with QA teams. This review is held after the establishment of HILS/OILS Test bed and on availability of inputs needed for carrying out HILS/OILS of a specific project. TRRC presentation be made available by Service Provider in consultation with HILS/OILS team. The Service Provider should start interfacing AOCS elements after obtaining the approval from corresponding TRR committee.

6.2 Peer Review Team (PRT):

After completion of each phase of various control mode testing, presentation of test results has to be generated for review by PRT and necessary clearance is obtained before moving on to next mounting configuration of HILS test. Also TRRC/PRT meeting will be

called for any changes in the approved plan of testing and any new requirements or modifications while testing is in progress for both HILS and OILS.

6.3 Test Results Review (TRC):

This review is held after completion of all planned test cases indicating the completion of testing activity for both HILS and OILS. The Service Provider should provide necessary test data for all the reviews. Detailed AOCS performance Analysis, Observations, Non-conformances, and Closeouts to be presented to committee by Service Provider.

6.4 Non-Conformance Management

The non-conformances observed during tests are to be clearly addressed for observations. The following are the guidelines.

- Observation report, Control System Performance Analysis, Closeouts to be generated by Service Provider
- Non-conformance report to be raised by URSC engineers
- Presentation of Non-conformance/observation to TRRC/PRT committee will be given by Service Provider in consultation with URSC team.

Subsequently, subsystem in consultation with QA shall have the necessary review/closeout for the reported non-conformance. The continuation of the testing activities shall be after clearance and closeout from respective subsystem.

7.0 Classification of Project Category

Table-1 and Table-2 shows the major activities involved in testing of AOCS of a specific project of HILS and OILS respectively. The complexity and time requirement for each activity may vary based on the type of spacecraft mission objectives. Table-3 provides the classification of HILS/OILS project category which is broadly divided into three types - Type-1, Type-2 and Type-3.

Table-3 Classification of Project category

TYPE of Project category	Description
Type-1	Regular or Repetitive Projects
Type-2	New / Complex / Interplanetary Projects
Type-3	Micro/ Nano Projects

The following section gives a brief description on three different project categories.

7.1 Type1: Regular/Repetitive projects:

This category of project is generally less complex in terms of establishment of test bed. As they are regular type, it does not call for any new developments. The test bed is realized with proven hardware and software – Electrical Interconnection Unit (EIU) or test console / TM TC databases / TM TC Interfaces. But time required for other activities like interfacing and test cases execution is on par with Type 2 category – complex with new requirements. Regular INSAT, GEOSAT and IRS types of projects which are repetitive in nature fall under this category.

7.2 Type2: New/Complex/Interplanetary Projects:

The interplanetary missions and first project of any new series will fall under this category. This will call for new developments in terms of dynamics simulation software, TM and TC functionalities, special test cases, payload simulations, new EIU/test console generation, new interfaces. The time required for realization of test-bed and test case execution will be more. Usually this class of project will be tested in two phases, for initial validation and final validation.

Some special projects like Gaganyaan, Spadex, ISRO Servicer Mission will involve testing at different phases

Hence the time required and work involved is considered double of Type-I for this category.

7.3 Type3: Microsatellite / Nano satellite Projects:

Micro satellites are similar to normal IRS spacecrafts except that all sub-systems like OBC, IRU and wheels are miniaturized in size and with no redundancy. The realization time of EIU will be less and No. of test cases will be optimized. In case of Nano satellites, during HILS test, the whole spacecraft will be mounted on AMS and only star sensor will be dis-integrated from spacecraft and mounted in front of DMSS.

The classification of type will be decided and approved by internal committee chaired by respective Group Director.

8.0 Scope of work:

The Service Provider is responsible for carrying out HILS / OILS testing activities as identified in Table-1 (HILS) and Table-2 (OILS) for three different categories of projects as given in Table-3.

8.1 Complexity Factor:

The Complexity factor X1 and X2 are defined based on the effort needed for carrying out activities defined in Table-1 and Table-2. Table-4 consolidates the complexity factor for Type-1, Type-2 and Type-3 projects of HILS. Table-5 consolidates the complexity factor for Type-1, Type-2 and Type-3 projects of OILS.

