

APPROVED

Director of

**State Institution "Uzbek National
Institute of Metrology"**

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Terms of Reference for the purchase of
a time and frequency standard complex

Tashkent

2026

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SECTION 1. GENERAL INFORMATION

Subsection 1.1 Name
Time and frequency standard complex
Subsection 1.2 Reason and purpose of purchasing equipment
In accordance with Presidential Decree of the Republic of Uzbekistan No. PF-25 dated February 16, 2026, paragraph 5 of Annex No. 4 approves the list of standards to be procured by the State Institution "UzNIM" during the 2026 year.
Subsection 1.3 Information about novelty (year of manufacture / release of equipment)
The supplied goods must be new, not taken out of production, not earlier than 2026 (which was not in use, including which has not been restored, whose consumer properties have not been restored).
Subsection 1.4 Development / manufacturing stages
The supplied standard is subject to production at the factory, in accordance with the manufacturer's design documents.
Subsection 1.5 Development / Manufacturing Documents
The standard must be manufactured in accordance with international standards and regulatory documents of the manufacturer.
Subsection 1.6 TN VED code and other international codes, if applicable
9031803800

SECTION 2. APPLICATION AREA

Purpose: The standard of units of time and frequency, designed to reproduce, store units of time (second, s), frequency (hertz, Hz) and the national time scale UTC (Uz) and transfer their size to secondary standards, working standards and working time measuring instruments and frequencies in accordance with GOST 8.129 - 2013 "State verification scheme for time and frequency measuring instruments" in order to ensure the uniformity of measurements in the country.

The unit size can be transferred both to secondary standards and to working standards and working measuring instruments:

- units of frequency by the method of direct measurements and by the method of measurements using a comparator;
- units of time by the method of direct measurements of time intervals;
- time scales by measuring the difference in time scales using signals transmitted over communication channels and global navigation satellite systems.

Application area:

- calibration of working standards (cesium and rubidium frequency and time standards) both in laboratories and on-site, HF/LF signal generators, frequency synthesizers, time scale synchronization devices with a reference cesium or rubidium frequency standard, spectrum analyzer, network simulator, GNSS signal receivers;
- calibration and verification of working time and frequency measuring instruments (devices for general technical or specialized purposes, based on the use of various periodic processes: optical, quantum and quartz frequency measures, universal and electronic counting frequency meters, resonant and heterodyne frequency meters, generators of electromagnetic oscillations, frequency synthesizers, equipment of receiving points of the universal time system, shapers and meters of telephone connections, as well as pendulum, balance and other mechanical clocks (chronometers), electronic and mechanical stopwatches).

A time and frequency calibration system traceable to the national time scale and capable of generating and measuring frequencies up to 50 GHz, including signal analysis and phase noise measurements, opens up the possibility of calibrating measuring instruments used in the fields of telecommunications, defense, transportation, financial operations, scientific research, etc.

SECTION 3. TERMS OF USE

Subsection 3.1 General operating conditions	
The total area of the Time and Frequency Laboratory shall be not less than 40 m². The laboratory shall be protected from dust, aggressive chemical substances, vibration, mechanical shock, and strong electromagnetic interference. The laboratory is equipped with an automatic fire alarm system, ventilation and air-conditioning systems that ensure the safe and uninterrupted operation of the equipment. No toxic substances are present in the laboratory premises. According to the fire and explosion hazard classification, the laboratory premises are classified as Category D (non-fire-hazardous). The laboratory environmental conditions shall be maintained as follows: Ambient temperature: (23 ± 1) °C Relative humidity: 35% to 55% The power supply shall be a single-phase 220 V AC ±10%, 50 Hz ±1% mains supply with mandatory protective grounding. The Time and Frequency Reference Complex shall be installed on stable equipment racks or specialized mounting structures designed to prevent the transmission of mechanical vibrations.	

