Annexure-1

Up-gradation of Automated Multipoint Loading System (AMLS) Software

1.0 Description of System

Vikram Sarabhai Space Centre (VSSC) is the lead Centre of Indian Space Research Organisation (ISRO) under the Department of Space (DOS), Government of India. VSSC is responsible for the development of launch vehicles which involves design and realisation of metallic and composite structures. To test and qualify these structures, a 40-channel Automated Multipoint Loading System (AMLS) is being used. This system is realised and supplied to VSSC by M/s. Godrej & Boyce Mfg. Co Ltd., Mumbai. The system basically consists of a closed loop feedback control system part (PLC based or PXI based) and a hydraulic system part to energise hydraulic actuators. Feedback taken from load measuring device (load cell) will be used to control proportional pressure reducing valves or direct drive servo valves in closed accuracies. An user-friendly software developed in labVIEW-2012 (compatible with Windows XP OS) is being used for the program and control of loads. Three different independent software's were developed to operate the systems in different configurations located at different centres.

- 24 channel software to run PLC based system
- 16 channel software to run PXI based system
- 40 channel software to run the PLC + PXI system in the integrated mode

This proposal is for the up gradation and modification of these software to **labVIEW-2021** to operate the software in latest operating system (**Windows 11**) and to cater the requirement of communication with other data acquisition systems installed in VSSC, IPRC and SHAR.

The system can function in three different modes:

Fully Automatic Mode

a) Total load sequence will be programmed (Loading steps, loading rate, Dwelling time, unloading etc.)

b) No Manual Intervention

c) Provision for Emergency abort at any time.

Semi Automatic Mode

a) Total load sequence will be programmed but loads will be applied at each step on command authorization only.

b) Provision to proceed to next step, go back to previous step & abort.

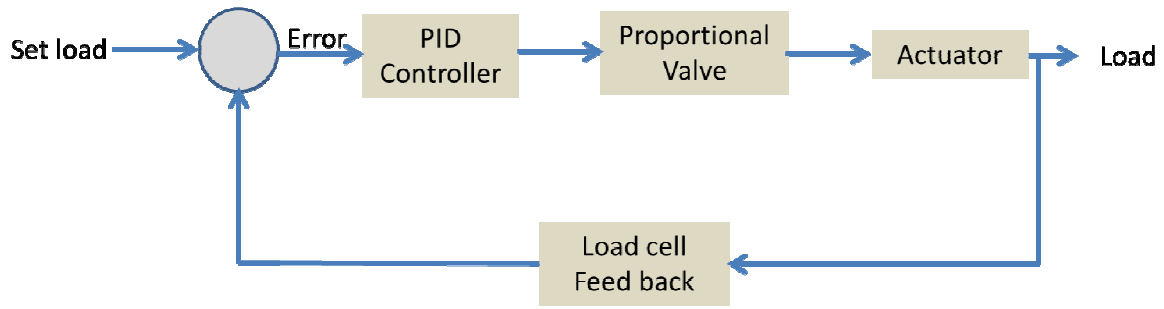
Manual Mode

a) Auto loop control system will be inactive

b) Load application through manually to control valves through the push button switches/or though software.

In Auto/Semi-auto mode, system functions in a feedback control system as follows:

Double acting Hydraulic actuators are used for the application of structural loads and these loads are measured with a load cell and the measured loads are compared with the set load programmed in the system. The controller controls/drives the hydraulic valve based on the error computed from the set load and measured load. The typical block diagram of the system is as follows:



2.0 System architecture

The system consists of two parts

a. 24 channel System (Siemens make PLC based system & employs Rexroth make proportional pressure reducing valves) realised in 2008 and modified on 2012. ***One***

24 channel system is installed at IPRC, Mahendragiri, TN and one 24 channel system is installed at VSSC, Trivandrum

b. 16 channel System (Adlink make PXI based system & employs Rexroth make direct drive servo valves) realised in 2012. ***Presently this system is available at VSSC, Thriruvananthapuram.***

