

SECTION 5. TERMS OF REFERENCE

Department of Geology and Mines
Ministry of Energy and Natural Resources
Terms of Reference

Assessment, System Design, Supply, Installation, Integration, Testing and Commissioning of the Upgraded National Earthquake Monitoring Network (NEMN)

1. Background

Bhutan is located in the seismically active Himalayan region and remains highly vulnerable to earthquake hazards and their associated socio-economic impacts. To strengthen national seismic monitoring and resilience, the Department of Geology and Mines (DGM) established the National Earthquake Monitoring Network (NEMN) in 2015, which has since expanded to 14 permanent earthquake stations and 221 intensity meters across the country with support from Government of Japan and Regional Integrated Multi-hazard Early Warning System (RIMES).

After several years of operation, significant components of the network have become antiquated and increasingly vulnerable to system failure, signal degradation, unstable power supply, communication disruptions, and limited maintenance capacity. These challenges can affect the quality, reliability, continuity, and timely transmission of seismic data, particularly during emergencies when near-real-time information is critical. The existing central infrastructure also requires modernization to strengthen processing capacity, data storage, backup and redundancy, cybersecurity, dissemination and overall system resilience.

There is therefore a need to upgrade and modernize the NEMN into a reliable, resilient, secure, scalable, and state-of-the-art seismic monitoring system. The modernization will improve the quality and availability of seismic data, strengthen communications and power resilience, enhance data processing and storage, improve automated dissemination of seismic information, and establish more robust backup, maintenance, and operational arrangements.

The upgraded NEMN will enhance the Department's capacity to provide reliable and timely seismic information and support earthquake hazard assessment, disaster preparedness and response, urban and infrastructure planning, seismic risk reduction, and evidence-based decision-making.

A brief overview of the NEMN is provided below:

1.1. Earthquake Stations

Out of 14 earthquake stations, 6 stations are equipped with the Guralp CMG 3T broadband sensors while the remaining 8 stations are equipped with the Trillium 120 broadband sensors by Nanometrics. All the stations use Centaur Digitizer from Nanometrics. To power the seismic station, 100 Ah and 150 Ah batteries are used. The battery is recharged through solar panels.

For communication and data transmission, Bhutan Telecom (BT) sim cards are used in the cellular modem. This cellular network connectivity sends the digitized data over the internet to the central servers hosted in the DGM.

For earthquake monitoring, a dual-server infrastructure set is used. Data from the stations is first transmitted to the Apollo Server (used solely for data acquisition) and then the data is forwarded to the SeisComP server, where automatic processing, analysis, and earthquake detection are carried out.