Table-4 Complexity Factor for Various Project category of HILS

Type of Project category	Description	Complexity Factor	Effort for HILS Activities	Tentative duration for execution of all milestone activities
Type-1	Regular or Repetitive Projects	X1	(1) In Activity-1 (Pl refer Table-1), existing EIU (less than 75 connectors) will be used with 10% modifications (2) Verification & Validation of EIU with available Harness and test set-up (3) Activity-3 (Pl refer Table-1) will have proven test cases and test procedures. (4)Detailed AOCS performance Analysis, Observations, Non-conformances, Closeouts are required to be prepared	3 months
Type-2	Complex / New / Interplanetary Projects	2 * X1	(1) In Activity-1 (Pl refer Table-1), new EIU (more than 100 connectors), harness and test set-up will be realized. (2) Verification & Validation of new EIU. (3) Activity-3 (Pl refer Table-1) will have new test cases. New Test procedures has to be established. (4)Detailed AOCS performance Analysis, Observations, Non-conformances, Closeouts are required to be prepared	6 months
Type-3	Micro/ Nano Projects	0.5 * X1	(1) In Activity-1 (Pl refer Table-1), existing EIU (less than 50 connectors) will be used with less than 10% modification (Micro) or no EIU at all (Nano) (2) Verification & Validation of EIU with available Harness and test set-up (3) Activity-3 (Pl refer Table-1) will have proven test cases and test procedures. (4)Detailed AOCS performance Analysis, Observations, Non-conformances, Closeouts are required	1.5 months (45 days)

Note: The tentative duration required for execution of all 3 milestone activities is estimated based on two shift / round the clock mode of operations with required technical expertise.

Table-5 Complexity Factor for Various Project category of OILS

Type of	Descripti	Compl	Effort for OILS Activities	Tentative

Project category	on	exity Factor		duration for execution of all milestone activities
Type-1	Regular or Repetitive Projects	X2	(1) In Activity-1 Table-2), minor modification in existing Test Console realization (around 15%). (2) Verification & Validation of test console, harness and simulations (3) Activity-2 (Pl refer Table-2) will have proven test cases and test procedures. Additional test cases for new requirements will be provided. (4) Detailed AOCS performance Analysis, Observations, Non-conformances, Closeouts	3 months
Type-2	Complex / New / Interplanetary Projects	2 * X2	(1) In Activity-1 (Pl refer Table-2) New simulations interfaces and additional harness, Interconnection unit have to be realized. (2) Verification and Evaluation of Test Console. (3) In Activity-2 (Pl refer Table-2) New simulation Test cases, new FDIR & closed loop logics, test procedure for testing the same have to be established. (4) Detailed AOCS performance Analysis, Observations, Non-conformances, Closeouts	6 months
Type-3	Micro/ Nano Projects	0.5 * X2	(1) In Activity-1, (Pl refer Table-2), Existing console unit will be used with less than 10% modification. (2) Verification and Evaluation of Test Console. (3) In Activity-3 (Pl refer Table-2) New simulation Test cases, new FDIR & closed loop logics, test procedure for testing the same have to be established. (4)Detailed AOCS performance Analysis, Observations, Non-conformances, Closeouts	1.5 months (45 days)

8.2 Payment Milestones:

Payments will be made based on the milestone activity that was carried out for a particular type of Project. The milestone activities in detail are explained in the tables 1 & 2. Generation of necessary documentation at all stages is an included activity and hence not considered as a separate milestone activity.

8.3 HILS Activties:

Table-6 Payment Milestones based on Activities (HILS)

Sl. No	Nature of work	Payment Milestones		
		TYPE 1 (Regular)	TYPE 2 (New/Complex/ Interplanetary)	TYPE 3 (Micro/Nano)
1	Test bed Realization	20%	30%	20%
2	AOCS Interface and Open loop checks	30%	30%	20%
3	HILS Closed loop Testing	50%	40%	60%
Total Cost		X1 Assuming X1 as cost for one regular project	2 * X1	0.5 * X1

Table-7 No. of projects and their type (HILS)

	No. of projects	Cost per project	Total cost
Type I	5 projects	X1	5 X1
Type II	1 project	2 * X1	2 X1
Type III	2 projects	0.5 * X1	1.0 X1
Total Cost			8.0 X1

8.4 OILS Activities:

Table-8 Payment Milestones based on Activities (OILS)

Sl. No	Nature of work	Typical Cost		
		TYPE 1 (Regular)	TYPE 2 (New/Complex)	TYPE 3 (Mini/Nano)
1.	Test bed Realization and test console evaluation	25%	30%	20%
2.	Integration with Flight package and Testing	75%	70%	80%
	Total Cost	X2 Assuming X2 as cost for one regular project	2 * X2	0.5 * X2

Table-9 No. of projects and their type (OILS)

