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المواصفات الفنية التفصيلية لجدول الكميات

Detailed Technical Specifications for the Bill of Quantities

Detailed Technical Specifications for the Bill of Quantities

نبذة عامة

بهدف تعزيز قدرة المجتمع على الصمود في مواجهة الفيضانات والمخاطر المرتبطة بالمناخ في مدينة مأرب ومديرية الوادي، تعمل منظمنا على إنشاء نظام لرصد الطقس والإنذار المبكر. وسيوفر هذا المشروع بيانات الطقس الفورية (في الوقت الفعلي)، ومراقبة مستويات المياه، وتنبيهات الإنذار المبكر للسلطات المحلية والمجتمعات المعرضة للمخاطر.

Background

To strengthen community resilience against floods and climate-related hazards in Marib City and Al-Wadi District, our organization is establishing a Weather Monitoring and Early Warning System. This project will provide real-time weather data, water level monitoring, and early warning alerts to local authorities and communities at risk.

نطاق التوريد (Scope of Supply)

تشمل ما يلي:

1. محطات أرصاد جوية آلية (AWS)
2. محطات الرصد الهيدرولوجي (مراقبة المياه والطقس)
3. أنظمة صفارات الإنذار للإنذار المبكر
4. وحدات إمداد الطاقة الشمسية وأنظمة البطاريات الاحتياطية
5. معدات التحكم والطاقة
6. أجهزة المراقبة والاستشعار
7. معدات الاتصالات ونقل البيانات
8. الأنظمة البرمجية (برمجيات إدارة الإنذار، نظام الإشراف والتحكم واكتساب البيانات SCADA ، برمجيات الإشعارات، الرسائل النصية القصيرة SMS ، واجهة برمجة التطبيقات API ، وبرمجيات مسجل البيانات Data Logger)
9. الحاويات الواقية (الكابن) وهياكل التثبيت والتركيب
10. قطع الغيار وأطقم الصيانة
11. التدريب وبناء القدرات للمشغلين المحليين

Scope of Supply

Supply and installation of equipment and services related to the Early Warning System, including:

1. Automatic Weather Stations (AWS)
2. Hydrometeorological Stations
3. Early Warning Siren Systems
4. Solar Power Supply Units and Battery Backup Systems
5. Control and Power Equipment
6. Monitoring and Sensor Devices
7. Communication and Data Transmission Equipment

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8. Software Systems (Warning Management, SCADA, Notification, SMS, API, and Data Logger Software)
9. Protective Enclosures and Mounting Structures
10. Spare Parts and Maintenance Kits
11. Training and Capacity Building for Local Operators

PART I: PUBLIC VIRTUAL & AUDIBLE ALARM SYSTEM

1- PART I: PUBLIC VIRTUAL & AUDIBLE ALARM SYSTEM		
No	Parameter	Technical Specifications
TS-1	Key Features	1. Audio & Voice Specifications: ○ Minimum of two independent audio channel paths. ○ Customizable warning tones. ○ Remote update capability for prerecorded audio messages. ○ Live voice announcements via a local physical microphone input. ○ Digital audio processing features include Dynamic Range Compression (DRC), limiting, and band-pass filtering. ○ Text-to-Speech (TTS) capability with multi-language support (including the local language of the project area if required by the Employer). ○ High-efficiency Class-D amplification support. ○ Built-in low-power test speaker for local sound check and diagnostic testing. ○ Built-in FM receiver (for future/optional expansion). 2. Control & Communications (Mandatory PtP Backbone): ○ Supports both local and remote-control options. ○ Mandatory communications channels: Ethernet (primary point-to-point backbone interface). ○ Optional/future expansion channels: Cellular data (GSM/GPRS/LTE), analogue radio, open-standard digital radio, and Radio Data System (RDS). 3. Interfaces: ○ GPIO: Minimum 16 digital inputs and 4 digital outputs. ○ Serial: Minimum 2x RS232 and/or RS485. ○ USB: Minimum 2x virtual COM ports via USB device, and USB host interface. Optional Wi-Fi support. ○ Multi-channel control utilizing configurable priorities. ○ Capability to control multiple sirens from a single local control module. ○ Equipped with internal and external communication buses utilizing standardized open protocols or non-proprietary equivalent system buses. 4. Protocols & Integration: ○ Embedded web server supporting secure HTTPS/HTTP protocols. ○ Native Common Alerting Protocol (CAP) support. ○ Standardized interface protocol for third-party siren integration. ○ Modbus support: Modbus TCP Server, Modbus RTU Master, and Modbus RTU Slave. ○ Supports local automation scripting to execute fail-safe local logic and autonomous operations. 5. Diagnostics & Monitoring:

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		- Advanced automated self-diagnostics and remote status reporting of key parameters, including: battery voltage/status/fuse, mains voltage/fuse, charger status, amplifier status, speaker/line monitoring, internal temperature, door/enclosure status, authorized entry, and system test validity (intrusion, theft, error, service). 6. Security & Protection: - Amplifier short-circuit and overload protection. - Real-Time Clock (RTC) equipped with super-capacitor backup power. - Secure local service access interface via physical contact electronic keys (such as Dallas keys or equivalent security standards). 7. Power & Battery Management: - Low standby power consumption from mains power. - Power backup provided by maintenance-free batteries, supporting automatic battery testing and cell balancing. - Built-in solar battery charging support via an integrated maximum power point tracking (MPPT) or compatible solar charger. 8. Mechanical & Enclosures: - Support for high-durability aluminum-alloy horn loudspeakers. - Siren enclosure is constructed from stainless steel with an ingress protection rating of IP66 or higher. 9. Licensing & Software: - The supply shall include all required hardware and perpetual (lifetime) licenses to enable the stated functions (HTTPS, CAP, diagnostics, automation scripting, and audio functions) with no recurring subscription fees required for core system operation. 10. Scope of Acceptance: - Factory Acceptance Testing (FAT) and Site Acceptance Testing (SAT) must verify, at a minimum: remote Ethernet access (HTTPS), CAP-based alert activation, live microphone broadcasting, prerecorded message playback, diagnostic status reporting, and local automation script execution. Optional communication channels (cellular/radio) shall only be tested if procured and enabled.
TS-2	Siren Station (300 W)	Outdoor Electronic Siren (300 W) Acoustic Performance - Sound Pressure Level (SPL): ≥ 103 dB(A) at 30 m under standard test conditions. - Rated Acoustic Output Power: 300 W at an 800 Hz sine wave (or equivalent rated warning tone). Electrical Input - AC Input Voltage: 90–264 VAC, 50/60 Hz. - Standby Power Consumption (Mains): < 13 VA. - Maximum Mains Power (During battery charging): ≤ 330 VA. Environmental - Operating Temperature Range: -25°C to $+65^{\circ}\text{C}$. - Storage Temperature Range: -30°C to $+70^{\circ}\text{C}$. - Relative Humidity: Up to 95% RH, non-condensing. - Ingress Protection Rating: IP66 or higher. Mechanical - Enclosure Dimensions: Approx. $600 \times 650 \times 350$ mm ($L \times H \times W$). - Accessories: Includes all mounting brackets, hardware, and installation kits for the designated mast or structure.

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		Power Backup & Charger - Integrated battery charger and backup interface compatible with the system's overall power framework. - Autonomy: Must support at least the specified standby time and alert duration mandated by the site-specific operational requirements. Verification - Site Acceptance Testing (SAT) to verify acoustic output (SPL), operational functionality (tone playback, live public address), and generate a formal test report.
TS-3	Flash Beacon	Technical & Performance Specifications Mechanical Design: - Height: ~218 mm; Diameter: ~142 mm. - Housing Material: Impact-resistant Polycarbonate or PC-ABS blend with a high-visibility red dome. - Ingress Protection: Minimum IP65 (IP66 preferred). - Mounting Type: Base mounting, complete with all necessary fixing and installation accessories. - Cable Entry: Suitable for 5–7 mm cable diameter; equipped with screw terminals accepting conductors up to 2.5 mm² (14 AWG). Environmental Tolerances: - Operating Temperature: –30°C to +50°C minimum; higher maximum temperature range preferred for exposed outdoor environments. - Operating Humidity: Outdoor-rated, non-condensing. Electrical & Optical Specifications: - Supply Voltage: 24 VDC ± 10%. - Rated Operating Current: ≤ 0.8 A; Peak Inrush Current: ≤ 2.0 A. - Light Source Technology: High-intensity Xenon, red color. - Flash Pattern: Double flash, operating at 1 Hz frequency. - Flash Energy: 15 J. - Minimum Service Life: ≥ 4 million flashes. Control & Integration Interface: - The beacon must be directly controllable by the main siren controller via a dedicated relay or solid-state driver (such as a MOSFET driver) capable of safely handling the peak 2 A inrush current. - Direct connection to low-current open-drain outputs (≤ 100 mA) without power drivers is not acceptable. Site Verification: - During installation testing, the beacon must trigger automatically and run concurrently with the corresponding siren alarm mode, remaining fully operational under battery backup conditions.
TS-4	Core Modules Set	TS-4.1 Acoustic Control Unit (ACU) Power & Electrical: - Power Supply Input: 10–30 VDC. - Power Consumption: 70 mA at 12 V or 35 mA at 24 V. - Real-Time Clock Backup: High-reliability 1.5 F super-capacitor. Environmental & Physical: - Operating Temperature Range: –25°C to +65°C. Processing Core & Memory: - Microprocessor: 32-bit RISC core, minimum clock frequency of 500 MHz. - System Memory: Minimum 128 MB SDRAM, 4 GB internal eMMC flash, and support for expandable micro-SD cards.

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		○ Sound Processor: High-fidelity stereo audio codec featuring 24-bit Analog-to-Digital Converter (ADC) and Digital-to-Analog Converter (DAC). ● Interfaces: ○ Binary Inputs: Minimum 8x passive inputs. ○ Binary Outputs: Minimum 2x open-drain outputs (max. 100 mA/40 V). ○ Serial Connections: Minimum 2x RS232 and 1x RS485 interfaces. ○ USB Connections: 1x USB 2.0 Host and 1x USB OTG (On-The-Go) port. ○ System Expansion Buses: ▪ Standard internal multi-drop bus interface (supporting CAN-bus, system power, and 4x audio channels). ▪ Standard external system communication bus (supporting CAN-bus, system power, and 1x audio channel). ○ Integrated Sensors (Optional): 1x internal ambient temperature sensor. ○ Network Ports: 1x RJ45 10/100/1000 Mbps Gigabit Ethernet. ○ Wireless Modules: Integrated multi-band cellular module (supporting 2G/3G/4G network standards) and/or Wi-Fi 2.4 GHz. ○ FM Tuner: 1x built-in FM tuner with RDS decoding capability. ● Audio & Processing: ○ Storage Media: Internal eMMC flash for local audio files; supports external micro-SD cards or USB mass storage drives. ○ Digital Audio Processing: Integrated digital equalizer, dynamic compressor, and acoustic echo cancellation. ○ Audio Inputs/Outputs: ▪ 1x two-channel analog line input (1 Vrms). ▪ 1x two-channel analog line output (1 Vrms). ▪ 1x Microphone (MIC) input (20 mVrms with selectable bias voltage). ▪ Dedicated analog audio lines over internal/external communication buses (1 Vrms). ▪ Built-in Speaker: Integrated 0.5 W test speaker powered by a local audio amplifier for quick acoustic checks.
		TS-4.2 Power Amplifier Unit (AMP) ● Power & Electrical: ○ Power Supply Input: 21–30 VDC. ○ Power Consumption: Maximum 35 A at 24 V (fitted with a 40 A safety fuse). ● Environmental & Mechanical: ○ Operating Temperature Range: –25°C to +65°C. ● Performance & System Diagnostics: ○ Rated Output Power: Minimum 2x 300 W into an 11-Ohm load at an 800 Hz reference tone. ○ Audio Frequency Range: 250 Hz to 9.5 kHz (± 3 dB tolerance). ○ Audio Input Sensitivity: 1 Vrms. ○ Loudspeaker Line Diagnostics: Integrated automated impedance measurement for speaker system health monitoring. ○ Amplifier Module Diagnostics: Automatic reporting of input/output voltage, output current, and running temperature. ● Interfaces: ○ System Communication: Integrated standard internal system communication bus.

