Technical Compliance Evaluation Criteria							
Clause	**Clause Type**	**Requirement**	**Compliance (Compliant (2)/ Partially Compliant(1)/ Non Compliant(0))**	**Scoring (0,1,2)**	**Comments/ Proof of Compliance**	**TFR Comments**	**TFR Compliant Status**
1. General							
1.2	**Essential**	Qualified Personnel Requirement The supplier must demonstrate access to at least one qualified electrician (Red Seal) or electronics technician (National Diploma – Light Current), competent in soldering, cable routing, ESD-safe handling, and safe use of locomotive onboard power supplies. Evidence of qualifications must be submitted with the bid.					
1.3	**Essential**	Technical Documentation & Compliance Evidence The supplier must provide technical datasheets and supporting documentation for the CMOS batteries, GPS receiver cables, and maintenance tools, clearly demonstrating compliance with: BBH8405 – CMOS Battery Specification BBH8406 – GPS Receiver Cable Specification BBH8334 – Standardised Tool Specification					
1.4	**Desirable**	Warranty The supplier must provide a minimum 12-month warranty covering defects in materials, workmanship, and performance for all supplied CMOS batteries, GPS receiver cables, and tools. The warranty shall include replacement or repair at no additional cost to Transnet during the warranty period.					
2. BBH8406 – GPS Receiver Cable Specification							
2.1	**Essential**	Cable Length The GPS receiver antenna cable shall be 5.0 m ± 0.05 m, coiled to maintain minimum bend radius during packaging and transport.					
2.2	**Essential**	Cable Type & Construction The cable shall be a 50 Ω low-loss coaxial cable with nominal 6.10 mm OD (0.240"), ultra-flexible, UV-resistant PVC jacket. Inner conductor shall be solid bare copper-clad aluminium, dielectric shall be foamed polyethylene (PE), with bonded aluminium foil + ≥90% tinned copper braid shielding coverage.					
2.3	**Essential**	Electrical Performance - Impedance: 50 Ω ± 2 Ω - Velocity of propagation: ≥ 83% - Capacitance: ~79.4 pF/m - Attenuation: ≤ 32.4 dB/100 m at 1500 MHz (≤ 1.9 dB over 5 m) - VSWR: ≤ 1.5 at 1.5 GHz - Insulation resistance: ≥100 MΩ @ 500 VDC					
2.4	**Essential**	Frequency & GPS Compatibility Cable shall support GPS frequencies, specifically L1 band at 1.57542 GHz, ensuring full compatibility with locomotive GPS systems.					
2.5	**Essential**	Shielding & EMI Protection Shielding effectiveness shall be ≥90 dB against EMI/RFI, equivalent or superior to LMR240 UF performance.					
2.6	**Essential**	Bend Radius & Durability - Minimum bend radius: 19.1 mm (single bend), 63.5 mm (repeated bends) - Cable must withstand locomotive vibration (IEC 61373, Category 1, Class B) and repeated flexing without degradation.					
2.7	**Essential**	Environmental Conditions - Operating temperature: –40 °C to +85 °C - Jacket: black, UV-resistant PVC - Connectors shall be sealed with adhesive-lined heat-shrink sleeves for moisture protection.					
2.8	**Essential**	Connectors - Receiver side: Right-angle (90°) BNC crimp plug, 50 Ω, DC–4 GHz, VSWR ≤ 1.2 @ 1 GHz. - Antenna side: Straight SMA crimp plug, 50 Ω, DC–18 GHz, VSWR ≤ 1.15 @ 3 GHz. - Materials: brass or stainless steel, gold-plated contacts. - Attachment method: crimp (outer conductor), solder (centre conductor).					
2.9	**Desirable**	Certification & Compliance Supplier must provide evidence of compliance with ISO 9001, RoHS, and REACH.					
2.10	**Desirable**	Labelling & Traceability Each cable shall be labelled with specification number, assembly length, revision, date code, and manufacturer batch number on yellow heat-shrink sleeves with protective clear sleeve for durability (legible after UV and 85 °C exposure).					

2.11	**Desirable**	Documentation Supplier must provide datasheets and supporting compliance documentation (BBH8406, IEC 61196-1/6, MIL-C-17 reference, RoHS/REACH).					

