Annexure-1

1. SCOPE

Supply, installation and commissioning of cDAQ / equivalent Data acquisition and control system with necessary display nodes, data processing nodes, rack, power supplies, application software etc as per the details given below.

2. GENERAL

Two independent Data acquisition systems are required in two different test bays. Details are given below:

a) Data acquisition and control system requirements -1

ANALOG INPUT	
Input Signals	**No. of Channels**
Current (4-20 mA)	16
Pressure Transducer (Strain gauge)	4
TC input	4
RTD input	4
ANALOG OUTPUT	
Signal Type	**No. of Channels**
Current (4-20 mA)	8
DIGITAL I/O	
Type	**No. of Channels**
Digital Input (24 VDC)	16
Digital Output (24 VDC)	8

b) Data acquisition and control system requirements -2

ANALOG INPUT	
Input Signals	**No. of Channels**
Current (4-20 mA)	24
Pressure Transducer (Strain gauge)	4
TC input	4
RTD input	4
ANALOG OUTPUT	
Signal Type	**No. of Channels**
Current (4-20 mA)	8
DIGITAL I/O	
Type	**No. of Channels**
Digital Input (24 VDC)	28
Digital Output (24 VDC)	14

a) To meet the above requirement the following subsystem to be provided accordingly.

   i. Data Acquisition Chassis
   ii. Analog Input modules
   iii. Analog Output modules
   iv. Digital Input and Output modules
   v. Data Processing Nodes
   vi. Display Nodes
   vii. Remote Configuration node
   viii. Instrumentation Rack
   ix. Software: Operating System software along with drivers and application software
   x. Power Supplies & Relays
   xi. Ethernet Switch
   xii. Cables & Connectors
   xiii. Printer

b) Rack mountable type DIN rail/chassis based system is considered.

c) Data acquisition system with integral signal conditioners and variable sampling rate is planned. The input signal shall be band limited and conditioned as per requirement.

d) Software should have provision for acquisition, control, channel configuration, recording, monitoring, diagnostic and calibration of system. Two data processing nodes, two display nodes and a portable configuration system are to be provided.

3. SPECIFICATION CDAQ BASED

3.1 Acquisition Chassis

Quantity: 2Nos.

SL.NO	DEVICE PARAMETERS	REQUIRED SPECIFICATION
1	Number of Slots	12 slot
2	Timing Accuracy of Analog Input and output	50 ppm of sample rate or better
3	clock accuracy	50 ppm or better
4	Analog Input and output Internal base clocks	80 MHz, 20 MHz, 13.1072 MHz, 12.8 MHz, 10 MHz, 100 kHz
5	Chassis PFI Characteristics	
	Maximum input or output frequency	≥ 1 MHz
6	Network Interface	TCP/IP, UDP
7	Bus Connector	Ethernet
8	Number of Ethernet Port	Min. 2
9	Communication rate	10/100/1000 Mbps
10	Power Requirements	9 VDC to 30 VDC
11	Safety Voltage	30 V maximum
12	Operating Temperature Range	10 °C to 70 °C
13	Safety Certification	IEC 61010-1, EN 61010-1
14	Operating Shock	30 g, 11 ms half-sine
15	CE Compliance	• 2014/35/EU; Low-Voltage Directive (safety) • 2014/30/EU; Electromagnetic Compatibility Directive (EMC)
16	Document from Vendor	OEM Authorization Certificate

3.2 Analog Input Modules

3.2.1 Current

SL.NO	DEVICE PARAMETERS	REQUIRED SPECIFICATION
1	No. of Channels	16 nos. for DAQ requirement -1 24 nos. for DAQ requirement -2
2	Type of ADC	Delta-Sigma with analog prefiltering
3	Analog Input Resolution	16 bits or better
4	Sampling rate	5Ks/s/ch or better
5	**Input Signal**	
	Type	Analog current
	Range	4 to 20 mA
6	Analog Input Isolation	250 Vrms ch- Earth Ground Isolation
7	Front Connection Type	Push in spring terminal
10	Filter	Butterworth, Comb
11	Frequency of internal master time base	≥12.8 MHz

