

**V2.3**

**15 September 2021**

**Annex A STATEMENT OF REQUIREMENT**

**Global Navigation Satellite System**

**Simulator System for the**

**Anechoic Chamber Test Facility**

LIST OF ABBREVIATIONS

| **Abbreviation** | **Definition** |
| --- | --- |
| AC | Alternating Current |
| ACTF | Anechoic Chamber Test Facility |
| AES | Advanced Encryption Standard |
| AGL | Above Ground Level |
| AJ | Anti-Jam |
| ALARP | As Low As Reasonably Practicable |
| Az | Azimuth |
| BPSS | Baseline Personnel Security Standard |
| COTS | Commercial Off The Shelf |
| CRPA | Controlled Radiation Pattern Antenna |
| DoF | Degrees of Freedom |
| DSTL | Defence Science and Technology Laboratory |
| EGNOS | European Geospatial Navigation Overlay Service |
| El | Elevation |
| EME | Electromagnetic Environment |
| ES | Encrypted Signal |
| FAT | Factory Acceptance Test: A factory trial, demonstration or simulation conducted by the supplier at the supplier premises to demonstrate that the Simulator System complies with the Authority’s requirement contained within this Statement of Requirement. The Contractor shall carry out FAT of the Simulator System for the agreement by the Authority.  |
| GNSS | Global Navigation Satellite System |
| GPS | Global Positioning System |
| GUI | Graphical User Interface |
| HAS | Hardened Aircraft Shelter |
| HS&EP | Health Safety & Environmental Protection |
| ICD | Interface Control Document |
| ILS | Integrated Logistic Support |
| IMU | Inertial Measurement Unit |
| IRNSS | Indian Regional Navigation Satellite System |
| ISSS | Information Set Safety Summary |
| ITAR | International Traffic in Arms Regulation |
| ITEAP | Integration Test Evaluation and Acceptance Plan |
| JSP | Joint Services Publication |
| MCOS | Multi Constellation Open Service |
| MGUE | M-Code GPS User Equipment |
| MoP | Measure of Performance |
| MOTS | Military Off The Shelf |
| NAVWAR | Navigation Warfare |
| NCSC | National Cyber Security Centre |
| OS | Open Signal |
| PMP | Project Management Plan |
| PNT | Position, Navigation and Timing |
| POEMS | Project Orientated Environmental Management System |
| POSMS | Project Orientated Safety Management System |
| PRS | Public Regulated Service |
| PSS | Products, Services and/or Simulator System |
| QZSS | Quasi Zenith Satellite System |
| REACH | Registration, Evaluation, Authorisation and restriction of Chemicals |
| RF | Radio Frequency |
| RGNS | Robust Global Navigation System |
| RHCP | Right Hand Circular Polarized  |
| ROMP | Risk and Opportunity Management Plan |
| SAT | Site Acceptance Test: Installed performance testing conducted by the Contractor at the Authority’s ACTF premises at MoD Boscombe Down. The Contractor shall conduct SAT to confirm the Simulator System meets the installed performance requirements to the satisfaction of the Authority or its representative.  |
| SBAS | Space Based Augmentation System |
| Simulator System | The Simulator System delivered by the Contractor shall comprise the GNSS Simulator System hardware and software including all necessary antennas, cables (excluding simulator to antenna cables), connectors, ancillaries (including any unique adaptors, connectors, jigs, tools and test aids required for its operation) and documentation to enable operation in the ACTF. |
| SIS | Signals In Space |
| SoR | Statement of Requirement |
| SQEP | Suitably Qualified and Experienced Personnel |
| SQuaRE | Software Product Quality Requirements and Evaluation |
| TEAS | Test, Evaluation and Acceptance Schedule |
| TEAP | Test, Evaluation and Acceptance Plan |
| TME | Test Measurement Equipment |
| UUT | Unit Under Test |
| WAAS | Wide Area Augmentation System |
| WEEE | Waste Electrical and Electronic Equipment |