	No. of projects	Cost per project	Total cost
Type I	5 Projects	X2	5 X2
Type II	1 projects	2 * X2	2 X2
Type III	2 project	0.5 * X2	1.0 X2
Total Cost (Rs)			8 X2

Table-10 Total Cost (HILS & OILS):

	Cost per Type-I project activities	Total quantity	Total cost
HILS Testing	X1	8	8* X1
OILS Testing	X2	8	8* X2
Total Cost (Rs)			8* X1 + 8* X2

8.5 Details of Quote to be Provided:

- The Service Provider is required to quote for Type-1 project execution cost i.e for 'X1' for HILS activities and 'X2' for OILS activities. Based on this cost, the total cost can be arrived for executing this work considering types of project and the required quantity as mentioned above.
- The Service Provider shall provide total cost and break-up for each activity.
- This Total cost given in Table-10 is for all the activities and for all the three types of Projects which will be utilized interchangeably among different types of projects within HILS OILS.
- The work order will be released for the total testing activity required indicating the type of project category.

Format for Quote from Service Provider for complete testing is provided in section 19.

9.0 Summary of Work – Activity and Responsibility Matrix of HILS

Below table gives the responsibility matrix of both Service Provider and Service Receiver.

Table-11 Activity and Responsibility Matrix (HILS)

Sl.No	Activity	Service Receiver Responsibility	Service Provider Responsibility	Work Place	Necessary Documentation by Service Provider
1	Test Bed Realization	Providing EIDs, ICDs, AOCS configuration documents, Test plan document, checklist document. Data acquisition cards Device driver and Application programs, All Hardware for	Preparation of EIU Connections based on EID, Harness realization. Harness realized will be subjected for QC validation by Service Provider by generating QC certificate .Assistance in QA verification Clearance from URSC focal point to proceed further Installation of necessary software and hardware.	URSC/ ISITE	1.HTS Report 2.Checklist document 3.Test procedure

		test bed integration ICD, FRD of all subsystems Preparation of Test Plan document and approval from TRRC and PRT	Test bed integration, Simulators Health Check Database Updation for TM and TC Based on FRD, ICD, SRS, SDD, Test cases identification		document.
2	AOCS Interface & Open loop checks	Sub-system User Interface Document, All Flight Hardware Packages with saver buffers Preparation of Test Plan document and approval from TRRC and PRT Inputs for Test Procedure from test plan	Integration of packages (As per User Interface document from sub-system) Sensor characterization Actuator data acquisition and verification Subsystem Level Performance Analysis, Observations, Non Conformance.	URSC/ ISITE	User Interface document with all details of observed signal characteristics, current, voltage and command/TM verification. Open loop Test Report. Analysis Report of any observations.
3	HILS Closed loop Testing	Dynamic Simulation Software, Data book, Mounting Fixtures, Simulators.	Preparation of Test Procedure document from Test Plan and clearance URSC Engineer. Closed loop testing as per test plan for various AOCS control modes Detailed AOCS performance Analysis, Observations, Non-Conformance.	URSC/ ISITE	1. Test procedure document 2. HILS Test report 3. Detailed Performance Report, Analysis, Non-conformances, Closeouts.
4	Documentation (Parallel Activity)	Ensuring the readiness of all necessary documents TRRC/PRT/ TRC review	All necessary documents for presentations pertaining to each activity MoM, Action closeouts to be prepared by Service Provider	URSC/ ISITE	Presentations of TRRC/TRC/ PRT and HILS Report.

9.1 Summary of Work – Activity and Responsibility Matrix of OILS

Below table gives the responsibility matrix of both Service Provider and Service Receiver.

Table-12. Activity and Responsibility Matrix (OILS)

Sl.No	Activity	Service Receiver Responsibility	Service Provider Responsibility	Work Place	Necessary Documentation
1	OILS Test System Realization and Test Console Evaluation (Activity-1)	Identification of Test Console Resources all hardware Units. Providing Onboard EIDs, ICDs, FRDs. Test cases identification from FRD/SRS/SDD. Simulation Requirements based on FRD.	Preparation of Test console EIDs. Realization of Test Console Harness, Interconnection unit, Integration of Test console units, Updation of TC and TM database. Test Console Evaluation results. Presentation to TRRC,PRT for Test Bed readiness.	URSC	HTS Report And Test Console Simulation and evaluation Report.
2	Integration with Flight package and Testing. (Activity-2)	FM/QM/SM NGC/OBC/AOCE package to be tested. Databook. Dynamic Simulation Software, Host and FEP Software for Interface Simulation. Test plan document having all the test cases approved by TRRC,PRT.	Isolation checks Connection with Console, Powering ON, and Open loop interface test. Test procedures to be prepared in guidance with URSC Engineers as per Test plan. Closed loop testing as per test plan for various AOCS control modes and FDIR Testing. Detailed AOCS	URSC	1. Test Console Simulation report indicating open loop interface test results. 2. Test Procedure document 3.Test Report Document after closed loop Testing. 4. Detailed Performance Report,