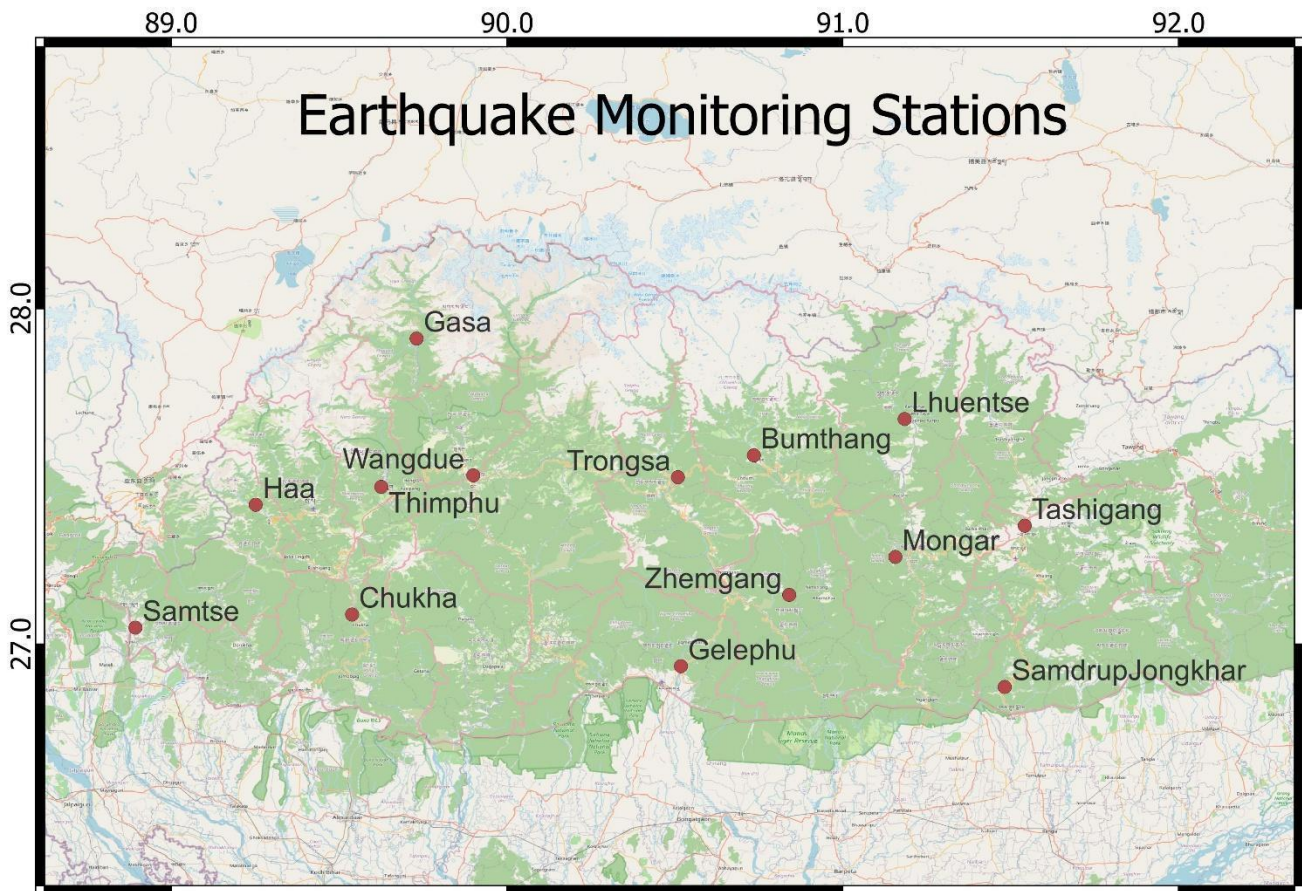


Figure 1. Location of 14 earthquake stations.

1.2. Intensity Meters

Bhutan is divided into 20 districts (Dzongkhags), which are further subdivided into 205 village blocks (Gewogs). The Intensity Meter Network has 221 stations in total installed across the country. Each Dzongkhag Administration Office, except Thimphu Dzongkhag, has one intensity meter installed. In Thimphu Dzongkhag, the intensity meter is installed in the DGM Office. Rest of the 201 stations are installed at each Gewog Administration Office, except for 4 highland gewogs (Soe & Laya Gewogs in Gasa Dzongkhag, and Lingzhi & Naro Gewogs in Thimphu Dzongkhag).

The Intensity Meters are equipped with accelerometers to measure earthquake-induced structural vibrations. A Raspberry Pi system at each station runs the software for event detection and data processing. To make this data accessible, a Raspberry Pi screen displays real-time waveforms, event lists, and intensity measurements. With a large number of stations, a stable and affordable network connection was crucial. Therefore, all stations are connected to the Government Wide Area Network (GWAN) via an ethernet connection. The data from each station is transmitted to a central server at the DGM every 10 seconds for continuous monitoring.

