The Senior Manager (Project Purchase)   **Ref: CIE/USAR/030/2019**
                                                          Date: 19.08.2019

Open Tender No: CIE/USAR/030/2019

Due Date: 19th September 2019, 3 PM

Pre-Bid meeting: - 30th August, 2019, 03:15 PM, at BSB 105 Department of Civil Engineering.

Eligibility Bid and Technical Bid opening meeting on 19th September 2019, 4:00 PM at Department of Civil Engineering, IIT-Madras.

Dear Sir/Madam,

On behalf of the Indian Institute of Technology Madras, offers are invited for the supply of **"Data acquisition system, sensors, installation and commissioning to perform continuous remote monitoring of Pamban Bridge"** conforming to the specifications given in Annexure I.

Instructions to the Bidder

  I.   **Preparation of Bids:** - The tenders should be submitted under three-bid system (i.e.) Eligibility bid, Technical bid and Financial bid.

  II.   **Delivery of the tender:** - The tender shall be sent to the addresses mentioned below, either by post or by courier so as to reach our office before the due date and time specified in our schedule.
        The offer/bid can also be dropped in the tender box on or before the due date and time specified in the schedule.
        The tender box is kept in the office of the:

        The Senior Manager,
        Project Purchase,
        IC & SR Building 2nd floor,
        I.I.T. Madras,
        Chennai – 600 036.

  III. **Opening of the tender:** - The offer/bids will be opened by a committee duly constituted for this purpose. The Eligibility bids will be opened first and will be examined by a committee which will decide the suitability of the bids as per our specifications and requirements. All bidders will be invited for opening of the technical bids. With respect to opening the financial bid, only technically qualified bidders will be called.

IV. **Prices:** - The price should be quoted in net per unit (after breakup) and must include all packing and delivery charges to the **Department of Civil Engineering.** The offer/bid should be exclusive of taxes and duties. The percentage of tax & duties should be clearly indicated separately. Kindly note that IIT Madras is eligible for concessional GST and relevant certificate will be issued.

In case of import supply, the price should be quoted without custom duty. IIT Madras is exempted from levy of IGST on Imports and eligible for concessional custom duty (not exceeding 5%) and the price should be quoted on EX-WORKS and CIP basis indicating the mode of shipment.

V. **Agency Commission**: - Agency commission, if any, will be paid to the Indian agents in rupees after receipt of the equipment and its satisfactory installation. Agency Commission will not be paid in foreign currency under any circumstances. The details should be explicitly shown in the tender document even in the case of 'Nil' commission. The tenderer should indicate the percentage of agency commission to be paid to the Indian agent. The foreign Principal should indicate the percentage of payment and it should be included in the basic price quoted originally (if any)..

VI. **Terms of Delivery**: - The item should be supplied to the **Department of Civil Engineering, IIT Madras** as per the Purchase Order. In case of import supply, the item should be delivered at the cost of the supplier to our Institution. The Installation/Commissioning should be completed as specified in our important conditions.

VII. **Technical Bid Opening:** The technical bid will be on 19th September, 2019, 4:00 PM at the **Department of Civil Engineering, IIT-Madras.** The financial bids of those tenders who are technically qualified will be opened at a later date under intimation to them.

VIII. **IIT Madras** reserves the full right to accept / reject any tender at any stage without assigning any reason.

Yours sincerely,

The Senior Manager (Project Purchase)
IC&SR Building, I.I.T. Madras,
Chennai – 600 036.

SCHEDULE

Important Conditions of the tender

1. The due date for the submission of the tender is **19.09.2019, 3 PM.**

   The offers / bids should be submitted in three bids system (i.e.) Eligibility bid, Technical bid and financial bid. The Eligibility bid should contain Consortium details. Technical bid should consist of all technical details / specifications only. The Financial bid should indicate item-wise price for each item and it should contain all Commercial Terms and Conditions including Taxes, transportation, packing & forwarding, installation, guarantee, payment terms, pricing terms etc. The Eligibility, Technical bid and financial bid should be put in separate covers and sealed. All the sealed covers should be put in a bigger cover. The Open Tender for supply of **"Data acquisition system, sensors, installation and commissioning to perform continuous remote monitoring of Pamban Bridge"** should be written on the left side of the Outer bigger cover and sealed.

2. **EMD: -** The **EMD in the form of account payee DD for 2% value of the item in favor of The Registrar – IIT Madras, payable at Chennai should be enclosed in the cover containing financial bid.** Any offer not accompanied with the EMD shall be rejected summarily as non-responsive.

