

Items of Servo-Hydraulic System (Actuators, Hydraulic Power Unit, Controller, Software with other related items) for the proposed full scale testing facility at CSIR-CBRI, Roorkee

Item No.	Description	Quantity/Set
01	High Performance Linear Servo-Controlled Hydraulic Actuator (500kN) with related accessories	02
02	High Performance Linear Servo-Controlled Hydraulic Actuator (250 KN) with related accessories	02
03	Hydraulic Power Unit 300 lpm and HSM with related accessories	01
04	Digital Electronic Controller with related accessories	01
05	Software's related to carry out Quasi-static testing and Field data simulation software	01
06	Hoses, Cables	01
07	Installation, Commissioning, and Warrantee (3 years)	01
08	Set of Spares	01

OPTIONAL:

01	Pseudo-Dynamic Testing (PDT)/ quasi-static testing/ Quasi-static Hybrid simulation software with computer simulation interface & configurator	01
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SPECIFICATIONS AND ALLIED TECHNICAL DETAILS

Technical Specifications of Servo-Hydraulic System (Actuators, Hydraulic Power Unit, Controller, Software with other related items) for the proposed full scale test Facility at CSIR-CBRI, Roorkee

Item 1: High Performance Linear Servo-Controlled Hydraulic Actuator (500 kN) – 2 No.'s

S. No.	Technical Specification	Details of Technical Specifications
1.	Type of Actuator	Double acting with equal piston area for static and dynamic applications. The actuator should be hysteresis-free in quasi-static and cyclic operation with alternating forces up to nominal value.
2.	Bearing Type	Plain bearing with Co-axial PTFE seals
3.	Dynamic Load Capacity	+/- 500kN at 210 bar (3000 psi) supply pressure
4.	Stroke Capacity	500mm (+/- 250mm)
5.	Peak Velocity	The Design of manifold and Servo valves should cater to a minimum of 1mm/sec and a maximum of 20 cm/sec
6.	Load Cell Capacity	+/- 500 kN dynamic capacity Safe Mechanical Overload +/- 300 % static error: 0.06%capacity Reading from 1 to 100% range); Non Repeatability: $\pm 0.05\%$; Hysteresis: $\pm 0,1\%$ Nonlinearity (related to full scale) $\leq 0.06\%$. Factory and Calibration certificate should be provided Dynamic (without calibration change):100% of full load Static (without calibration change): 150% of full load
7.	Stroke Transducer	Integrated Linear Variable Differential Transducer (LVDT) co-axially mounted with actuator for accurate measurement of stroke position. LVDT should be calibrated at factory and at the lab including its certification and chart.
8.	Servo-Valve	Suitable Servo valve to meet performance specification Sr. 5 , above. A separate low flow servo valve to meet the low velocity performance along with Suitable adapter plate to be provided, if required.
9.	Hydraulic Accumulators	Pressure oil accumulator and return oil accumulator of required capacity for smoothening out pressure fluctuations
10.	Swivel Base Assembly (Adjustable) and Attachment kit	Dynamic force capacity: at least 90% of the static force capacity of actuator; Adjustable bearing clearance to minimize backlash; Swivel angle: + 90 degrees, - 30 degrees; Tilt angle: +/- 6 to7 degrees; Adjustable bearing/washers to minimize backlash, For use on cyclic, reversing load applications. Attachment kit: Includes high strength threaded bolt/washer/ springs at the requirement of swivel assembly.
11.	Lifting Arrangement	Lifting shackles configured for balanced lifting of actuator.
12.	Maintenance device	Rubber rest pads prevent damage
13.	Performance curve	Performance curve of the actuator must be enclosed and should at least satisfy the following at <u>No Load Condition</u> 1 Hz frequency, ± 25 mm displacement 10 Hz frequency, ± 2.5 mm displacement

Item 2: High Performance Linear Servo-Controlled Hydraulic Actuator (250 kN) – 2 No.'s