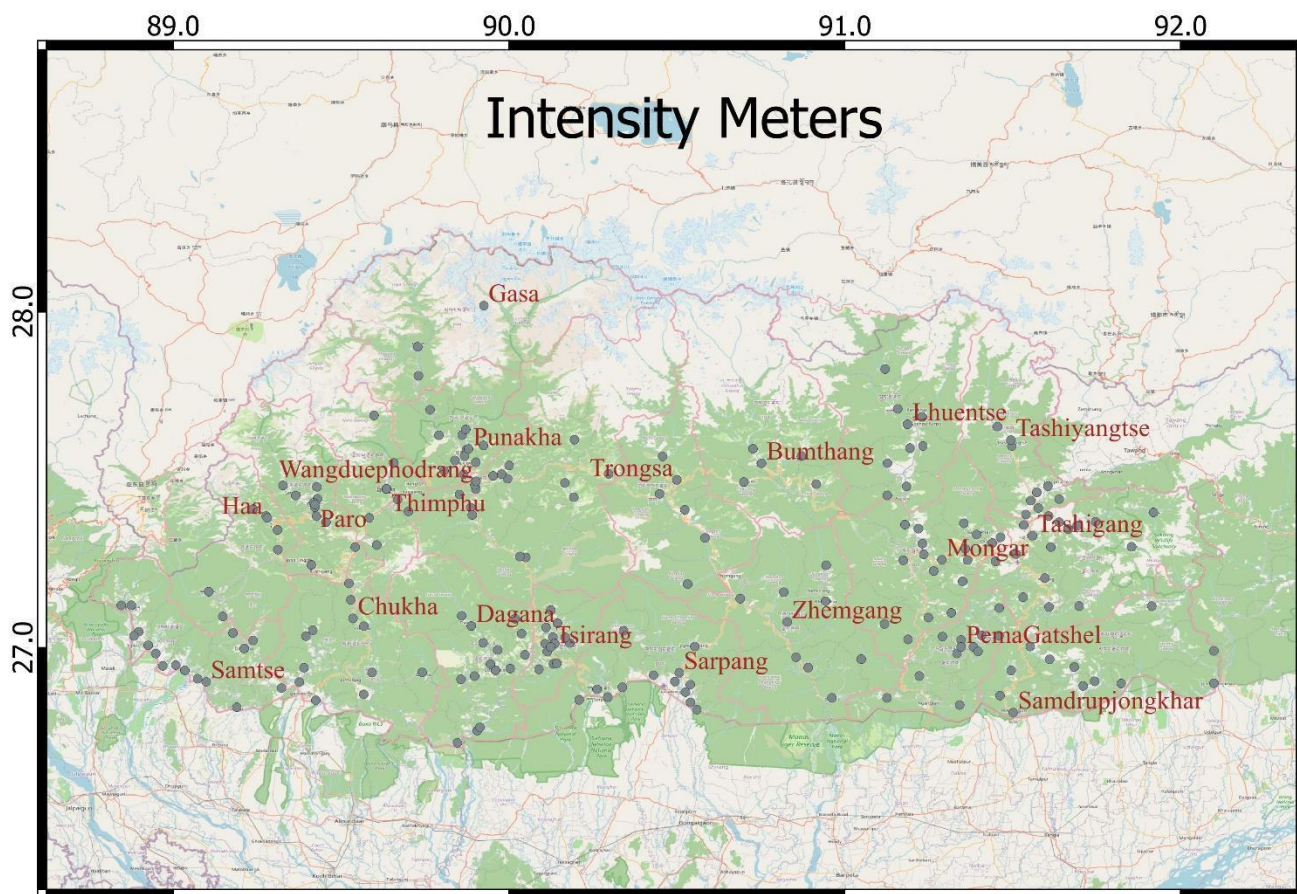


Figure 2. Location of 221 Intensity Meters.

2. Objectives

The overall objective of this assignment is to upgrade and modernize the existing National Earthquake Monitoring Network (NEMN) into a secure, reliable, resilient, scalable, and maintainable state-of-the-art seismic monitoring system capable of providing continuous, high-quality, near-real-time seismic information.

The specific objectives are to:

- i. Assess the existing NEMN infrastructure and establish a verified baseline to identify system gaps, compatibility requirements, vulnerabilities, and priority areas for upgrade.
- ii. Upgrade seismic monitoring equipment and associated field infrastructure to improve data quality, accuracy, reliability, and network performance.
- iii. Modernize the central servers, processing, and data-storage infrastructure to provide adequate capacity, redundancy, scalability, and reliable continuous operation.
- iv. Strengthen power and communication resilience at field stations and the central server to ensure uninterrupted data acquisition and real-time transmission, including appropriate terrestrial and satellite communication solutions.
- v. Enhance network security and controlled two-way connectivity between field stations and the central system through improved network architecture, cybersecurity, access control, monitoring, and secure remote administration.
- vi. Strengthen data management, backup, redundancy, and disaster recovery to protect seismic data and ensure continuity of critical monitoring services.
- vii. Upgrade and integrate the automatic seismic information and alert dissemination system to enable timely, reliable, and controlled dissemination of validated seismic information through approved

- communication channels.
- viii. Integrate, test, commission, and operationalize the upgraded NEMN as a unified system with minimal disruption to existing monitoring services.
- ix. Strengthen institutional and operational capacity through appropriate documentation, training, knowledge transfer, warranty, and technical support to ensure sustainable operation and maintenance of the upgraded network.

3. Scope of the Services

The assignment shall be implemented as an integrated turnkey solution covering assessment, design, supply, installation, configuration, integration, testing, commissioning, training, and initial technical support. All activities under the scope of this project shall be implemented only upon obtaining the prior approval of the Client. The scope shall involve

3.1. Assessment of the existing Network and Development of system Upgrade Design

- i. Assess the existing NEMN infrastructure, including stations, sensors, digitizers, telemetry, power, servers, storage, software, cybersecurity, dissemination systems, licenses, and operational procedures.
- ii. Inspect relevant field stations and the central system; verify site conditions, available power, grounding, communications coverage, mounting requirements, and environmental constraints.
- iii. Prepare the proposed infrastructure designs, network and security design, data-flow diagrams, migration approach, bill of quantities, risk register, and implementation plan.
- iv. Identify dependencies, regulatory approvals, frequency or satellite-service permissions, subscriptions, recurring costs, and client-side actions required before implementation
- v. NEMN design will focus mostly on two-way network telecommunications, update earthquake monitoring softwares/systems, information display and dissemination system, archival system, and mitigation measures.
- vi. Present the assessment findings to the client for approval before beginning implementation.