			performance Analysis, Observations, Non Conformance.		Analysis, Non-conformances, Closeouts.
4	Documentation (Parallel Activity)	Ensuring the readiness of all necessary documents for TRRC,PRT, TRC review	All necessary documents for presentations pertaining to each activity. Minutes of Meeting, Action closeouts of reviews	URSC	Presentations of TRRC/TRC/ PRT and OILS Report.

10.0 Provision for Repeat/Rework related tests:

Service Provider teams are required to conduct the open loop / closed loop AOCS simulations of a project more than once (more than one phase) as and when required due to various requirements, suggestions and practical problems.

Service Provider shall conduct additional tests / re-tests which amount to less than 30 percent of the planned regular total work involved without any financial implications. The requirements for these tests may arise at any point due to several reasons.

If the quantum exceeds 30%, additional tests based on the type of activity involved in additional phases of testing, payment will be worked out, as decided by a STEC Committee (Special Tec) from URSC, after aggregating and planning the activities with equivalent 1 Unit of Type1.

11.0 Roles and Responsibilities

11.1 Role and Deliverables of URSC

- Identification of Focal Person for the respective projects.
- Checklist of each sub-system that are participating in tests like Electrical Interconnection Details (EID) Document, Mechanical ICDs, Electrical ICDs, TM/TC list, dynamics parameters and configuration documents, data book.

- Test Systems, Infrastructure and facilities to execute the work order
- Standard equipment as needed.
- Preparation of Test plan, Inputs to test Procedures.
- User Interface documents prepared by Subsystem and approved by URSC for Flight system interfacing of HILS activity.
- Conduct and Participation in Reviews (TRRC,PRTTRC) with Service Provider inputs.
- Review of test results, Observations and analysis provided by Service Provider.
- Non-conformance management through participation in PRT.
- The NCRs and analysis report originated by Service Provider during HILS/OILS test to be cycled through respective review mechanism and proper close-outs to be ensured.
- STEC Committee has to evaluate the proposals. The Committee should decide the complexity of the project. The selection of Service Provider is decided in the STEC Committee.

11.2 Role and Deliverables by Service Provider

- Activities to be conducted: Console Evaluation, interfacing flight packages, AOCS open loop simulation, sensor noise characterization, Actuator data verification, closed loop simulation.
- Duly approved complete set of Interface and test procedures document.
- Reporting any observation during testing to the concerned focal point. Control System Performance Analysis, and support for troubleshooting of the observation and provide closeouts.
- Non-conformance observation report generation
- Final Test Report Document after Testing with Detailed Performance Report, Analysis, Non-conformances and Closeouts.
- Presentations for several reviews - configuration and readiness to TRRC / PRT, Test Results to TRC for final clearance

- Log Book maintenance and test results reports approved by URSC (To be delivered along with handing over of AOCS flight elements of a project)

12. Schedule and Work Force Planning

Based on the work and delivery schedule given by URSC through work order, Service Provider has to discuss with OILS/HILS lab representatives and assess the number of work force required to meet the delivery schedule and provide the required man power with the required skill sets. The same is to be implemented without any slippage within 15 days of receiving the work order. The Service Provider should ensure the availability of engineers, technical assistants and technicians for executing the work order.

The engineers deployed by the Service Provider should be B.E (Electronics/Instrumentation/Controls) graduates with 2 years of experience in testing of electronic systems and aerospace Control system. Should have knowledge in Simulation tools like MATLAB, and Simulink.

The technical assistants deployed by Service Provider should be Diploma (Electronics) with 3 years of experience in testing of electronic systems. Service Provider shall ensure the availability of same personnel from start to end of entire project. The man power should support for round the clock shift operations based on project schedules.

The technician deployed by Service Provider should be ITI (Electronics) with 3 years of experience in fabrication and testing of electronic systems. Service Provider shall ensure the availability of same personnel from start to end of entire project. The man power should support for round the clock shift operations based on project schedules.

13. Status Reporting

Status report on testing and documentation to be submitted for review periodically to OILS/HILS lab representatives.