12	Accuracy of internal master time base	±50 ppm or better
13	Operating temperature	10 °C to 70 °C
14	Overvoltage protection	±30 V, between any two pins of the connector
15	Crosstalk (CH to CH) f_{in} < 100 Hz f in < 15 kHz	 100 dB or better 90 dB or better
16	Safety Certification	IEC 61010-1, EN 61010-1
17	Operating Shock	30 g, 11 ms half-sine
18	CE Compliance	• 2014/35/EU; Low-Voltage Directive (safety) • 2014/30/EU; Electromagnetic Compatibility Directive (EMC)
19	Document from Vendor	OEM Authorization Certificate

3.2.2 Pressure Transducer (Strain Gauge) Module

SL.NO	DEVICE PARAMETERS	REQUIRED SPECIFICATION
1	No. of Channels	4 nos. for DAQ requirement -1 4 nos. for DAQ requirement -2
2	Signal Type	To support Bridge configuration
3	Type of ADC	Delta-Sigma with analog pre filtering
4	ADC Resolution	16 bits or better
5	Max. data rate range by internal master time base	50Ks/s or better
6	Signal Input Range	0 to 25 mV/V
7	Accuracy	100 ppm or better
8	Overvoltage protection	30 V between any two pins
9	Common-mode voltage, all signals to earth ground	±60 VDC
10	Isolation channel-to-earth ground	60 VDC
11	Operating temperature	10 °C to 70 °C
13	Operational Shock	30 g, 11 ms half-sine
15	Document from Vendor	OEM Authorization Certificate

3.2.3 Thermocouple Module

SL.NO	DEVICE PARAMETERS	REQUIRED SPECIFICATION
1	No. of isolated Thermocouple Channels	4 nos. for DAQ requirement -1 4 nos. for DAQ requirement -2
2	Type of ADC	Delta-Sigma
3	ADC Resolution	16 bits or better
4	Sampling rate	1Ks/s/ch or better
5	Voltage measurement range	0 to 75 mV
6	Temperature measurement ranges	Temperature ranges defined by NIST (J, K thermocouple types)

7	Temperature Measurement Accuracy	≤ 0.05 deg C
8	Overvoltage protection	±30 V between TC+ and TC-
9	Isolation channel-to-earth ground	60 VDC
10	Operating temperature	10 °C to 70 °C
12	Operating Shock	30 g, 11 ms half-sine
14	Document from Vendor	OEM Authorization Certificate

3.2.4 RTD Module

SL.NO	DEVICE PARAMETERS	REQUIRED SPECIFICATION
1	No Of Channels	4 nos. for DAQ requirement -1 4 nos. for DAQ requirement -2
2	RTD	PT100 / PT 500
3	Type of ADC	Delta-Sigma
4	ADC Resolution	16 bits or better
5	Sampling mode	Scanned
6	Isolation channel-to-earth ground	250 Vrms
7	Temperature Measurement range	-100 °C to 800 °C
8	Overvoltage	±30 V between inputs
9	Excitation Current	1 mA per channel
11	Safety Certification	IEC 61010-1, EN 61010-1
13	Operational Shock	30 g, 11 ms half-sine
14	CE Compliance	• 2014/35/EU; Low-Voltage Directive (safety) • 2014/30/EU; Electromagnetic Compatibility Directive (EMC)
15	Document from Vendor	OEM Authorization Certificate

3.3 Analog Output Modules

3.3.1 Current Signal

SL.NO	DEVICE PARAMETERS	REQUIRED SPECIFICATION
1	No of Channels	8 nos. for DAQ requirement -1 8 nos. for DAQ requirement -2
3	DAC Resolution	16 bits or better
4	Output Signal Range	4 to 20 mA
5	Compliance voltage	12 V DC maximum
7	Maximum load	600 Ω
8	Power Supply	9 V DC to 30 V DC
9	Overvoltage protection	±36 V b/w AO-to-COM and Vsup-to-COM
10	Noise	600 nA RMS or better
	Cross talk	-90 dB
11	Isolation channel-to-earth ground	60 VDC
12	Operating temperature	10 °C to 70 °C
13	Operating Shock	30 g, 11 ms half-sine
14	Document from Vendor	OEM Authorization Certificate

