TECHNICAL SPECIFICATION FOR TIME SYNCHRONIZATION EQUIPMENT

1. This specification covers the design, manufacture, inspection and testing before dispatch, packing, Supply, Installation & commissioning of "GPS based time synchronization unit". The offered equipment shall be of reputed make, type tested and shall be subjected to acceptance & routine tests in accordance with relevant standards, as applicable. The bidder shall provide Operation and maintenance manual including drawings in English language.

2. The equipment shall confirm in all respect to the high standard of design, workmanship and be capable of performing the duties specified herein. The equipment shall be robust, rugged in design so that these can be used even in adverse site conditions. In the event of tenderer offering equipment manufactured by different manufacturers, it will be responsibility of the tenderer to fully coordinate the activities of each manufacturer/dealer in such a way that the complete offered equipment is manufactured, supplied & guaranteed for successful operation.

3. All the materials used for the manufacture of the equipment shall be of the best quality and the design and workmanship shall be of the highest order, so as to ensure satisfactory operation over its full life. The offered equipment shall be complete with all components & accessories necessary for their effective and trouble-free operation and for meeting technical requirements stipulated herein below. Such components & accessories shall be deemed to be within the scope of supply, irrespective of whether these are specifically brought out in this specification or not.

4. **Features:**

a) Supply of GPS Master Clock based Time Synchronization Equipment (GPS-TSE) shall include GPS master clock unit, Antenna and its mounting kit, Surge protector.

b) GPS-TSE shall be compatible for synchronization of all IEDs, Numerical Relays, Event Loggers, disturbance recorders at a substation.

c) GPS-TSE equipment shall support synchronisation of all IEC-61850 compliant devices.

5. **Antenna**

The antenna shall be an active antenna to provide the timing signals even under weak signal conditions. In addition, antenna shall be waterproof to operate satisfactorily in an open environment under all weather conditions. The basic specifications of this antenna are:

a) **Technical Specifications:**

i) Type : GNSS (NavIC + GPS + GLONASS)

ii) Frequency : Active L1 band (1575.42 MHz) and L5 band (1176.45 MHz)

iii) Gain: minimum 30 dB

iv) Position Accuracy : <20 meters

v) Coverage : 360 deg

vi) Output Impedance : 50 Ohms.

b) **Environmental Specifications:**

i) Operating Temp: -35 Deg C to +75 Deg C

ii) Storage Temp: -40 Deg C to +55 Deg C

iii) Humidity: Max. 95 % non-condensing

c) **Physical Characteristics:** All mounting poles, fixtures accessories and cables required to commission the antenna on substation rooftop or at any other clear sky view location, as specified by the purchaser, shall be supplied by the supplier.

i) Antenna Weight: Low weight complete with supporting arrangements
ii) Mounting plate: Stainless-Steel wall mounting plate.

d) **Cable Specifications**

i) Type: LMR200 or Equivalent / LMR400 or Equivalent
ii) Impedance: The antenna and cable shall have matching impedances; for a 50 Ω antenna, use a 50 Ω cable
ii) Length: Minimum 20 meters

6. **Control Unit**

The Control Unit shall house the GPS receiver and necessary electronics to generate all Time Code signals, as required for interfacing with all equipment in the substation.

a) **Specifications of GPS Receiver:**

i) Frequency: Active L1 band (1575.42 MHz) and L5 band (1176.45 MHz)
ii) Satellite Reception Capability: GNSS (NavIC + GPS + GLONASS)
iii) No. of satellites: 22
iv) Signal Receiver feature: Anti-Jamming and Anti-Spoofing
v) Acquisition time
Hot Start: Less than 5 sec
Warm Start: Less than 70 sec
Cold Start: Less than 70 sec

The Control Unit shall be of microprocessor / microcontroller based with all the electronic required to generate the time synchronizing and control signals. All control signals shall be derived from the standard Pulse Per Second (PPS) signal available from the GPS. Besides, in the event of loss of signal from GPS, the time code generator should running in RTC time.

Also, all the control signals shall be buffered to meet the requirements of end equipment like Event Logger, Disturbance Recorder etc. The unit shall be small and compact conforming to 19 inch rack standard, with 1U height with industrial grade. The electronic boards shall be manufactured using the Surface Mount Technology (SMT) to provide high reliability. The unit will be placed indoor close to the end-equipment like Disturbance Recorder, Event Logger etc., where the control and timing signals will be used.

b) **Specifications of GPS Time Synchronizer:**

i) Timing Accuracy: Better than 50 ns, accuracy certificate required from NPL-Lab within last 1 year validate
ii) Display of Time: Indian Standard Time
iii) Local Display: min 16 characters x 2 lines LCD with backlit
iv) Keyboard: sufficient nos. to view parameters

c) **IRIG-B Output – Modulated (AM) Signal**

i) Modulating a 1 kHz / 1ms carrier with a minimum of 5 V peak-to-peak
ii) Modulation Ratio 3:1
iii) 75 Ohms source impedance
iv) No. of outputs – 1 Ports

d) **IRIG-B Output – PWM signal**

i) Open circuit levels: High: > 4.0 volts, Low: < 0.6 volts
ii) Loading: Output TTL
iii) No. of Outputs: 1 Ports