SECTION 4. TECHNICAL REQUIREMENTS

Subsection 4.1 Main technical characteristics		
A time and frequency standard complex		
4.1.1	Name	Qty (PCS.)
	Cesium Frequency Standard (Cs) Accuracy: 1×10^{-14} and long-term stability 5×10^{-14} (over 30 days). Outputs: 1PPS, 5 MHz, 10 MHz. Warranty Period: 1 year for the electrical components of the cesium (Cs) frequency standard; 5 years for the high-performance cesium (Cs) beam tube.	2
	Multichannel Phase Comparator Sine wave frequencies: 5 MHz, 10 MHz, 100 MHz RMS voltage: (1.0 ± 0.2) V into 50 Ohm load Frequency instability introduced by the comparator: $\tau = 1 \text{ s} \quad 1.5 \times 10^{-13}$ $\tau = 10 \text{ s} \quad 2.0 \times 10^{-14}$ $\tau = 100 \text{ s} \quad 3.0 \times 10^{-15}$ $\tau = 1000 \text{ s and above} \quad 5.0 \times 10^{-16}$ Time interval measurement range (τ): from 1 s to 1×10^6 s Maximum measurable relative frequency difference ($\Delta f/f$) between input signals: $\pm 5.0 \times 10^{-9}$ Interfaces: RS-232C and USB Supplied with software for stability analysis under Microsoft Windows environment.	1
	Multichannel GNSS Signal Receiver with GNSS Antenna Supported signals: GPS (L1P, L1CA, L2, L5), GLONASS (L1, L2, L3), GALILEO (E1, E5ab, AltBoc, E6), BEIDOU (B1, B2, B3), SBAS (L1, L5), IRNSS (L5), QZSS (L1, L2, L5)	1

	(GALILEO, BEIDOU, and IRNSS are optional features) Tracking of P-code on L1 and L2 to prevent CA-P code bias 10 MHz reference input 1 PPS input x PPS output (up to 100 Hz) 10 MHz reference output 1 PPS output accuracy: 5 ns 1 PPS rise time accuracy: <2 ns	
	Time Distribution System (Stratum 0 NTP/PTP Server) National time scale UTC(k) distribution via NTP/PTP. GPS - Global Positioning System GLONASS - Russian GNSS GALILEO - European GNSS BeiDou - Chinese GNSS PZF - German DCF77 longwave radio signal PTP/IEEE1588 - Precision Time Protocol NTP - Network Time Protocol SyncE - Synchronous Ethernet Timecodes - IRIG/AFNOR timecodes (AM/DCLS) PPS -Pulse Per Second 10MHz - 10MHz reference frequency 2.048kHz - 2.048kHz reference frequency E1/T1 - Telecom Synchronization Input with full SSM/BOC support	1
	1 pps distribution amplifier 1 pps input / 5 pps output 19" rack mountable	1
	10 MHz Distribution Amplifier 1, 10 MHz input / 5, 10 MHz output 19" Rack Mountable	1
	Phase and frequency shift generator HROG 10 Phase resolution: up to $2\pi/232$. Frequency resolution: up to $1e-16$. Harmonic distortion <-35 dBc	1
	Coaxial Switch Matrix 1 input / 5 outputs	1
	Precise Timing Grandmaster With Gateway Clock,High-Accuracy (Time code generator) L1 calibrated PRTC Class B (40 ns) Designed with ToD input Accuracy: < 5 ns relative to 1 PPS output of active unit	1
	Computer and programming software (DELL) Characteristic PK Software: Operating system - Windows 10 Pro; Microsoft Office. Processor: 6 cores Processor frequency: no less than 3.2 GHz. Video card with no lower memory 2 GB; Operating memory: 32 GB The monitor is 25 inches. Multimedia keyboard and mouse.	1
	Notebook Operating memory 16 GB Built-in memory 512 GB Diagonal screen 16"	1