   The EMD of the unsuccessful bidders shall be returned within 30 days of the end of the bid validity period. The same shall be forfeited, if the tenderers withdraw their offer after the opening during the bid validity period. The Institute shall not be liable for payment of any interest on EMD. EMD is exempted for Micro and Small Enterprises (MSE) as defined in MSE Procurement Policy issued by Department of Micro, Small and Medium Enterprises (MSME).

3. **Performance Security: -** The successful bidder should submit Performance Security for an amount of 5% of the value of the contract/supply. The Performance Security may be furnished in the form of an Account Payee DD, FD Receipt from the commercial bank, Bank Guarantee from any nationalized bank in India. **The performance security should be furnished within 21 days from the delivery of the purchase order.**

   Performance Security in the form of Bank Guarantee:- Incase the successful bidder wishes to submit Performance Security in the form of Bank Guarantee, the Bank Guarantee should be routed through the Beneficiary Bank to the end user bank. Otherwise, the Indian Agent of the foreign vendor has to submit a Bank Guarantee from a Nationalized Bank of India.
   The Bank Guarantee should remain valid for a period of sixty days beyond the date of completion of all contractual obligations of the supplier including the warranty obligations.

4. **Indian agent:** If an Indian agent is involved, the following documents must be enclosed:
   Foreign principal's proforma invoice indicating the commission payable to the Indian Agent and nature of after-sales service to be rendered by the Indian Agent.
   - ✓ Copy of the agency agreement with the foreign principal and the precise   relationship between them and their mutual interest in the business.

5. The offer/bids should be sent only for a machine that is available in the market and supplied to a number of customers. A list of customers in India and abroad with details must accompany the quotations. Quotations for a prototype machine will not be accepted.

6. Original catalogue (not any photocopy) of the quoted model duly signed by the principals must accompany the quotation in the Technical bid.

7. Compliance or Confirmation report with reference to the specifications and other terms & conditions should also be obtained from the principal.

8. **Validity:** Validity of Quotation not less than 90 days from the due date of tender.

9. **Delivery Schedule**: - The tenderer should indicate clearly the time required for delivery of the item (subjected to the executive committee-IITMadras approval). In case there is any deviation in the delivery schedule, liquidated damages clause will be enforced or penalty for the delayed supply period will be levied.
   If there is delay, the penalty will be @1% per week of delay subject to a max of 10% of the value of purchase order and if the delay is more than accepted time frame by IITM, the PO would be cancelled and liquidated damages will be enforced.

10. **Risk Purchase Clause**:- In the event of failure of supply of the item/equipment within the stipulated delivery schedule, the purchaser has all the right to purchase the item/equipment from other sources on the total risk of the supplier under risk purchase clause.

11. **Payment**:-
    (i) No Advance payment will be made for Indigenous purchase. However 90% Payment against Delivery and 10% after installation are agreed to wherever the installation is involved. In case of import supplies the payment will be made only through 100% Letter of Credit i.e. (90% payment will be released against shipping documents and 10% after successful installation wherever the installation is being done).
    (ii) **Advance Payment:** No advance payment is generally admissible. In case of specific percentage of advance payment is required, the Foreign Vendor has to submit a Bank Guarantee equal to the amount of advance payment and it should be routed through the Beneficiary Bank to the end user Bank. Otherwise, the Indian Agent of the foreign vendor has to submit a Bank Guarantee through a Nationalized Bank of India.

12. **On-site Installation**: - The equipment must be installed and commissioned by the successful bidder within a month from the date of receipt of the item at Pamban Bridge.

13. **Warranty/Guarantee**: - The offer should clearly specify the warranty or guarantee period for the machinery/equipment. Any extended warranty offered for the same has to be mentioned separately (For more details please refer our Technical Specifications).

14. **Late offer**: - The offers received after the due date and time will not be considered. The Institute shall not be responsible for the late receipt of Tender on account of Postal, Courier or any other delay.

15. **Acceptance and Rejection**: - I.I.T. Madras has the right to accept the whole or any part of the Tender or portion of the quantity offered or reject it in full without assigning any reason.