3.2. Deployment and Establishment of upgrades

3.2.1 Seismic sensors and relevant equipment

- i. Upgrade seismic sensors and associated equipment at 7 earthquake stations, ensuring compatibility with existing or proposed digitizers, timing systems, telemetry, metadata standards, and central processing applications.
- ii. Supply, install, configure the seismic sensors and associated equipment at approved station locations, and integrate each upgraded station with the central server.
- iii. Conduct end-to-end performance testing covering sensor response, timing accuracy, noise performance, data completeness, telemetry reliability, power reliability, and data transmission to the central server.

3.2.2 Server Infrastructure

- i. Supply and install servers sized for data acquisition, processing, database, application, web notification, monitoring, and administrative workloads.
- ii. Provide rack integration, operating systems, management tools, security hardening, licenses, network interfaces, and redundant components.
- iii. Upgrade and/or migrate required applications, databases, and configurations with minimal disruption to continuous monitoring.
- iv. Configure monitoring, alerting, backup, access control, logging, and documented recovery

procedures.

3.2.3 Power Backup System

The requirement for a power backup system shall be assessed and implemented for the central monitoring equipment as well as 221 intensity meters and 14 earthquake stations.

- i. Conduct a load assessment and define the required backup autonomy for central and field equipment.
- ii. Supply and install suitable uninterruptible power supplies, automatic transfer, protection, monitoring, and all necessary electrical works.
- iii. Configure orderly shutdown and restart where applicable and provide battery-health, alarm, maintenance, and replacement procedures.
- iv. Test load, transfer performance, autonomy, alarms, recovery, and electrical safety.

3.2.4 Data Storage and Protection

- i. Supply and configure scalable storage for waveform data, events, databases, metadata, logs, configurations, and projected growth over the agreed design period.
- ii. Provide redundancy, health monitoring, access controls, encryption where required, and integration with the central servers.
- iii. Implement backup, off-site copy, restoration, and disaster-recovery arrangements.
- iv. Migrate data and demonstrate successful backup and restoration against defined recovery objectives.

3.2.5 Secure Network and Two-Way Connectivity

A secure network shall be implemented for the central monitoring equipment as well as 221 intensity meters and 14 earthquake stations. The secure two-way connectivity shall be assessed and implemented for all 221 intensity meters and 14 earthquake stations.

- i. Conduct a comparative technical and commercial assessment of terrestrial, conventional satellite, and Starlink connectivity, considering performance, operational feasibility and cost.
- ii. Design and implement a secure two-way network between stations and servers for data transmission and station health monitoring without exposing field devices directly to untrusted networks.
- iii. Design and implement secure networks for administration, dissemination, backup, and external services.
- iv. Deploy appropriate firewalls, virtual private networks or equivalent encrypted connections, strong authentication, least-privilege access, secure remote administration, monitoring, configuration backup, and vulnerability mitigation.

3.2.6 Automatic Dissemination System

- i. Review the existing data processing and dissemination workflow, event bulletins, channels, interfaces, and failure modes.
- ii. Upgrade required components, and integrate them with the data processing servers, databases, and approved dissemination gateways.
- iii. Design configurable thresholds, geographic filters, bulletin templates (multilingual content where required), delivery-status monitoring, manual override, and provisions against duplicate or false alerts.
- iv. Test the system for various scenarios such as normal, delayed, duplicates, failed-delivery, failover,

- and recovery scenarios.
- v. Verify that only validated information is disseminated through authorized channels.
- vi. Considering the absence of round-the-clock monitoring at DGM, secure remote access for event monitoring, data dissemination, and troubleshooting shall also be established.

3.2.7 Comprehensive Testing of New Infrastructure

- i. Conduct comprehensive tests encompassing equipment, integration, performance, security, failover, backup-and-restore, power, telemetry, and dissemination.
- ii. Provide warranty and technical support for a minimum of twelve months after final acceptance, including defined response and resolution times, and software updates. The correction of defects arising from the manufacturer/supplier's deliverables remain the sole responsibility of the Consultant.

3.3. Training/Capacity building

- i. Provide administrator, operator, and maintenance training, including practical exercises and knowledge transfer using the commissioned system.
- ii. Submit complete project documentation, system manuals, and operational procedures required for long-term maintenance and troubleshooting.
- iii. Provide all asset and license registers, configuration backups, and system credentials.

4. Key Deliverables and Completion Schedule

The duration of the contract will be 34 weeks from contract signing, with deliverables due as specified in the table below.