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		TS-4.3 Power and Device Management Module (PDM) • Power Inputs: ○ Mains AC Input: 110/230 VAC, 50/60 Hz. ○ Solar Input: 15–40 VDC solar panel input with integrated Maximum Power Point Tracking (MPPT) capability. • Electrical Outputs & Performance: ○ Mains Power Consumption: Max. 7 W during idle state. ○ Charging Capacity: > 200 W. ○ Output Current for 24 VDC (unregulated/battery-tied): > 10 A. ○ Output Current for 12 VDC (regulated): > 5 A. ○ Battery Charging Current: > 5 A. ○ Battery Health Diagnostics: Short-duration high-current pulse testing (approx. 20 A/10 ms) for internal resistance monitoring. • Environmental Limits: ○ Operating Temperature Range: –25°C to +65°C. ○ Battery Charging Temperature Range: –20°C to +50°C. • Diagnostics & Hardware Interfaces: ○ Monitored Parameters: Mains voltage presence, main power switch status, battery charging active status, real-time battery voltage, battery temperature, and monitoring of the auxiliary 24V/12V DC power lines. ○ Binary Inputs: Minimum 8x passive digital inputs. ○ Binary Outputs: Minimum 2x open-drain digital outputs (max. 100 mA/40 V). ○ Serial Connections: 1x RS232, 1x RS485, and 1x USB device interface (virtual COM port). ○ System Bus Interface: Integrated connection for standard internal system communication.
		TS-4.4 Mains Automatic Voltage Stabilizer • Electrical Input/Output: ○ Mains Voltage Input Range: 165 to 270 VAC, 50 Hz single-phase. ○ Mains Voltage Output: 230 VAC $\pm 10\%$, 50 Hz. ○ Power Handling Capability: 5000 VA. ○ Stabilizer Power Consumption: Maximum 7 W from the mains. ○ Safety Protections: Automatic output cut-off if the voltage drops or spikes beyond the 230 VAC $\pm 10\%$ threshold; automatic reconnection when incoming voltage returns within normal operating limits. • Environmental & Physical: ○ Operating Temperature Range: –25°C to +65°C. ○ Ingress Protection: IP65 enclosure.
		TS-4.5 Analogue and Digital Input/Output Module (ADIO) • Power & Electrical: ○ Power Input: 10–30 VDC (powered via the system bus or through an external DC power source). ○ Power Consumption: 50 mA at 12 V. • Environmental & Mechanical: ○ Operating Temperature Range: –25°C to +65°C. • Interfaces: ○ Reconfigurable I/O: 24x lines, configurable as either open-drain digital outputs or passive digital inputs (switched to ground). ○ Analog Inputs: 8x galvanically isolated inputs equipped with 12-bit ADC: ▪ Voltage sensing mode: 0–30 V range.

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		▪ Current sensing mode: 4–20 mA range (reconfigurable as active digital inputs). ○ Serial Connections: 1x RS232 and 1x RS485. ○ System Communication: Integrated internal system bus connection (supporting CAN-bus and module power distribution). ○ Wireless Connectivity: Integrated multi-band cellular module (supporting 2G/3G/4G standards). ○ Analog Audio Output: 1x balanced Line Out port (1 Vrms).
TS-5	Warning Management Software (Server-Client System)	• Core Operational Capabilities: ○ Map/Device Control: Simple and intuitive activation/deactivation of audible warnings directly from a GIS map display or a structured devices list. ○ Remote Sound Management: Secure remote recording and uploading of alerts/voice messages into distant field warning devices. ○ Event Automation: Automated execution of pre-defined event sequences, including live-voice streaming and broadcasting (microphone input, Text-to-Speech engines, and prerecorded messages). ○ Scheduling: Creation, modification, and execution of scheduled alarm/test events. ○ Event Logging: Automatic database logging of device status transitions, alarms, and asynchronous system events, rendered as comprehensible system reports. ○ Log Retrieval: Centralized system to retrieve event logs from local field devices (logger agents). ○ Asynchronous Alerts: Receiving and managing incoming spontaneous event messages from field units. ○ Time Synchronization: Automatic system-wide time synchronization for all connected devices. ○ Diagnostics: Silent testing of acoustic units, remote health monitoring, troubleshooting, and generating detailed reports on the current health of all assets. ○ Grouping: Seamless organization of warning stations/sirens into an unlimited number of logical groups and sub-groups. ○ GUI: Multilingual support with rich graphical representation of real-time device health states. • Licensing Requirements: ○ Supply must include perpetual software licenses (for both server software and client stations) with no ongoing subscription costs for core operational features.
TS-6	SCADA Software	• Core Capabilities: ○ Collection, analysis, processing, and real-time visualization of data acquired from site-installed monitoring sensors (e.g., water depths, water pressure, flow rates, rain levels, and weather variables). ○ Automatic assessment of incoming telemetry and direct notification to operators when critical or dangerous threshold values are exceeded. ○ Seamless integration with the Warning Management Software to trigger alerting pipelines via standard protocols (CAP/HTTPS/API). ○ General environmental monitoring and regulatory control of local automation systems (such as ventilation, air conditioning, doors, gates, signaling lights, etc.).

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		- Execution of automated, concurrent multi-system workflows when trigger events are met. - Cross-platform data display, supporting both desktop environments and lightweight, secure mobile apps for portable devices. - Comprehensive monitoring dashboard displaying real-time parameters, trend graphs, historical data sheets, and real-time video/camera feed overlays.
TS-7	Notification Software	Core Capabilities: - Automated initiation of phone calls (voice alerts) and short message service (SMS) notifications to predefined user databases. - Support for unlimited recipients, customizable emergency user groups, and prioritized delivery rules. - Automatic call retry logic and alternate recipient routing for unanswered alerts. - Multi-lingual notifications based on individual recipient profiles. - Centralized logging database storing: initiator's profile, alert title/content, exact dates/timestamps of initiation and completion, notification delivery method, and final confirmation/response status of every recipient. - Granular alert templates allowing quick mapping of events to specific recipient groups, custom text templates, notification methods, and confirmation requirements. - Dynamic resource balancing considering the availability or duty schedules of critical personnel throughout the day. Licensing & Acceptance: - Supply includes all firmware and software licenses for complete on-prem operations with zero recurring subscription fees. - Verification (FAT/SAT) must successfully demonstrate: Ethernet remote access, remote status diagnostics, stable audio playback, power supply switchover (AC to Solar to Battery), and auxiliary beacon actuation.
TS-8	Additional	Supply shall include all required licenses/firmware to enable controller functions, diagnostics, and local automation. FAT/SAT minimum tests: Ethernet connectivity, remote status reporting, audio playback, amplifier output test, power failover (AC/PV/battery), and beacon activation via driver interface.

PART II: AUTOMATIC WEATHER STATIONS (AWS) & SENSORS

All sensors must meet the requirements recommended by the **World Meteorological Organization (WMO)** for automatic weather station systems.

2- AUTOMATIC WEATHER STATIONS (AWS) & SENSORS		
No	Parameter	Technical Specifications
TS-9	Wind Speed Sensor	Measuring Range: 0 to 90 m/s. Starting Threshold: ≤ 0.5 m/s. Measurement Accuracy: ± 0.5 m/s or better. Non-linearity: $\pm 0.6\%$ above 3 m/s. Resolution: ≤ 0.1 m/s. Environmental Tolerances: Operating temp -10°C to $+70^{\circ}\text{C}$; Operating humidity 0–100% RH (non-condensing); Storage temp -10°C to $+50^{\circ}\text{C}$. Electrical: Supply voltage 2–24 VDC; Power consumption < 15 mA at 12 VDC.

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		• Interface Output: Pulse/frequency, SDI-12, or RS485 (must be natively compatible with the supplied data logger). • Scope of Supply: Complete with mounting accessories and field installation kit.
TS-10	Wind Direction Sensor	• Measuring Range: 0–360° continuous. • Sensor Time Constant: ≤ 0.30 s. • Maximum Operational Wind Speed: ≥ 90 m/s. • Measurement Accuracy: $\pm 5^\circ$ or better. • Resolution: $\leq 1^\circ$. • Environmental Tolerances: Operating temp -10°C to $+70^\circ\text{C}$; Operating humidity 0–100% RH (non-condensing); Storage temp -10°C to $+50^\circ\text{C}$. • Electrical: Supply voltage 2–24 VDC; Power consumption < 15 mA at 12 VDC. • Interface Output: SDI-12, RS485, or analog interface compatible with the data logger. • Scope of Supply: Complete with mounting accessories and installation kit.
TS-11	Solar Radiation Sensor	• Spectral Range: 305 to 2800 nm. • Measuring Range: 0 to 2000 W/m². • Sensitivity: Approximately 1 mV/(W/m²) or equivalent. • Resolution: ≤ 1 W/m². • Accuracy (Daily Sums): $\pm 3\%$ or better. • Response Time: ≤ 1 second. • Temperature Compensation: $\pm 0.5\%$ deviation over -10°C to $+50^\circ\text{C}$ range. • Environmental Tolerances: Operating temp -10°C to $+70^\circ\text{C}$; Humidity 0–100% RH; Storage temp -10°C to $+50^\circ\text{C}$. • Electrical: Supply voltage 2–24 VDC; Power consumption < 15 mA at 12 VDC. • Interface Output: Analog millivolt, SDI-12, or RS485 compatible with the data logger. • Traceability: Sensor must be supplied with a factory calibration certificate traceable to recognized international meteorological standards.
TS-12	Barometric Pressure Sensor	• Intended Use: High-stability meteorological applications compliant with WMO standards. • Measuring Range: 600 to 1100 hPa. • Measurement Accuracy: ± 0.5 hPa or better. • Resolution: ≤ 0.1 hPa. • Response Time: ≤ 1 second. • Environmental Tolerances: Operating temp -10°C to $+70^\circ\text{C}$; Humidity 0–100% RH (non-condensing); Storage temp -10°C to $+50^\circ\text{C}$. • Electrical: Supply voltage 2–24 VDC; Power consumption < 15 mA at 12 VDC. • Interface Output: SDI-12, RS485, or analog compatible with the data logger. • Scope of Supply: Includes mounting accessories, field installation kit, and a traceable factory calibration certificate.
TS-13	Rain Gauge Sensor	• Type: High-precision Tipping-Bucket Rain Gauge. • Collector Aperture Area: 400 cm². • Resolution: 0.1 mm per tip or better. • Measurement Accuracy: $\pm 1\%$ or better under specified typical rainfall intensities. • Environmental Tolerances: Operating temp -10°C to $+70^\circ\text{C}$; Humidity 0–100% RH; Storage temp -10°C to $+50^\circ\text{C}$. • Electrical: Supply voltage 2–24 VDC; Power consumption < 15 mA at 12 VDC. • Interface Output: Pulse or contact-closure signal compatible with data logger pulse counters.