3. BNC Plug Requirements							
3.1	**Essential**	Connection The GPS receiver connection shall use a right-angle (90°) BNC crimp plug designed for 0.240″ (6.10 mm) 50 Ω coaxial cable, mated to the GPS receiver jack.					
3.2	**Essential**	Mechanical Design The BNC plug shall have a 90° right-angle design to facilitate installation in confined locomotive spaces and ensure proper cable routing.					
3.3	**Essential**	Environmental Sealing When mated, the connection shall meet or exceed IP65 rating, providing protection against dust ingress and low-pressure water jets.					
3.4	**Essential**	Compliance Evidence The supplier shall provide datasheets and compliance documentation demonstrating IP65 performance, electrical specifications, and VSWR limits, as per BBH8406.					
3.5	**Essential**	Materials The BNC plug shall be constructed from nickel-plated or stainless-steel body materials with gold-plated brass centre contacts, ensuring corrosion resistance, mechanical durability, and reliable electrical performance.					
3.6	**Essential**	Electrical Characteristics - Impedance: 50 Ω nominal - Frequency range: DC – 4 GHz - VSWR: ≤ 1.2 up to 1 GHz - Insertion loss: ≤ 0.3 dB @ 1.5 GHz - Rated for ≥ 500 mating cycles without significant performance degradation					
3.7	**Desirable**	Mechanical Retention The BNC plug shall provide a retention force of ≥100 N, preventing accidental disconnection in environments subject to vibration and movement (IEC 61373 Category 1, Class B).					
3.8	**Essential**	Operating Conditions The BNC plug shall operate reliably within –40 °C to +85 °C, suitable for locomotive vibration, shock, and environmental conditions.					
3.9	**Essential**	Crimp Compatibility The BNC plug shall be specifically designed for LMR240-type coaxial cable, with appropriate ferrule and centre pin dimensions to ensure a secure crimp connection.					
3.10	**Essential**	Cable Termination Protection The BNC-to-cable joint shall be finished with an adhesive-lined heat-shrink sleeve (Ø 6 mm), or equivalent approved sealing solution, providing mechanical support, strain relief, and moisture protection.					
3.11	**Desirable**	Labelling - Each plug shall be labelled with the designation: - "44D/43D GPS RX-BULKHEAD" for Class 44D/D43 - The label shall be applied ≥30 mm from the heat-shrink sleeve. - Labels shall use a Ready Print HS 6.4-2.1 mm yellow sleeve (or equivalent) and be covered by a 4041-2598-HS 6.4 mm clear sleeve (or equivalent) for durability. - Labels shall remain legible after exposure to 85 °C and UV light.					
4. Bulkhead Connector Plug							
4.1	**Essential**	Connection The bulkhead connection shall use a straight SMA crimp plug, designed for 0.240″ (6.10 mm) 50 Ω coaxial cable, providing direct alignment to the antenna bulkhead port without unnecessary bending or strain.					
4.2	**Essential**	Mechanical Design The SMA plug shall be a straight design to allow efficient routing and stress-free connection to the bulkhead interface.					
4.3	**Essential**	Environmental Sealing When mated, the SMA connection shall meet or exceed IP65 rating, protecting against dust ingress and low-pressure water jets.					
4.4	**Essential**	Compliance Evidence The supplier shall provide datasheets and compliance documentation for SMA plug performance, including IP65, VSWR, and mechanical retention per BBH8406.					
4.5	**Essential**	Materials The SMA plug shall use stainless steel or brass body materials, with gold-plated brass centre contacts, ensuring corrosion resistance and stable conductivity.					

4.6	**Essential**	Electrical Characteristics - Impedance: 50 Ω nominal - Frequency range: DC – 18 GHz - VSWR: ≤ 1.15 up to 3 GHz - Insertion loss: ≤ 0.3 dB @ 1.5 GHz - Rated for ≥ 500 mating cycles without degradation					