16. **Do not quote the optional items or additional items unless otherwise mentioned in the Tender documents / Specifications.**

17. **Disputes and Jurisdiction**:

Settlement of Disputes: Any dispute, controversy or claim arising out of or in connection with this PO including any question regarding its existence, validity, breach or termination, shall in the first instance be attempted to be resolved amicably by both the Parties. If attempts for such amicable resolution fails or no decision is reached within 30 days whichever is earlier, then such disputes shall be settled by arbitration in accordance with the Arbitration and Conciliation Act, 1996. Unless the Parties agree on a sole arbitrator, within 30 days from the receipt of a written request by one Party from the other Party to so agree, the arbitral panel shall comprise of three arbitrators. In that event, the supplier will nominate one arbitrator and the Project Coordinator of IITM shall nominate on arbitrator. The Dean IC&SR will nominate the Presiding Arbitrator of the arbitral tribunal. The arbitration proceeding shall be carried out in English language. The cost of arbitration and fees of the arbitrator(s) shall be shared equally by the Parties. The seat of arbitration shall be at IC&SR IIT Madras, Chennai.

a. **The Applicable Law:** This Purchase Order shall be construed, Interpreted and governed by the Laws of India, Court at Chennai shall have exclusive jurisdiction subject to the arbitration clause.
b. Any legal disputes arising out of any breach of contact pertaining to this tender shall be settled in the court of competent jurisdiction located within the city of Chennai in Tamil Nadu.

18. All Amendments, time extension, clarifications etc., will be uploaded on the website only and will not be published in newspapers. Bidders should regularly visit the above website to keep themselves updated. No extension in the bid due date/ time shall be considered on account of delay in receipt of any document by mail.

Acknowledgement: - It is hereby acknowledged that the tenderer has gone through all the conditions mentioned above and agrees to abide by them.

SIGNATURE OF TENDERER
ALONG WITH SEAL OF THE
COMPANY WITH DATE

Proposal request for data acquisition system, sensors, installation and commissioning to perform continuous remote monitoring of Pamban Bridge

Preamble:

IIT Madras is going to instrument the Bascule section of the Pamban bridge, connecting the mainland India to the Pamban island. The Pamban bridge is to be continuously and remotely monitored for a minimum period of 2 years. The purpose of the instrumentation is to detect the changes in average member axial stiffness towards ensuring the serviceability of the bridge. Custom algorithms developed by IIT Madras would be used to check the serviceability of the bridge based on the measurements made at specific locations. It is critical for the installed system to be fail safe to ensure continuous and safe operation of the bridge.

The bridge is to be instrumented with strain gauges, accelerometers and temperature sensors. The bridge opens in the middle and hence needs a full data acquisition system on each end. On each side there would be 41 linear strain gauges, 11 bidirectional accelerometers and 7 temperature sensors. Thus, each of these data acquisition system consists of 70 channels and a controller that can transfer the measured data onto a cloud through mobile network automatically. Synchronization of the two data acquisition systems is not required. The data corresponding to each train pass from each of the data loggers must be stored as an ASCII text file with the data logger identifier, date and time as its name for subsequent analysis. Detail specifications for the sensors, data acquisition system and software are given subsequently in this document.

As part of this bid, installation of the strain gauges, accelerometers and temperature sensors needs to be done at the site. These sensors must be fixed at locations specified by IIT Madras team with due care considering that the environment is the second most corrosive in the world. Both the manpower and consumable charges must be quoted as part of this bid. The sensors must be then connected to the data acquisition system housed in a ventilated IP 66 enclosure. The bid should include the cost of the enclosure as well. IIT Madras would liaison with the Railways and provide access to the instrumentation locations. The required personal safety equipment is the responsibility of the vendor. Accidental insurance of workers deployed at the site is the responsibility of the bidder. Details of services required, and responsibilities is provided later in the document.

Towards this a bid is called from potential vendors for supplying the requisite hardware, software, system integration and installation. To ensure the compatibility of the supplied data acquisition system, software and sensors as well as proper installation of them, a single quotation is sought for hardware, software and services. **The vendors are free to form a consortium and submit one bid as a consortium**. Bids for hardware or services alone would be deemed incomplete and rejected.

The bid would be scrutinized in three stages. Stage 1: Scrutinize the completeness of the bid, acceptance to the terms and conditions of the bid and the credibility of the consortium. Stage 2: Scrutinize the technical compliance of the bid. Stage 3: Compare the commercial bid. Only bids that passed the previous stage would be considered for the next stage.

The duly completed forms given at the end of this document and relevant documents to support the claims in the form following the prescribed format should be submitted for each of the three forms corresponding to each stage in **3 SEPARATE SEALED ENVELOPES**. Bids not as per the

prescribed format would be disqualified. Bids not containing the completed forms 1 through 3 at the end of this document would be considered as incomplete and rejected.