Sl. no.	Milestone / Deliverable (Workflow chart)	Target Timeline (weeks from signing of the contract)
1.	Contract Signing	
2.	Submission of report on assessment of the current infrastructure and network (including detailed work plan, methodology, upgraded NEMN design)	6 weeks
3.	Supply and delivery of Equipment (Sensors, Servers, Power backup, Data storage, Telecommunication Network)	8 weeks
4.	Field Installation, Calibration, and System Integration (Sensors, Power backup, Data storage, Telemetry)	12 weeks
5.	Upgrade of Central Server, Secure Network Connectivity, and Develop Automatic Dissemination System.	
6.	Comprehensive Testing and Acceptance	3 weeks
7.	Capacity Building/Training	2 weeks

8.	Final Operation Handover and Submission of Completion Report	3 weeks
Total		34 weeks

5. Key Experts

Sl. no	Key Expert/Relevant field	Qualification and Experience
1.	Team Leader/Senior Seismologist (1)	- Leads overall assessment. - A minimum of 10 years of experience in relevant projects. - A minimum of master's degree in Seismology, Geophysics or related fields. - Knowledge in seismic network design and implementation of effective earthquake monitoring. - Understanding of seedlink protocols and real-time data transmission. - Knowledge in installing and calibrating seismic sensors (broadband seismometers, short-period sensors, strong-motion accelerometers), especially in mountainous regions. - Proficient with applications related to seismology, including SeiscomP. - Deep familiarity with seismic data formats (SEED, miniSEED, SAC, etc) and data archiving protocols. - Knowledge of automatic earthquake information dissemination systems and protocols.
2.	Network and Telecommunications Specialist (1)	- Minimum of 8 years of experience in relevant projects. - Degree in relevant fields - Expertise in terrestrial and satellite telecommunications. - Knowledge in remote data telemetry, real-time data communication, and robust communication protocols. - Knowledge in real-time device communication and rapid emergency information dissemination.
3.	IT/Software developer (2)	- Minimum of 8 years of experience in relevant projects. - Degree in relevant field - Technical Skills in programming languages such as Python, JavaScript, or Java, web development, database management systems. - Expertise in server management: security, storage, power systems, and performance tuning. - Software development, troubleshooting and debugging, including automated early-warning systems. - Expertise in applications related to seismology, including SeiscomP.

Key personnel shall be available for the periods stated in the proposal. Replacement shall require prior written approval and shall be permitted only with personnel of equal or higher qualifications and experience, without additional cost or delay to the client.

6. Reporting Requirements

- i. The consultant shall prepare and submit a report upon the completion of each deliverable, documenting the activities undertaken, results achieved, and compliance with the requirement of the ToR.
- ii. The consultant shall submit manufacturer's catalogues and technical datasheets for all proposed equipment for verification of compliance with the approved technical specifications prior to delivery and installation.

7. The consultant shall Payment Schedule

The Consulting firm is expected to present a lump sum price for completion of all tasks. The price shall include design, equipment, software, licenses, subscriptions for the period stated in the bidding document, freight, insurance, customs and duties as applicable, site works, travel, installation, integration, migration, testing, training, documentation, spares, warranty, support, and all incidental costs necessary for completion. A detailed price breakdown and recurring charges shall be provided separately, including satellite or Starlink subscriptions, data plans, software subscriptions, support renewals, and license renewals.

Bidders must quote their prices in Bhutanese Ngultrum as per the format provided in Annexure-1 of this ToR.

Sl.no	Deliverable	Payment Percentage
1.	Advance Payment	5%
2.	Submission of report on assessment of the current infrastructure and network (including detailed work plan, methodology, and upgraded NEMN design)	10%
3.	Supply and delivery of Equipment (Sensors, Servers, Power backup, Data storage, Telecommunication Network)	30%
4.	Field Installation, Calibration, and System Integration (Sensors, Power backup, Data storage, Telemetry)	40%
5.	Upgrade of Central Server, Secure Network Connectivity, and Develop Automatic Dissemination System.	
6.	Comprehensive Testing and Acceptance	
7.	Capacity Building/Training	5%
8.	Final Operation Handover and Submission of Completion Report.	10%
Total		100%

Prices shall remain firm except for approved variations or adjustments expressly allowed by the contract. Any provisional sums, taxes, currencies, exchange-rate rules, and price-adjustment provisions shall be stated in the bidding document.

8. Selection Method

The Contract shall be awarded on a lump-sum basis. The Consultant/Firm shall be selected in accordance with the Procurement Rules and Regulations (PRR) 2025 of the Ministry of Finance, Royal Government of Bhutan. The selection shall be carried out using the Quality- and Cost-Based Selection (QCBS) method, through a combined quality and cost evaluation, whereby the technical and financial proposals shall be evaluated and weighted in accordance with the criteria specified in this SRFP

9. Variation

- i. The client may request any variation to the work. Such variations may include additions, deletions, substitutions or any other alterations including changes in Scope of work. The consultant shall upon the request for a variation, promptly advise the client of any effect thereof on the provisions of the Agreement or the performance of the work.
- ii. The client may give the consultant written notice of a proposed variation. As soon as possible, and within seven days of getting the notice, the consultant will inform the client whether the change is possible. If it is, the Consultant will provide an estimate of its impact on the work schedule and any additional costs.
- iii. Upon written agreement of both parties of the request for a variation, parties shall proceed diligently with its execution.