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		• Scope of Supply & Accessories: ○ Robust mounting pedestal with complete leveling provisions. ○ Aperture debris screen and bird wire/spike ring. ○ Aerodynamic windshield/wind screen. ○ Calibration documentation and certificate.
TS-14	Combined Temperature & Relative Humidity Sensor	• Relative Humidity Element: ○ Measurement Range: 0–100% RH. ○ Accuracy: $\pm 5\%$ RH or better. • Air Temperature Element: ○ Measurement Range: -20°C to $+70^{\circ}\text{C}$. ○ Accuracy: $\pm 0.5^{\circ}\text{C}$ or better. • General Specifications: ○ Response Time: ≤ 1 second. ○ Environmental Limits: Operating -10°C to $+70^{\circ}\text{C}$; Storage -10°C to $+50^{\circ}\text{C}$; Humidity 0–100% RH. ○ Electrical: Supply 2–24 VDC; Power consumption < 15 mA at 12 VDC. ○ Interface Output: SDI-12, RS485, or analog compatible with the data logger. ○ Required Accessories: Naturally aspirated multi-plate solar radiation shield designed for outdoor meteorological use, and full mounting accessories. ○ Calibration: Individual factory calibration certificate covering both parameters.
TS-15	Radar Water Level Sensor for Dams (With Telemetry Package)	• A) Sensor Type & Performance: ○ Technology: Non-contact radar level sensor designed for continuous, high-accuracy outdoor liquid level monitoring. ○ Measurement Range: 0.5 m to 70 m minimum. ○ Accuracy: ± 2 mm or better. ○ Resolution: ≤ 1 mm. • B) Environmental & Enclosure: ○ Operating Temperature: -20°C to $+80^{\circ}\text{C}$. ○ Storage Temperature: -10°C to $+50^{\circ}\text{C}$. ○ Humidity: 0–100% RH (non-condensing). ○ Protection Rating: IP68 hermetically sealed housing or higher. • C) Power Requirements: ○ Supply: 12–24 VDC (optimized for standalone battery and solar systems). ○ Power Design: Ultra-low power consumption profile. • D) Output Interfaces: ○ Primary Output: RS485 (Modbus RTU). ○ Secondary Outputs: SDI-12 and/or 4–20 mA current loop. • E) Telemetry & Transmission Package: ○ Telemetry Setup: Sensor connects directly to the site data logger/RTU. ○ Primary Remote Link: Ethernet telemetry over point-to-point wireless link operating in the 5 GHz band using high-gain outdoor wireless bridge units. ○ Backup Telemetry Link: Independent of cellular or internet infrastructure, using a long-range point-to-point data link (such as dedicated LoRa PtP or UHF/VHF data modem links) supporting a 10–15 km Line-of-Sight range. ○ Package Scope: Includes both the transmitting telemetry device at the sensor location and the receiving interface (gateway, network adapter, or receiver) at the Control Room. • F) Physical Accessories:

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		- Handheld field display/adjustment module for configuration, built-in leveling bubble, robust mounting brackets, outdoor-rated cables, and full documentation. G) Services & Warranty: - Warranty: Minimum 2 years. - On-site training covering system operation and basic maintenance for the technical team. - SAT to verify level readings against physical reference targets and confirm link stability to the SCADA system.
TS-16	Data Logger & Accessories	A) Environmental Limits: - Operating Temperature: -40°C to $+70^{\circ}\text{C}$ minimum; extended range of -55°C to $+85^{\circ}\text{C}$ is preferred. - Suitable for deployment in exposed outdoor environments when housed in the specified weather-resistant enclosure. B) Measurement Performance: - Analog-to-Digital Converter (ADC): 24-bit high-resolution. - Maximum Scan Rate: ≥ 1000 Hz; Sensor scan rate ≤ 0.2 seconds per channel. - Analog Input Channels: ≥ 16 single-ended (or ≥ 8 differential), with individual channel configurations. - Current Inputs: ≥ 2 integrated channels natively supporting 0–20 mA and 4–20 mA measurements without external shunts. - Pulse Counters: ≥ 10 hardware counters (optimized for tipping-bucket rain gauges and wind speed pulses). - Input Range Limits: ± 5 V. C) Communications & Interfaces: - Hardware Ports: Ethernet, USB, RS232, RS485, and native SDI-12 support. - Protocols: Supports secure data transmissions via HTTPS, TLS v1.2, and MQTT for data publishing. - Web Server: Embedded web-based graphical user interface for local and remote configuration, monitoring, and diagnostics. D) Storage & Timekeeping: - Internal Storage: Solid-state SRAM + flash storage; expandable via micro-SD card slot (supporting up to 16 GB or greater). - Real-Time Clock (RTC) Accuracy: ± 3 minutes per year or better; supports Network Time Protocol (NTP) and optional GPS time synchronization. E) Power Requirements: - Operating DC Input: 10–18 VDC. - Power Draw: < 1 mA during idle state at 12 VDC; approx. 55 mA during active state at 12 VDC (or equivalent low-power performance). F) Enclosure & Accessories: - Enclosure Type: Double-gasketed, white fiberglass-reinforced polyester enclosure with an external grounding lug, stainless-steel hinges, and lockable hasps. - Dimensions: Approx. $45.7 \times 40.6 \times 22.9$ cm. - Enclosure Environment Kit: Multi-size cable entry glands (2 large, 2 medium, 2 small), desiccant packs, internal humidity indicator card, and sealing grommets. - Internal Monitoring: Enclosure equipped with an internal relative humidity sensor for monitoring moisture levels inside the electronics compartment. G) Protection Systems:

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		○ Surge and over-voltage protection modules on all sensor input lines, battery power terminals, and communication lines. • H) Sizing & Sourcing: ○ Solar PV panel and battery capacities must be dimensioned based on local load requirements and provided under the appropriate powering items. Supply must include a secure lockable housing with a sun shield designed to house the solar accessories and battery bank. • I) Acceptance Criteria: ○ FAT/SAT testing must verify: error-free sensor data acquisition, successful data logging to micro-SD card, NTP time synchronization, data publishing via Ethernet, and correct reading of active 4–20 mA and pulse counters.
TS-17	Data Logger Software Suite	• A) Application Capabilities: ○ Full suite for data logger programming, configuration, diagnostics, and management. ○ Automated scheduled data collection as well as on-demand retrieval. ○ Network monitoring, link health metrics, and remote troubleshooting tools. ○ Real-time monitoring and visual dashboard displays supporting role-based administrative and client access. • B) Database & Storage: ○ Maintains a secure central on-premises database for archiving all raw and calculated meteorological data. ○ Data Retention: Configurable minimum of 1 year of high-resolution records. ○ Integration: Open database export utilities (SQL/ODBC and/or REST APIs) for integration with third-party graphing and reporting packages. • C) Calculations & Quality Control: ○ Calculates derived parameters, including dew point, wet-bulb temperature, and vapor pressure. ○ Real-time calculation of wind statistics (averages, minimum, maximum, and gust values). ○ Automated sensor status diagnostics and system integrity logs. ○ Integrated Data Quality Control: Automated flags for logical or meteorological inconsistencies, out-of-range sensor readings, or missing data points. • D) Alarms & Messaging: ○ Generates system alarms with visual and audible notifications on client terminals. ○ Supports multi-tier hierarchical alarm routing. ○ System log generation recording sensor failures, diagnostics, user actions, and system messages. • E) Communications: ○ Supports full remote configuration of stations via Ethernet over the project's wireless point-to-point network. ○ Supports optional/backup communications via cellular (GSM/GPRS/LTE) and radio links. • F) Notifications & External Sharing: ○ Automatically dispatches email/SMS alerts to maintenance personnel and integrates with the project's central Notification Software via standard APIs. ○ Features related to global meteorological telecommunication networks (such as GTS/WMO code exchange), manual synoptic observer workflows, or voice-report generators are treated as optional/out-of-scope unless explicitly requested by the Employer.

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		• G) Licensing: ○ Includes all necessary server and client terminal software licenses to manage the proposed network of automatic weather stations with zero recurring subscription fees for core operations.
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PART III: VIDEO SURVEILLANCE SYSTEM

3- PART III: VIDEO SURVEILLANCE SYSTEM		
No	Parameter	Technical Specifications
TS-18	Fixed Outdoor IP Camera (4K)	• Imaging & Video Performance: ○ Image Sensor: 1/2.5" progressive-scan CMOS or equivalent. ○ Resolution: 3840 × 2160 (4K) at ≥ 20 fps. ○ Lens: Motorized varifocal lens, 2.8–12 mm focal length. ○ Low-Light Capability: High-sensitivity sensor for low-light environments. ○ Night Vision: Integrated IR illuminator with an effective range of ≥ 50 m. ○ Video Compression: Efficient multi-streaming utilizing H.265, H.265+, H.264, and H.264+ formats. ○ Image Correction: WDR ≥ 120 dB, Backlight Compensation (BLC), 3D Digital Noise Reduction (3D DNR), and Region of Interest (ROI). • Enclosure & Protection: ○ Weatherproof Ingress Rating: IP67 or higher. ○ Vandal Resistance: IK10 rated housing. • Video Streams & Storage: ○ Configurable dual-streaming with Constant Bit Rate (CBR) or Variable Bit Rate (VBR) management. ○ Edge Storage: Integrated micro-SD card slot supporting cards ≥ 128 GB to prevent data loss during network disruptions. • Electrical: ○ Power Inputs: Power-over-Ethernet (PoE 802.3at, 42.5–57 V) and/or 12 VDC. ○ Max Power Consumption: ≤ 19 W. • Networking, Compatibility & Cybersecurity: ○ Protocols: HTTPS, 802.1X network access control, IP address filtering. ○ Hardening: Anonymous default camera access must be disabled by default. ○ System Compatibility: Conformity with ONVIF Profile S and Profile G standards (minimum). ○ Edge Analytics (Optional): Behavior analysis and face detection. • Environmental: ○ Operating Temperature: –30°C to +60°C, ≤ 95% relative humidity (non-condensing).
TS-19	Pan-Tilt-Zoom (PTZ) IP Camera	• Imaging & Video Performance: ○ Image Sensor: 1/2.8" progressive-scan CMOS (or better). ○ Resolution: Minimum 8MP at ≥ 25 fps or at least 4MP at ≥ 25 fps. ○ Compression: H.265, H.265+, H.264, and H.264+. ○ Low-Light Performance: Ultra-low light high-sensitivity sensor. ○ Image Functions: True WDR ≥ 120 dB, BLC, Highlight Compensation (HLC), 3D DNR, and digital Defog. • PTZ Mechanics: ○ Pan Movement: 360° continuous rotation.