The entire monitoring system is required to be operational at the earliest. Hence, supply of the hardware should be within 10 weeks of the release of purchase order. Undue time taken to supply hardware or complete the installation could be a cause for disqualification of the bid.

Scope of Work:

The scope of work shall be supply, installation and commissioning of sensors (as per the specifications below) along with an appropriate cloud-based data acquisition system required for proper functioning of the monitoring system of the Pamban bridge over a period of 3 years.

The consortium will offer a turn-key solution to acquire, store and process the data from minimum 140 analogue channels at sample rate of 200 to 1000 samples per second per channel. The power supply cable, interface cable, sensor connection cable, software, essential data acquisition accessories and any other item not explicitly specified in the bid but required for proper functioning of the system are to be provided by the consortium. IIT will provide only 2 SIM cards for data transfer all other accessories for secure cloud-based storage of data will be in scope of supply and included in the cost.

Requirements of the consortium:

    a. The consortium should be capable of supply of all hardware, software and services

    b. Software should be developed by certified developers

    c. Service should be provided by technically trained manpower

    d. Each vendor or service provider should be in existence for at least 5 years as on 1 August 2019

    e. Reference to 3 clients who could testify to the service provided by each vendor needs to be provided in the prescribed format

    f. Latest income tax clearance and sales tax clearance should be produced for each vendor in the consortium.

Requirements of the bid:

a. Compliance with the requirements of the bid in the prescribed format (Form 1) and documents to establish the meeting of the eligibility of the consortium should be submitted separately in a sealed envelope. This envelope should be clearly marked: Consortium details.

b. Technical specifications table in the prescribed format (Form 2) and relevant data sheets to be submitted in sealed envelope marked: Technical bid

c. Commercials of the bid in the prescribed format (Form 3) along with a detailed working of costs to be submitted in a sealed envelope marked: Commercial Bid.

d. All the three sealed envelopes to be put in another envelope and sealed and submitted.

Important Dates:

Event	Date
• Release of Specifications to Bidders	August 19, 2019
• Pre bid meet	August 30, 2019 at 15:15 hours
• Last date for response from Bidders	September 19, 2019 at 15:00 hours
• Opening of Eligibility &technical bid	September 19, 2019 at 16:00 hours

Right to reject

IIT Madras reserves the right to reject all the bids without assigning any reason. Responses should be submitted with the most favorable terms that the Vendor could offer.

General terms and conditions

- The supplier/vendor must be an original equipment manufacturer or the sole authorized agent/dealer/seller of the proprietary item.
- The system should be delivered within 10 weeks from the opening of the letter of credit or issue of purchase order, whichever is later.
- Costs and related information should be given only in the financial bid.
- The cost should include 24 months warranty of the overall system and CIP up to Chennai.
- Prices quoted should be valid for at least 90 days.
- Item-wise break up of cost should be provided for the different items (parts).
- IIT Madras reserves the right to exclude some items from the purchase.
- Training at IIT Madras should be provided with no additional cost.

Specification for hardware and services

A photograph of the bascule section of the bridge is shown in figure 1. Each lifting portion of the

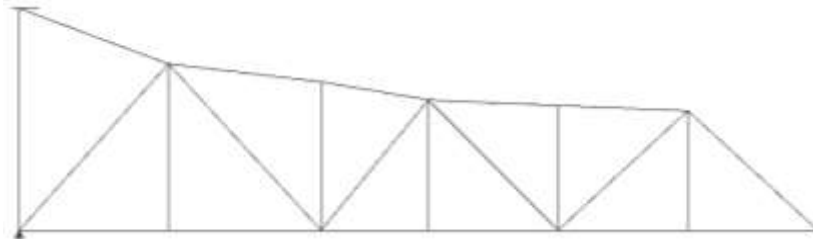**Figure 1**: Photograph of Bascule section of Pamban bridge

Figure 2: 2D idealization of the bascule section truss of the Pamban bridge for analysis

section is 33.75 m in length with the depth varying from 5.03 m to 9.33 m. The members of the truss are made of steel. Two trusses on either side, as shown in figure 2, are connected at the top and bottom make up each of these lifting portions. Each of these trusses consists of 13 node points and 23 members. 17 of these 23 (diagonal, top chord, and bottom chord) members are to be instrumented with linear strain gauges. Strain gauges would be placed at more than one location in the diagonal members. 5 out of the 13 nodes is to be instrumented with accelerometers. Temperature sensors are to be placed at three locations in each truss. The data acquisition system is to be placed on the pier at each end of the truss.