The type of operating memory is DDR5	
Low Frequency Generator (Frequency Synthesizer) Sine wave output from 10 μ Hz to 25 MHz Permissible error limits: 1×10^{-6}	1
High Frequency Signal Generator Frequency range from 8 kHz to 50 GHz Output power (amplitude) from -50 dBm to +30 dBm Permissible error limits: - Frequency accuracy $< 5 \times 10^{-8}$ - Amplitude accuracy $< \pm 1.5$ dB	1
Electronic Frequency Counter Frequency range from DC up to 50 GHz Time interval: from 0.5ns to 10^{10} s Measurement of period and frequency for all inputs High resolution: 12 digits frequency resolution at 1-second measurement time, 100 ps in time measurements Reference source error: $< 5 \times 10^{-7} \times f$	1
Signal Analyzer Frequency range from 100 kHz to 50 GHz Measurement receiver option USB RF power sensor up to 50 GHz Low noise level Modulation: AM (5% to 95%); FM (1 kHz to 200 kHz); PM (from 0.1 rad to 10 rad). Permissible error limits: AM accuracy $< 0.5\%$ RF power accuracy < 1 dB (from -20 dBm to +10 dBm)	1
Precision Digital 8.5-Digit Multimeter DC voltage measurement 5 ranges: 0.1 V; 1 V; 10 V; 100 V; 1000 V Annual accuracy: 0.01% AC voltage measurement 6 ranges: 10 mV; 100 mV; 1 V; 10 V; 100 V; 1000 V Frequency range: from 1 Hz to 10 MHz	1
Power Meter Thermal RF power sensor from 0 MHz to 50 GHz Range from -35 dBm to +20 dBm Error < 0.143 dB ($23^\circ\text{C} \pm 2^\circ\text{C}$, from -10 dBm to +10 dBm) Broadband RF power sensor from 50 MHz to 44 GHz Range from -60 dBm to +20 dBm Error < 0.2 dB ($23^\circ\text{C} \pm 2^\circ\text{C}$, from -10 dBm to +10 dBm) 2-channel base unit with source for sensor testing Virtual meter application for Windows with pulse analysis function	1
Oscilloscope 4 analog channels Minimum bandwidth of 1 GHz Software upgrade available up to 6 GHz and beyond Vertical gain accuracy $< 1\%$	1
Broadband Oscilloscope Base unit of broadband oscilloscope Two-channel module with bandwidth up to 16 GHz Channel rise time < 20 ps	1

Electronic Step Attenuator Attenuation from 0 dB to 75 dB in 5 dB steps Electronic stepped attenuation Frequency range from 0 Hz to 67 GHz With driver unit Repeatability 0.02 dB	1
Voltmeter Number of channels: 2 Basic error: 1% AC voltage: 0 V – 100 V Resolution (ACV): 0.1 μ V AC voltage frequency range: 10 Hz – 1.2 GHz	1
Measurement system for current time and speed values Permissible absolute synchronization error of the system to the UTC(k) time scale: ± 0.1 ms Permissible absolute error of time display: ± 0.1 ms Measurement and display range of vehicle speed values: from 0 km/h to 350 km/h Permissible error of vehicle speed measurement and display: ± 0.1 km/h	1
Navigation and Timing Equipment for GNSS Users GLONASS/GPS/GALILEO/SBAS Error in determining navigation parameters (RMS)*: Position coordinates in plane, not exceeding: - In autonomous mode ± 2.5 m - In differential mode using SBAS ± 1 m - In differential mode DGNSS ± 0.5 m	1
Cables, connectors, attenuators, terminators and other necessary accessories Required cables, connectors up to 50 GHz (metrological class of adapters from 1.85 mm (m)(f) to 1.85 mm (m)(f) Metrological class Adapters from 1.85 mm (m)(f) to 2.4 mm (m)(f) Metrology Grade Adapters 1.85mm(m)(f) to 3.5mm(m)(f) Metrology Grade Adapters 1.85mm(m)(f) to N-Type (m)(f) Cables in various lengths 1.85 mm up to 50 GHz Cables in various lengths 2.4 mm up to 50 GHz Cables in various lengths 3.5 mm 2.4 mm attenuator set (3, 6, 10, 20 dB) 3.5 mm attenuator set (3, 6, 10, 20 dB) 2.4mm RF splitter 3.5mm RF splitter Terminator 2.4 mm 50 ohm (male) (female) Terminator 3.5 mm 50 Ohm (male) (female) 50 ohm N-type terminator (m)(f)	1 set
Uninterruptible power supply with voltage stabilization capability - Output voltage (220 V / 230 V / 240 V) - Input voltage (adjustable 100 - 275 V)	1
Laboratory racks for calibration system installation	4
Laboratory table	2
Laboratory trolley	2
Laboratory cabinet with casters	2
UPS and DC battery unit (24 V)	1