Detailed Technical Specifications for the Bill of Quantities

		○ Tilt Movement: -15° to $+90^{\circ}$ range (or better). ○ Presets & Patterns: Minimum 300 presets, 8 programmable patrols, and 4 patterns. ○ Accuracy: Positioning accuracy within $\leq \pm 0.1^{\circ}$. ○ Auto-tracking: Optional feature. • Optical Zoom & Night Vision: ○ Optical Zoom Capability: $\geq 25x$ (preferred 32x). ○ Digital Zoom Capability: $\geq 16x$. ○ IR Illumination Range: ≥ 150 m (preferred 200 m range), featuring True Day/Night operation with an IR Cut Filter (ICR). • Network & Integration: ○ Network Port: 1x RJ45 10/100/1000 Mbps self-adaptive Ethernet. ○ Protocols: TCP/IP, HTTP, HTTPS, DHCP, DNS, NTP, RTSP, RTP, SMTP, SNMP, IPv4/IPv6. ○ Compatibility: Native ONVIF Profile S and Profile G (and Profile T if supported), with open-standard API / SDK interfaces. ○ Streams: Supports dual streams (main stream for centralized recording, sub stream for low-bandwidth live viewing). • Edge Storage & Reliability: ○ Storage Interface: Integrated micro-SD card slot supporting ≥ 256 GB storage. ○ Edge Recording: Automated recording to local micro-SD storage during network or link loss. • Electrical: ○ Power Options: PoE+ (802.3at), PoE++ (802.3bt), or 24 VAC / 12 VDC depending on system configuration. ○ Max Power Draw: ≤ 40 W typical (including IR activation). • Environmental & Protection: ○ Ingress Protection: IP66 or higher. ○ Vandal Resistance: IK10 (preferred). ○ Operating Temperature: -30°C to $+60^{\circ}\text{C}$; Humidity $\leq 95\%$ (non-condensing). ○ Surge Protection: Integrated transient/lightning surge protection of ≥ 6 kV. • Cybersecurity & Management: ○ Secure communication via HTTPS/TLS, strict password policies, and role-based user management. ○ Anonymous access disabled by default. Support for signed firmware and secure remote upgrades. • Accessories & Warranty: ○ Complete with site-specific mounting kits (wall, pole, or pendant mounts), necessary PoE injectors, minimum 2-year warranty, and on-site installation, alignment, and commissioning.
TS-20	360° Panoramic IP Camera	• Imaging & Video Performance: ○ Image Sensor: 1/2.8" progressive-scan CMOS or better. ○ Resolution: 1920×1080 (Full HD) at ≥ 25 fps. ○ Compression: H.265, H.265+, H.264, and H.264+. ○ Low-Light / Image Enhancement: Ultra-low light performance, WDR ≥ 120 dB, BLC, HLC, 3D DNR, ROI, and digital Defog. • Panoramic Coverage & Viewing:

Detailed Technical Specifications for the Bill of Quantities

		- Field of View: Full 360° continuous panoramic coverage utilizing fisheye or multi-sensor configuration. - Dewarping Support: Client-side or Network Video Recorder (NVR) side image dewarping. - Viewing Modes: Support for panoramic views, split screens, and electronic PTZ (ePTZ) within the 360° capture. Night Vision: - Day/Night: ICR true day/night. - IR Illumination: Integrated IR array with an effective range of 15–30 m (or low-light performance backed by external lighting). Network, Storage & Power: - Network Port: 1x RJ45 10/100 Mbps (Gigabit preferred). - Protocols & Profiles: TCP/IP, HTTP, HTTPS, DHCP, DNS, NTP, RTSP, ONVIF Profile S & G (and Profile T if available). - Dual Stream: Main stream for recording, sub stream for live monitoring. - Edge Storage: Micro-SD slot supporting ≥ 128 GB cards, with automated edge recording on link failure. - Power Input: PoE (802.3af) or PoE+ (802.3at) with typical power consumption ≤ 12 W. Environmental & Cybersecurity: - Enclosure Protection: IP66 minimum (IP67 preferred for exposed installations). - Vandal Resistance: IK10 preferred. - Operating Temperature: -30°C to $+60^{\circ}\text{C}$; Humidity $\leq 95\%$ non-condensing. - Surge Protection: Transient protection $\geq 4\text{--}6$ kV. - Security Hardening: HTTPS/TLS, robust password enforcement, user roles, anonymous access disabled, signed firmware, and online upgrade capability. Accessories & Warranty: - Complete with pole or wall mounting hardware for mast deployment, PoE injector, minimum 2-year warranty, and on-site installation/commissioning.
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PART IV: DATA TRANSMISSION NETWORK

4- PART IV: DATA TRANSMISSION NETWORK		
No	Parameter	Technical Specifications
TS-21	Managed PoE Switch (Field Deployment)	Ports: Minimum 8x Gigabit Ethernet RJ45 ports (sufficient to support local IP cameras, PtP radio links, local router, and local maintenance laptops). PoE Delivery: - Supports 802.3af/at standard PoE/PoE+ outputs on designated ports. - If passive 24V PoE is required by any PtP radio links and not natively supported by the switch, the supply must include compatible dedicated passive PoE injectors for each wireless link. - The total switch PoE budget must exceed the cumulative maximum power requirements of all connected field devices (including camera IR states and heater accessories). Layer 2 Management Features:

Detailed Technical Specifications for the Bill of Quantities

		○ VLAN (IEEE 802.1Q) segmentation. ○ Quality of Service (QoS) and traffic prioritization. ○ SNMP-based remote monitoring and diagnostics. ○ Port statistics, port diagnostics, and port isolation/security features. ○ Loop prevention protocol (STP/RSTP). • Power & Physical Specification: ○ Direct compatibility with site-level DC power networks (solar battery systems and/or local industrial DC supplies), supplied with appropriate DC voltage conversion/regulation input modules as required. ○ Compact form factor optimized for installation inside outdoor-rated field control enclosures. • Environmental Limits: ○ Operating Temperature Range: -20°C to $+60^{\circ}\text{C}$ or better. • Cybersecurity & Management: ○ Secure local and remote management access (HTTPS/SSH); system configuration backup and recovery support.
TS-22	Wireless Data Transmission Devices (link between the main site and system locations/ Industrial Ethernet Router/Gateway)	• Performance & Core Specs: ○ CPU: Quad-core processor, operating speed ≥ 1.2 GHz or equivalent. ○ System Memory: ≥ 1 GB RAM. • Physical Interfaces: ○ Gigabit Ethernet Ports: $\geq 8 \times 10/100/1000$ Mbps RJ45 ports (or equivalent port count to support all local field infrastructure). ○ Optional SFP or modular expansion slot. • Routing, Switching & Software Features: ○ Supports Static Routing. ○ Virtual LAN (VLAN, IEEE 802.1Q). ○ QoS and traffic shaping rules. ○ Local DHCP server/client and static IP reservations. ○ NTP client support. ○ SNMP-based performance and alert monitoring. ○ Stateful firewall and Access Control Lists (ACLs). • System Management: ○ Secure remote configuration over HTTPS/SSH. ○ System configuration backup/export utilities. ○ Insecure services (e.g., Telnet, HTTP) disabled by default. • Electrical & Power: ○ Direct compatibility with the site's DC battery/solar system, featuring low power consumption. • Environmental & Security: ○ Industrial enclosure-ready design with operating temperatures from -20°C to $+60^{\circ}\text{C}$. ○ Strong password enforcement, role-based access control, and restricted administrative paths. ○ Optimized to support network separation across video, sensor/SCADA telemetry, warning control, and management VLAN networks.
TS-23	Wireless Data Transmission Devices (Point-to-Point Radio)	• Type: airFiber Outdoor-rated, high-gain 5 GHz Point-to-Point (PtP) dish radio transceiver for robust long-range Ethernet backhaul. • Operating Mode: Dedicated PtP link configuration only (Point-to-Multi-Point modes must be disabled).

Detailed Technical Specifications for the Bill of Quantities

		• Frequency Band: 5 GHz spectrum, compliant with locally permitted spectrum authorities. • Antenna Performance: High-gain integrated directive parabolic antenna (≥ 29 dBi). • Link Range: Capable of establishing robust wireless links exceeding ≥ 25 km Line-of-Sight (LoS) conditions. • Network Interface: 1x 10/100/1000 Mbps Gigabit Ethernet port. • Data Throughput: Capable of supporting simultaneous real-time streams of IP video, diagnostic telemetry, and siren control signals with a recommended real-world throughput of ≥ 300 Mbps. • Channel Width Flexibility: Configurable channel widths (e.g., 10/20/30/40/50/60/80 MHz). • Wireless Security: AES encryption (WPA2-AES or stronger standard). • Network Features: VLAN pass-through support, traffic shaping/QoS, remote performance monitoring, and built-in mechanical/software alignment meters. • Power: 24V passive PoE input; compatible PoE adapter/injector included. • Power Draw: Low-consumption design (≤ 10 W typical). • Environmental & Mechanical: ○ Operating Temperature Range: -40°C to $+70^{\circ}\text{C}$ minimum. ○ Enclosure Material: Outdoor UV-resistant and weather-sealed. ○ Wind Survival Rating: ≥ 200 km/h. ○ Integrated ESD/EMP protection. ○ Includes heavy-duty pole-mounting kit and all necessary hardware. ○ Equipped with a dedicated grounding terminal block compatible with the project's lightning protection system.
TS-24	Gigabit Ethernet/PoE Surge Protection & Grounding Kit	• Surge Protection Devices: ○ Outdoor-rated inline surge protection devices (SPDs) designed for high-speed Gigabit Ethernet cables connected to PtP radios, outdoor cameras, and network enclosures. ○ Electrical compatibility with 10/100/1000 Mbps interfaces. ○ Compatibility with 802.3af/at PoE, PoE+, and 24V passive PoE voltages. • Grounding and Bonding Kit Components: ○ High-conductivity copper grounding/bonding cables. ○ Industrial clamps, terminal lugs, and mechanical bonding accessories designed for mast, tower, and enclosure frames. ○ Earthing hardware compatible with the site's master earth grounding ring. • Installation Standard: ○ Surge protectors must be installed at the primary network cable entrance point of each outdoor equipment enclosure and directly bonded to the ground system. ○ Continuous physical electrical bonding must be established between the antenna mast, equipment enclosure, and surge protection assemblies. ○ Contractor must perform physical ground loop and continuity testing during installation.