The specification of the sensors and the total number required for the project – Actual number required plus some for backup – is provided in the table 1.

The strain gauge and temperature sensors are to be pasted in the structure following standard procedures which ensures their viability for at least 2 years in the world second most corrosive environment. These sensors must be covered with protective layers to prevent moisture ingress. The wiring from the sensors to the data acquisition system should be routed neatly through the members and concealed in PVC pipes. Detailed specification is given in table 2.

Table 1: Type, specification and number of sensors

S. No	Sensor Type	Specification	Quantity
1.	Electrical type linear strain gauge	Gauge length: 3 mm; Strain range: ±1500 microstrain; Resistance: 350 Ohms; Type: Encapsulated Foil type IP67 Strain Gauge; Temperature compensation: 10 to 60 degree Celsius matched to steel; Should have zero signal stability with changing moisture; Moisture proof and resistant against chemicals; Prewire with 1m insulated wire in 4 wire circuit	100
2.	Temperature sensor – Structure	Type: Resistance based; Base material: Steel; Range: 10 to 60 degree Celsius; Sensitivity: 0.2 degree Celsius;	15
3.	Temperature sensor – Ambient	Type: Resistance based or Thermocouple; Range: 10 to 60 degree Celsius; Sensitivity: 0.2 degree Celsius; Protection: IP 65;	2
4.	Accelerometer	2 directional – vertical and axial; Range: ±1g; Sensitivity: ±10 mm/s^2; Frequency range: 0.3 to 100 Hz; Type: Piezoelectric; Operating temperature: 10 to 60 degree Celsius; Maximum cable length: 50 m. Protection: IP 65	22

Table 2: Specification for installation of sensors

S. No	Sensor Type	Specification	Quantity
1.	Electrical type linear strain gauge	Grinding, cleaning of the surface and bonding using appropriate adhesive to ensure viability for 2 years. Wiring of the sensors to data acquisition system should be done neatly and concealed through PVC piping. The environment is second most corrosive in the world; hence use of appropriate materials for the system to be viable for 2 to 3 years is required.	82
2.	Temperature sensor – Structure		12
3.	Temperature sensor – Ambient	Wiring of the sensors to data acquisition system should be done neatly and concealed through PVC piping.	2
4.	Accelerometer		22

2 numbers of 70 channel data acquisition system is required to digitize, store and transmit the data from linear strain gauges (41 channels), resistance-based temperature sensor (6 or 7 channels, depending on how ambient temperature is measured), 11 bidirectional accelerometer (22 channels), if thermocouple is used as the sensor for ambient temperature measurement, one channel for the same. It is understood that the cards would be modular and hence the actual number should not be less than that prescribed above. For the sensors in contact with the steel truss – electrical strain gauges and resistance-based temperature sensor – there might be back current due to lightning strikes against which the data acquisition system needs to be protected. To prevent damage to the data acquisition system due to this back current a surge protector must be connected in series with the sensor.

Event based data acquisition is to be implemented. The train moves over the bridge on either direction. Hence, an accelerometer is to be placed at the upstream and downstream of the bridge. When the train is moving towards the Pamban side, the accelerometer at the upstream end would wake up the data acquisition system towards the Mandapam end and the data acquisition system at the Pamban end would be waked up by the accelerometer at the tip of the cantilever truss. On the other hand, when the train is moving towards the Mandapam end, the accelerometer at the downstream end would wake up the data acquisition at the Pamban side and that at the tip of the cantilever would wake up the Mandapam side data acquisition system. Thus, some accelerometers are used to both trigger the collection of data as well as collect data.

Detailed minimum specifications for the data acquisition system, surge protector and the minimum quantity required is given in table 3. Making the data acquisition system compatible with the sensors is the responsibility of the consortium. The choice of sensor and the number of channels in the data acquisition system can be tuned to achieve economy. The data acquisition system and the surge protector should be continuously functioning for three years. In case of a malfunction the consortium should replace the unit immediately.