14. Log Books, DOR, Folders & File Maintenance

Service Provider shall make entries in log books, test procedures and test results. Service Provider shall maintain these database as per procedures in vogue at URSC and these are to be submitted to URSC.

15. Facilities

URSC will provide the necessary testing facility for establishment of HILS/OILS test bed and tools based on the requirements. Service Provider will be using the HILS/OILS facilities of ISITE/URSC/ identified location within India during testing of the AOCS elements.

15.1. Remote Operations Facility

The Service Provider should have facility to access HILS & OILS facility remotely from their work place. The work place should have adequate infrastructure with dedicated, secured high-speed network facility to communicate with HILS & OILS test beds. Both HILS & OILS Activities - Testing and Operations should be carried out remotely and independently from Vendor's Working location after initial set up establishment at user's work place.

The Service Provider should ensure smooth control, operations and testing of HILS and OILS test beds without any data loss. Video conferencing tools have to be available for meetings and reviews. Data backup and Redundancy systems availability have to be ensured and provided.

15.2. Inspection of Facility

The Remote Operations facility at Service Provider's Working Location will be inspected by URSC team for compliance.

16. General Conduct & Safety Precautions

- The Service Provider personnel should adhere to the general work rules, procedures and office timings followed at URSC/ISITE/Service Location and keep

maintain harmonious relations with URSC/ISITE staff during their visit to URSC/ISITE/Service Location.

- The personnel of Service Provider must adhere to all the safety guidelines while handling flight packages while testing and transporting, particularly the ESD protection measures such as wearing ESD overcoats, shoes / chapels, wrist bands, grounding and other measures as per ESD protection guide line document.
- It is imperative that the Service Providers personnel do not touch any card, component, package without ESD protection.
- Service Provider personnel are strongly encouraged to duly report discrepancies / accidents / procedural violations occurring during course of tests as these transparencies improve the overall reliability of the product being tested.

17. Secrecy and Security

- All documents prepared for test procedures, log books, drawings, schematics and any other communications, codes revealed during the process of testing will be exclusive property of URSC and Service Provider shall have no right what so ever on them.
- These documents are to be strictly confidential and should not be reproduced, copied / transmitted to any media
- Further, the Service Provider must not quote any of these works in any publications or to any of their customers without explicit permission from URSC and adhere to strict confidentiality.

18. Validity and Delivery Schedule

- Validity of the order is for a period of two years and extendable by one year based on mutual agreement between URSC and Vendor.
- The Service Provider shall complete the list of activities as mentioned in the work statement. The ordered Activities shall be carried out within the stipulated time from the availability of all inputs.

- URSC reserves the right to monitor all activities and to withdraw the work if found unsatisfactory or delayed beyond project requirements.

19. Format for quote

1. The Service Provider should clearly understand the activities involved in terms of Test bed setup, test system related activities, various phases of testing, documentation and roles and responsibilities therein and quote.
2. Under this order, Service Providers would be given work orders for testing indicating the category of project and the milestone activity along with expected schedule to complete.
3. The Service Provider is required to quote for TYPE1 project i.e for 'X1 for HILS' and 'X2 for OILS'. Based on this cost, the total cost can be calculated for the required quantity for categories of projects, which will be arrived for executing this work.

Table-13 Typical quote from Service Provider for complete testing:

S.No#	Item	Unit Cost	Total cost for executing 8 Units
1	Type-1 category project Cost for completion of HILS test (X1)		
2	Type-1 category project cost for completion of OILS test (X2)		

The split up cost for the following activities based estimation shall also be given by Service Provider:

Table 14: Typical breakup from Service Provider for Activities:

S.No#	Activities for Type#1 Category Project	Remarks	Cost

1	Test bed Realization + Documentation	HILS	
2	AOCS Interface and Open loop checks + Documentation	HILS	
3	HILS Closed loop Testing + Documentation	HILS	
4	Test bed Realization and test console evaluation + Documentation	OILS	
5	Integration with Flight package and Testing + Documentation	OILS	

20. Placement of Work Orders for Testing

Work orders shall be placed by URSC for a particular type of activity (As mentioned in Table 1.0 and Table 2.0 OILS) and for a particular project category. Before any work order is placed, engineers of URSC and Service Provider representatives should confirm the technical feasibility of meeting the delivery schedule by the Service Provider based on joint review of the work content and inputs availability.

Based on mutual agreement and confirmation, URSC will issue work orders initiated by identified focal person approved by the concerned Group Director through URSC purchase procedures/formats. As more than one instance of work allotment is likely, multiple work orders may be issued.

