Scope of the work

The Instrumentation System outsourcing contract consists of Command system, Measurement system, Display &Processing works for Main Engine & Stage Test facility, Thrust Chamber Test Facility, Integrated Cryo Engine Test Facility, and Steering Engine Test Facilities. The detailed Instrumentation works are described in the following sections.

1. **Testing of E/P Valves**

   Part A:

   - Removing of cables from Terminal blocks of field SOV cubicle junction box and valve driver racks.
   - Cable resistance, coil resistances (2 coils) and insulation resistances to be measured and recorded.
   - Re-connection of all cables at the respective terminal blocks after measurements.
   - ON/OFF status to be tuned physically at each valve.
   - Verification of valve operation at valve end.
   - Sealing of electrical connectors with rubber compound or silicone sealant.

   Part B:

   - Voltage at rack and at coil to be measured and recorded.
   - Operation of valve from operator console to be verified.
   - Verification status recording at data acquisition system and digital recording system.
   - Test results to be recorded in the Test and Evaluation format.

2. **Testing of Control Valves**

   Part A:

   - Removing of cables from Terminal block of smart valve positioner, junction box and control valve isolator racks.
   - Cable resistance and insulation to be measured and recorded.

- Re-connection of all cables at the respective terminal blocks after measurements.
- If the valve operation and position feedback deviates for more than 0.5%, the valve has to be re-tuned and repeat the valve operation as specified above.
- Sealing of electrical connectors with rubber compound or silicone sealant.

Part B:

- Valve is to be operated in manual mode to open 0%, 25%, 50%, 75% and 100% and verification of valve opening and closing physically at valve end and measurement of valve status current output from I/P converter. The position detector output current is to be recorded in the T&E format and to be acquired in the data acquisition system.
- T&E report is to be prepared and updated.

3. Testing of Engine valves & Pyro

Part A:

- Cable resistance and coil resistances (dual) and insulation resistances to be measured and recorded.
- Re-connection of all cables at the respective terminal blocks after measurements.
- Preparation of pig tail cables.
- Preparation of connectors.

Part B:

- Voltage at rack and at coil to be measured and recorded.
- Operation of valve from operator console to be verified.
- Verification status recording at data acquisition system and digital recording system.
- All data to be recorded in the Test and Evaluation format.

4. Testing of Test Article Pressure Measurements

Part A:

- Preparation of cables and termination of cables at sensor connectors.
- Termination of pig tail cables at terminal blocks at field junction boxes.
- Laying of pig tail cable from field junction box to sensor.
- Tagging of pig tail cables.
- Removing of cables at the terminal blocks on the racks.
- Re-connecting the sensor with the connector.
- Harnessing of cables with fiber glass cloth.
- Sealing of electrical connectors with rubber compound or silicone sealant.

Part B:

- Measurement of cable continuity resistance and insulation resistance of cables connecting from Instrumentation rack to field connector end and recorded.
- The signal conditioner to be calibrated by zero input and full scale input.
- Programming of signal conditioners gain, zero offset, span offset and bandwidth.
- The measurement channels are to be calibrated using DC calibrator in four steps from field junction boxes/sensor connector.
- Estimate of measurement channel accuracy.
- Measurement of sense voltage and adjust the power supply accordingly.
- Removing of cables at isolator rack and record the bride resistance of the sensor.
- The test results are to be recorded in Test and Evaluation format.

- Entering 4th order constants up to 6 decimal places at init file and verification of the constants.
- Checking and recording the excitation voltage and ambient output.

5. Testing of Test Article Temperature Sensor Measurements

Part A:

- Preparation of cables and termination of cables at sensor connectors
- Termination of pig tail cables at terminal blocks at field junction boxes.
- Laying of pig tail cable from field junction box to sensor.
- Tagging of pig tail cables.
- Removing of cables at the terminal blocks on the racks.
- Re-connecting the sensor with the connector.
- Harnessing of cables with fiber glass cloth.
- Sealing of electrical connectors with rubber compound or silicone sealant.

Part B:

- Measurement of cable continuity resistance and insulation resistance of cables connecting from instrumentation rack to field connector end and recorded.
- The signal conditioner to be calibrated by zero input and full scale input.
- Programming of signal conditioners with 20 calibration points, filter constants and output range.
- The measurement channels are to be calibrated using DC calibrator/decade resistance box in 5 steps from sensor connector.
- Estimate of measurement channel accuracy.
- Removing of cables at isolator rack and record the RTD/TC resistance of the sensor.