3.4 Digital Input and Output modules

SL.NO	DEVICE PARAMETERS	REQUIRED SPECIFICATION
1	**Digital Input**	
	No of Digital Input Channels	16 nos. for DAQ requirement -1 28 nos. for DAQ requirement -2
	Input Type	Sinking
	Input Voltage range	0 to 24 VDC
	Digital Logic Level	
	OFF State Input Voltage Input current	 $\leq$ 5V $\leq$ 150 µA
	ON State Input Voltage Input current	 ≥10V ≥330 µA
	Input Impedance	30k Ω $\pm$ 5%
	Update time	< 10 µs
2	**Digital Output**	
	No of Digital Output Channels	8 nos. for DAQ requirement -1 14 nos. for DAQ requirement -2
	Digital Output type	Sourcing
	External power supply voltage range	6 VDC to 24 VDC
	Current per channel	100 mA miminum (per channel)
	Update time	< 10 µs

	Isolation channel-to-earth ground	60 VDC
	Operating temperature	10 °C to 70 °C
	Operational Shock	30 g, 11 ms half-sine
	Document from Vendor	OEM Authorization Certificate

3.5 DATA PROCESSING NODE, DISPLAY NODE AND PORTABLE SYSTEM

Two PCs are to be configured as display nodes and 2 PCs are configured for data processing node. One portable system is required for the remote configuration of the smart transmitters used in the facility.

3.5.1 Configuration for Data processing nodes.

Quantity: 2Nos.

SL.NO	DEVICE PARAMETERS	REQUIRED SPECIFICATION
1	Processor	Intel Core i7 12th generation or better
2	Operating System	Windows 11
	RAM	64 GB DDR4 or better
3	GPU	Nvidia 16 GB or better
4	Hard Disk	Primary: minimum 1TB SSD Secondary: 2TB Hard Disk
5	Removable Media	DVD-RW for all format
7	I/O Ports	6 No's of USB 3.0; minimum 2 front side, 1 RJ-45 Gigabit Ethernet, 3.55mm Audio
8	Monitor size	27" Monitor having resolution of 1920x1080or better with Digital Input & Aspect Ratio 16:9 & built-in speaker
9	Display port	Dual Display Ports (at least one VGA & one HDMI)
10	Power Supply	230V AC, 50Hz. Indian standard
11	OS	64 bit Windows 11 prof. or higher version preinstalled
12	Accessories	Connecting cables with Indian Standard plug top s. Wireless Keyboard and Mouse Microsoft professional Office 2021 or latest

3.5.2 Configuration for display nodes. (Quantity: 2Nos.)

Screen	27-inch or above, LED-backlit, Resolution 1920×1200
Processor	Intel core i7 13th Gen processor
Memory	16 GB DDR4 RAM or higher version
Hard Disk	500GB SSD or higher
Graphics	Integrated HD Graphics
Network	10 /100/1000 Ethernet controller in-built
USB Ports	USB 4 Nos; Minimum 2 ports in front side
Optical Drive	16× DVD +/- RW (Optional)
OS	64 bit Windows 11 prof. or higher version
Accessories	Wireless Keyboard and Mouse Microsoft professional Office 2021 or latest

3.5.3 Specification for Remote configuration node

Quantity: 1 No.

Screen	14-inch or above, LED-backlit, Resolution 1920×1200
Processor	Intel core i7 12th Gen processor
Memory	8 GB DDR5 RAM or higher version
Hard Disk	500GB SSD or higher
Graphics	Graphics- 4 GB
USB Ports	USB 3.0 minimum 2 Nos
Ethernet port	Required
OS	64 bit Windows 11 prof. or higher version
Accessories	Wireless Keyboard and Mouse Microsoft professional Office 2021 or latest