10. General Provisions

10.1. Responsibilities of Consultant

- i. The Consultant shall provide all professional expertise and components (sensors & relevant equipment, servers, telecommunication devices, etc.) required to complete the services and be responsible for all aspects of the performance of services as outlined in the components of this TOR.
- ii. The Consultant's Team Leader will be the principal contact and will be expected to be readily available during project implementation.
- iii. The Consultant will work closely with the client and will report to the DGM focal officer.

10.2. Responsibilities of DGM

- i. A focal officer for the assignment at DGM will support with formal communications. The focal officer will also liaise with the firm's national coordinator who will be responsible for coordinating and organizing meetings.
- ii. Will provide the Consultant with all available studies and reports and data relevant to the services.
- iii. Will provide access to the existing facilities and information required for the study and provide assistance where the Consultant, for the purpose of executing these services, needs to coordinate with other RGoB agencies, and other stakeholders. The Client will also participate in all stakeholder consultation events.
- iv. To assist the Consultant in recognising hazards and activities that may impact the performance and safety of the Survey.
 - a. Shall provide a limited office space with power connectivity and internet facilities.
 - b. To facilitate the application and process of VISA and other applicable fees for the experts and personnel involved in the project.

11. Evaluation Criteria

The minimum technical score required to qualify is 70%. 70% weightage shall be accorded to Technical Proposal For the technical evaluation, the criteria, sub-criteria and points systems for evaluating the technical proposal are as follows:

11.1. Technical Evaluation Criteria

Sl.no	Evaluation Criteria	Score
1.	Specific experience of the Consultant relevant to the assignment:	10 pts
2.	Adequacy of the proposed methodology and work plan in responding to the Terms of Reference: {Notes to Consultant: the Client will assess whether the proposed methodology is clear, responds to the TORs, work plan is realistic and implementable; overall team composition is balanced and has an appropriate skills mix; and the work plan has right input of Personnels/Experts} 2.1 Understanding of the Assignment in responding to Terms of Reference (20 Points) Understanding on the Assignment with regard to the Terms of Reference. The firm shall demonstrate clear understanding of the assignment topic, objectives and scope of the task and expected outcome, any technical requirements of this task. This should be demonstrated through a written technical proposal. (For this, there should be a detailed write-up (essay) on your understanding of the assignment) 2.2 Technical Approach and Methodology including Work Plan in responding to Terms of Reference (15 Points) The expression of the technical approach, and the methodology that would be adopted for implementing the tasks to deliver the expected output(s), and the degree of detail of such output. The plan for the implementation of the main activities/tasks of the assignment, their content and duration, phasing and interrelations, milestones (including interim approvals by the Client), and tentative delivery dates of the reports. 2.3 Organization and Staffing (5 Points) The structure and composition of the team, including the list of the Key Experts, Non-Key Experts and relevant technical and administrative support staff.	40 pts
3.	Key professional staff qualifications and competence for the assignment: a. Team Leader/Seismologist (1 person) (15 pts) General Qualification (40% of 15points) Minimum master's degree in the relevant field (6) 1. Above master's degree (100%) 2. Master's degree (75 %) Adequacy for the Assignment (60% of 15 Points) Implemented in relevant projects (9) 1. Above 5 Projects (100%)	45 pts

	2. 3-4 Projects (75%) 3. 1-2 Project (50%) b. Network and Telecommunications Specialist (1 person) (10 pts) General Qualification (40% of 10 points) 1. Master's degree (100%) Adequacy for the Assignment (60% of 10) Implemented relevant projects (6) 1. Above 5 Projects (100%) 2. 3-4 Projects (75%) 3. 1-2 Project (50%) c.IT/Software Developer (2 persons) (20 pts) General Qualification (40% of 20) 1. Master's degree (100%) Adequacy for the Assignment (60% of 20) Implemented relevant projects (12) 1. Above 5 Projects (100%) 2. 3-4 Projects (75%) 3. 1-2 Project (50%) The number of points to be assigned to each of the above positions or disciplines shall be determined considering the following three sub-criteria and relevant percentage weights: i. General qualifications (40%) ii. Adequacy for the assignment (60%)	
4.	Suitability of the transfer of knowledge (training) program: i. Relevance of training program (2.5 pts) ii. Training approach and methodology (1 pts) Qualifications of experts and trainers (1.5 pts)	4 pts

11.2. Financial Evaluation Criteria

The formula for determining the final scores is the following: 30% of the weightage shall be accorded to Financial Proposal.

The formula for determining the financial scores is the following:

$S_f = 100 \times F_m/F$, in which S_f is the financial score, F_m is the lowest price and F the price of the proposal under consideration.