<i>Note: It is allowed to use similar software and measuring instruments (including mutually integrated ones) with superior metrological and technical characteristics specified in this technical assignment.</i>	
4.1.2	Technical characteristics of the time and frequency standard complex
4.1.3	Outputs: 1 PPS, 5 MHz, 10 MHz Accuracy: 1×10^{-14} and long-term stability of 5×10^{-14} (over 30 days) - Frequency range: DC to 50 GHz (signal generation), from 10 μHz to 50 GHz (signal analysis) - Time interval: from 0.5ns to 10^{10}s; - Frequency measurement uncertainty (k=2) from DC to 2 GHz: $1 \times 10^{-11} \times f(\text{Hz})$; accuracy 1×10^{-8} - Amplitude range: -50 dBm to +30 dBm (minimum, up to 50 GHz) - Modulation: AM (5% to 95%); FM (1 kHz to 200 kHz); PM(from 0.1 rad to 10 rad).
Subsection 4.2 Reliability requirements	
The Time and Frequency Reference Complex shall be designed for continuous 24-hour operation throughout the year (24 hours a day, 365 days a year) while maintaining its specified metrological performance. The operational availability factor of the Complex shall be confirmed by the manufacturer and shall be not less than 0.99. The mean time to restore (MTTR) the Complex to operational condition (by replacement of the defective component) shall be no more than 8 hours, excluding the time required for the delivery of spare parts. The average service life of the complex shall be at least 10 years. The mean time between failures (MTBF) of the complex shall be at least 50,000 hours. The reliability indicators (mean time between failures, average service life, coefficient of technical readiness, and mean time to repair) shall be confirmed by the manufacturer's operational documentation or official technical documentation issued by the manufacturer and shall comply with the requirements of GOST 27.002, GOST 27.003, and GOST 12.2.045. The Time and Frequency Reference Complex shall: - to exclude the possibility of incorrect assembly and incorrect connection of cables and other errors of the operating personnel during use and maintenance; - to provide the optimal number of elements in the composition of the standard complex allowing the system to perform all the functions assigned to it with the required reliability; - provide fast automated measurements, printout of measurement results of a verification certificate (passport) and data export in Microsoft Excel format; - all components of measuring instruments and auxiliary equipment must maintain the established values of metrological characteristics for a specified time in accordance with the operational documentation, as well as storage and transfer of the unit size, both to working standards and working measuring instruments under normal operating conditions and operating conditions; - parts of the standard not intended for user access must be protected or sealed.	
Subsection 4.3 Design requirements, installation and technical requirements	
Flexibility and scalability to primary standards (expand capabilities when new needs arise). In accordance with the manufacturer's NTD.	
Subsection 4.4 Requirements for materials	
In accordance with the manufacturer's NTD.	
Subsection 4.5 Power / Energy Requirements	

Power supply - AC mains with voltage (220 ± 20) V, mains frequency (50 ± 1.0) Hz, low-impedance independent functional grounding, the standard must withstand both positive and negative contact discharges with respect to the ground potential up to 4 kV air discharges up to 8 kV.

The standard should include a means of monitoring the supply voltage sufficient for normal operation, or to ensure that the output signal turns off when the supply voltage drops to a value below the minimum required.