3.5 19" Checkout Rack

- Size : 19 inch rack conforms to EIA 310 with minimum height-42U. Party can choose the height to properly place all the equipment in the rack with ensuring minimum gap between equipment for removal and maintenance
- Aluminium extruded frame along with side, top and bottom panels in steel.
- Lockable front door made of toughened tinted glass of 5 mm Thick. Steel frame of 18 Gauge CRCA sheet.
- Rear steel door to be provided with a lock facility made of 18 Gauge CRCA sheet
- Side panels with slam latches vented top cover made of 18 Gauge CRCA sheet.
- Base frame to be made up of 13 Gauge CRCA sheet
- 19" Mount for equipment mounting channels and support angles are to be made of 14 Gauge CRCA sheet
- Maximum Load rating of 500 kg.
- Cooling fans and trays (in a group of 4 fans, two sets per rank) to be provided.
- One No of AC mains distribution board with 5 Nos of 5A socket (Horizontal mounting to be provided).
- Vertical cable tray to be made up of polymide with cover to be provided.
- Internal lighting to be provided with On/Off Switch.
- Rollers to be provide at the bottom for moving the racks. The rollers should be lockable type for positioning the racks.
- Side panels, Top and Bottom panels and doors to be power coated EPOXY/Anti flame property specified in RAL 7035 grey.
- Frame to be made of Aluminium extrusions power coated specified in RAL 7037 Dark Grey.
- The cabinet shall be supplied with all necessary hardware and accessories with complete wiring.

3.6 Regulated DC Power Supply 24 VDC/5A - 8 nos.

DEVICE PARAMETERS	REQUIRED SPECIFICATION
Item Description	DC power supply
Output	24 V DC ±20%, Current rating 5 Amps.
Line Regulation	≤ ±0.2% (for ± 10% change in supply voltage)
Load Regulation	≤ ±0.2% from no load to full load
Ripple @ Noise	≤ 100mVrms
Over Voltage Protection	To be provided
Current Limit(Overload)	To be provided
Stability	≤0.1% for eight hours
Operating Power	230V AC ±10% 50Hz
Operating Temperature	0-50ºC

3.7 ETHERNET SWITCHS & CABLE

Ethernet Switch

DEVICE PARAMETERS	REQUIRED SPECIFICATION
Type	Layer 2 Manageable switch
Standards	802.3 Ethernet, 802.3u Fast Ethernet, 802.3ab Gigabit Ethernet
No of Ports	8 Ports
Form factor	Rack mount
Network media	UTP cable
Switching capacity	10 Gbps or higher
Transmission method	Store and forward
Packet forwarding rate	14 Mbps or higher
Power supply	24V DC/ 230 V+ 10%AC, 50+1Hz

Ethernet Cable

DEVICE PARAMETERS	REQUIRED SPECIFICATION
Category	CAT5/ CAT6
Type	Stranded and Shielded
Wire Gauge	24 AWG
Cable impedance	100 Ω
Operating temperature	0ºC to 50ºC
Connector	RJ 45

3.8 Multipin Connector

DEVICE PARAMETERS	REQUIRED SPECIFICATION
Contacts	Male and Female Contacts
Type	Crimp
Contact material	Copper alloy- hard gold plated Au over Ni
Gold plating thickness	0.8µm(min)
Ni thickness	2 µm(min)
Contact size	18 AWG or 20 AWG
Working current	5 A
Working voltage	300 V
Contact resistance	≤4 milli ohm

3.9 Relay Interface Module

DEVICE PARAMETERS	REQUIRED SPECIFICATION
Type	Electro Mechanical moulded Relay
Operation voltage	24 V DC
Nominal input current	≤25mA
No. of poles	2 Pole [NO, COM, NC]
construction	Supply status indication LED , Freewheeling diode and Reverse polarity protection diodes shall be assembled as integral part of the socket
Limiting continuous current	6 amps
Power rating (ohmic load)	≥140 W
Contact material	Au Ni /Ag Alloy
Mechanical life	≥ 1×10^7 cycles
Response time	≤ 20 ms
Release time	≤ 10 ms
Ambient temperature range	Upto 60ºC
Type of connection	Screw connection
Identification label	Provision is to be provided
Removal of relay	Provision is to be remove the relay from socket
Standards/ regulations	IEC 60 664/IEC 60 664 A/ / IEC 60695-2-11
Approvals/ Certification and certificate	Relay modules shall have approval confirms to UL508/ EN61810- 1/GL standard / IEC 61810-1