- The test results are to be recorded in Test and Evaluation format.
- Entering 1st order constants up to 6 decimal places at Aimast file and verification of the constants.
- Checking and recording the ambient output.
- Functional verification of Thermocouple channels with ice.

6. Testing of Test Article Flow / Speed Sensor Measurement

Part A:

- Preparation of cables and termination of cables at sensor connectors
- Termination of pig tail cables at terminal blocks at field junction boxes.
- Laying of pig tail cable from field junction box to sensor.
- Tagging of pig tail cables.
- Removing of cables at the terminal blocks on the racks.
- Patching of direct coil output to the high speed vibration measurement system.
- Sealing of electrical connectors with rubber compound or silicone sealant.

Part B:

- The sensor integrity checks, resistance and insulation to be measured and recorded.
- The measurement channels are to be tested using frequency calibrator from junction box once in three months.
- The tests to be carried out periodically and data to be measured and recorded.
- Functional testing of flow measurement chain with function generator by simulating frequency, for speed measurement chain, spare sensor, excitation coil & function generator.

7. Testing of Test Article Vibration Measurements:

Part A:

- Preparation of cables and termination of cables at sensor connectors
- Termination of pig tail cables at terminal blocks/ BNC connectors at field junction boxes.
- Laying of pig tail cable from field junction box to sensor.
- Tagging of pig tail cables.
- Removing of cables at the terminal blocks on the racks.
- Sensor is to be removed from the test article and mounted on the 1 g calibrator using proper tools.
- Sealing of electrical connectors with rubber compound or silicone sealant.
- Sensor is mounted back on the test article with the defined torque.

Part B:

- Measurement of cable continuity resistance and insulation resistance of cables connecting from instrumentation rack to field connector end and recorded.
- The signal conditioner to be calibrated by zero input and full scale input with function generator.
- Sensor is to be vibrated at 1 g rms level and the data is to be recorded.
- FFT plot for the data recorded is to be carried out to verify the chain calibration / integrity.
- AC signal is to be fed at the input of signal conditioner in 5 steps viz. 0%, 25%, 50%, 75% and 100%. The data is to be recorded. The linearity of measurement chain is to be verified.
- Hammer tap test is to be carried out and data recorded and processed.

- Configuration of remote nodes [Main and Redundant] with necessary coefficients, filter settings, gain etc.
- Acquiring data through remote nodes [Main & Redundant] and local nodes [Main & Redundant].
- Processing data from all four nodes with respect to time domain, FFT and water fall graphs for each channel.
- Transferring the graphs to presentation form in power point.
- Taking hard copy of the plots.
- The tests to be carried out periodically and data measured and recorded.
- Necessary tools and equipments will be provided by the Department.

8. Testing of Test Article Strain Measurements:

Part A:

- Preparation of cables and termination of cables at sensor connectors
- Termination of pig tail cables at terminal blocks or multi pin connectors at field junction boxes.
- Laying of pig tail cable from field junction box to sensor.
- Tagging of pig tail cables.
- Removing of cables at the terminal blocks on the racks.
- Harnessing of cables from the test article to junction box.
- Sealing of electrical connectors with rubber compound or silicone sealant.

Part B:

- Measurement of cable continuity and insulation resistance of cables connecting from instrumentation rack to field connector end and recorded.
- The signal conditioner to be calibrated by zero input and full scale input.

- Daily ambient is to be taken by balancing and un balancing the resistance
  bridge.
- Necessary tools and equipments will be provided by the Department.

9. Testing of Test Article Displacement Measurement:

Part A:

- Insulation and continuity checking is to be carried out for each Channel.
- Preparation of mating connectors from the test article cables.
- Cables from the test article are to be terminated at the junction box.
- Installation of non contact type displacement sensor on the test stand.
- Harnessing of cables from the test article to junction box.
- Sealing of electrical connectors with rubber compound or silicone sealant.

Part B:

- Measurement of cable continuity resistance and insulation resistance of cables connecting from instrumentation rack to field connector end and recorded.
- Each channel is to be checked with placing the target before the sensor.
- Daily ambient is to be taken.
- Functional testing of displacement measurement with slip gauges.