The Service Provider shall acknowledge the receipt of the work order and confirm his readiness to execute the work within the specified schedule as per the SoW.

A typical work order (based on P.O): This is indicative only for issue of work orders.

Table-15 Typical Work order:

Sl.No.	Project	Work order Activity	Type of Project (Type-1 / Type-2 / Type-3)	Expected Duration to complete	Cost per Activity INR	Total cost INR
1	Project 1	Test bed Realization	Type-1			
2	Project 2	HILS Closed loop Testing	Type-2			
3	Project 1	Integration with Flight package and Testing	Type-1			
4	Project 1	Test bed Realization and test console evaluation	Type-1			

21. Payment Terms

Payment will be made based on the completion of all activities as per the milestones mentioned in Table-6 (HILS) and Table-8 (OILS).

22. Payment Terms for Re-testing

The re-testing cost would be decided based on the quantum of work decided and approved by internal committee chaired by concerned Group Director, URSC and it would be in terms of percentage of total cost aggregated in terms of Units.Separate work orders shall be issued to carry out re-test.

23: Delay in Completion/Liquidated Damages: The time and date stipulated in the **Individual Work Order** for completion of the work shall be deemed to be the essence of the contract. If the Service Provider fails to deliver the Work within the time specified in the Purchase Order/Contract or any extension thereof or if the Service Provider fails to maintain the required progress or comply with the relevant provisions of the general conditions of contract or special conditions of P.O/contract/Work Order, if any and clear the site on or before the contract or extended date of completion, the Purchaser shall, without prejudice to any other right or remedy available under the law to Purchaser on account of such breach, recover from the Service Provider as Liquidated Damages a sum one-half of one percent [0.5 percent] of the Contract/ Purchase Order price of the undelivered Stores for each calendar week of delay or part thereof. The total Liquidated Damages shall not exceed Ten percent [10 percent] of the Work Order Value.

In case of delay in delivery of the Services beyond the delivery date stipulated in the Purchase Order/Contract or any extension thereof, such Services shall be received without prejudice to the right of the Purchaser to claim Liquidated Damages and without prejudice to the terms and conditions of the Purchase Order/Contract.

24. Other Terms & Conditions

1) Service Provider shall provide the point by point compliance as per the Compliance Table along with the quotation.
2) A Pre-bid meet will be arranged prior to submission of quotations by the Service Providers. Service Providers who are interested should attend the Pre-Bid meeting to understand the requirements and Purchase Process.
3) It is to be noted that one-time training will be provided will be free of cost. If any subsequent training is required by Service Provider, due to change of the work force as identified mutually by service receiver and provider, training cost will be deducted from the work order payment, as 10% of Type1 Activity.
4) The Service Provider should be a Registered and established company for executing the work and should have an exposure to quality and reliability standards as applicable to avionics hardware testing.
5) Service Provider personnel shall have knowledge regarding Test & Evaluation procedures and methodologies for critical electronic hardware including Experience in

6) It is to be noted that documentation cost is included in quotation.
7) After technical bid opening and review, if found necessary, URSC reserves the rights to visit Service Provider's premises for auditing.
8) L1 rates for Qualified Service Providers will be arrived separately for HILS and OILS testing based on the cost quoted for complete HILS / OILS test as in Table#13.
9) L1 rates for Qualified Service Providers shall be arrived at based on the price bids received from the suitable qualified Service Providers. URSC reserves the right to Negotiate with L1 rates with respective Service Provider(s) if required.
10) In order to enter multiple orders with qualified Service Providers, L1 rates of Qualified Service Providers will be counter offered to other suitable Qualified Service Providers and work order will be placed with those qualified Service Providers who have agreed for the counter offer. The work is planned to be distributed as minimum 60% for L1 and 40% for L2 at L1 rates among the chosen two Service Providers based on the requirement. In case of L2 not accepting the offer at L1 rates, the Service Provider of L1 rate will be given the full (100%) work order.
11) Based on the number of projects expected in HILS and OILS for the tenure of 2 years, L1 will be given minimum of 5 project as 60% of order and L2 will be given 3 projects as 40% of order at L1 rates during the period of 2 years. In case of L2 not accepting the offer at L1 rates, the Service Provider of L1 rate will be given the full (100%) work order.
12) Based on the work order, the service provider should deploy the required team and start the activity as mentioned in work order within 15 working days from the reception of work order.
13) During the execution of the order, if any Service Provider does not comply for the delivery schedules/Quality requirements, and/or any other non-compliance , URSC reserves the right to cancel the work orders and/or re-distribute the work orders among remaining Service Providers in order to meet the project schedule/requirements.