3.10 LaserJet Multifunction Printer

DEVICE PARAMETERS	REQUIRED SPECIFICATION
Type	Multifunction Black and White Printer
Standard Function	Print, Copy, Scan
Print Speed	> 20 ppm
Processor	1GHz Dual Core
Memory	512MB
Copy and Print Resolution	minimum 600 X 600 dpi
First copy-out and print-out time	< 10 sec
Duty Cycle	minimum up to 2000 pages per month
Connectivity	1. High-Speed USB 2.0 (Type A) 2. High-Speed USB 2.0 (Type B) 3. Ethernet 10/100 BaseTX
Paper Output	Automatic Two sided printing available
Paper size	A3, A4
Paper Tray	Separate Tray for A3 and A4 paper with capacity of at least 200 papers in each Tray
Power Input	Voltage : 220-240V AC Frequency: 47-63 Hz
OS support	Support for a wide variety of industry standard operating systems including Windows 7 32 bit and 64 bit, windows Vista 32 bit and 64 bit, windows 8 64 bit, windows XP 32 bit, Apple Mac, OS/2, UNIX and Linux
Warranty	Minimum 1 Year

Note: Installation and Demonstration of printer function at Purchaser's site. Software CDs and user manuals shall be supplied for the printer.

4. Integration and Wiring

a) Instrumentation Rack- 19" to be used to house the entire data acquisition and control unit including power supplies, relays etc

b) Wiring for different voltage signals and different functions shall be terminated separately on dedicated terminal strips.

c) Wiring shall be accomplished with flexible stranded tinned copper wires sized 20/22 AWG, PTFE Shielded cable with multipin connectors for termination.

d) Wires shall be hosed in plastic raceways of suitable dimensions to accommodate system cables, I/O signal cable etc. having 20% spare space for future expansion.

e) Terminations, cables, wiring, components shall be properly tagged with ferruling at both sides of the termination. Terminal strips shall be of adequate size min 1.5 mm2

f) The system cabinet shall have two separate grounding bars, one for safety purposes (power earth) and the other one for operation purposes (Instrumentation earth).

g) Required electrical, mechanical accessories & consumables like fuses, terminals, DIN rails, cable manager, cable harnessing materials etc should be supplied.

Notes: This specification provides the minimum requirement of the system but it does not relieve the supplier from his responsibilities for completeness of the system concerning the design, the reliability and the safe operation of the supplied equipment.

5. GENERAL SPECIFICATION OF DATA ACQUISITION AND CONTROL SOFTWARE

The software should be developed in latest version of LabVIEW with following feature.

- The vendor has to supply the complete data acquisition, control, storage, and analysis software package with necessary source code.
- Supply of source code for data acquisition system application program development with details for modification during future requirement.

5.1 Login

The software should have two levels of security namely Administrator and Operator. The administrator should have access to all the features provided by the software and operator's accessibility should be limited to conducting the tests.

5.2 Configuration Settings

a. The acquisition software shall be capable of scanning the selected user required channels.
b. Also the per channel selection of legend, description, range selection shall be possible.
c. Logging of set configurations in notepad or in spreadsheet format.

5.3 Acquisition Software

a. The software should be capable of entering channel wise legends, description, units and first & fourth order constants for Engineering Unit (EU) conversion.
b. Data from each channel should be acquired by selecting the engineering unit. . The data should be displayed in two different PC's in the control room. The control valves and solenoid valves should be controlled in the open loop/closed loop using necessary setting in the software.
c. The acquisition software shall be capable of being operated with acquisition ON/OFF & file writing ON/OFF features. Data to be stored in controller hard disk in text format.
d. Interlock, Auto and Abort sequence, Process variable measurement, Data storage, manual /auto operation, emergency shutdown etc. shall be considered. Event acquisition & auto sequence command generation are required.
e. All the data should be logged as per the instruction from the PC with necessary command. All necessary information should be stored while logging such as Run number, Start time of the test etc.