10. Testing of Facility Pressure Transmitters:

Part A:

- Pressure transmitters are to be removed from the facility lines and sent to calibration laboratory for calibration. The pressure ports are to be closed with protective covers.
- After calibration, the pressure transmitter is to be reinstalled in the facility line. (Calibration of pressure transmitters is not in the scope of contractor.)
- Pneumatic pressure test at 1.1 times rated pressure is to be carried out for leak check.
- The Cabling is to be done to the Pressure Transmitter and is to be terminated properly.
- Sealing of electrical connectors with rubber compound or silicone sealant.

Part B:

- Measurement of cable continuity resistance and insulation resistance of cables connecting from instrumentation rack to field connector end and recorded.
- The transmitter is to be powered and measurement chain calibration is to be carried out by simulating 4, 8, 12, 16, and 20 mA current in transmitter output. The output of signal conditioner is to be monitored and recorded.
- The display on the MIMIC at Control room is to be monitored and recorded.
- The measurement chain calibration of data is to be entered in the Test and Evaluation format.

11. Testing of Facility Temperature Transmitters

Part A:

- Sensor is to be removed from the transmitter and checked for its ambient resistance and insulation resistance.

- In the case of Surface RTD and Thermocouples, the sensor is to be pasted / welded to the measuring surface.
- Cabling from sensor to transmitter and Junction box is to be done.
- Sealing of electrical connectors with rubber compound or silicone sealant.

Part B:

- The transmitter chain is to be calibrated by feeding corresponding ohms/mV from calibration data sheet using a Decade resistance box/Calibrator in five steps.
- The output of the signal conditioner is to be monitored and recorded.
- The MIMIC at Control room display is to be monitored and recorded.
- The data is to be entered in the Test & Evaluation format.
- Continuity and insulation resistance of cables connecting from instrumentation rack to field connector end and to be recorded.

12. Testing of Facility Flow measurements

Part A:

- The flow meter pick up coil termination is to be removed from the pre amplifier.
- Installation of pre-amplifiers.
- Patching of direct coil output to the high speed vibration measurement system.
- Sealing of electrical connectors with rubber compound or silicone sealant.

Part B:

- The coil resistance, inductance and insulation resistance of the pickup coil is to be measured.
- Threshold adjustment of pre-amplifiers using function generator to the pre-determined level.

- The frequency signal is to be fed at the input of the preamplifier in five steps using function generator as per the chart provided.
- Programming of flow signal conditioner with respect to range, scale factor, filter and resetting of totalizer counts is to be done.
- The output of the signal conditioner is to be monitored and recorded.
- The MIMIC display at Control room console is to be monitored and recorded.
- Functional testing of flow meter, data recording and plotting the graph [Time vs Flow].
- The data to be entered in the Test & Evaluation format.

13. Verification and Validation of Automatic test sequence/Article Protection system software with hardware

Part B:

- Initial setting of analog parameters and valve conditions [ON/OFF].
- Setting of countdown clock.
- Logging of digital events.
- Estimation of response time of valves.

14. Testing and Verification of display/data logging software by electrical simulation.

Part B:

- Display of process and Control parameters in operator console.
- Data logging of process and control parameter.

15. Generation of process and monitoring mimics

Part B:

- Animation of valves.

- Animation of pipe lines.
- Drawing of special objects.
- Animation of interlock controls.
- Animation of analog parameters.
- Copying & preparation of icons in runtime server.
- Updation of animated records.

16. Control system analog & digital parameters logging & processing:

Part B:

- The analog and digital parameters in the mimics are to be logged and to be processed.

17. CD backup raw data and processed files

Part B:

- Recording of process parameters and events on CD's and DVD's.

18. Control system T&E sheets generation

Part B:

- Updation of sensor constants in AIMAST file.
- Updation of Digital events.
- Test and Evaluation reports.

19. DAS Data Entry Work

Part B:

- Create and maintain an AIMAST file (Analog Input Master file) and DMAST file (Digital Input Master File).
- Update this file with proper Abbreviation, Card no, Channel no, Sampling Frequency, Conversion constants, Gain and Offset correction etc. for each parameter.

20. DAS T&E of Analog Channels

Part B:

- Rack level continuity and Integrity checks.
- Functional checks by giving simulated input at rack end and acquiring the output in the DAS.
- Updation of Calibration constants during sensor simulation.
- Checking the constants with software simulation inputs.
- Gain & Offset updation.
- Acquisition of the channels during Electrical simulation.
- T&E sheet preparation with Error calculation.
- Online Noise analysis for all the channels.