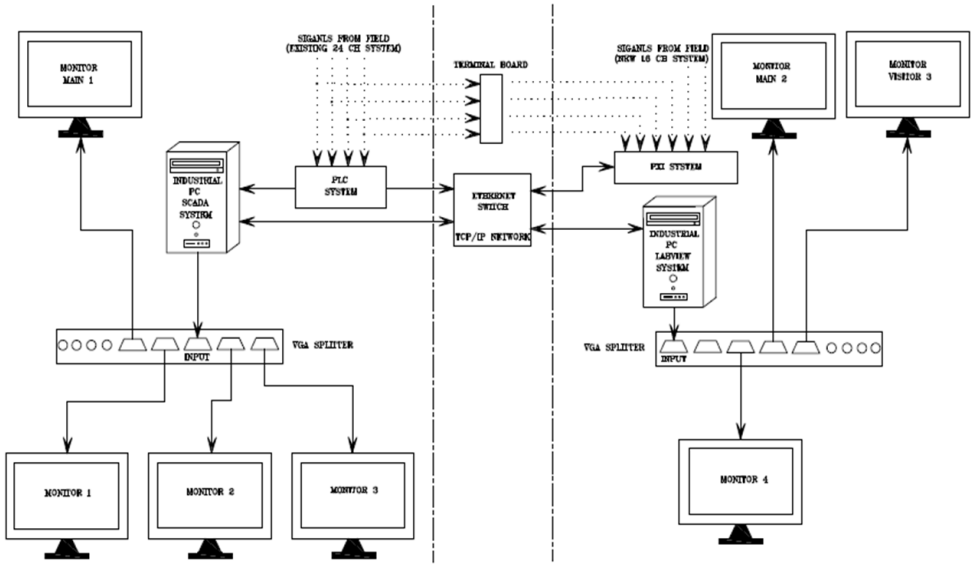
Typical operating pressure of the system = 210 bar (Hydraulic)

Hydraulic Power pack capacity= 350 bar , 100 lpm

These 24 channel systems in IPRC/SHAR and 16 channel system can be operated in independent mode or integrated 40-channel mode with available software's. While working as a 40 Channel System, the new High Speed PXI system (16 channel System) will be the master. Existing Siemens PLC (24 channel system) will be communicated to NI Labview through NI OPC Server. PXI and NI LABVIEW will be communicated by CAT – 6 Ethernet Cable. Typical architechture is shown below.

24-Channel System

16-Channel System



3.0 System Hydraulic circuit

The hydraulic circuit of 24 channel system (identified as channel 1 to 24) is shown below. The major components in this system are:

a. Rexroth make Pressure Reducing valve (CETOP-5) - **3** Nos.

Model No.: DREBE 10Z-1X/315XYMG24K31A1M

b. Rexroth make Pressure Reducing valve (CETOP-3) - **24** Nos.

Model No.: DREBE 6X-1X/175MG24K31A1M

c. Rexroth make Direction control valves (CETOP-3) - **24** Nos.