4.7	**Essential**	Mechanical Retention The SMA plug shall provide a retention force of ≥100 N to prevent disconnection under locomotive vibration (IEC 61373, Category 1, Class B).					
4.8	**Essential**	Operating Conditions The SMA plug shall operate reliably within –40 °C to +85 °C, suitable for locomotive vibration, shock, and environmental conditions.					
4.9	**Essential**	Crimp Compatibility The SMA plug shall be designed for LMR240 UF-type coaxial cable, with ferrule and pin dimensions to ensure secure crimping.					
4.10	**Essential**	Cable Termination Protection The SMA-to-cable termination shall use an adhesive-lined heat-shrink sleeve (Ø 6 mm) or equivalent solution, providing mechanical support, strain relief, and moisture protection.					
4.11	**Desirable**	Labelling - Each SMA plug shall be labelled with the designation: - "BULKHEAD-44D/43D GPS RX" for Class 44D/43D - Labels shall be applied ≥30 mm from the heat-shrink sleeve. - Labels shall use a Ready Print HS 6.4-2.1 mm yellow sleeve (or equivalent), covered by a 4041-2598-HS 6.4 mm clear sleeve (or equivalent) for durability. - Labels must remain legible after exposure to 85 °C and UV light.					
5. CMOS Battery							
5.1	**Essential**	Removal & Replacement Procedure The supplier must demonstrate a safe and effective desoldering and re-soldering process for removing depleted CMOS batteries and installing new ones, ensuring no damage to GPS receiver PCBs.					
5.2	**Essential**	Battery Type & Compatibility The CMOS battery shall be a rechargeable lithium coin cell with characteristics as per BBH8405, fully compatible with Class 43D/44D GPS receivers.					
5.3	**Essential**	Installation Integrity The supplier must ensure precise installation of new CMOS batteries, maintaining correct polarity, secure soldering, and ESD protection measures.					
5.4	**Desirable**	Packaging Batteries must be individually sealed in anti-static blister packaging to prevent short-circuiting and maintain shelf life. Bulk packaging must be available for industrial use.					
5.5	**Essential**	Electrical Characteristics (as per BBH8405) - Nominal voltage: 3.0 V - Charge voltage: 3.1 V ± 0.15 V (constant voltage, tapering to ≤ 0.5 mA) - Nominal capacity: ≥ 100 mAh (15 kΩ continuous discharge, to 2.0 V at 20 °C) - Discharge cut-off voltage: 2.0 V - Nominal discharge current: 0.3 mA - Nominal charge current: 4.5 mA - Internal resistance: ≤ 50 Ω (fresh cell, 25 °C) - Voltage stability: Output ≥ 2.5 V during service life					
5.6	**Essential**	Performance Requirements - Stable voltage throughout discharge cycle - Self-discharge rate ≤ 2% per month at 25 °C - Cycle life: ≥ 500 cycles at 20% depth of discharge (IEC 61960) - Capacity retention: ≥ 80% after 500 cycles - Long-term reliability ≥ 3 years of RTC/memory support under normal ops					
5.7	**Essential**	Environmental Conditions - Operating temperature: –20 °C to +60 °C - Storage temperature: –20 °C to +70 °C (≤ 12 months at ≤ 60% SOC) - Vibration resistance: IEC 60068-2-6 (10–500 Hz, 0.75 mm, 1 g) - Shock resistance: IEC 60068-2-27 (150 m/s², 11 ms, 3 axes) - Humidity resistance: 95% RH at 40 °C for 48 h (≤ 10% capacity loss) - Altitude tolerance: Operable up to 15,000 m equivalent (UN38.3)					
5.8	**Essential**	Safety & Protection - Must meet IEC 60086-4, UL 1642, and IEC 62133 standards - Protection against overcharge, over-discharge, and short-circuit - No leakage, swelling, or venting permitted within rated conditions					
5.9	**Essential**	Tooling & Equipment The supplier must provide all required precision soldering tools, ESD mats, and handling fixtures for safe removal, installation, and testing of CMOS batteries in GPS receivers.					
6. Tools Requirements (BBH8334 Aligned)							

6.1	**Desirable**	Standards Compliance All tools must comply with EN 50343 (railway cabling installation), IEC 61010-1 (safety of electrical measurement instruments), SANS/IEC 60900 (insulated hand tools), and other relevant IEC/ISO standards as applicable.					
6.2	**Desirable**	TFR Specification Alignment Tools must conform to Transnet Freight Rail (TFR) Standardised Tool Specification BBH8334, covering: - GPS receiver cable testing tools - CMOS battery charging and verification tools - Precision soldering tools - ESD-protected handling equipment					
6.3	**Desirable**	Calibration & Certification - All electrical test instruments (e.g., digital multimeters) must carry valid calibration certificates issued by accredited laboratories. - Product-level certifications (CE, UL, RoHS, IEC 62133 where applicable) must be provided for chargers, soldering kits, and ESD tools.					
6.4	**Desirable**	Continuity & Electrical Testing Tools Continuity test tools (digital multimeters) must: - Be True RMS, CAT III 1000 V / CAT IV 600 V rated - Detect open/short circuits down to milliohm resolution - Support measurement of resistance, capacitance, frequency, and diode tests - Include audible continuity function and backlit display					
6.5	**Essential**	Lithium Coin-Cell Charger The supplier must provide lithium coin-cell chargers compliant with BBH8334: - Output voltage: 3.1 V ± 0.05 V, ripple ≤ 50 mV - Charge current: 0.3–1.0 mA, suitable for CMOS backup cells - Safety: over-voltage, over-current, reverse polarity, thermal protection - Certification: CE/UL or equivalent					
6.6	**Essential**	Precision Soldering Kit The supplier must provide intelligent soldering kits compliant with BBH8334, featuring: - Temperature range 80–420 °C, PID closed-loop control (±2%) - Heat-up time ≤ 8 s to 350 °C - OLED display, multi-tip compatibility, auto-sleep/auto-shutoff - ESD-safe with tip-to-ground resistance ≤ 2 Ω					
6.7	**Essential**	Portable ESD Mat Suppliers must provide IEC 61340-5-1 compliant portable ESD mats with: - Dimensions ≥ 600 × 900 mm - Surface resistance: 10^6–10^9 Ω - Roll-up design, weight ≤ 1.5 kg, supplied with ground cord and press stud					
Total Scoring							