Section 1 – Background

* 1. The UK Global Navigation Satellite System Project Office (UK GNSS PO) currently operates a Global Positioning Satellite (GPS) simulator capability in an Anechoic Chamber Test Facility (ACTF) at MoD Boscombe Down. This simulator is now obsolete and will be replaced with a Simulator System capable of supporting the full open service Global Navigation Satellite System (GNSS) constellations/signals and GPS P-Code/M-Code services. For the avoidance of doubt, acquisition of the new ACTF and Hardened Aircraft Shelter (HAS) in which the ACTF will be housed are outside of the scope of this requirement.
	2. This Statement of Requirement is for a GNSS Simulator System to be installed in the Authority’s new ACTF and will be used to provide a test capability for various GNSS receivers and Controlled Reception Pattern Antenna (CRPA) based Anti-Jam (AJ) systems within the ACTF. Operation of the Simulator System will be by personnel from Defence Science and Technology Laboratories (DSTL).
	3. The current ACTF is housed within a Hardened Aircraft Shelter (HAS) at MoD Boscombe Down and comprises a 7m dome fitted with appropriate Radar Absorbent Material (RAM) together with all necessary electrical supply services. It is expected that the new HAS that the Simulator System this requirement is to be delivered into will be of similar dimensions- see Appendix 3 to this Statement of Requirement for details. The new ACTF will also be located at MoD Boscombe Down.
	4. The operational context for the delivery of a GNSS capable ACTF Simulator System is to test, analyse and evaluate MoD platform Position, Navigation and Time (PNT) systems in a representative Navigation Warfare (NAVWAR) environment to inform PNT assurance, system validation and inform platform NAVWAR mitigation requirements.

**CONTRACTOR DELIVERABLES**

Section 2- technical

2.1 The Contractor shall deliver to the Authority and install in the Authority’s ACTF a Simulator System to the thresholds and, where confirmed in the Contractor’s tender, to the objectives as defined in Appendix 1 to this Statement of Requirement.

2.2 The Simulator System delivered by the Contractor shall comprise the GNSS Simulator System hardware and software including all necessary antennas, cables (excluding simulator to antenna cables), connectors, ancillaries (including any unique adaptors, connectors, jigs, tools and test aids required for its operation) and documentation to enable operation in the ACTF.

2.3 The Contractor shall deliver an Integration Test Evaluation and Acceptance Plan (ITEAP) within 10 days of contract commencement. The Contractor shall update the ITEAP as necessary and reissue to the Authority to reflect project changes and circumstances throughout the contract.

2.4 The Contractor shall deliver a Factory Acceptance Test (FAT) at its own premises and shall invite the Authority to attend. The FAT shall be a demonstration or simulation to demonstrate that the Simulator System complies with the Authority’s requirement contained within Appendix 1 of this Statement of Requirement. The FAT must be delivered by the date confirmed in the Contractor’s tender which shall either be on or before 31 May 2022.

2.5 Following the FAT, the Contractor shall provide a FAT Report which shall detail and explain the results of the FAT, specifying how it met the Authority’s requirement in Appendix 1 of the Statement of Requirement by the date confirmed in the Contractor’s tender which shall either be on or before 31 May 2022 .

2.6 Within 30 days from delivery of the FAT Report the Contractor shall deliver to the Authority the following:

2.6.1 Copies of all installed software in a suitable format for re-installation if required in CD, DVD or downloadable from an internet site

2.6.2 All licence information for supplied software including registration keys soft copy in MS Word format

2.6.3 A Simulator System Handbook in hard copy and soft copy in Microsoft (MS) Word and Adobe pdf format that shall contain, but not limited to the following:

2.6.3.1 Operator instructions

2.6.3.2 Installation and commissioning instructions including environmental operating parameters

2.6.3.3 Diagnostic procedures and maintenance schedules

2.6.3.4 Calibration procedure/schedule

2.6.3.5 Preventative/corrective maintenance schedules and procedures

2.6.3.6 Disposal guide

2.6.3.7 Illustrated parts catalogue showing all spared Line Replaceable Units (LRUs)

2.6.3.8 Modification and upgradeability details

2.6.3.9 Software user’s guide

2.6.3.10 Systems architecture and detailed design document

Section 3 Project Management

3.1 Project Progress Update Report

3.1.1 The Contractor shall deliver to the Authority’s Project Manager on a monthly basis until the FAT Report is delivered by the Contractor and accepted by the Authority and thereafter on a quarterly basis in either Microsoft Office, Adobe, or .pdf format, the following documents which shall be discussed as agenda items during the Project Review meetings at 3.2:

3.1.1.2 Project schedule;

3.1.1.3 Risk register;

3.1.1.4 Project Financial Management report;

3.1.1.5 Progress against the Social Value Performance Objectives at Table 1 of Condition 45.5 of the contract.

3.1.2 In addition to 3.1.1, if the Support and Maintenance Option is taken up, the Contractor shall deliver a report in either Microsoft Office, Adobe, or .pdf format on a quarterly basis a Quarterly Progress Report which details support and maintenance services/work that has been carried out in the previous quarter.

3.2 Project Review Meetings

3.2.1 The Contractor shall attend Project Review Meetings to be held virtually via either Skype or MS Teams on a monthly basis until the FAT Report is delivered by the Contractor and accepted by the Authority and quarterly thereafter. The Contractor shall take minutes of the meeting and submit for the Authority’s review within 5 working days before issuing the final version.

**SECTION 4 SAFETY AND ENVIRONMENTAL**

4.1 The Contractor shall be compliant with and provide management of safety information for proprietary Commercial Off The Shelf (COTS) in accordance with the principles of Def Stan 00-56.

4.2 The Contractor shall be compliant with applicable environmental standards as set out in Appendix 2 of this Statement of Requirement.

**SECTION 5 SECURITY**

5.1 The Contractor shall ensure all their staff who will undertake work on this contract have passed BPSS checks.

5.2 As requested by the Authority, the Contractor shall provide details on the Contractor’s staff for the Authority to carry out SC checks.

5.2 The Authority reserves the right to refuse access to MoD Boscombe Down to any Contractor personnel who are not BPSS cleared or have failed Security Clearance checks.

**SECTION 6 STORAGE, INSTALLATION AND SAT**

6.1 The Contractor shall provide suitable secure storage of the Simulator System and ancillaries for up to 12 months from the delivery of the FAT Report ahead of the Authority’s new ACTF being available.

6.2 The Authority will notify the Contractor when the new ACTF is available and the Contractor shall deliver and install the Simulator System in the ACTF facility at MoD Boscombe Down and conduct a Site Acceptance Test (SAT) within 1 month of the Authority’s notification.

6.3 The Contractor shall provide a SAT Report which shall detail and explain the results of the SAT, specifying how it met the Authority’s requirement in Appendix 1 of the Statement of Requirement within 1 month of the SAT.

### SECTION 7 DISPOSAL OF DEFECTIVE PARTS

7.1 The Contractor shall be responsible for identification, removal and any necessary disposal of defective parts (with the exception of the Authority’s removable drive in item SR-22 of Appendix 1 of this Statement of Requirement, which remain the responsibility of the Authority to manage).

SECTION 8 – OPTION: support and maintenance

8.1 Following delivery of the SAT Report, the contract may be extended at the discretion of the Authority to 31 March 2024 to provide for the Contractor to deliver support and maintenance services to the Simulator System in accordance with SS-3 of Appendix 1 of this Statement of Requirement. Support and maintenance shall cover all elements of the delivered Simulator System including the software, hardware, firmware, ancillaries and any factory recalibration. The Contractor shall provide resources required to correct a deficiency or design error, incorporate an enhancement, or respond to a hardware/software change or manage obsolescence.