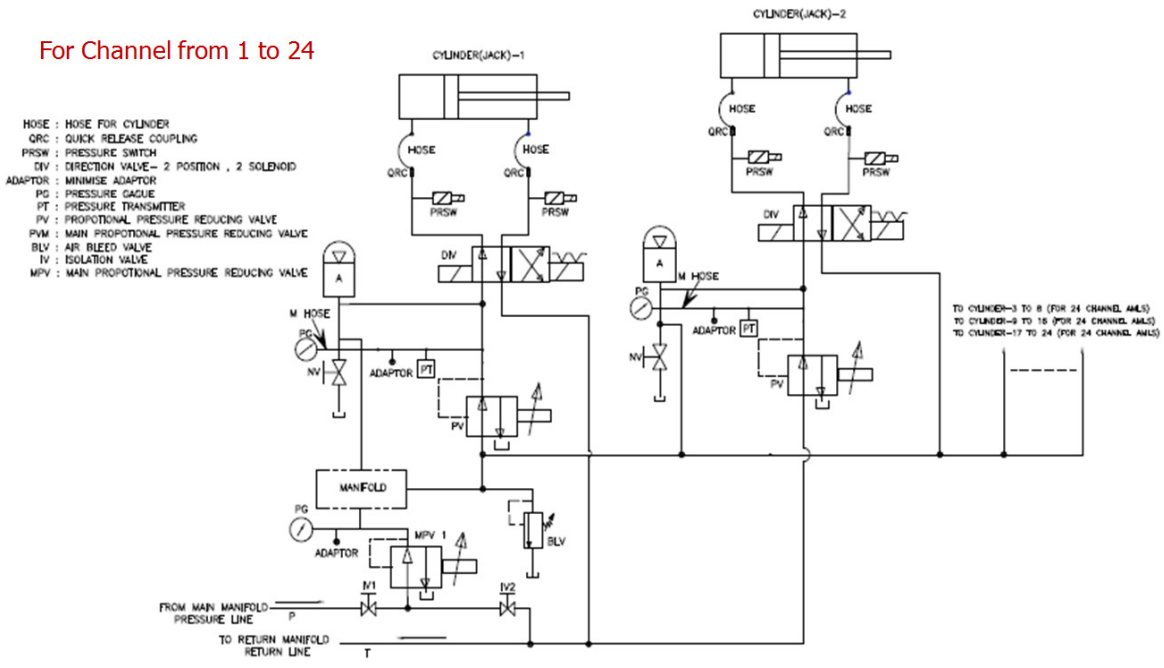
Model No.: 4WE6C 6X/OFE G24 N9 K4

d.Pressure transmitter - 27 Nos.

e. Pressure switches- 48 Nos.

f.Pressure Gauges- 27 Nos.

g. Accumulator - 24 Nos.



The hydraulic circuit of 16 channel system (identified as channel 25 to 40) is shown below. The major components in this system are:

a. Rexroth make Pressure Reducing valve (CETOP-5) - **2** Nos.

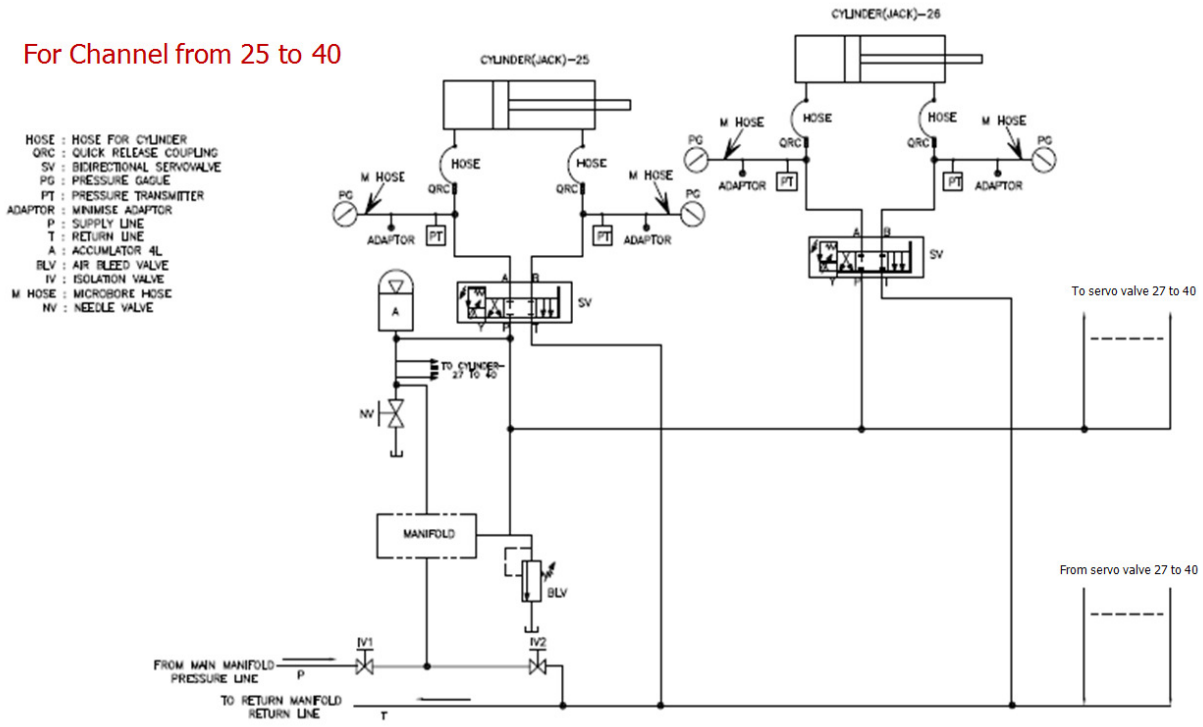
Model No.: DREBE 10Z-1X/315XYMG24K31A1M

b. Rexroth make Bi-directional flow control valve (CETOP-3) - **16** Nos.

Model No.: 4WRPEH 6 C4 B12L-2X/G24K0/A1M

c.Pressure transmitter - 34 Nos.

d.Pressure Gauges- 34 Nos.