14) The Service Provider personnel should strictly adhere to the general work rules, procedures and office timings followed at URSC and keep harmonious relations with URSC/ISITE staff during their visit to URSC/ISITE.

15) The performance of the Service Provider(s) will be evaluated periodically by URSC and URSC reserves the right to take appropriate decision based on the performance evaluation report.

16) Service Provider shall deploy work force in required numbers and required qualification & technical capabilities for realization of the work.

17) The Service Provider shall be responsible for all statutory obligations arising out of deployment of personnel at URSC under this order. The antecedents of employee deputed at URSC including Police verification shall be carried out by Service Provider.

18) Service Provider should be prepared to work beyond working hours, in shifts and on holidays to meet the project schedules.

19) The cost of components/systems damaged due to negligence/mishandling by the Service Provider shall be recovered from the Service Provider's payment.

20) **Workmen Compensation/ Insurance**: Service Provider has to arrange comprehensive insurance at their own cost, for all the category of workforce deployed to get compensation of Rs. 10 Lakh in the event of Death/ permanent disability and Rs. 7 Lakh in case of Accident related issues.

21) Service Provider shall ensure the necessary resources (other than the Lab Facilities provided by URSC) and logistic support required for the execution of the work at URSC/ISITE.

22) Start of the project activity will be decided and communicated by URSC focal point / indenting officer through work orders.

23) Service Provider shall be prepared to accept any short closure of the work order decided by URSC.

24) All documents, drawings, package details and any written communication furnished by URSC to the Service Provider as part of the P.O., shall remain the Intellectual Property of the Government of India and the Service Provider is prohibited from further utilizing or passing on any of such information / details / drawings in whole or in part to any other agency / third party.

25) Transport / Conveyance, Canteen and Medical Facilities will not be extended to Service Provider/Service Provider personnel deployed at URSC.

26) The employees deputed to undertake the work by the Service Provider shall remain the employees of the Service Provider and they shall not acquire any claim for future employment or regularization in URSC or any other ISRO Centres.

27) Any security violations or involvement in any unauthorized movement / transaction of official material / properties by the Order Technicians deployed will be viewed seriously and the Order will be terminated and action deemed fit will be taken.

Compliance matrix and Evaluation criterion shall be agreed and provided in the Technical quote

Table-16 Compliance Matrix for Service Provider Pre-requisites:

Refer General Prerequisites 2.1 and Technical Prerequisites 2.2

S.No	Compliance Criteria	Evaluation Criteria	Compliance
2.1.1	The registration details of the company shall be provided.	Quote should contain Service Provider Registration Documents.	**Complied/ Not complied**
2.1.2	The company profile, workforce ,experience and the past works executed are to be indicated clearly. Details of the execution of similar avionics for spacecraft sub-system/aerospace sub-system testing activity, the time taken to execute the order and the Principals for	Service Provider shall provide Registration Documents and Previous Purchase Orders, Experience certificates, Training	**Complied/ Not complied**

	whom the work was carried out should be provided	certificates for carrying out Aerospace activities covering Control Electronics / Sensor / Actuator performance testing, brief details of work and completion details.	
2.2.1 **2.2.2** **2.2.3** **2.2.5** **2.2.6**	Knowledge in spacecraft/Aerospace/industrial control system. Ability to understand technical specifications. Experience in Testing of Aerospace/Avionics software and hardware Skills in test performance analysis. Preparation of test reports and documentation.	Service Provider should provide previous purchase orders and completion certificate for testing of any avionics /aerospace /industrial control packages Or For Startups, MSME and Service Providers without any previous PO, the service providers shall participate in testing of pilot project for a week (5 working days) at URSC. The evaluation will be carried out at URSC and Service provider is expected to provide the required resources	**Complied/** **Not complied**

		within 10 days of notification before evaluation of technical Bid. The vendor's performance will be evaluated and assessed by URSC committee with participation of vendors. The details of the evaluation plan is provided in Table-17 and will be elaborated during Pre Bid meeting. Only qualified vendors after above evaluation will be considered as technically qualified for bidding process.	
2.2.4	Knowledge in quality and reliability standards. Service Provider should have an exposure to quality and reliability standards like ISO as applicable to avionics hardware/industrial electronics testing.	Should provide project completion certificate at ISRO Or Provide PO for execution of contract with ISO or Equivalent certified industry/ or	**Complied/** **Not complied**