Table 3: Data Acquisition system: minimum specification and Quantity

S. No	Part	Specification	Quantity
1.	Controller	Modular and expandable to receive 128 channels; Real-Time Embedded controller for deterministic data logging; Realtime operating system; Inbuilt memory >200GB SSD; Possibility to expand storage with Exchangeable CFast 2.0 card, USB 3.0 stick / HDD; Ring buffer memory for 10 minutes; Record data continuously for a specified duration on trigger and save it to a file without data loss or black out time; Recording rate 4 to 5 MS/s; Synchronous data acquisition from all channels; Ethernet ports with embedded Web and file servers for remote user interfacing and directly connect to mobile internet; 2 Trigger channels to trigger acquisition on exceedance of a preset criteria of an analogue or computed signal; digital input and output channels; DC power input; Available interfaces: Fire wire, 2x Gigabit Ethernet, USB 3.0, WLAN, DVI; Operating temperature: 10 to 60 degree Celsius; Vibration endurance: 50 m/s^2 Shock endurance: 350 m/s^2 Protection: IP 20, EN 61326	2
2.	48 channel – Bridge amplifier and signal conditioner – Resistance type	Input: 350 Ω strain gage or RTD temperature sensor; Channel Isolation: Electrically isolated & individually configurable channels Sampling Frequency: Maximum 1 kS/s/ch and software selectable for each channel Built-in voltage excitation for sensors: 0.5, 1, 2.5, 5V. Both DC & Carrier Frequency excitation required; Carrier frequency	2

1200 Hz

Accuracy class: 0.05

Bridge measurement range: ±20 mV

Connection: Stain Gauge in 3–wire regulated and 4–wire Quarter bridges; in 5 wire Half bridges; in 4 & 6 wire Ratio metric Full bridges measurements PT100, Resistance, Potentiometric transducers, Voltage (10 V differential, 0...30 V unipolar)

Bridge completion: Internal Completion resistors of 350 ohm with ±2 ppm/^{o}C temperature co-efficient. Software selectable. No external completion resistors or manually hardwiring of completion resistors is acceptable.

Auto and shunt calibration: Inbuilt shunt with ±2 ppm/^{o}C temperature co-efficient required giving 1mv/V on every channel. Software selectable. No external shunt resistors or manually hardwiring of shunt resistors is acceptable. Background Auto calibration with 2nd calibration channel is required

Filtering: Bessel & Butterworth 0.01 HZ to 3.2 KHz individually adjustable per channel

A/D converter: Each channel should have separate 24-bit A/D Converter for synchronous & parallel measurements. No Multiplexing / sample & hold. Min 19-bit Measurement resolution required

Transducer cable length: > 80 m

TEDS support: TEDS (IEEE 1451.4) supported on every channel

Connection via screw terminal or D connector, RJ45 is not acceptable

Common mode rejection: > 100 dB

Common mode voltage: 60V

Zero drift: <0.002% of full scale

Full scale drift: < 0.005% of the measured value

Operating temperature: 10 to 60 degree Celsius

		Vibration endurance: 50 m/s^2	
		Shock endurance: 350 m/s^2	
		Protection: IP 20, EN 61326	
3.	22 channel – Bridge Amplifier – Piezoelectric type	Input: Piezoelectric accelerometer; ICP type sensors, 4-20mA current, Voltages (± 60V ± 10V, ±100 mV) Channel Isolation: Electrically isolated & individually configurable channels Sampling Frequency: Maximum 1 kS/s/ch and software selectable for each channel Built-in voltage excitation for sensors: 5V to 24V adjustable on every channel Accuracy class: 0.05 Signals: 60V, 10V, 100mV, 20mA, IEPE Filtering: 4th order Bessel & Butterworth low-pass filter individually adjustable per channel A/D converter: Each channel should have separate 24-bit A/D Converter for synchronous & parallel measurements. No Multiplexing / sample & hold. Min 19-bit Measurement resolution required Transducer cable length: 35 m TEDS support: TEDS (IEEE 1451.4) supported on every channel Connection via screw terminal or D connector, RJ45 is not acceptable Common mode rejection: > 100 dB Common mode voltage: 60V Operating temperature: 10 to 60 degree Celsius Vibration endurance: 50 m/s^2 Shock endurance: 350 m/s^2 Protection: IP 20, EN 61326	2

4.	Surge Protector	Sensor to be protected: Strain gauge and RTD temperature sensor;	100
		Maximum Discharge Current: 100 A;	
		Voltage protection: 30 V (excitation)	
		Continuous operating voltage: 10 V (excitation);	
		Reaction time: < 5 nsec;	
		Operating temperature: 10 to 60 degree Celsius;	
		Protection: IP 20	

The software should be included for hardware setup, automatic sensor recognition through TEDS, data Logging on arrival of a trigger from a sensor(s) and data transfer to the cloud at the end of the trigger event. The specific requirements of the software are:

1. **Security:** All access to the internet should be through secured shell protocols. There should be password or hardware controls and encryption to prevent third party access to the system or data.
2. **Sensor fault tolerant design:** The software should be such that even if a sensor is not functioning the data from the remaining sensors should be logged correctly.
3. **Data logging:** Start logging when the reading from a sensor(s) (accelerometer) exceeds a predefined threshold. The threshold should be user specifiable and changeable. Logging is to be continued for 300 seconds. Package the data collected, save locally and send to the cloud. Reset and wait for the next trigger. Perform Pre-Post trigger operations automatically. Repetitive acquisition and parallel recording of channels possible. Automatic start and stop of the data acquisition system should be possible.
4. **Data storage:** The complete meta data (sensors, measurement, configuration, test parameters), statistics log should be stored for data traceability. All data should be stored. Local data storage should be in binary format. The same file should be transmitted to the cloud. On the cloud, the data should be convertible into ASCII tab delimited text file with the meta data always occupying a fixed number of header lines.
5. **On the fly configuration:** The controller should be reconfigurable through internet.
6. **Auto bootup:** The system after a power down event should boot and arrive at data acquisition mode automatically.

In this project the cloud is used to only store and retrieve data. No computations need to be done. The requirements of the cloud service provider are as follows:

1. **Security**: The data in the cloud should not be accessible to third parties. Any data upload or download should be password protected and encrypted.
2. **Storage**: The amount of storage on the cloud should be not less than 1 TB.
3. **Availability**: The data should be available to IIT Madras immediately on arrival to the cloud. There should be no limits on data download.
4. **Bandwidth**: The cloud should have enough bandwidth to allow upload and download at speeds not less than 10 MB/s at any time.
5. **Downtime**: There should be no downtime of the cloud.

The Pamban bridge is in the second most corrosive environment in the world. Hence protecting the electronic equipment is essential. It is expected that a single enclosure should be provided for both the data acquisition system and the surge protector. Since, the data acquisition system would be in operation 24 by 7, if heating is an issue appropriate ventilation should be provided. The **enclosure should be IP 66 rated**. **Quantity required – 2**.

Uninterrupted power supply (UPS) is not available at the site. Depending on the power requirements of the system, an inverter and battery backup enough to power the system for 12 hours should be supplied as part of this bid. 2 such systems are required.

Proper functioning of the system according to the specifications should be demonstrated at IIT Madras through standard tests. Then the system is to be transported to Pamban bridge by the bidder at their own cost. The system with full functionality should be installed and commissioned within one month of IIT Madras approving the installation of the system on the bridge. The commissioned system should pass standard calibration tests that would be carried out by the IIT Madras team. Any shortcomings of the system should be rectified by the bidder. **Proper installation of the system is deemed to be achieved only when the system passes the calibration tests at the Pamban bridge.**

It is understood that some systems might require additional equipment like routers which has not been specified. List of these equipment and their specifications need to be specified in the technical bid clearly and explicitly and their cost included as part of the commercial bid.

FORM–I (Bid and Consortium Details)

Bid Details:

S. No	Equipment / Service	Name of the Supplying Vendor / service provider	Original Equipment Manufacturer	Sole / Authorized representative of equipment manufacturer	Days to supply / complete installation
1.	Strain gauge				
2.	Accelerometer				
3.	Temperature sensor for Structure				
4.	Temperature sensor for ambient				
5.	Installation of sensors				
6.	Data acquisition system				
7.	Surge protector				
8.	Software				
9.	Cloud service provider				
10.	IP 65, enclosure				
11.	Uninterrupted power supply				
12.	System integration				
13.	Others, if any				

Consortium Details (Use separate sheets for each vendor in the consortium)

Vendor Name:	Service offered in this project:
Address: Contact Person: e-mail: Phone: Mobile: FAX:	Date of Establishment in India: Turnover in the last 3 years: (Valid documentary evidence is mandatory) No of Projects executed in the last 3 Years: (Valid documentary evidence is mandatory) Profile of Technical Manpower: No. of ITI's: No. of BE or equivalent: No. of postgraduates:

Reference details

S. No.	Client Details	Date of the order	Completion Date	Cost of the Project
1	Project Title: Address: Contact Person: e-mail: Phone: Mobile: FAX:			
2.	Project Title: Address: Contact Person: e-mail: Phone: Mobile: FAX:			
3.	Project Title: Address: Contact Person: e-mail: Phone: Mobile: FAX:			

FORM II (TECHNICAL SPECIFICATIONS TABLE)

NOTE: For each specification, please enter an **appropriate value/range or "YES" / "NO"** in the last column of this table. If a cell in the last column is blank, then it will be assumed that the quotation does not comply with the respective specification/requirement. Provide catalogues, data sheets and/or other documentation to support the compliance of your equipment to the given specifications.