The standard must be provided with information on the energy efficiency class of the energy-consuming devices included in the standard.

All measuring instruments, including technical means and organizational equipment included in the standard, must have a plug and a plug (plug and socket) in accordance with Type F and / or Type E / F for connection to the power supply network.

Subsection 4.6 Requirements for components, raw and operational raw materials / materials, as well as finished products

In accordance with the manufacturer's NTD and this technical assignment. The supplied goods must comply with international standards, which must be the latest produced by the relevant institutions, and have the appropriate certificates.

Subsection 4.7 Marking requirements

Labeling must be in accordance with international standards and manufacturer requirements.

Marking of goods must be clearly indelible paint or stamped, and also contain the decrypted name of equipment, model, serial numbers, manufacturer's name, address, location of the manufacturer and date of issue.

Marking must be applied to each pallet and must be in accordance with the requirements of international standards.

Subsection 4.8 Packaging requirements

Packaging should ensure the safety of the goods during transportation, handling and movement of goods to the place of their installation.

The equipment included in the standard must be supplied in its original packaging. The packaging should not have any mechanical damage and traces of exposure to adverse climatic conditions. During transportation, it is necessary to be guided by the requirements for packaging and transportation of the standard specified in the manufacturer's documentation.

The goods must be shipped in the manufacturer's standard export packaging, ensuring its complete safety from any kind of damage during long-term storage and transportation of products, taking into account several transshipments along the way.

The Contractor must be fully responsible for any damage to the Goods that occurred as a result of inappropriate packaging.

SECTION 5. REQUIREMENTS FOR RULES FOR DELIVERY AND ACCEPTANCE

Subsection 5.1 Delivery and acceptance procedure

The standard is considered to be delivered properly and accepted from the moment of signing the consignment note. Additional conditions for the acceptance of the standard are established by the contract between the Contractor and the Customer.

In order to accept the results of work on the project, the Customer has the right to create an Acceptance Commission in accordance with the established procedure. Together with the presentation by the Acceptance Commission of goods (works, services), the set of documentation, a list and requirements for registration, developed by the Contractor, is handed over in accordance with international and other standards and guidelines in force in the territory of the Republic of Uzbekistan.

Upon completion of each stage, a bilateral act of completed work is drawn up and presented to the Acceptance Commission.

Subsection 5.2 Requirements for the transfer of technical and other documents to the customer when supplying equipment
The equipment included in the standard must be supplied with passports, operating manuals, standard connection diagrams and auxiliary equipment. At the same time, provide a passport and operating manual in Russian and / or English. The equipment included in the standard must have originals of valid calibration certificates with confirming calibration protocols for each supplied measuring instrument issued by the national metrology authorities of the signatory countries. Arrangements for mutual recognition of national measurement standards and calibration and measurement certificates issued by national metrology institutes (CIPM MRA) or laboratories accredited by the International Organization for Laboratory Accreditation (ILAC). The equipment included in the standard must have originals of certificates of origin of goods, an invoice and an air waybill. Calibration instructions (verification procedure if necessary). All technical documentation must be in the same packing box as the equipment.
Subsection 5.3 Equipment insurance requirements
The equipment shall be insured.

SECTION 6. TRANSPORTATION REQUIREMENTS

It is allowed to use boxes for packing, made according to working drawings, approved in accordance with the established procedure. If necessary, specific requirements for the limiting mass and overall dimensions of each package are established in the standards and (or) technical specifications. The use of adhesive tape for pasting boxes must be established in the standards and (or) technical specifications for a specific type of measuring instrument. It is allowed to fill the space between cases or covers with measuring instruments and the wall of the shipping container with shock-absorbing materials. Individual parts and moving parts of measuring instruments must be equipped with wooden inserts or braking devices that prevent the movement of moving parts of measuring instruments. In places where the inserts touch the measuring instruments, there should be gaskets made of soft material. Large-sized measuring instruments must be securely fastened to the transverse bars of the bottom or runners of the box with bolts (or pins). It is allowed to use for these purposes persistent, spacer and pressure bars and other means that ensure reliable fastening of loads. The execution of the method of fastening a large-sized measuring instrument and its individual parts should be shown in the working drawings for a specific type of measuring instrument. Boxes with measuring instruments should be transported in covered vehicles or containers. Transportation of measuring instruments must be carried out in accordance with the rules for the carriage of goods in force for each type of transport. The transportation conditions for the measuring instruments in their packaging, with respect to climatic environmental factors, shall comply with the requirements of GOST 15150, "Machines, Instruments and Other Industrial Products — Versions for Different Climatic Regions; Categories, Operating, Storage and Transportation Conditions with Respect to Climatic Environmental Factors"