**APPENDIX 1: SIMULATOR SYSTEM SPECIFICATIONS**

| **ID** | **Simulator System Requirement** | **Measures of Performance** | **Demonstrated at [followed by FAT Report/ SAT Report delivered to the Authority]** |
| --- | --- | --- | --- |
|  |  | **Threshold** | **Objective** |  |
| SR-1 | The simulator system shall broadcast signals that replicate those emitted by all current GNSS constellations. | GPS:All open signalsP CodeAES M-codeGalileo:All open signalsPseudo PRSGLONASS:All open signalsBeidou:All open signals | As threshold plus:SBAS including IRNSS, QZSS, EGNOS and WAAS. Galileo High Accuracy Service. | FAT |
| SR-2 | The simulator system shall broadcast signals across all frequency bands emitted by current GNSS constellations. | 1559MHz – 1612MHz (GNSS L1/E1 band)1215MHz – 1256MHz (GNSS L2 band)1160MHz – 1214MHz (GNSS L5/E5 band)  | As threshold plus:1260 - 1300 MHz (GNSS E6 band). 2483 – 2501 MHz (IRNSS S-Band) | FAT |
| SR-3 | The simulator system shall simultaneously and synchronously broadcast the signals and frequencies aligned with these requirements. | Simultaneous broadcast of signals and frequencies from all satellites 'in view' at a given place and time across all implemented GNSS constellations. | N/A | FAT |
| SR-4 | The simulator system shall allow the independent selection and deselection of any individual signal and frequency. | Selection of any combination of implemented signals in SR-1 and frequencies from all satellites 'in view' at a given place and time.  | As threshold plus:Dynamic 'in-run' selection and deselection of signals and frequencies. | FAT |
| SR-5 | The simulator system shall be controlled via a single User Interface | Single GUI for run-time controlAdditional applications/files for lower level set-up is acceptable (e.g. parameter files, calibration, etc.).The simulator system shall not incur unreasonable physical strain on the user to view or operate the simulator system. | As threshold plus:Single GUI which allows set-up of:* Calibration
* Generation and tuning of all low level parameters
* Control / Display of data from external systems
* Batch processing / Auto running scenarios
 | FAT |
| SR-6 | The simulator system shall generate the necessary number of independently controlled Radio Frequency (RF) outputs to drive broadcast antennas representing the geometry of the Pseudo GNSS constellation to within a defined angular error. | The maximum angular error between the simulated satellite and the physical broadcast antenna position is 15° measured from the chamber centre (1m Above Ground Level - AGL) for the entire validity period. | The maximum angular error between the simulated satellite and the physical broadcast antenna position is 12.5° measured from the chamber centre (1m AGL) for the entire validity period. | SAT |
| SR-7 | The simulator system shall broadcast signals for all satellites ≥7° above the simulated horizon at 1m AGL at the chamber centre. | 7° | All satellites ≥ 0° | SAT |
| SR-8 | The simulator system shall allow valid testing compliant with all requirements continuously for at least 40 minutes. | 40 minutes | Greater than 24 hours | SAT |
| SR-9 | The simulator system shall replicate signals emitted by all satellites visible to a receiver at a given place and time. | Fixed location (MoD Boscombe Down ACTF)Fixed date and time period. | Global24/7/365 (throughout the entire day, and on every day of the year) | SAT |
| SR-10 | The simulator system shall provide the required Right Hand Circular Polarised (RHCP) GNSS broadcast antennas covering all implemented frequency bands. | The simulator system shall provide the required Right Hand Circular Polarised (RHCP) GNSS broadcast antennas covering all implemented frequency bands. | N/A | SAT |
| SR-11 | The simulator system shall provide the ability to input almanac; ephemeris; Ethernet motion and file transfer motion data, and output platform state data. | Input:Almanac (All constellations)Ephemeris (RINEX)Ethernet Motion (9DOF)File transfer Motion (9DOF)Output:Platform state (PVT, Accel, Attitude, etc.) file | As threshold plus:Input:In-run ephemeris updates via external source.Output:Platform state (PVT, Accel, Attitude, etc.) live stream | FAT |
| SR-12 | The simulator system shall provide the ability to emulate platform motion in 9 Degrees of Freedom (DOF).Note that the Authority will not provide dynamic models for representative platforms. | Internally generated basic motion elements (including but not limited to):•Static•Acceleration•Straight•Turns•Climb•HaltExternal motion input via:•Pre-recorded user motion.•Real-time control via external interface.100Hz minimum update rate | As threshold plus:Internally generated dynamic models:•Land•Maritime (including emulation of sea state)•Air (fixed wing / rotary wing / missile)•Update rate of at least 1KHz. | FAT |
| SR-13 | The simulator system shall provide the ability to model ionospheric and tropospheric delay. | Implementation of standard models (e.g. Klobuchar).Implementation of constellation specific models (as defined in the SR-1 SiS ICDs). | As threshold plus:Ability to modify the standard and constellation model parametersAbility to enter user-defined custom models (user provided/defined). | FAT |
| SR-14 | The simulator system shall allow both the conditioning of its internal oscillator/clock from an external source and provide an output to condition downstream equipment from its internal source. | 10MHz (in and out)1 Pulse Per Second (PPS) (in and out) | N/A | FAT |