PART V: PUBLIC SMS ALERTING SERVICE

5- PART V: PUBLIC SMS ALERTING SERVICE		
No	Parameter	Technical Specifications
TS-25	SMS ALERTING SERVICE	• Service Provider Framework: ○ The Contractor shall coordinate and establish a service level agreement (SLA) with a licensed telecommunications network operator active in the target region ([Target Governorate/Region]). ○ The selected network provider must have a documented local active subscriber base of at least 100,000 subscribers. ○ The provider must support high-volume mass SMS alert generation to residents located in the designated metropolitan area ([Target City]) and its surrounding valley ([Target Valley]). ○ The alerting system must support public warning dissemination through bulk SMS mailing lists and/or localized, cell-broadcast/location-based SMS dissemination where supported. • Alert Message Quota: ○ The Contractor must procure and deliver a minimum quota of 300,000 SMS messages dedicated solely to public emergency warning dissemination, targeting subscribers within the designated region ([Target Governorate]). ○ The distribution and triggering of this SMS quota across emergencies will be managed by the Employer's operations room. ○ All retry, queue-backlog, and delivery-failure counts must be clearly quantified and reported in real-time. • Performance, Reporting & Compliance: ○ The technical interface must be designed for emergency warning dissemination, outputting delivery and transmission confirmations directly from the carrier. ○ The Contractor shall provide complete system integration and API mapping with the project's central Notification and Warning Management platforms. ○ The SMS service must comply fully with all regional telecommunication authorities, and the Contractor must submit official carrier-signed declarations confirming the committed quota and coverage.

PART VI: POWERING SYSTEM

6- PART VI: POWERING SYSTEM		
No	Parameter	Technical Specifications
TS-26	Solar PV Module & Battery Bank (Field/Repeater Sites)	• Solar PV Module Specifications: ○ Cell Technology: High-efficiency Monocrystalline. ○ Power Rating: Minimum 350 Wp. ○ Standards: Tier-1 classification, certified to IEC 61215 and IEC 61730 or equivalent. ○ Built-in outdoor-rated weatherproof junction box with standardized connectors. ○ Complete with heavy-duty structural mounting brackets. ○ Automatic Fire Extinguisher Ball • Battery Bank Specifications: ○ Chemistry: Lithium Iron Phosphate (LiFePO₄). ○ Nominal Output: 12 VDC, 200 Ah capacity.

Detailed Technical Specifications for the Bill of Quantities

		- Integrated Battery Management System (BMS) with built-in protections against overcharging, over-discharging, deep discharge, short circuit, and cell temperature anomalies. Lithium battery charger - Optimized for high-cycle outdoor solar storage applications. - Includes heavy-duty, outdoor-rated DC power cables, terminal lugs, high-current fuses, and circuit breakers. - Natively compatible with the station's central charging and power monitoring module. System Charge Controller (MPPT): - A high-efficiency Maximum Power Point Tracking (MPPT) solar charger with a conversion efficiency of at least 99% must be provided under the designated power management line items.
TS-27	Anti-Lightning / Grounding System	Technical Specifications (IEC-Compliant Telecom Standard): - Lightning Interceptor Rod: Pure solid copper construction. - Mounting Base: Pure copper base plate designed for structural mast installation. - Sensor/Air Terminal: Pure copper interceptor rod, minimum 1 meter in length. - Down-Conductor Cable: Pure copper grounding cable, sized to run continuously from the mast air terminal to the grounding electrode pit without sharp bends. - Grounding Electrode: Pure copper ground rods and a solid copper plate measuring 50 × 50 cm installed in the master earthing pit.
TS-28	Power Supply and Voltage Conversion (AC to DC)	All stations must include high-reliability power supplies and step-down/step-up converters capable of taking an input source of 220 VAC and converting it into stable 12 VDC and 24 VDC rails, meeting the specific electrical loads of each field device.
TS-29	Control Room Power Infrastructure	The Control Room electrical distribution panel must include all necessary automatic/manual transfer switches, surge protection devices, and electrical breakers to accept three independent incoming power feeds: public utility grid, solar PV energy system, and auxiliary diesel generator power.
TS-30	Control Room Battery Backup	Chemistry: Lithium Iron Phosphate (LiFePO₄). Energy Storage Capacity: Minimum 10 kWh or higher. Integrated Protection: Advanced Battery Management System (BMS) providing overcharge, over-discharge, short-circuit, and temperature monitoring. Components: Complete with high-current DC cables, lugs, circuit breakers, and sub-panel integration kits. MPPT Sizing: Integrates with an ultra-high efficiency solar MPPT charger/power conditioner (≥ 99% efficiency).
TS-31	Sizing & Sizing Documentation (Solar System General Data)	- The Contractor must submit professional system calculations, including: - Equipment current draw and sizing calculations. - Daily energy balance matrices proving solar-to-battery autonomy under worst-case cloud cover. - Comprehensive technical datasheets for all proposed power modules.

PART VII: CONTROL ROOM EQUIPMENT

7- PART VII: CONTROL ROOM EQUIPMENT

No	Parameter	Technical Specifications
TS-32	Main Server (High-Availability Node)	• Processor: Minimum Server-Grade Processor with at least 8 Cores / 16 Threads, base frequency ≥ 3.2 GHz and ≥ 12 MB L3 cache (or equivalent performance). • Storage Configuration: 6x 2TB Server-Grade Enterprise Hard Drives configured in hardware RAID-10 or RAID-5. • System Memory (RAM): Minimum 64 GB DDR4 ECC Server Memory. • Network Interfaces: 2x Gigabit Ethernet (10/100/1000 Mbps) RJ45 ports. • Peripherals: Minimum 17" LCD display console, mouse, and keyboard. • Uninterruptible Power Supply (UPS): Line-interactive or double-conversion on-line UPS with a minimum power rating of 2500 VA. • High-Availability (HA) & Disaster Recovery: ○ Real-time database replication and synchronization across failover servers. ○ Automated non-disruptive primary-to-secondary failover scripting. ○ Full system backup and bare-metal restoration suite. ○ Demonstrated on-site failover test during SAT with formal testing report. • System Software: Licensed, original system operating software, productivity suite, and enterprise antivirus/malware endpoints.
TS-33	PC Workstation Computers	• Processor: High-performance Desktop/Workstation class processor (minimum 8 Cores / 16 Threads, or equivalent performance). • Storage Configuration: Minimum 4TB Solid State Drive (SSD). • System Memory (RAM): 32 GB RAM. • Graphics Interface: Dedicated professional workstation-class graphics card with a minimum of 4GB of dedicated VRAM. • Display & Peripherals: Minimum 19" LCD monitor, keyboard, mouse, and local 1500 VA UPS backup. • Software: Fully licensed, original operating system software, office utilities, and antivirus endpoints.
TS-34	Core Network Router	• Processor Architecture: High-performance 32-bit RISC core or multi-core network processor (minimum 4 cores, ≥ 1.4 GHz clock speed). • Operating Software: Professional-grade Network Router Operating System. • Memory & Storage: 1 GB RAM; 128 MB internal NAND flash storage. • Mean Time Between Failures (MTBF): $\geq 200,000$ hours at 25°C. • Environmental Range: Operating -40°C to $+70^{\circ}\text{C}$. • Routing & Security Acceleration: Onboard hardware IPsec encryption engine. • Power Inputs: Redundant power system featuring 2x AC inputs and 2x DC inputs (supporting PoE-In and 2-pin terminal lines with working voltages from -48 to 57 V). • Power Consumption: Maximum 33 W (with attachments); passive/silent cooling system design. • Power-Over-Ethernet Input: Compatible with 802.3af/at standards. • Ethernet Ports: 32x 10/100/1000 Mbps Gigabit RJ45 interfaces. • Storage Expansion: Minimum 1x M.2 slot populated with a 60GB M.2 SSD, 1x micro-SD slot, and 2x SATA3 interfaces. • Interfaces: 1x RS232 Serial console interface; 2x M.2 slots.

Detailed Technical Specifications for the Bill of Quantities

		• Core IP Services: Must act as the primary local DHCP server, supporting static DHCP reservations for all cameras, wireless bridges, field routers, switches, NVR nodes, and host servers across dedicated logical VLAN scopes. • Compliance Certifications: CE, EAC, RoHS or equivalent European standards.
TS-35	Enterprise Firewall (Next-Generation Firewall - NGFW)	• Performance Metrics: ○ Firewall Throughput: ≥ 1.5 Gbps. ○ Next-Generation Intrusion Prevention System (NGIPS) Throughput: ≥ 1.5 Gbps. ○ Firewall (FW) + Application Visibility & Control (AVC) Throughput: ≥ 1.5 Gbps. ○ Firewall + AVC + IPS Throughput: ≥ 1.5 Gbps. ○ Transport Layer Security (TLS) Decryption Throughput: ≥ 700 Mbps. ○ IPsec VPN Throughput: ≥ 1 Gbps. ○ Maximum Concurrent Sessions (with AVC): 200,000. ○ New Connections per Second (with AVC): 15,000. ○ Maximum VPN Peer tunnels: 150. • Physical Properties: ○ Chassis Form Factor: Standard 1RU rack-mountable chassis. Includes physical mounting brackets. ○ Physical Interfaces: 8x Gigabit Ethernet RJ-45 ports and 4x SFP transceiver ports. ○ Management Interfaces: 1x 10/100/1000 Mbps RJ45 out-of-band port, 1x RJ-45 serial console interface, and 1x USB 3.0 Type-A. ○ Onboard Storage: Minimum 200 GB solid-state drive (SSD). • Electrical & Thermal: ○ Power Supply: Internal AC unit (100 to 240 VAC, 50 to 60 Hz). ○ Efficiency: $> 85\%$ efficiency at 50% load. ○ Acoustic Noise level: ≤ 31.7 dBA at 25°C ambient. • Environmental Specifications: ○ Operating Temperature: 0°C to +40°C. ○ Storage Temperature: -25°C to +70°C. ○ Humidity Limits: 90% non-condensing. • Advanced Security Features: ○ Next-Generation Management: Supports both local on-box management and centralized management software options. ○ Application Visibility and Control (AVC): Supports detection of over 4,000 applications, user profiles, geolocation data, and website categorizations. ○ Open Detection Engine: Natively supports custom, open-source application and signature detection engines. ○ Next-Generation Intrusion Prevention System (NGIPS): Includes passive asset discovery, automated threat correlation, and Indicators of Compromise (IoC) logging. ○ Advanced Malware Defense: Integrates sandbox detection, retrospective tracking, threat intelligence analysis, and file containment capabilities. ○ URL Filtering: Categorizes over 280 million web pages across 80+ dynamic categories. ○ Automated Updates: Secure, automated signature, and threat-intelligence feed updates. ○ High-Availability: Supports Active/Standby hot failover modes. ○ Hardware Protection: Built-in secure boot and hardware-based image verification.