SECTION 7. STORAGE REQUIREMENTS

In accordance with the manufacturer's NTD.

SECTION 8. SCOPE AND / OR DURATION OF WARRANTIES

The warranty period of operation is at least 1 year from the date of commencement of the standard operation, or at least 2 years from the date of shipment to the consumer.

If during the warranty period the product turns out to be defective, incomplete and does not meet the requirements of this technical assignment, or the manufacturer's specifications, the Contractor or an independent authorized service center is obliged to eliminate defects, document, and if it is impossible to replace the Products with a new one after receiving written notification from the Customer. All costs associated with the elimination of defects, replenishment and replacement are at the expense of the Contractor or an authorized service center.

In the event of a breakdown or a defect in the product during the warranty period, the supplier is obliged to eliminate the defect or make an adequate replacement at its own expense within 120 working days.

SECTION 9. SERVICE REQUIREMENTS

The equipment must be repairable. Typical malfunctions and methods of their elimination must be indicated in the operating instructions.

SECTION 10. SERVICE REQUIREMENTS

Subsection 10.1 Service Requirements

In accordance with the manufacturer's NTD. The manufacturer / contractor must provide information on the service life of the equipment in accordance with the manufacturer's regulatory documents and on energy consumption.

Subsection 10.2 Service requirements

The contractor must perform service during the warranty and post-warranty period. After-sales service after the warranty period is possible on the basis of a separate contract.

SECTION 11. ENVIRONMENTAL AND SANITATION REQUIREMENTS

According to the laws and regulations in force in the Republic of Uzbekistan or international requirements.

SECTION 12. SAFETY REQUIREMENTS

According to the laws and regulations in force in the Republic of Uzbekistan.

Must comply with safety requirements in accordance with GOST 12.2.007.0-75 "Occupational safety standards system. Electrical products. General safety requirements" and GOST 12.4.011-89 "Occupational safety standards system. Protective equipment for workers. General requirements and classification".

SECTION 13. QUALITY AND CLASSIFICATION REQUIREMENTS

The quality of the goods must be confirmed by a quality certificate issued by the manufacturer. Remaining service life, shelf life and quality guarantee period - at least 10 years.

SECTION 14. ADDITIONAL (OTHER) REQUIREMENTS

The standard complex must be able to take part in international comparisons.

To determine the criterion for technical assessment, the Customer is provided with information on:

- the personal composition of the project team, including the project manager, engineers, heads of working groups, functional consultants, etc. Key employees of the project team must have experience in implementing similar projects.

Experience and certifications must be confirmed by the resume of the project team.

Providing information by the Contractor about the list of work (services) performed with the specification of the volume and the specialists involved (justification for the formation of the cost of the services provided).

- the total cost of ownership TCO (Total Cost of Ownership) due to the proposed technological solution (goods, services), functionality, etc. unique solutions of the manufacturer for a period of at least 5 years.

The supplier guarantees that the end-of-support date (including the product lifecycle) for the system will be no earlier than 10 years from the date of the supply contract signing.

Support for the system implies the availability of maintenance services for all units and components of the hardware and software tools.

The supplier guarantees that the end-of-orders, production, and delivery date for individual EOM (End of Market) boards and modules will be no earlier than 5 years from the date of the hardware supply contract signing.