Proposals will be ranked according to their combined technical (S_t) and financial (S_f) scores using the weights (T = the weight given to the Technical Proposal; P = the weight given to the Financial Proposal; $T + P = 1$) indicated in the Data Sheet: $S = S_t \times T\% + S_f \times P\%$. The firm achieving the highest combined technical score and financial score will be invited for negotiations.

Form FIN-2 Summary of costs

Sl. No.	Description of Services / Deliverables	Lump-Sum Price (Nu.)	Remarks
1	Assessment of Existing NEMN and Development of System Upgrade Design		The technical specifications and quantities of the equipment are provided in Annexure 1, Annexure 2, and Annexure 3. No item-wise cost breakdown is required. However, the Bidder shall include the complete cost of all equipment, materials, accessories, installation, configuration, testing, commissioning, and other associated requirements specified in the Annexures in the Lumpsum price.
2	Design, Supply and Delivery of Equipment including seismic sensors, servers, power backup, data storage and telecommunication network		
3	Field Installation, Calibration and System Integration including sensors, power backup, data storage and telemetry		
4	Upgrade of Central Server, Secure Network Connectivity and Development of Automatic Dissemination System		
5	Comprehensive Testing and Acceptance of the Upgraded NEMN, including Capacity Building and Training, Final Operation, Handover, and Submission of the Completion Report		
6	Warranty, Maintenance and Technical Support, as specified in the ToR		
	TOTAL LUMP-SUM PRICE		
	Applicable Taxes and Duties		
	GRAND TOTAL – Inclusive of all applicable taxes, duties and charges		

Note: The financial evaluation shall be solely on the grand total quoted. And this is the Lumpsum tender

11. Confidentiality and Non-Disclosure

The consultant at all times should maintain confidentiality and use the information or other sensitive property or materials in the strictest confidence and except with the consent of the Client, should not directly or indirectly reveal, report, publish, disclose, or transfer any Confidential Information to any person or entity or utilize any Confidential Information for his/her own benefit or for the intended benefit of any other person or entity.

Annexure1- List of Goods and Related Services

Item No.	Description of Supply / Service	Specification	Unit	Qty	Unit Price in BTN	Total Price in BTN	Remarks
1	Seismic Sensors & Instrumentation						
1.1	Broadband seismic sensors (inc. cables & connectors)	The Trillium Horizon 120	Unit	7			
2	Central Monitoring Power Backup		Set				
2.1	Central monitoring UPS System (Minimum 8-hour continuous runtime under full load)	Equivalent to the specification in Annexure-2 of this ToR.	Set	1			
2.2	High-Capacity Battery Bank for Central monitoring		Set	1			
2.3	Intensity meters UPS System with Battery Bank (if required) (Minimum 2-hour continuous runtime under full-load)		Set	20			
3	Computing Infrastructure & Storage						
3.1	High-performance Earthquake Monitoring Servers (Preferred OS is Ubuntu) (Rack mountable)	Equivalent to the specification in Annexure-2 of this ToR.	Unit	3			
3.2	Centralized High-Availability Data Storage System		Unit	1	No breakdown cost is required but		Specification will be finalised upon completion of the upgraded NEMN design by the consultants

3.3	Software Updates & Integration Licenses		Lot	[]	should be included in the lump sum price.		
4	Network & Telecommunication Setup						
4.1	Two-way connectivity system (hardware & software)		Set		No breakdown cost is required but should be included in the lump sum price.		Specification will be finalised upon completion of the upgraded NEMN design by the consultants.
4.3	Two-Way Network Communication Configuration & Activation		Station	14			
TOTAL	GRAND TOTAL (Inclusive of all items, services, and taxes)					[Bidder to Insert]	

Annexure 2-Technical Specification: UPS

TITLE: - TECHNICAL DATA SHEET FOR 20 KVA UPS (for Central monitoring)		
Sl. No	DESCRIPTION	SPECIFICATION
	Brand	To be mentioned by the bidder
	Model	To be mentioned by the bidder
	Country of Origin	To be mentioned by the bidder
1	UPS capacity	20 kVA / 20kW
1.1	Technology	Front-end IGBT with Digital Signal Processor controlled for the following: a. Rectifier & Charger b. Battery management. c. Inverter d. Static Switch
1.2	UPS type and configuration	True On-Line, Double conversion meeting VFI-SS-111.
1.4	Rated Output	20 kVA / 20 kW
		The UPS system has to be compatible for 0.7 lagging to 0.9 leading PF loads without deration.
1.5	Power factor at full load	> 0.99
	Power factor at 50% load	> 0.99
1.6	Input current THDi at full load	<= 5.0%
2	Input	
2.1	Voltage	380/400/415 V
2.2	Voltage tolerance	380-415 V 3 Ph + N
2.3	Frequency	50 Hz
2.4	Frequency tolerance	50 Hz +/- 3% Auto Sensing
2.5	Input power factor	0.99
3	Rectifier/Charger	
3.1	Type of rectifier	IGBT based DSP controlled 6 pulse Rectifier.
3.2	Ripple voltage at full load	Typically, 0.
3.3	Battery charger features	
	i) Type of charging circuit.	Constant Voltage Constant Current.
	ii) Battery status monitoring facility.	Throw the LCD display at the front panel.
4	Inverter	
4.1	Technology of inversion	IGBT based PWM design with DSP controlled.
5	Output	
5.1	Voltage	380/400/415 VAC, 3 phase, 4 wire Settable.
5.2	Output voltage regulation	