21. Data Acquisition system Real time display

Part B:

- Creation input tables for Numeric/Trend Graph displays.
- Verification network connection in all PCs.
- Checking of Display systems before the test as per test plan.
- Providing Display during test/trials.

22. Data Acquisition System Offline Plotting

Part B:

- Plot the anlog parameters data as per the test request.
- Check the plotted parameters with previous test data request.
- Print the plotted graph.

23. Data Acquisition System Offline Processing

Part B

- Select the requested analog parameters before processing.
- Identify the SYNC signal in data to take the reference time.
- Process the analog parameters data with reference time.
- Store the processed data in Excel format and save in NAS Server.

Format for quotation:

Sl.No	Descriptions	Quantity	Unit Rate in Rs	Total Rate in Rs
1.	Testing of E/P valves	4500		
2.	Testing of Control valves	750		
3.	Testing of Engine valves & Pyro	650		
4.	Testing of Test Article Pressure Measurements	1100		
5.	Testing of Test Article Temperature Sensor Measurements	2000		
6.	Testing of Test Article Flow/speed sensor Measurements	250		
7.	Testing of Test Article Vibration Measurements	750		
8.	Testing of Test Article Strain measurement	800		
9.	Testing of Test Article displacement measurement	250		
10.	Testing of Facility Pressure transmitters measurements	4800		
11.	Testing of Facility Temperature measurements	4000		
12.	Testing of Facility Flow measurements	800		
13.	Verification &validation of Automatic test sequence/Article Protection System Software with Hardware	5000		
14.	Testing and Verification of display/data logging software by electrical simulation	5000		
15.	Generation of process and monitoring mimics	850		
16.	Control system analog, digital parameters logging & processing	10000		
17.	CD backup raw data and processed files	5000		
18.	Control system T&E sheets generation	15000		
19.	Das data entry work	10000		
20.	DAS T&E of Analog channels	60000		
21.	Data Acquisition System Real Time Display	1600		
22.	Data Acquisition System Offline Plotting	60778		
23.	Data Acquisition System Offline Processing	60778		

Terms and Conditions:

Above the Annexure-1 terms and conditions, the party should meet the following terms and conditions also.

1. Only registered Company/Firm/Society as per relevant Act are eligible to apply for work outsourcing contract. Copy of registration certificate should be produced at the time of submission of quotation.

2. The registered Company/Firm/Society should have executed similar work between 01-04-2016 and 31-03-2023. The value of work outsourcing contract executed during the afore mentioned period should not be less than 75.0 lakhs, in case of single work, or 45.0 lakhs, in case of two works, or 37.50 lakhs in case of three works.

3. Past performance record of contractor in ISRO centres will be considered for evaluation of quotation.

4. The department reserves the right to terminate the contract at any time by giving two week`s notice without assigning any reason thereof.

5. An Engineer In charge will be identified as focal point for operation of this contract. The focal point will be responsible for intimating the work load prevailing time to time, monitoring the work execution and certification of bills for work executed. Payment will be made as per the actual quantum of work executed and certified. Billing is permitted on monthly basis.

6. For carrying out the activities mentioned under **Part A** in **Sl.nos**. **1-12** Personnel with ITI in Instrumentation/ Electronics mechanic/Electrical Qualification shall be engaged by the Contractor. For carrying out the activities mentioned under **Part B** in **Sl.nos 1-12**., personnel with Diploma in Electronics & Communication/Electrical & Electronics Engineering qualification shall be engaged by the Contractor. For carrying out the activities mentioned under **Part B** in **Sl.nos 13-23**, personnel with Diploma in Computer science/ Electronics & Communications engineering qualification shall be engaged by the Contractor.

7. Based on our past experience, the average number of Personnel may be required for carrying out the activities mentioned under **Part A are 3 nos. of ITI holders** and **Part B are 14 nos. of Diploma holders**. However, depending on the work load, the Party may deploy

more people as and when required. Payment will be made only for the quantum of work executed.

8. The Safety and other regulations of IPRC should be complied with during the execution of work. Entry into areas/facilities at IPRC without proper authorization from the focal point will not be entertained. The contractor is responsible for any injury or loss to their personnel.

9. The work shall be carried out without any damage or loss to IPRC property/equipment. The responsibility for loss, if any, occurring due to negligence of contract personnel solely rests on the contractor and contractor is liable to compensate IPRC for any such loss/damage.