Detailed Technical Specifications for the Bill of Quantities

		Compliance Certifications: UL 60950-1, EN 60950-1, IEC 60950-1, AS/NZS 60950-1 or equivalent safety standards.
TS-36	Network Video Recorder (NVR)	A) Capacity & Throughput: - Camera Channels: Supports ≥ 32 IP camera input channels. - System Bandwidth: Incoming bandwidth ≥ 256 Mbps; Outgoing bandwidth ≥ 256 Mbps. B) Video Performance & Compression: - Input Resolution: Support for camera resolutions up to ≥ 12 MP or greater. - Video Codecs: H.265, H.265+, H.264, H.264+, and MPEG4. - Dual-Stream Recording: Enabled. - Synchronous Playback: Supports up to 16 channels of simultaneous playback. - Decoding Capability: Multi-channel decoding performance (at least: 1-ch @ 32 MP, 2-ch @ 12 MP, 4-ch @ 8 MP, 8-ch @ 4 MP, or 16-ch @ 1080p). C) Physical Video Outputs: - HDMI 1: Out 4K (3840 $\times$ 2160) at 60Hz. - HDMI 2: Out 1080p (1920 $\times$ 1080). - VGA: Out 1080p (1920 $\times$ 1080). - Output modes: Simultaneous HDMI1/VGA output, and independent HDMI2/VGA output options. - CVBS Output: 1-ch, BNC (1.0 Vp-p, 75 Ω) for legacy displays. D) Storage Capabilities: - SATA Interfaces: Minimum 4x internal SATA ports. - Hard Disk Size: Supports up to 12 TB per SATA slot. - Project Storage Sizing: Populated with 4x 12 TB surveillance-grade hard disks (minimum 48 TB total storage). - Data Retention: System must ensure ≥ 20 days of continuous video recording under defined stream bitrates across all active cameras. E) Interfaces & Ports: - Network: 2x RJ-45 10/100/1000 Mbps self-adaptive Ethernet ports. - USB: 2x USB 2.0 (Front-facing); 1x USB 3.0 (Rear-facing). - Audio: 1-ch Output (RCA, Linear, 1 kΩ), and 1-ch Two-way Audio (RCA, 2.0 Vp-p, 1 kΩ). - Alarm I/O: 16 inputs and 4 outputs. F) Security & Time Sync: - Multi-level user access controls with configurable role-based permissions; comprehensive audit logs tracking system changes, administrative access, and video file playbacks. - NTP time synchronization. G) Form Factor & Electrical: - Input Voltage: 100–240 VAC, 50/60 Hz; system power consumption ≤ 20 W (excluding HDDs). - Form Factor: Standard 19-inch 1.5U rack-mountable chassis. - Operating Temperatures: -10°C to $+55^{\circ}\text{C}$.
TS-37	TV Monitors (Display Wall)	55-inch professional commercial display, minimum 4K UHD resolution, LED/LCD /IPS/ OLED display technology, minimum 500 cd/m² brightness, 24/7 operation, Minimum three digital video inputs (HDMI and/or DisplayPort). inputs, VESA compatible.
TS-38	Backup Cellular Modem / Gateway	Hardware Interface: - Minimum three Gigabit Ethernet LAN interfaces - Buttons: Some manufacturers no longer support WPS/Reset, Wi-Fi on/Off.

Detailed Technical Specifications for the Bill of Quantities

		- Antennas: 2x detachable external 4G LTE antennas. Wireless Specifications - Standards: IEEE 802.11b/g/n (operating on 2.4 GHz band). - Maximum Signal Rate: LTE Category 4 or higher providing sufficient throughput for project communication requirements. - Transmit Power: < 20 dBm. - Failover Capability: Supported (Automatic WAN to Cellular backup routing). - Cellular Networks: 4G: FDD-LTE Cat4 (800/900/1800/2100/2600 MHz) and TDD-LTE (2300/2500/2600 MHz). 3G: DC-HSPA+/HSPA+/HSPA/UMTS (900/2100 MHz). Software & Protection Features: - QoS: WMM and bandwidth management rules. - Modes: 3G/4G Router mode and standard Wireless Router mode. - Security: 64/128-bit WEP, WPA/WPA2, and WPA-PSK/WPA2-PSK encryption standards. - Routing: DHCP Server, DHCP Client List, and Address Reservation. - NAT Management: Port forwarding, virtual servers, port triggering, UPnP, and DMZ. - VPN Pass-Through: IPSec, OpenVPN, WireGuard or equivalent secure VPN protocol., L2TP, and IPsec. - Virtual Private Network (VPN) Server: Local IPSec, OpenVPN, WireGuard or equivalent secure VPN protocol and OpenVPN server hosting. - Firewall: DoS prevention, Stateful Packet Inspection (SPI) firewall, and IP/MAC Address Binding. - IP Formats: Native IPv4 and IPv6 dual-stack support.
TS-39	All-in-One Multi-Function Office Printer	System Architecture: Cartridge-free continuous ink reservoir system with low-cost high-volume refill bottles. Features: Printing, copying, flatbed scanning, and Fax capabilities. Document Feeder: Automatic Document Feeder (ADF). Connectivity: Integrated USB, Gigabit Ethernet, and wireless connectivity. Power: AC 100–240V Automatic Universal Power Supply, 50/60 Hz.
TS-40	Control Room Network & Electrical Fittings	Fittings: High-grade, flame-retardant standard data wall sockets, data floor sockets, and telecom wall sockets. Lighting: Energy-efficient, high-lumens LED ceiling lights. Power Distribution: High-quality wall outlets, floor outlets, and rack-mountable Power Distribution Units (PDUs). Wiring & Routing: - Power cabling: High-conductivity insulated copper wiring. - Data cabling: Shielded Twisted Pair Category 6A or higher compliant with ANSI/TIA-568 and ISO/IEC 11801. - All physical electrical, data, and network extensions must be routed inside concealed wall conduits, surface raceways, or structural wireways.
TS-41	Control Room Office Furnishings	One Executive Desk: High-quality L-shaped executive desk constructed of Office desk manufactured by MDF, plywood, laminated engineered wood or equivalent commercial office furniture material, matching standard office specifications (approx. L 2800 x W 2000 x H 760 mm). One Executive Chairs: Orthopedic high-back mesh chairs equipped with adjustable headrests, adjustable armrests, synchronized tilt-and-height

Detailed Technical Specifications for the Bill of Quantities

		mechanisms, adjustable lumbar support, and heavy-duty cast aluminum base rollers. • Conference Table: Conference table manufactured from MDF, laminated engineered wood, plywood or equivalent commercial office furniture material with finished edges designed to seat at least 6 people, featuring integrated power and data routing sockets (approx. L 2400 x W 1100 x H 760 mm) including 6 chairs. • One Storage Cabinets: Matching Steel or engineered wood storage cabinet suitable for office use and lockable storage cabinets with functional shutters (approx. L 2200 x H 1900 x W 400 mm).
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PART VIII: MAST & MOUNTING ACCESSORIES

8- PART VIII: MAST & MOUNTING ACCESSORIES

[Mast: 15-meter Steel Pipe Structure]

- Upper Section: Lightning Rod (Solid Copper)
- Mid-Section: Antenna Mounting Arms (PtP Radios)
- Lower Section: Camera & Sensor Mounts
- Structural: Guy Cables, Climbing Ladder, and Steel Bracing
- Foundation: Reinforced Concrete Base (Grade C40) with Heavy Hex Anchor Bolts

No	Parameter	Technical Specifications
TS-42	Siren Station Mast & Foundations	• Engineering & Wind Loading: ○ Designed to withstand a reference wind speed (3-second gust) of up to 65 m/s. • Concrete & Grout Standards: ○ Reinforced cast-in-place concrete must meet structural Grade C25 strength. ○ All underground concrete foundations exposed to soil must utilize Sulfate-resistant cement complying with ASTM Type V, EN 197 or equivalent national standard. with a 28-day cylinder compressive strength of at least 25 MPa. • Steel Structure Specifications: (some details match the drawings) ○ Reinforcement rebars and structural steel components (pipes, flanges, gussets, and plates) must meet ASTM Grade 40 or equivalent international standard or equivalent international standard structural steel. ○ The structural mast must stand 8 to 10 meters high relative to the installation roof surface. ○ The structural design and analysis of the mast must be certified by the Contractor based on geotechnical soil investigations and the final physical wind loads of the equipment. • Fasteners & Connections: ○ Structural bolts and hex nuts must be manufactured from high-strength structural steel, meeting ASTM A325, ASTM Grade 65 or equivalent international standard. ○ Anchor bolts must be heavy hex head type structural steel, ASTM A325, ASTM Grade 65 or equivalent international standard. ○ All structural welding must meet ANSI/AISC 360 or equivalent international structural steel design standard-05 Section J.2 specifications. • Geotechnical & Soil Bearing Parameters:

Detailed Technical Specifications for the Bill of Quantities

		- Where ground-mounted, soil structures are assumed to support an allowable soil pressure and lateral bearing capacity of 20 ton/m². Geotechnical investigation must be conducted by the Contractor prior to foundation design. - All physical construction must follow the official design drawings, approved standard operating procedures, and technical instructions of the supervising consultant.
TS-43	Weather Station Mast & Foundations (Ground or Roof-Mounted)	Engineering & Wind Loading: - Designed to withstand a reference wind speed (3-second gust) of up to 65 m/s. Concrete & Steel Standards: - Reinforced cast-in-place foundation concrete: Grade C25. - Underground foundation concrete: Sulfate-resistant cement complying with ASTM Type V, EN 197 or equivalent national standard, with a 28-day compressive strength of 25 MPa. - Structural steel pipes, plates, and rebars: ASTM Grade 40 or equivalent international standard or equivalent international standard steel. - Structural bolts and nuts: High-strength steel ASTM A325, ASTM Grade 65 or equivalent international standard. - Welding standards: Compliant with ANSI/AISC 360-05 Section J.2. Geotechnical Requirements: - Assumed lateral soil bearing capacity: 20 ton/m². Requires site-specific geotechnical validation for ground installations. Scope of Supply & Erection (15-Meter Mast): - Manufacturing, shipping, and erecting a 15-meter tall, galvanized steel pole (mast) equipped with three independent antenna mounting brackets. Steel Structure: Includes main structural hollow pipe section, connection flanges, crossbeams, structural stiffeners, and base plates. Bracing Supports: Secondary steel bracing pipes, flat bar struts, and structural connection fasteners. Guying Wire System: Multi-strand steel guy cables reinforced concrete guy anchor blocks, turnbuckles, tension adjusters, and angular structural attachments. Master Foundation Block: Structural reinforced concrete foundation (minimum compressive strength of 25 MPa. or mixing ratio of 1:1.5:3) reinforced with a two-way grid of 10 mm steel rebar (6 rebars in each direction), with integrated cast-in-place base plates. Climbing Steps: Fully welded steel step bars with non-slip surfaces and safety handrails. Antenna Mounting Arms: Sized steel flat bars with heavy clamps, U-bolts, and locking nuts. Coating & Paint Protection: Surface pre-treatment (sanding, grinding, and rust removal), one anti-rust primer coat, one high-durability anti-corrosion epoxy base coat, and a silver industrial finish coat. Roof Structural Evaluation: Contractor must perform structural assessment calculations of the building roof slab before installing any heavy roof-mounted mast configurations to verify local load capacities.
TS-44	Main Data Transmission Site Mast & Foundations	Engineering & Wind Loading: - Designed to withstand a reference wind speed (3-second gust) of up to 65 m/s. Structural Materials & Standards:

Detailed Technical Specifications for the Bill of Quantities

		- Reinforced Concrete: Grade C25 with Sulfate-resistant cement complying with ASTM Type V, EN 197 or equivalent national standard. for subterranean works (28-day cylinder strength ≥ 25 MPa). - Steel Plates, Pipes, and Rebars: Structural ASTM Grade 40 or equivalent international standard steel. - High-Strength Bolts, Hex Nuts, and Anchor Bolts: ASTM A325, ASTM Grade 65 or equivalent international standard. - Welding Quality: Compliant with ANSI/AISC 360-05 Section J.2. - Site-specific geotechnical survey required to verify a minimum soil bearing capacity of 20 ton/m².
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PART IX: GENERAL CONTRACTUAL & TECHNICAL REQUIREMENTS

9- PART IX: GENERAL CONTRACTUAL & TECHNICAL REQUIREMENTS		
No	Parameter	Technical Specifications
TS-45	Documentation Requirements	The Contractor must submit a complete documentation package, consisting of: - Standard device datasheets, user guides, and installation manuals. - Detailed technical descriptions, service manuals, and diagnostic guides. - Routine maintenance manuals, troubleshooting flows, and recovery guides. - Complete factory testing, calibration records, and site acceptance documents.
TS-46	Warranty and Operations Support	Operational Service: The offer must include a minimum of 12 months of on-site operations and preventative maintenance. Product Warranty: Written product warranty covers all parts, modules, and accessories for a minimum of 3 years following the initial year of operation and maintenance.
TS-47	Subscriptions and Utility Fees	The contract price must include all activation fees, dynamic IP allocation fees, and commercial internet subscription costs for all field stations and the central Control Room for a period of one calendar year.
TS-48	Local Deployment Proof	The bidder must submit documentation showing that the proposed hardware models have a history of successful long-term operations under similar climatic conditions.
TS-49	Certificates of Conformity & Testing	The bid submission must include official certificates of origin, certified factory test reports, warranty certificates, and valid international quality standard certifications for all critical electronic components.
TS-50	Installation, Training, and Commissioning	Deployment Scope: The selected Contractor is responsible for complete on-site assembly, wiring, termination, leveling, calibration, configuration, and commissioning. Site-Level Training: On-site operational training for at least 3 operators at each system node. System-Level Training: Intensive advanced training program covering full system management, diagnostic software, meteorological databases, telemetry data processing, and analytical modeling. - Trainee cohort: 7 dedicated operations and engineering staff. - Training program duration: Minimum of 12 working days.
TS-51	Manufacturer Authorization	The bidder must provide a valid Manufacturer's Authorization Form (MAF) from the original equipment manufacturer (OEM) for all primary sensors, core networks, firewalls, and siren modules, confirming long-term supply, spare parts availability, and factory backup support.

Detailed Technical Specifications for the Bill of Quantities

TS-52	Preliminary Design Information	Prior to structural construction or equipment ordering, the selected Contractor must submit: - Detailed overall system block diagrams with functional descriptions (25 to 50 pages) detailing the integration, signal flows, and data interactions between all sub-systems. - Detailed software design diagrams, database structures, and protocol layouts. - Procurement scheduling identifying long-lead-time imports. - Project milestone schedule covering shop drawings, engineering, factory tests, custom calibrations, site shipping, civil foundation construction, wiring, and final commissioning. Instrument Schedule: Broken down into: - Long-lead-time assemblies. - In-line process instruments. - Offline instruments. - Local control cabinets and terminals. - Point-to-point interconnection wiring schematics for the entire control network. - Distributed control and SCADA equipment layouts. - FAT program procedures for the digital control system.
TS-53	Software Design Information	The Contractor must provide: - A comprehensive architectural diagram of the central software platform. - A complete inventory of all installed process control packages and software drivers. - A user configuration manual detailing database editing, control loop programming, and alarm threshold configuration.
TS-54	System Recovery	- The Contractor must supply a full archival backup media set (such as optical disc, high-durability flash, or hard drives) containing all system software, configuration profiles, PLC/logger scripts, and database initialization profiles. - The Contractor must maintain an off-site master image backup of the system's finalized configuration for the entire service life of the equipment.
TS-55	Safety Management, International Standards & Compliance	Health & Safety Framework: The Contractor must implement a comprehensive safety management system in accordance with international occupational health and safety protocols. This must include: - Detailed site-level hazard identification and risk assessment. - Established local mitigation and accident prevention measures. - Consistent use of personal protective equipment (PPE). - Training for staff on high-altitude climbing, electrical safety, and hazardous material handling. - Regular safety audits and reviews. Applicable Standards: All works, assemblies, and employee protocols must comply with: - International Labour Organization (ILO) Safety and Health at Work Convention (No. 155). - ISO 45001:2018 (Occupational Health and Safety Management Systems). - Regional and international OSHA safety regulations.

تفصيلة الفلنشة النهائية مع جلسة مانع الصواعق .

SIDE ARMS

ربط مواسير التدعيم الجانبية مع القفشات المثبتة مع الماسورة الرئيسية

تثبيت مواسير الدعم الجانبية مع ماسورة البوول الرئيسية

تثبيت مواسير الدعم الجانبية مع بعضها

الشدادات الخاصة بالبوول .

FEEDER LEADER

الدعسات STEPS

تثبيت ماسورة البوول الرئيسية مع القاعدة.

وصلة ربط مواسير التدعيم الجانبي مع قاعدة البوول .

دعامات وقواعد الشدادات .

Sheet	1/5
Style	Civil
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No.	
Structural design by :	
Date	DEC-2025



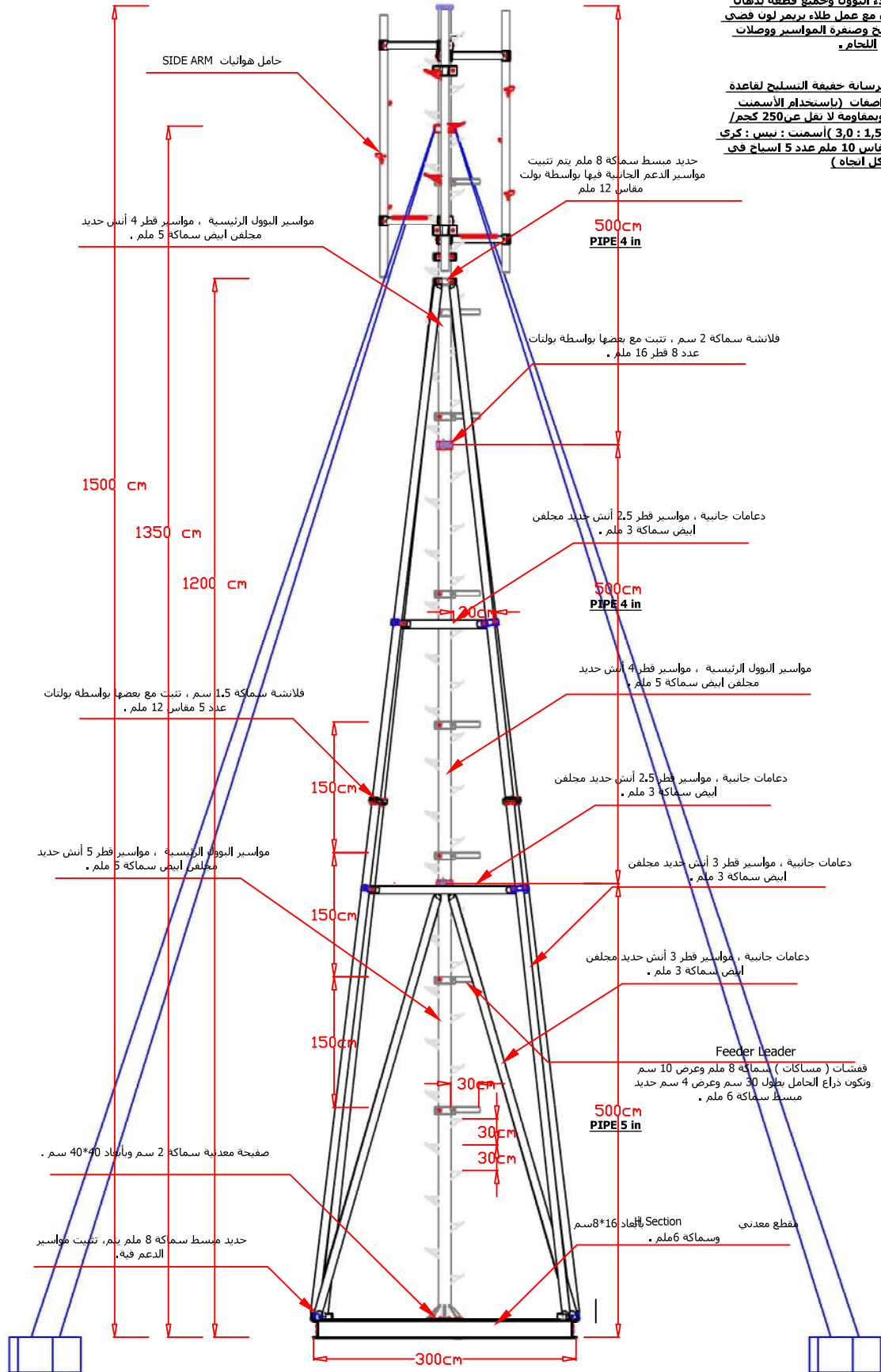
مواصفات البوول- 15 متر
MASTS SPECIFICATION

نموذج رقم (1)



تتم مراعاة ان يتم طلاء البوول وجميع قطعة يدهان
إوكسي مقاوم للصدأ مع عمل طلاء بريمر لون فضي
كطبقة نهائية بعد جاح وصغرة المواسير ووصلات
الجام .