	I) Balanced load	$\pm 1\%$
	ii) Unbalanced load	$\pm 3\%$ for 4 wire system
5.3	Output Frequency	50 Hz
5.4	Output Frequency range	± 0.5 Hz
5.5	OP Frequency synchronising range with Bypass	Selectable between 1Hz to 5Hz
5.6	Transient voltage regulation for 0 to 100% and vice versa	$\pm 5\%$, 20msec
5.8	Wave form	Sinusoidal
5.9	Crest Factor	3:01
5.10	Phase displacement:	
	i) Balanced load	120 ± 1 deg. Electrical
	ii) 100 % Unbalanced load	120 ± 2 deg. Electrical
5.11	Overload	At 25°C: 105% ~ 125%, 5min; 125% ~ 150%, 1min; 150%, 200ms
6	Static and Manual Bypass :	Standard and built-in static and manual bypass
7	Eco mode	Required
8	Intelligent Eco Mode	Preferred
9	Efficiency	
a	At Full load	Up to 96.2% at full load
b	At 75 % load	
c	At 50% load	
d	At 25% load	
e	THD At Full load	<2% for Linear loads & <5% for Non-linear loads
f	THD At 75 % load	
g	THD At 50% load	
h	THD At 25% load	
10	Environmental conditions	
i)	Temperature (design ambient)	0 - 40 deg C
ii)	Relative humidity	95% RH
iii)	Acoustic Noise measured at 1 Mt distance	< 60 Db
11	Event logging	Required
12	Communication option	RS232 Port for remote contacts Slot for communication interface for SNMP or BMS Integration
13	UPS Parallel Capacity	Up to 4 Unit
14	Protection	
a	Overload	
b	Short circuit	
c	Input low voltage	

d	Output over voltage	
e	Battery over charging	
f	Battery over discharging	

NOTE:

UPS: 20kVA with 8-10 hrs backup and 3 phase outlet is required at the side before the installation and commissioning of UPS.

Annexure 3-Technical Specification: Server

TITLE: - Earthquake monitoring servers	
Form Factor/Height	1U rack server
Processor	Up to 2x Intel® Xeon® 6 processors, support P-core and E-core SKUs, up to 288 cores and 350W TDP
Drive Bays	- Front: Up to 10x 2.5" SAS/SATA/NVMe, or 16x E3.S NVMe, or 8x CXL memory modules - Rear: Up to 2x 2.5" SAS/SATA/NVMe - Bootable device: Up to 2x M.2 SATA/NVMe drives with RAID support, optional hot swap - Supports Direct NVMe, VROC/VMD
Memory	Supports 32x TruDDR5 3DS/RDIMMs with speeds up to 6400MHz; 16x TruDDR5 MRDIMMs with speeds up to 8000MHz Maximum memory capacity up to 8TB
Expansion Slots	- Up to 3x PCIe 5.0 slots 2x OCP 3.0 slots 1x cabled internal HBA/RAID adapter
GPUs	Up to 3x single width 75W GPUs
Network Interface	OCP adapters in OCP 3.0 slot, optional cabled x16; Networking PCIe adapters
Ports	Front: - Default LED and external diagnostic port - Optional 2x USB 3.0 with XClarity Mobile support and 1x mini-DP port - Optional 1x external diagnostics handset Rear: 2x USB 3.0 1x VGA port 1x 1GbE RJ-45 dedicated management port - Optional 2nd 1GbE management port in OCP slot location - Optional 1x serial port
HBA/RAID Support	- VROC for NVMe SW RAID (0,1,5,10) - Common building blocks including standard and internal PCIe RAID/HBA adapters
Cooling Solution	Lenovo Neptune® Core for processors & memories Neptune® Air technology for processors
Power	Dual Redundant AC & DC (multiple wattages); Platinum & Titanium efficiency ratings

	Support standard CRPS form factor power supply
Systems Management	Lenovo XClarity Controller 3
OSes Supported	Microsoft, SUSE, Red Hat, VMware. Visit lenovopress.com/osig for more information.
Limited Warranty	1-year and 3-year customer replaceable unit and onsite service, next business day 9x5; optional service upgrades