		Provide ISO certification or For Startups and MSME's, they should provide plan for future certification.	
2.3	Terms and conditions		**Complied/** **Not complied**
3.0	Bid submission details		**Complied/** **Not Complied**
4.1 to 4.4	HILS Test details		**Agreed/ Not agreed**
5.1 to 5.3	OILS Test details		**Agreed/ Not agreed**
6.0, 6.1 to 6.4	Support for review process		**Complied/Not complied**
7.0 ,7.1 to 7.3	Classification		**Complied/Not complied**
8.0 **8.1 to 8.4**	Scope of work		**Complied/Not complied**
9.0	Summary of Work – Activity and Responsibility Matrix of HILS		**Complied/Not complied**
9.1	Summary of Work – Activity and Responsibility		**Complied/Not**

	Matrix of OILS		**complied**
10.0	Provision for Repeat/Rework related tests		**Complied/Not complied**
11.0 **11.1** **11.2**	Roles and Responsibilities Role and Deliverables of URSC Role and Deliverables by Service Provider		**Complied/Not complied**
12.	Schedule and Work Force Planning		**Complied/Not complied**
13. **14.**	Status Reporting, Log Books, DOR, Folders & File Maintenance		**Complied/Not complied**
15. **15.1**	Facilities Remote Working Facility	Vendor shall provide proof of executing a PO carried out with in 3 years for remote execution of activities for an aerospace testing activity OR Shall provide proof of infrastructure for execution of remote operation facility, by way of computing, networking and video conferencing infrastructure OR Testimonial for plan to establishing the required computing, networking and video conferencing	**Agreed/Not agreed**

		facility with required along with proof for discussions with vendors for establishing the facility.	
15.2	Inspection of facilities	Vendor shall be ready to provide the required infrastructure / or the plan for location of infrastructure along with testimonials in 15.1 for inspection before technical evaluation of bid by URSC within 2 weeks of request	**Complied/Not complied**
16.	General Conduct & Safety Precautions		**Complied/Not complied**
17.	Secrecy and Security		**Complied/Not complied**
18.	Validity and Delivery Schedule		**Complied/Not complied**
19.	Format for quote		**Agreed/Not agreed**
20.	Placement of Work Orders for Testing		**Complied/Not complied**
21. **22.**	Payment Terms Payment Terms for Re-testing		**Complied/Not complied**
23.	Delay in Completion/Liquidated Damages		**Complied/Not complied**

24.	Other Terms & Conditions		**Complied/Not complied**
I.	Engineers deployed by Service Providers will be based on their technical competence assessed by URSC.	Technical competence requirement Work report/Resume indicating the following expertise with minimum 1-year experience. 1.Knowledge in programming languages C/C++, Python and MATLAB. 2.Knowledge in MIL-STD-1553B Bus formation, Bus Monitor Data Analysis. 3. Knowledge in socket programming and network administration. 4. Linux Device driver installation and RHEL operating System installation. 5.Configuring the Power Supply with safety provisions like UVP, OVP,Current limits.	**Complied/Not Complied/**

Table -17 Evaluation Plan Details for MSMEs/Startups

S.No	Evaluation Plan	Evaluation Activity	Remarks	
1.	**Control System Parameter Analysis** Team will be given a Test report and Control System requirements & Parameter data with different simulation conditions.	Team should be able to analyze, validate simulation results and provide a detailed performance report.	Valid for OILS and HILS	**Complied/ Not complied**
2.	**Control System Modelling in Matlab and C language** Team will be given system parameters to be modeled and simulated	Team should carry out Mathematical modelling of physical systems in MATLAB design, verify algorithm and provide the software code in MATLAB and C with analysis report.	Certification from MathWorks is preferable. Valid for OILS and HILS	**Complied/ Not complied**
3.	**Interface (Mil Std 1553B) Data Analysis** Team will be given MILSTD 1553B Bus Monitor Data with error simulation	Team should be able to identify the bus error, data analysis and provide the timing and simulation analysis	Valid for OILS and HILS	**Complied/ Not complied**

4.	**Instrument Management** Working Knowledge of DC Power supply Settings with Power Supply through RS232 Interface	Team should be able to set the DC Power Supply for voltage, current, OVP,UVP,UVL and test the supply.	Valid for OILS and HILS	**Complied/ Not complied**
5.	**Harness Verification** Harness and Test setup	Team should be able to test the given harness buffer with HTS(Harness Test System) and verify both passive, active checks ,safety checks, cross continuity checks and provide the harness report.		**Complied/ Not complied**

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