4.0 Power pack and accessories

The power pack identified for 24 channel system operation and 40- channel operation (24 +16 configuration) is:

Make: Achieve Hydraulics & Pneumatics, Pune

Model No.: AHP-77-2012-13

Pressure rating- 350 bar

Flow rate- 100 lpm

Power rating- 75 kW

Accessories:

a. Chiller

Make: Advance Cooling System Pvt.

Model: 00-30000-22NT-DCPHE-AC-A-T3

Capacity, 30,000 KCal

b. Filtration Trolley

Make**:** Achieve Hydraulics & Pneumatics, Pune

Model- AHP-50-3

Pressure & Flow Rating - 10 bar, 50 LPM

Power- 1.1 kW

The Power pack identified for 16 channel operation is:

Make: M/s. Godrej & Boyce Mfg. Co Ltd.

Pressure-350 bar

Flow- 40 LPM

Power rating-20 kW

Accessories

1. Electrostatic cleaner

Make : Ferrocare machines Pvt.Ltd

Model: ELC-25A

5.0 Control System Components and communication

Major control System components in the system are as follows

For 24 channel system (identified as channel 1 to 24)

i. Siemens make PLC 315-2PN/DP- 1 No.

ii. Siemens make Analogue Output/Input & Digital Output/Input modules for 24 channel operation.

iii. Adam make signal conditioning cards for feedback load cells - 24 Nos.

iv. Vignan make auto manual station cards for 24 channel operation (0-10 V DC).

v. Power supply units and ammeters for 24 channel operation.

vi. Industrial PC with monitor.

vii. 10 kVA UPS (Emerson Liebert GXT-MT)

viii. Lab View software.

For 16 channel system (identified as channel 25 to 40)

i. Adlink make PXI system.

ii. Analogue Output/Input & Digital Output/Input modules for 16 channel operation.

iii. Adam make signal conditioning cards for feed back transmitters - 16 Nos.

iv. Vignan make auto manual station cards for 16 channel operation (+/- 10 V DC)

v. Power supply units and ammeters for 16 channel operation.

vi. Lenovo make Laptop.

vii. 3 kVA UPS (Emerson Liebert GXT-MT)

viii. Lab View Software.

Data communication (present and future requirements)

At present all acquired data is made available to a third party Data Acquisition System, directly through the network (The acquired data is published in the form of Network Variables using NI-Publish Subscribe Protocol (psp). Any third party application /software can receive and use the data. (The third party system shall be scanning & acquiring the data at 1kHz rate).

The LabVIEW software presently used in AMLS system is of 2012 version and is running in Windows-XP Operating System. At that point of time the NI-OPC DA (Data Access) protocol was used for the real time transfer of data from PLC to the network. This protocol was discontinued by NI from 2017 onwards and NI-OPC UA (Unified Architecture) was introduced. OPC UA is a sophisticated, scalable and flexible mechanism for establishing secure connections between Client and Servers, but not compatible with Windows -XP OS, which has become obsolete and discontinued by Microsoft.

A new Integrated Signal conditioning and Data Acquisition System (Dewesoft) has been developed in 2020 for the structural testing activities. The Dewesoft software used in this system can support only Unified Architecture (UA) and it is necessary to operate in conjunction with the AMLS system of INSTEF in synchronous mode for conducting critical structural testing activities.

Note: The software are to be installed in three high end computers/laptops. One computer will be positioned at IPRC, Mahendragiri and one computer will be positioned at VSSC. The third computer or (laptop) will be positioned at VSSC or IPRC as per requirement. The runtime and deployment licences are to be procured to be arranged by party for the smooth operation.

6.0 SCOPE OF WORK:-

- Vendor has to transfer the whole source code of AMLS written in labVIEW-2012 version to latest LabVIEW 2021 software and with the latest NI (Unified Architecture). The windows operating system shall be latest Windows version (preferably Windows-11)
- All the three previous software's are to be updated, without affecting the existing functionalities.
    - 24 channel software to run PLC based system
    - 16 channel software to run PXI based system
    - Combined 40 channel software to run the 24 PLC + 16 PXI system in the integrated mode
- **The labVIEW-2021-SP1 licence available with VSSC shall be used for the software up gradation. Party shall visit VSSC to ensure the adequacy of**

available licence. Vendor has to procure and supply the additional required software/ runtime licences like DSC Modules, OPC UA tool kit etc. if required. Vendor has to procure and supply three nos. of all in one desktop computer with external DVD/CD drives for the software development activity. The software are to be installed in three computers/laptops to meet the operational requirement at IPRC and VSSC.