5.4 Online Display and Off-Line Analysis

a. Online monitoring (Data and Trend graph display) of process parameters during preparation and test phase. Online display to be provided in graphical and numerical format. Feedback status of all valves is to be displayed.
b. The engineering unit (EU) or voltage selection shall be made available in the numerical display and graphical display.
c. The graphical display shall start with trigger signal or based on time from an ethernet based countdown clock.

d. The graphical display shall have different scales user selectable for each parameter and shall have four parameters per screen. The different pages change over can be based on time reference or by keyboard control. The required parameters for display shall be entered in a text file.
e. The numerical and graphical display shall have the option for color change when threshold limits are not met.
f. Real time performance calculation with on-line data.

5.5 Offline Processing

a. Offline processing of selected channels in EU or Voltage with selectable averaging, printing intervals, time offset correction etc. The file shall have optional header and stored in DAT format.
b. Offline plotting of selected channels in EU or Voltage with optional headers.
c. Mathematical and statistic analysis tools like Time Domain plot, Average, Min, Max, curve fitting for analyzing offline processed data.

5.6 Special Conditions

a. Detailed software specification should be prepared after the detailed system study and the software specification should be submitted to LPSC and only after the approval, the party should start the necessary coding for our application.
b. Source code for the software, operation and maintenance of the software should be provided along with the software.
c. Source code should have provision for future up gradation such as increasing the channel count.
d. The software should be modular and documentation should be provided for the same in detail.
e. The software shall be accepted only after necessary satisfactory test run at our site and the party should be responsible for correcting any bug detected in the software within one year from date of acceptance of the software by LPSC.
f. Vendor shall be responsible for chain checking which shall include checking of the configuration, interconnection to DAS and display node.
g. Provision should be available in the software for checking the functional performance of all elements in the chain.
h. Event data Acquisition at every 20 msec and analog acquisition sampling rate can be user selectable.
i. Data updating in display and graph within 1 sec.
j. Auto sequence command generation with 20 msec interval.
k. There should be provision for calibration of measurement chain and also storage of sensor constant.
l. Also provide provision for manual and auto mode operation.
m. The supplier shall provide adequate training for the source code to department Engineers (2 persons), during control system and data acquisition system integration and software development at LPSC, Valiamala.
n. The training shall be so organized for control system and data acquisition system to provide complete understanding of the functions of the system, overall system concepts and routine operation for maintenance of the system and application software development. It is essential that all the system and other required document shall be available before commencement of training.

6. FINAL COMMISSIONING AND VALIDATION

After completing all the installation and software development activities party has to do the chain calibration, verification and validation of all measurement and control channels. Report of the same shall be submitted. The format of the report will finalise in the detailed engineering phase. Following check has to be done in Data Acquisition System

- Integrated System Performance
- Evaluation tests
  - Functional check
  - Linearity check
  - Gain accuracy
  - Filter performance evaluation
  - Time accuracy check
  - Cross talk check
  - A.C signal check
  - Over voltage check
  - Stability check
- Data Acquisition System Sampling rate with full channel capacity.
- CMRR, Isolation and CMV checks.
- Error diagnostics of the network failure, system failure, input card failure.
- Display updating Test.
- Data storage test (continuous storage for 5 hours with selectable sampling rate).
- Any other mutually agreed test.

7. DETAIL ENGINEERING

The detailed engineering shall be done on the basis of finally agreed Data Acquisition and display philosophy and process Input list. Hardware shall be selected accordingly. The quantity and model number for hardware and software version to be provided. The following documents shall be prepared and submitted by the party for the approval from the Department during detailed engineering.

- Instrument rack General Assembly diagrams
- Instrumentation rack wiring diagram
- Equipment earthing scheme/layout inside control room
- Data Acquisition system:
  - System Architecture & Configuration drawing
  - Wiring diagram with connector pin details
  - Interconnections diagram including communication links
  - Electrical power supply distribution diagram
  - Software life cycle model followed for software development should be mentioned.
  - Error budget calculation sheet for individual cards to be provided
- Quantity Estimation of items and its specifications
- Testing and Evaluation plan
- Inspection & Quality assurance plan
- Chain checking procedures.

Supplier shall supply detailed engineering documents (2 copies) with required specifications and drawing as Hard & Soft copies to the purchaser for review and approval. Only the approved configuration by the purchaser has to be followed for all commissioning activities.