العمل يشمل تنفيذ حرسانية خفيفة التسلح لقاعدة
البوول بحسب المواصفات (استخدام الأسمنت
البورتلاندي العادي وبمقاومة لا تقل عن 250 كجم /
سم² ونسبة خلط 1 : 1.5 : 3.0) أسمنت : نيس : كرى
وعمل حديد تسلح مقاس 10 ملم عدد 5 أسياخ في
كل اتجاه)



Sheet	2/5
Style	Civil
Scale	As show / not to scale
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Structural design by:	
Date	DEC-2025



مواصفات البوول- 15 متر
MASTS SPECIFICATION

نموذج رقم (1)





Sheet	3/5
Style	Civil
Scale	As show / not to scale
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Structural design by :	
Date	DEC-2025

مسقط افقى للبوول

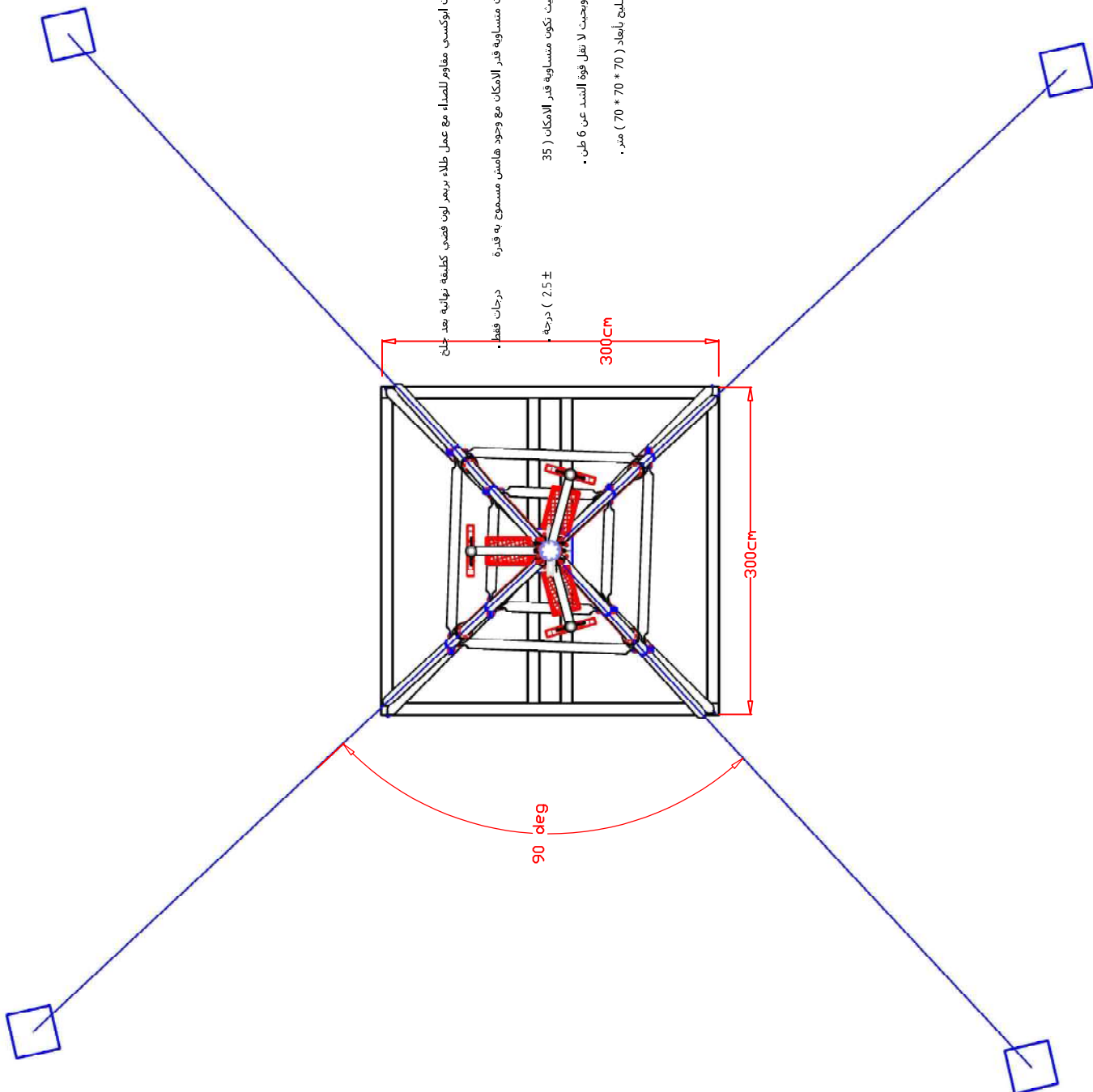
تتم مراعاة ان يتم طلاء البوول وجميع قطعه بدهان اوكسى مقاوم للصدأ مع عمل طلاء برنمر لون فضي كثيفة نهائيه بعد خلع وصفره الماسير ووصلات الخام .

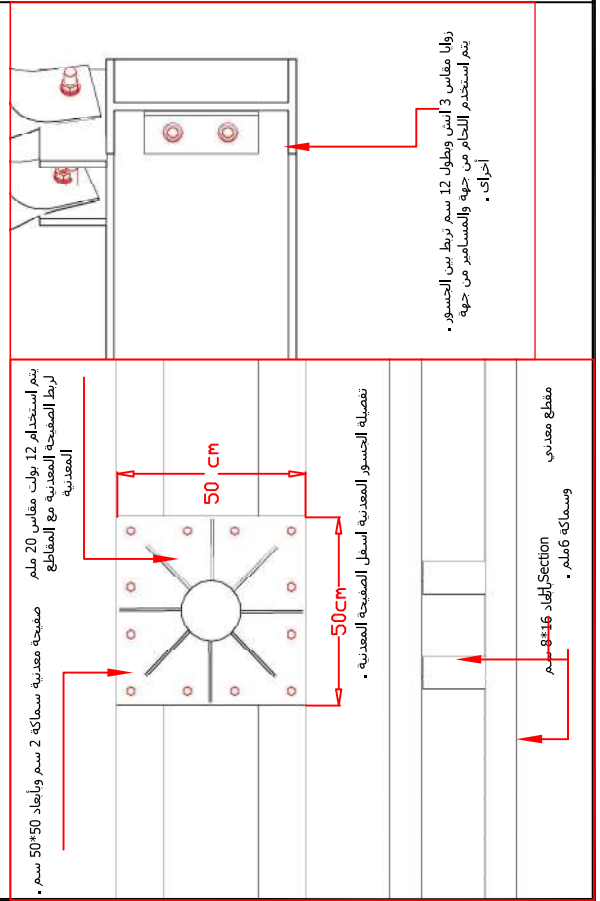
يتم ضبط الازوية الافقيه بين السدادات بحيث تكون متساوية قدر الامكان مع وجود هامش مسموح به قدره ± 5 درجات فقط .

يتم ضبط الازوية الرأسية للسدادات والبوول بحيث تكون متساوية قدر الامكان (35 درجة)

يتم استخدام سدادات (كبلات) بقطر 2.5 سم ويجب لا تقل قوة الشد عن 6 طن .

تكون قواعد السدادات من الخرسانه الثقيله المتسلح بأبعاد (70 * 70 * 70) متر .





مواصفات البوول- 15 متر
MASTS
SPECIFICATION

النموذج رقم (1).

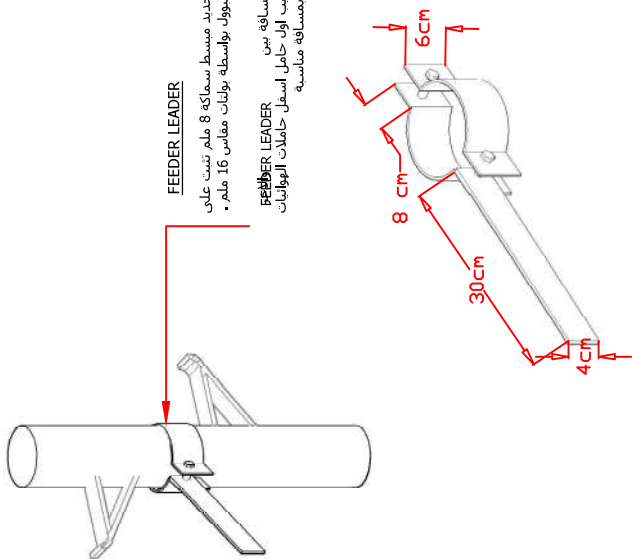


Sheet	5/5
Style	Civil
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Date	DEC-2025

FEEDER LEADER

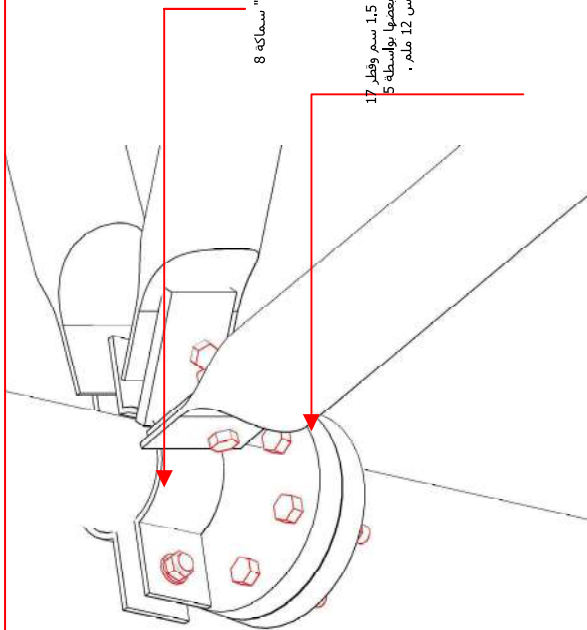
مساكن " قشبان " حديد مسط سماكة 8 ملم تثبيت على
الماسورة الرئيسية للبوول بواسطة بولبات مفاس 16 ملم .

يراعى ان لا تزيد المسافة بين
FEEDER LEADER يتم تركيب اول حامل اسفل حاملات البولبات
عن 1.5 متر ، يتم تركيب اول حامل اسفل حاملات البولبات
بمسافة مناسبة



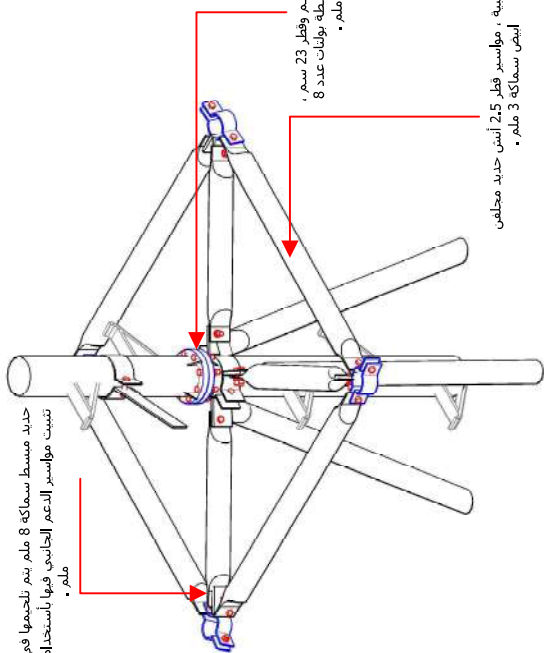
قشبان " مساكن " سماكة 8 ملم .

فلانشة سماكة 1.5 سم وقطر 17
سم تثبت مع بعضها بواسطة 5
بولبات مفاس 12 ملم .



فلانشة سماكة 2 سم وقطر 23 سم ،
تثبت مع بعضها بواسطة بولبات عدد 8
قطر 16 ملم .

دعامات خاسية ، مفاسير قطر 2.5 انش حديد مخلفن
ابيض سماكة 3 ملم .



حديد مسط سماكة 8 ملم يتم تلحيما في المساكات ويتم
تثبيت مفاسير الدعم الجانبي فيها باستخدام بولت مفاس 12
ملم .

مساكن " قشبان " حديد مسط سماكة 8 ملم تثبيت
على الماسورة الرئيسية للبوول بواسطة بولبات
مفاس 16 ملم .

حديد مسط سماكة 8 ملم وارتفاع 8 سم وطول مناسب ،
يتم تلحيما في المساكات ويتم تثبيت مفاسير الدعم
الجانبي فيها باستخدام بولت مفاس 12 ملم .

رولان بابعاد 4 * 4 سم وسماكة 8 ملم
عدد 4 رولان .