The IRIG-B signal configurable formats - IEEE1344, C37.118, AFNOR NFS and B122 and difference with respect to PPS should be in nanoseconds.

e) **RS-232 Output** : 1 Port.

f) **RS-485 Output for Slave Clock Synchronization :** 1 Port

g) **Pulse Output:** The Control Unit shall provide various pulse outputs required for synchronizing IEDs., which include

i) Pulse per Second (PPS)
ii) Pulse per 5 sec (PP5S)
iii) Pulse Per Minute (PPM)
iv) Pulse Per Quarter Hour (PPQH)
v) Pulse Per Half Hour (PPHH)
vi) Pulse per Hour (PPH)
vii) Pulse Per Day (PPD)

h) **SNTP / NTP Output:** Control Unit should provide Ethernet copper outputs 10/100 Mbps minimum of 2 ports with IPv4, SNMP, SSH, SCP, HTTP, SYSLOG, FTP, networking protocols

i) **Alarm output:** GPS Fail alarm in potential free contact - 1 Port

j) **Front panel visual indications:** The user is required to know whether GPS-TSE is deriving clock from GPS or its own Real Time Clock (RTC). To facilitate this, visual indications using LED for GPS LOCK/UNLOCK, status of NTP/SNTP, PPS and Power to be shown on the front panel of the GPS-TSE.

k) **LCD Display:** The GPS Time synchronizer shall have a LCD with the following capabilities. Display parameters of min.16 characters x 2 lines with LED backlight to give a clear view of the display parameters even in poor light conditions. The following parameters shall be displayed, either by keyboard selection or by automatic scrolling method:

i) IST time in 24 hour format (HH:MM:SS)
ii) Latitude and Longitude of the station
iii) The number of visible satellite for each – NavIC, GPS, and GLONASS to be displayed separately.
iv) Time Zone

7. **Event storage requirements**

i) GPS Lock / fail with time stamp
ii) IP address modification with time stamping.
iii) Time zone modification with time stamping.
iv) Configuration loaded with time stamping.
v) Stored event shall be downloaded through Ethernet.

8. **GPS Receiver Additional features:**

i) Leap second correction

ii) DST (Day light saving time)

iii) System configuration through Ethernet (using http software)- Username and password can be set by user for better security.

iv) Connector between Antenna to receiver, Antenna side “TNC” Type and Receiver Side “F” Type connector.

v) Time Zone must be configurable.

vi) The GPS Time synchronizer 19” 1 U Panel mount Rack industrial grade type with Powder coated box.

9. **Power Supply:** The GPS Time synchronization equipment shall be suitable to operation from AC / DC with operating range from 100V to 270V AC and 100V to 300V DC.

10. **GPS Holdover Performance Test :** The GPS-based time synchronization system shall be verified for holdover performance using a standard NTP client software tool in accordance with the procedure outlined below:

i) **GPS Lock Phase** - The unit shall operate under normal GPS signal conditions. The NTP client shall monitor,measure, and log time offset, stability, and synchronization status.

ii) **GPS Unlock (Holdover Entry) Phase** - The GPS signal shall be intentionally interrupted or disconnected to force the unit into holdover mode.

iii) **Holdover Performance Verification** - During the holdover period, the NTP client shall continuously record time offset, drift, and jitter. The unit shall maintain time accuracy of minimum 100 microseconds for a minimum duration of 24 hours.

iv) **GPS Re-Acquisition Phase** - Upon restoration of the GPS signal, the unit shall automatically reacquire GPS lock and resume normal time synchronization without any manual intervention.

v) **Compliance Evidence** - Compliance shall be demonstrated through NTP client logs, recorded measurements, and time-offset plots confirming that the holdover performance meets the specified accuracy and stability requirements.

Guaranteed Technical Particulars (GTP)

Sl. No.	Requirement	Compliance
1.	Manufacturer or Trader	
2.	If Manufacturer, in-house or licensed technology	
3.	Is the Company ISO 9001and ISO 14001 certified for PSTSE? (Attach copy of certifications)	
4.	Is the Company ISO 27001 certified for data security? (Attach copy of certification)	
5.	GPS-TSE antenna as per Section 5a to 5d	
6.	GPS TSE receiver as per Section 6a	
7.	Accuracy test certificate from NPL (Certificate should not be older than 1 year) as per section 6b	
8.	IRIG-B AM and PWM output formats are configurable as per section 6c and 6d	
9.	RS-232 and RS-485 outputs as per section 6e and 6f	
10.	Pulse outputs as per section 6g	
11.	SNTP/NTP output as per section 6h	
12.	Alarm output as per section 6i	
13.	Front panel visual indications as per section 6j	
14.	LCD display in control unit (number of individual satellite count- NavIC, GPS and GLONASS) as per section 6k	
15.	Event storage requirements as per section 7	
16.	GPS Receiver Additional features (The system configuration through Ethernet using http - Username and Password can be set by user for better security) as per section 8	
17.	Power supply as per section 9	
18.	GPS Holdover Performance Test as per section 10	