| SR-15 | The simulator system shall accept both an external 'trigger' for simulation start and provide the ability to 'trigger' downstream equipment. | Falling / Rising edge trigger pulse.1PPS Gated to scenario start. | N/A | FAT |
| SR-16 | The simulator system shall generate the full range of SiS ICD specified RF power levels as measured at all calibration points defined in SR-21 for all current GNSS constellations (SR-1).  | All SiS ICD powers (including M-Code Regional Military Power levels) at all calibration points defined in SR-21. | As threshold plus:Additional ±10dB dynamic range outside the SiS ICD power levels. | SAT |
| SR-17 | The simulator system shall automatically control power level 'in-run' to model real world GNSS constellation effects. | Satellite rangeSatellite transmit antenna pattern.Atmospheric lossesUser defined platform body masking (receiver antenna pattern). | N/A | FAT |
| SR-18 | The simulator system shall allow the user to control the RF power levels. | Modification at the individual signal level (both predefined before simulation start and dynamic/live). | As threshold plus:Ability to power control any combination of signals as multiple independent groups. | FAT and SAT |
| SR-19 | The simulator system shall operate without influence, interference or feedback while other RF generating sources are also being operated in the ACTF. | Maximum in-band power density at the simulator transmit antenna:No degradation of performance during operation at 10W/m2.No risk of damage at 100W/m2. | N/A | FAT |
| SR-20 | The simulator system shall provide the ability to modify the navigation message content on each signal individually. | At simulation start.Fixed throughout. | As threshold plus:Predefined changes 'in-run'andDynamically during simulation. | FAT |
| SR-21 | The simulator system shall have a calibration capability. | Self-calibration routines for the simulator system:RF power at chamber centre calibration. Per broadcast -antenna manual calibration of the simulator system.RF power calibration at the location of the equipment under test\*.Signal phase/delay calibration to ensure the generation of a fully coherent position solution at the location of the equipment under test\*. Any return to factory calibration requirement\*Test is defined to be between 1m and 3m above chamber ground-level anywhere within the ground footprint of the chamber to allow testing of antennas installed on military platforms  | As threshold, but fully automated calibration routines | FAT and SAT |
| SR-22 | The simulator system shall have removable drives to allow secure storage of all Software and data away from the main unit. | The contractor will provide 2 removable, fully operational copies of the system drives, with all necessary Software and licensing required to run the simulator system. This is required to allow different classifications of work to be completed via ‘hot swap’ system drives. | N/A | FAT |
| SR-23 | The simulator system shall be capable of being upgradable/modifiable for at least one additional future GNSS SiS change. | To be capable of responding to updates / changes to current GNSS SiS ICDs for:•Constellations•Signals•Frequencies | As threshold plus:Generation of all (as yet undefined) future GNSS Constellations, Signals and Frequencies | FAT |
| SR-24 | The simulator system shall be upgradable/modifiable to support a future augmentation for provision of simulated Inertial Measurement Unit (IMU) data, coherent with the simulated GNSS signals, via a live serial data stream. | Data stream and driving error model fully compatible with NATO STANAG 4572. | As threshold plus Additional test ports (for example but not limited to Litton and Honeywell) interface IMU data stream standards. | FAT |
| SR-25 | The simulator system shall operate from a single-phase AC, 50 Hz, 230V supply.  | The simulator system shall operate from a single-phase AC, 50 Hz, 230V supply. | N/A | FAT |
| SR-26 | The simulator system shall operate within a minimum temperature range of 15°C to 35°C and a relative humidity range of 25% to 75%.  | Conform within the environmental conditions for Category 2 TME as defined in Def Stan 66-31 Part 1 Issue 2. | N/A | FAT  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Training** |  |  |  |
| SS-1 | The Contractor shall deliver training at their premises or remotely to enable the operation of the simulator system by the Authority’s staff. | One month after the SAT Report on a date to be agreed with the Authority, training delivered as a one-off event for up to 5 people.  | Training available Training delivered as a one-off event for up to 10 people.  | (see Threshold) |
| SS-2 | The Contractor shall provide training material to enable the operation of the simulator system throughout its in-service life by the Authority. | 30 days after delivery of the training event at SS-1 Threshold provide training documentation pack such that internal MOD training can be provided by Authority personnel who attended Contractor training at SS-1 above. The training pack shall be delivered in Microsoft Office Word format. | N/A | (see Threshold) |
|  | **Support** |  |  |  |
| SS-3 | The Contractor shall deliver a support solution that provides a technical help line and repair facility that guarantees minimal simulator system downtime.  | 24-hour response time for all support queries between the hours of 0800 to 1700 on working days.Engineer Support on-site within 3 working days.System is fully operational within 5 days | System is fully operational within 2 working days. | (see Threshold) |