The proposed Time and Frequency Reference Complex shall ensure compatibility and interoperable operation with the National Time and Frequency Standard of the Republic of Uzbekistan (NTFS). The technical characteristics of the NTFS are as follows:

Time tracking system

Time scale, UTC (UZ):

- total standard deviation characterizing the total error of the standard is $\leq 1.0 \cdot 10^{-14}$;
- limits of allowable shifts of the national coordinated time scales of the UTC standard (UZ) relative to the UTC time scale per month ± 30 ns.

Method of measurement:

- General view of GNSS.

Measurement uncertainty ($k=2$):

- Type A: ≤ 1 ns

- Type B: ≤ 4 ns

Signal frequency measurement range:

- 1 PPS, 100 kHz, 1 MHz, 5 MHz, 10 MHz and ≤ 20 GHz

GNSS receiver for timing system

GPS / GLONASS / GALILEO system support.

Phase observation accuracy for short-term short baseline accuracy < 12 ps rms.

Code observation accuracy < 0.5 ns rms for short baseline.

Output data formats: RINEX and CGGTTS.

Availability of CGGTTS data: 30 s after each observation session

Receiver access via local console / built-in touch screen, web interface and remote access

via network.

Time Distribution System

National time scale UTC (k) Propagation via NTP;

1 level NTP server (Stratum 1)

Time tracking system

Expanded measurement uncertainty (k=2):

Local network: ≤ 5 ms;

WAN: ≤ 100 ms

SECTION 15. REQUIREMENTS FOR QUANTITY, EQUIPMENT, PLACE, TIME (PERIODICITY) OF DELIVERY AND IMPLEMENTATION

The equipment comprising the Time and Frequency Reference Complex, complete with all components and accessories described in Section 4 of these Technical Specifications, shall be supplied.

Quantity: One (1) complete set.

Place and Terms of Delivery:

For foreign bidders: Delivery shall be on a DDP (Delivered Duty Paid) basis to the Customer's warehouse located at 333B Farobiy Street, Tashkent, Republic of Uzbekistan, in accordance with INCOTERMS® 2020.

For domestic bidders: Delivery shall be made to the Customer's warehouse located at 333B Farobiy Street, Tashkent, Republic of Uzbekistan.

Delivery Time and Conditions:

For foreign bidders: The equipment shall be delivered within 365 calendar days from the date of opening of the letter of credit.

For domestic bidders: The equipment shall be delivered within 365 calendar days from the date of advance payment.

SECTION 16. REQUIREMENT FOR RELATED SERVICES WHEN DELIVERING EQUIPMENT

Subsection 16.1 Requirements for the implementation of project documentation

In accordance with the manufacturer's NTD.

Subsection 16.2 Installation supervision requirements

The Supplier undertakes to install, install, commission and test the equipment at the Customer's site. When installing the equipment, the contractor undertakes to lay all the necessary cables and mark them, as well as provide a step-by-step work plan before starting work.

The contractor undertakes to comply with safety precautions.

Installation and commissioning are the responsibility of the contractor.

Subsection 16.3 Commissioning requirements

Commissioning works mean that the supplier provides all the necessary materials, tools, auxiliary equipment necessary for the installation of the standard and their normal functioning, which are not listed in the terms of reference, depending on the technological solution.

Subsection 16.4 Training requirements for the customer's personnel

The Supplier shall provide training for three (3) of the Customer's specialists (training shall ensure that the specialists are fully interchangeable and capable of independently performing all activities related to the operation, maintenance, diagnostics, and technical support of the Time and Frequency Reference Complex, thereby eliminating dependence on a single operator) shall be conducted at institutions that have published Calibration and Measurement Capabilities (CMC) entries in the BIPM KCDB (Key Comparison Database) and have proven experience in contributing to the generation of UTC (Coordinated Universal Time) and in operating time and

frequency equipment. The training shall enable the Customer's personnel to independently operate, maintain, calibrate, and diagnose the equipment during both the warranty and post-warranty periods.