1.	**Strain Gauge**	Resistance	
		Gauge length	
		Protection Type (IP rating)	
		Fatigue life	
		Sensing element	
		Temperature response matched to	
		Zero signal stability with changing moisture	
		Prewiring	
2.	**Accelerometer**	Type	
		Number of axis	
		Measurement range	
		Sensitivity	
		Frequency range	
		Operating temperature	
		Protection (IP rating)	
		Maximum cable length	
3.	**Temperature sensor for Structure**	Type	
		Sensing element	
		Temperature range	
		Sensitivity	
4.	**Temperature sensor for ambient measurement**	Type	
		Sensing element	
		Temperature range	
		Sensitivity	
5.	**Installation of sensors**	Surface preparation	
		Adhesive to be used for strain gauge	
		Adhesive to be used for temperature sensor	
		Material used for protection of strain gauge	
		Material used for protection of temperature sensor	
		Type of cable used to connect strain gauge and temperature sensor	
		Resistance of cable used to connect strain gauge and RTD	
		Type of Mounting for accelerometer	
		Wiring concealed in PVC pipes	

6.	**Data acquisition system (DAS)**	Number of channels for quarter bridge strain gauge in each DAS	
		Number of channels for resistance-based temperature sensor in each DAS	
		Number of channels for thermocouple in each DAS	
		Number of channels for accelerometer in each DAS	
		In built memory in controller	
		Ring buffer memory in controller	
		Possibility of trigger-based acquisition	
		Time Synchronous data acquisition from all channels	
		Directly connect to mobile network	
		DC power input	
		TEDS support	
		Interfaces	
		Channel isolation	
		Sampling frequency	
		Accuracy class	
		Built in excitation for sensors	
		24-bit delta-sigma, simultaneous ADCs	
		Built in Antialias filter	
		Connection via	
		Zero drift	
		Full scale drift	
		Should accept four wire regulated circuit	
		Protection	
		Operating temperature range	
7.	**Surge Protector**	Maximum discharge current	
		Maximum voltage	
		Reaction time	
		Operation temperature	
		Protection	
8.	**Software**	Security enabled	
		Sensor fault tolerant design	
		Trigger based automatic data logging and cut off	
		Automatic data transfer to cloud	
		Data stored in binary and ASCII format	
		Date, time and location stamped data file name	
		Data file contains meta data on the configuration of the DAS	
		Fixed number of meta data header lines	
		On the fly configuration of the hardware	
		Auto bootup on power restoration	

9.	**Cloud service provider**	Security enabled	
		Storage provided	
		Connectivity bandwidth	
		Anticipated downtime	
10.	**Industrial Enclosure for Data Acquisition System**	Rugged, hinged door, with or without window	
		Dimensions	
		Panel for internal mounting of data acquisition system	
		UL 508A, 508, File No. E61997 – Type 4 and Type 12 rated	
		NEMA/EEMAC rated – Type 4, Type 12, and Type 13	
		IEC 60529, IP66 rated	
11.	**UPS**	12-hour battery backup provided	
12.	**System Integration**	Demonstration of the full functionality of the system at IIT-Madras.	
13.	**Scope of commercial bid**	Warranty for 2 years for the hardware with immediate replacement guarantee in case of malfunction (repaired unit may be reused)	
		Software and cloud service to be available for 2 years	
		Cost of inspection and maintenance of sensors for 2 years	

FORM III (COMMERCIAL BID)

S. No	Equipment / Service	Unit price	Quantity	Total cost	Cost including tax (CIP Chennai)
1.	Strain gauge		100		
2.	Accelerometer		22		
3.	Temperature sensor for Structure		15		
4.	Temperature sensor for ambient		2		
5.	Installation of sensors		NA		
6.	Data acquisition system including the accessories		2		
7.	Surge protector		100		
8.	Software		NA		
9.	Cloud service provider		NA		
10.	IP 66, enclosure		2		
11.	Inverter and battery		2		
12.	Warranty / Maintenance cost for 2 years		NA		
13.	Others, if any				
14.	**GRAND TOTAL**				

Detail working of the above cost should be provided.