S. No.	Technical Specification	Details of Technical Specifications
1.	Type of Actuator	Double acting with equal piston area for static and dynamic applications. The actuator should be hysteresis-free in quasi-static and cyclic operation with alternating forces up to nominal value.
2.	Bearing Type	Plain bearing with Co-axial PTFE seals
3.	Dynamic Load Capacity	+/- 250kN at 210 bar (3000 psi) supply pressure
4.	Stroke Capacity	500mm (+/- 250mm)
5.	Peak Velocity	The Design of manifold and Servo valves should cater to a minimum of 1mm/sec and a maximum of 40 cm/sec
6.	Load Cell Capacity	+/- 250 kN dynamic capacity Safe Mechanical Overload +/- 300 % static error: 0.06%capacity Reading from 1 to 100% range); Non Repeatability: ± 0.05%; Hysteresis: ± 0,1% Nonlinearity (related to full scale) ≤ 0.06%. Factory and Calibration certificate should be provided Dynamic (without calibration change):100% of full load Static (without calibration change): 150% of full load
7.	Stroke Transducer	Integrated Linear Variable Differential Transducer (LVDT) co-axially mounted with actuator for accurate measurement of stroke position. LVDT should be calibrated at factory and at the lab including its certification and chart.
8.	Servo-Valve	Suitable Servo valve to meet performance specification Sr. 5 , above. A separate low flow servo valve to meet the low velocity performance along with Suitable adapter plate to be provided, if required.
9.	Hydraulic Accumulators	Pressure oil accumulator and return oil accumulator of required capacity for smoothening out pressure fluctuations
10.	Swivel Base Assembly (Adjustable) and Attachment kit	Dynamic force capacity: at least 90% of the static force capacity of actuator; Adjustable bearing clearance to minimize backlash; Swivel angle: + 90 degrees, - 30 degrees; Tilt angle: +/- 6 to7 degrees; Adjustable bearing/washers to minimize backlash, For use on cyclic, reversing load applications. Attachment kit: Includes high strength threaded bolt/washer/ springs at the requirement of swivel assembly.
11.	Lifting Arrangement	Lifting shackles configured for balanced lifting of actuator.
12.	Maintenance device	Rubber rest pads prevent damage
13.	Performance curve	Performance curve of the actuator must be enclosed and should at least satisfy the <u>following at No Load Condition</u> 1 Hz frequency, ± 50 mm displacement 10 Hz frequency, ± 5 mm displacement

Performance criteria

1. Actuator performance requirements mentioned in specification of item 1 and item 2 – are considering that they will be running one actuator at a time with full flow of Hydraulic Power Unit (HPU).
2. Following is the performance requirement should be met when all four actuators are running simultaneously:

Frequency (Hz)	250 kN. actuator (Qty 2) Stroke p-p (mm)	500 KN. actuator (Qty 2) Stroke p-p(mm)
0.01	500	500
0.05	500	380
0.10	400	180
1.00	40	18

Item 3: Hydraulic Power Unit and HSM

S. No.	Technical Specification	Details of Technical Specifications
1.	Delivery	At least 300 l/min at 210 bar
2.	Operating Pressure	210 bar/21 MPa /3000 psi
3.	Noise Level	75 dbA or less
4.	Type and Number of Pump	High pressure Variable Displacement pump in required number to develop at least 210 bar/21 MPa /3000 psi pressure, preferable submersible type in hydraulic tank
5.	Motor Size/ Motor Type	As per requirement of pump
6.	Communing Facility	Provision of separate motors pump units each drawing oil from a common reservoir and deliver to a common pressure supply line. It should have the provision to run individual pump module to save power. Tank should have communing port for future expansion.
7.	Tank capacity	Minimum 1500 liters; stainless steel reservoir
8.	High pressure Filter	3 micron filtration on pressure line and low pressure 10 micron Filter on Offline pump
9.	Accumulator	Pressure oil accumulator and return oil accumulator of required capacity are to be provided for smoothing out pressure fluctuations
10.	Minimum Controls	Pressure gauge/Pressure control Valve, Temperature Trip/Thermostatic water valve/Pump isolator and local controls
11.	Cooling System	Offline oil cooling pump and water cooled heat exchanger. Heat exchanger must be designed for cooling water inlet at 35 Deg. C.
12.	Hydraulic service manifold\ Hydraulic substation	2 stations (2 No.'s) operating pressure 210 bar. Each station with suitable flow capacity for each actuator Accumulators - pressure and return line accumulator Filters – 25 Micron pressure line filter Controls – Low pressure and High pressure Slow pre-filling to 75 % of nominal pressure for smooth start-up-shut-down in the event of a pressure drop to approximately 75 % of nominal pressure. Load protect mode with reduced pressure (ON/LOW/HIGH) and slow piston velocity (flow) to avoid hazardous movements. Rapid shut-down and pressure relief on the consumer side.
13.	Type of Oil	Must be available in India. First Fill to be provided by firm.
14.	Minimum Protection Device	Shut down in case of drop to approx. 75 % of nominal pressure. Arrangement for rapid shut-down/ emergency shut down
15.	Technical instruction manual and Circuit drawings	Should be supplied by the company
16.	Lifting/ Movement	The HPU should have the facility to lift by fork lift or moved on rollers, or slung from a crane
17.	Remote Control	To allow control of the power pack from the control room along with necessary cable
18.	Emergency Stop	A minimum of 5 (Five) Emergency stop unit with cable, in the test lab area (including control room)