- Vendor has to ensure the availability of all the drivers in the latest windows version for Siemens S7-300 PLC and Adlink PXI-3950 for this software upgradation.
- The vendor has to convert the existing software to latest LabVIEW platform without affecting any of the operational/ functional aspects and shall establish the latest network communication protocol.
- It has to be interfaced with the Data Acquisition systems installed at IPRC and the communication/ data transfer with the Data Acquisition systems at IPRC (Dewesoft system) and VSSC (Data Pattern System) has to be established and demonstrated for real-time synchronous data transfer.
- The data are to be published in network with time stamping and it should have a provision to synchronize with the DAS. Modification of software for this is in the scope of vendor.
- The 1 milli-second data transfer and logging is to be demonstrated.
- The vendor shall conduct end to end functional tests and satisfy the indenter that all the specifications are adhered without sacrificing any of the capabilities built in the earlier AMLS system.
- The total software shall be verified with dummy test rig for the overall evaluation/ qualification of software, before certification and acceptance by VSSC.
- The source code will be the property of VSSC. A detailed operation manual with software installation/debugging procedure with the details of licences shall be handed over to VSSC after completion of work.
- **Vendor has to submit a design document with the detailed action plan to VSSC within four weeks of confirmed purchase order. Once the design document is approved, party shall complete the total activity within 28 weeks. However vendor shall give their expected time schedule for the**

completion of this activity in detail in the technical bid. Facility readiness and test rig availability will be ensured by VSSC.

Additional software features to be added/incorporated

- Any minor software modification required after the software up gradation shall be done by party

6.1 Sequence of development and testing

The software has to be developed in VSSC/Vendor site and it has to be tested with the 16 channel PXI & 24 channel PLC system available at VSSC. Then this 16 channel system will be transferred to IPRC, Mahendragiri and all the three software are to be tested. The test rigs for testing will be provided by VSSC.

The Guest House accommodation will be arranged by VSSC at IPRC. The transportation of systems from VSSC to IPRC and back will be done by VSSC.

6.2 Specification of All in One Desktop PC

- Processor :- 13th Generation Intel® Core™ i7 processor (30 MB L3 cache, 16 cores)
- Memory & Storage :- 16 GB DDR4 RAM/ 512 GB SSD.
- Display :- 23.8-inch FHD (1920 x 1080)
- Operating System :- Windows 11 professional or latest.
- Connectivity: HDMI (in), HDMI (out), USB-2, USB-3.1, RJ-45 Ethernet, SD Card Reader, Universal head phone jack and WiFi connectivity.
- External CD/DVD drive is to be supplied extra
- Make: DELL, HP, ACER, LENOVO

7.0 Payment Terms & warranty

- 100% payment with applicable taxes will be done after successful completion of supply of software and hardware, software development and testing.
- **Three year warranty/software support** is to be provided by the vendor after the successful demonstration and the date of commissioning of the software & acceptance by VSSC.

8.0 How to quote

- Parties with previous experience of developing/ operating feedback based automated control system (minimum 10 channels) using labVIEW Software only need to apply.
- The vendor shall have prior working knowledge in the area of hydraulics/ Electronic/ instrumentation area. **They have to submit all relevant certificates for proving their capability and prior experience along with quotation.**
- The vendor shall submit the documentary evidence on the details of systems developed earlier, end user details including address, user feedback etc.. for scrutiny.

Interested parties may visit VSSC facility for assessing the system and evaluating the quantum of work, before submitting the quotations. Vendor has to assess the software modules/driver requirements & requirement of run time and deployment licences correctly, before submitting the quote.

The vendor shall submit their quotation in two parts. The technical bid will be evaluated by a technical expert committee and the suggestions/recommendations of the committee are to be incorporated in the final software.

The format for quoting (price bid) is:

Sl. No.	Description		Quantity	Price in Rs
1	Procurement and supply of Software or licence.. if any (List all the software, drivers, development and deployment licenses separately	a.	As per requirement	
		b.	As per requirement	
		c.	As per requirement	
		d.	As per requirement	
2	Supply of All in One Desktop computers		3	
3	Software up gradation charges.		1	
4	Software testing and demonstration at VSSC and IPRC		1	