**APPENDIX 2: List of Applicable Standards that the Contractor must adhere to**

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| **Ser** | **Standard Title** |
| 1 | Def Stan 66-31, Pt 1, Issue 2 (Dec 2008), Basic Requirements & Tests for Electronic & Electrical Test & Measurement Equipment Part 1: Introduction and Guide to the Specification and Selection of Test and Measurement Equipment by the Procuring Authority |
| 2 | Def Stan 66-31, Pt 2, Issue 2 (Dec 2008), Basic Requirements & Tests for Electronic & Electrical Test & Measurement Equipment Part 2: Contractor General Requirements |
| 3 | Def Stan 00-51, Pt 1, Issue 1, Environmental Management Requirements for Defence Systems Part 1: Requirements |
| 4 | Def Stan 00-51, Pt 2, Issue 1, Environmental Management Requirements for Defence Systems Part 2: Guidance |
| 5 | Def Stan 00-056, Pt 1, Issue 7, Safety Management Requirements for Defence Systems Part 1: Requirements |
| 6 | Def Stan 00-056, Pt 2, Issue 5, Safety Management Requirements for Defence Systems Part 2: Guidance on Establishing a Means of Complying with Part 1. |
| 7 | Def Stan 00-600, Pt1, Issue3, Integrated Logistics Support requirements for MOD projects Part: 01: Integrated Logistics Support (ILS) Requirements |
| 8 | BS EN 61326-1 Electrical Equipment for Measurement, Control and Laboratory Use - EMC requirements Part 1: General Requirements |
| 9 | ISO 25051:2014 Software Engineering - Software Product Quality Requirements and Evaluation (SQuaRE) - Requirements for quality of COTS software product and instructions for testing. |
| 10 | NATO STANAG 4572 Open System Architecture Interface to Enable Simulator Laboratory Test Of Integrated Global Positioning System (GPS) Inertial Navigation Equipment |
| 11 | DEFSTAN 05-135 Avoidance of Counterfeit |
| 12 | DEFSTAN 05-061 Pt 4 Quality Assurance Procedural Requirements - Contractor Working Parties Issue 3 |

**APPENDIX 3:** **Illustrative diagram of ACTF**



Figure 1 provides an indicative illustrative view of the 7 metre radius dome (B) housed within the Hardened Aircraft Shelter (A).

The key point to note is that access may be limited by the 1.5 metre (C) access walkway to the dome.