The duration and training program shall be appropriate for the supplied equipment, comply with the manufacturer's operating documentation, and provide the Customer's personnel with the theoretical knowledge and practical skills required for the safe and efficient operation of the Complex.

The training shall consist of both theoretical and practical components.

Theoretical Training

The theoretical training shall include, but not be limited to, the following:

purpose, operating principles, and technical characteristics of the Time and Frequency Reference Complex;

composition of the Complex, functions of its principal components, and their interaction;

requirements for installation, connection, and commissioning of the equipment;

operating conditions required to maintain the specified metrological characteristics;

operation of the Complex software;

equipment configuration and parameter settings;

principles of generation, transmission, and distribution of time and frequency signals;

phase difference measurement techniques;

generation and interpretation of phase drift plots;

measurement of relative frequency deviation;

simultaneous operation with multiple reference standards;

methods for verifying metrological performance, including measurement of short-term and long-term frequency stability, as well as phase and time deviations;

evaluation of measurement uncertainty in time and frequency measurements;

equipment diagnostics and troubleshooting of typical faults;

electrical safety requirements, equipment operation, and preventive maintenance procedures;

preparation and maintenance of operating documentation, measurement protocols, and technical reports.

Practical Training

Following delivery, installation, and commissioning of the equipment, the Contractor shall conduct practical on-site training at the Customer's facility, the State Institution "Uzbek National Institute of Metrology", with the participation of qualified specialists of the Contractor.

The duration of the practical training shall be sufficient to enable the Customer's personnel to acquire the practical skills necessary for the independent operation of the equipment and shall correspond to the scope of the supplied equipment, the approved training program, and the manufacturer's operating documentation.

The practical training shall include, but not be limited to:

assembly, installation, connection, start-up, operation, and shutdown of the Time and Frequency Reference Complex;

experimental measurement of equipment parameters;

calibration and verification procedures;

operation of the software;

equipment diagnostics and correction of typical faults;

preparation of measurement protocols, reports, and data required for maintaining the national time and frequency scale and participation in international comparisons;

calibration of signal generators;

comprehensive signal analysis;

calibration of spectrum analyzers and measuring receivers;

evaluation of measurement uncertainty;

measurement of phase and time deviations;
 operation of the GNSS-based synchronization system.
 In addition, the training program shall include instruction enabling the Customer's personnel to develop calibration procedures for the Time and Frequency Reference Complex, including:
 development of a procedure (method) for harmonic calibration;
 development of a procedure (method) for modulation parameter calibration;
 development of a procedure (method) for frequency calibration in the range from 0.001 MHz to 300 MHz;
 development of a procedure (method) for frequency calibration in the range from 300 MHz to 50 GHz;
 development of a procedure (method) for time interval calibration;
 development of a procedure (method) for tachometer calibration;
 development of a procedure (method) for stroboscope calibration;
 development of a procedure (method) for stopwatch calibration;
 development of a procedure (method) for GNSS receiver calibration.
 Upon completion of the training, the Contractor shall provide documentary evidence confirming that the Customer's personnel have successfully completed the training.

Subsection 16.5 Other related services

The equipment included in the standard must have passed metrological control in accordance with regulatory documents and have valid calibration certificates (protocols).

SECTION 17. REQUIREMENT FOR THE FORM OF INFORMATION TO BE SUBMITTED

Text information should be provided in Russian and / or English, in paper and electronic versions (1 copy each).

SECTION 18. LIST OF ACCEPTED ABBREVIATIONS

no	Reduction	Explanation of abbreviation
1	NTD	Normative and technical documentation
2	SI	Measuring Instrument
3	GNSS	Global Navigation Satellite System
4	UTC	Coordinated Universal Time
5	BIPM	International Bureau of Weights and Measures
6	TAI	International Atomic Time
7	CMC	Calibration and Measurement Capabilities
8	KCDB	Special database of key comparisons

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