Item 4: Digital Electronic Controller

S. No.	Technical Specification	Details of Technical Specifications
1.	Type	Modular type flexible digital compact controller, versatile, easy-to-use for general testing applications and to control six actuators. The controller should be suitable for Quasi-static and Dynamic Testing. It must provide real-time closed-loop control, with transducer conditioning signal from the transducer and function generation to drive various types of servo-actuators.
2.	Number of Control Channels/axis	Six
3.	Capability	Should have Multi axis test and multi-station test capability. The controller must be able to perform the quasi-static test and Dynamic Tests with ability to generate various forms, random data/time history playback.
	Stations	4 stations
4.	Signal Conditioning for each control channel	Following signal conditioning modules should be available on Each Channel /Axis - LVDT conditioning: Qty 1 - Load cell/Strain gauge Transducer conditioning : 1 - Accelerometer Conditioning (ICP) : 1
5.	Additional Signal conditioning	The system should include additional signal conditioners for data acquisition as follows: LVDT conditioners : 8 Strain Gauge /Loadcell Conditioners : 8
5.	Analog inputs	Analog inputs : (+/- 10 v) : qty 16 Analog outputs : (+/- 10 v) : qty 6
6.	Control System	Closed loop (PIDF) control. Position-Velocity –acceleration Control Calculated signals with corresponding control outputs.
7.	Safety Trips and other Facility	It must perform the primary system safety functions including setting of limits in the closed loop control of the actuator, processing of feedback data, safety trip detection and computer interface.
8.	Signal playback	It must be responsible for generating static/dynamic /cyclic / function generator. The system should be capable of time history signal playback.
9.	Data Acquisition Facility	It must be capable to capture the data or multiple block of data at high speed from all the feedback channels and then transfer it to the computer for processing and storage.
10.	External Input Facility	Capable of Accepting external command signal from an external analog source or function generator.
11.	Remote Control Pendant	To control the fine adjustment of actuator manually during setup.

Item 5: Related Software

S. No.	Technical Specification	Details of Technical Specifications
1.	Computer	Compatible PC workstation, with 2 X 23 inch Displays, Windows 10 Operating system, Microsoft Office. Configuration should be the latest at time of Delivery.
2.	General capability of the Software	<p>Multi-window graphical user interface (GUI) that allows viewing of all channels and quick adjustment of any test parameters. The interface should provide a test set-up wizard. The software should be capable of running multi-station/multi axis testing up to four actuators running as individual tests</p> <p>Features The set-up software should include actuator operating parameters and safety, drive signal definition, calibration factors, test annotation, and run sequencing or block cycling with facility to save each user defined set-ups which can be recalled, modified and archived. All data should be exported or saved in ASCII format.</p>
3.	Field data simulation software	<p>Capable to generating drive file to reproduce data on a specimen from target acceleration/strain gauge time history. Non square matrix simulation for upto 4 drive channels and 8 feedback channels.</p> <ul style="list-style-type: none"> • Signal viewer with statistical information, fatigue parameters, single and multiplot, time and XY plots, FFT and PSD analysis. • Signal editing functionalities like cut/copy/paste, filtering, remove offset and custom scripts • Import and export or various file format including Matlab© “mat”, ASCII and comma separated files • Real-time signal monitoring and oscilloscope • . • Batch iteration to run iterations for a batch of selected files • Sequence building using the setpoint, cycles, drive files, recording, and other instructions to create and preview a sequence • Sequence playing to run the created sequence on the controller
4.	Data Acquisition	Software and Hardware should be capable of Carrying out Time History Data Acquisition as well as periodic signal Data Acquisition for all available transducer channels

Item 6: Hoses, Cables

S. No.	Technical Specification	Details of Technical Specifications
1.	Flexible Hoses	The length of flexible hoses ((pressure, return, drain/pilot) from hydraulic power pack - hydraulic substation - actuator will be decided by the supplier on the basis actual site condition. However, a minimum length of hoses are 15 m (for Actuator) , 3 M (For HSM) and 3 M(for Power pack) will be used for comparing of financial bid. The flexible hose pipes should be of synthetic rubber based with steel reinforcement as per the relevant code of standard. The hoses with its end fitting must be bear required pressure with adequate factor of safety developed during the dynamic testing of structures.
2.	Signal Cable/ Electrical Cable	The length of all signal cable/ electrical cable from controller – actuator/ controller - hydraulic substation – actuator/ hydraulic power pack – controller will be decided by the supplier on the basis of actual site condition. However, a length of each type of cable up to 30m will be used for comparing of financial bid.

Item 7: Installation, Commissioning, Warrantee and Maintenance

S. No.	Technical Specification	Details of Technical Specifications
1.	Installation and commissioning	The bidder/firm should take full responsibility for supply, installation and commissioning of the hydraulic actuator system with related software's in the CBRI.
2.	Details about credentials of the bidder/firm, list of clients, details of similar equipment supplied in the last ten years	The bidder/firm should have installed similar equipment of minimum 4 actuators and above at least 20 institutions globally. Confirming this the firm has to submit copies of Purchase Order/Installation Reports/Institutional performance Certificate etc..
3.	Maintenance and service support of the servo-controlled hydraulic actuator system and related software's during and after the warranty period	The bidder/firm should have credentials of long standing in the supply and maintenance of similar equipment. Necessary proof to this effect should be produced along with the proposal. The bidder/firm should have competent and reliable service network in India for quick and necessary repair and maintenance of the equipment. The bidder/ should commit to provide maintenance service and supply necessary spares for the facility for at least 15 years after successful installation and commissioning.
4.	Warranty	3 years (as per GCC clause 15)
5.	Delivery Time Schedule	16 to 24 weeks or mutually agreed upon.
6.	Vendor Capability	Minimum turnover the last 3 years should not be less than 100 Crores(INR) per year A minimum installation Of 10 actuators with capacity 500 KN and above in india
6.	Operational and Technical manual, Circuit diagrams, Drawings	The bidder/firm should supply at least two sets of operation and maintenance manuals along with all necessary diagram /drawings that may be useful in case of repairing of any items of complete hydraulic actuator system should be supplied along with the equipment. The bidder/firm should also enclose all the relevant technical documents and catalogues for all the components included in the proposal. <i>Proposals without proper technical documents and catalogues will be rejected.</i>
7.	Training program, Software instruction manual and other training manuals	Supplier should conduct at least 5 days training program on the hardware and software part of the Final acceptance at site of the Test Facility which includes operational instructional, software training, data acquisition etc at own cost. No further payment will be made for the training program.
8.	Critical Spare Parts	The bidder/firm should also mention the critical spare parts/cards and other items of the hydraulic actuator system which may prone to failure/damage.

Item 8: Spares

S. No.	Technical Specification	Details of Technical Specifications
1.	HPU Filter	Pressure and Return Line filter for HPU- 1 set
2.	HSM Filter	Pressure Filter for HSM – qty1
3.	Servovalve	1) complete set of servovalve(s) mounted on 500 kn actuator-1 set 2) complete set of servovalve(s) mounted on 250 kN actuator-1set
4.	Actuator Seal-kit	Seal-kit for each actuator 500 kN. and 250 kN

Optional:

Pseudo-Dynamic Testing (PDT)/ quasi-static testing/ Quasi-static hybrid simulation software with computer simulation interface & configurator -

The complete testing software solution should have a feature that interfaces the servo-controller to widely accepted modeling software that simulates the performance of civil engineering structures. The software shall allow for easy exchange of command/feedback signals. The bidder should include the necessary set of tools to allow pseudo-Dynamic Testing (PDT)/ and quasi-static testing using the servo-controller, a computer simulation package and communication framework tool.
