



Ministry
of Defence



Type 23 - Power Generation and MCAS Update (PGMU)

ANNEX B TO SCHEDULE A TO CONTRACT SSA/004/01

General Technical Requirements (GTR)

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CONTENTS

CONTENTS	3
1 INTRODUCTION.....	7
1.1 Purpose.....	7
1.2 Document Description.....	7
1.3 Conventions	8
1.4 Relationship with Other Documents.....	8
1.5 Engineering Standards.....	9
2 SCOPE OF SUPPLY	10
2.1 Background	10
2.2 PGMU Equipment Overview.....	11
3 SAFETY, ENVIRONMENTAL AND MATERIALS REQUIREMENTS	13
3.1 Product Safety and Environmental Management.....	13
3.2 Overriding Constraints.....	13
3.3 Material Selection Requirements	14
3.4 Materials New to RN Warship Service	14
3.5 Qualification of New Materials.....	15
3.6 Personnel Safety.....	16
3.7 Arc-Flash.....	17
3.8 Low Fire Hazard Materials.....	17
3.9 Preventing Damage to the Environment	18
3.10 Paint Selection and Application	19
3.11 Paints Applied to Equipment in Manufacturer's Works	19
3.12 Paint Applied to Equipment Onboard Ship	20
3.13 Substrate Preparation	20
3.14 Materials - Resistance to Corrosion.....	20
3.15 Materials - Shock Resistance	21
3.16 Materials Suitability	21
4 SIGNATURE MANAGEMENT REQUIREMENTS.....	22
4.1 General.....	22
4.2 Radar Cross Section and Visual Signature.....	22
4.3 Infrared Signature	23
4.4 Magnetic Signature.....	23
4.5 Control of Noise and Vibration.....	23
4.6 Noise and Vibration Measurement.....	23
4.7 Vibration Limits	24
4.8 Interfaces	24

HANDLING INSTRUCTION – COMMERCIAL IN CONFIDENCE

Power Generation & MCAS Update	SSA004/01 General Technical Requirements
4.9	Airborne Noise Limits..... 24
4.10	Equipment Noise Mounts..... 24
4.11	Factory Acceptance Tests (FAT)..... 25
5	SHOCK REQUIREMENTS..... 26
5.1	General..... 26
5.2	Shock Mounting Design 26
5.3	Equipment Shock Class 27
5.4	Shock Capability Requirement..... 27
5.5	Shock Captivity Requirement..... 27
5.6	Shock Recoverability Requirement 27
5.7	Equipment Shock Qualification Data 28
6	HUMAN FACTORS ENGINEERING REQUIREMENTS 30
6.1	General Requirements..... 30
6.2	Human Environment - Noise..... 30
6.3	Human Environment - Vibration..... 30
7	SUPPORTABILITY REQUIREMENTS..... 31
7.1	General..... 31
7.2	Design Life and Operating Cycle..... 31
7.3	Availability 31
7.4	Standardisation of Equipment and Components 31
7.5	Reliability 32
7.6	Manning 32
7.7	Maintenance 33
7.8	Maintenance Burden and Operating Profile..... 33
7.9	Space and Removal Requirements..... 33
7.10	Maintainability Features 34
7.11	Ship Husbandry..... 35
7.12	Ship's Staff Maintenance Tasks 36
7.13	Base Staff Maintenance Tasks 36
7.14	Support and Test Equipment..... 36
7.15	Fire Suppression Ports 37
8	OPERATIONAL ENVIRONMENT REQUIREMENTS..... 38
8.1	Introduction 38
8.2	Climate - External Conditions..... 38
8.3	Internal Conditions 39
8.4	Ship Angles 39
8.5	Ship Motions..... 40
8.6	Vibration Levels 40

HANDLING INSTRUCTION – COMMERCIAL IN CONFIDENCE

Power Generation & MCAS Update	SSA004/01 General Technical Requirements
8.7	Electromagnetic Environmental Effects 40
8.8	Magnetic Fields 41
8.9	Effluxes and Exhausts..... 41
8.10	Provision of Ships Services..... 41
9	PREVENTING DAMAGE TO EQUIPMENT42
9.1	Solvents - Cleaning of Equipment..... 42
9.2	Solvents - Equipment Packaging 42
9.3	Contaminants - Deliberate Exposure to Equipment..... 42
9.4	Contaminants - Accidental Exposure to Equipment..... 42
9.5	Chemical Compatibility 43
10	PRODUCTION REQUIREMENTS.....43
10.1	General..... 43
10.2	Packaging 43
10.3	Lifting Points and Lifting Arrangements 43
10.4	Jigs and Tooling..... 43
10.5	Contractor Modules 44
10.6	Structural Requirements 44
10.7	Equipment Coating and Insulation..... 44
11	GENERAL ELECTRICAL REQUIREMENTS.....45
11.1	Conformance 45
11.2	General Electrical Standards 45
11.3	Quality of Electrical Supplies 45
11.4	Maintained Supplies - Policy 46
11.5	Loss of Electrical Supplies 46
11.6	Power Supplies - Fixed Equipment..... 46
11.7	Power Supplies - Portable Equipment 47
11.8	Enclosure Protection Rating..... 47
11.9	Earthing and Bonding 47
11.10	Use of Solder 47
11.11	Electrical Equipment Terminations and Connections 48
11.12	Anti-Condensation Heaters..... 48
12	GENERAL MECHANICAL REQUIREMENTS50
12.1	Terminal Flanges..... 50
12.2	High Pressure Air services 50
12.3	Sea Water Cooling Services 50
12.4	Flooding..... 50
13	GENERAL ENGINEERING REQUIREMENTS51

HANDLING INSTRUCTION – COMMERCIAL IN CONFIDENCE

Power Generation & MCAS Update	SSA004/01 General Technical Requirements
13.1	Equipment Arrangements 51
13.2	Metrication 51
13.3	Drawings 51
13.4	Lloyd's Notations 52
13.5	Equipment Handling/Portability 52
14	CONTROL AND INSTRUMENTATION REQUIREMENTS53
14.1	General Control & Instrumentation 53
14.2	Status and Condition Monitoring 53
14.3	Software Requirements 54
14.4	Software Safety 54
15	SECURITY REQUIREMENTS57
15.1	General Security Requirements 57
16	GLOSSARY59
16.1	Abbreviations 59
17	REFERENCED DOCUMENTS AND STANDARDS62
17.2	Non-Tradable Engineering Standards 62
17.3	Tradable Engineering Standards..... 65
17.4	Design Guidance Engineering Standards 66

Tables

Table 17-1 – Fixed Engineering Standards.....65
Table 17-2 – Tradable Engineering Standards65
Table 17-3 – Design guidance Engineering Standards.....66

Figures

Figure 1 – PGMU Equipment Interface Diagram.....10
Figure 2 – PGMU Equipment Boundary Diagram11

1 INTRODUCTION**1.1 Purpose**

- 1.1.1 The General Technical Requirements (GTR) specifies requirements with widespread applicability to Type 23 Power Generation and MCAS Update (PGMU) Equipment.

1.2 Document Description

- 1.2.1 The GTR is structured as follows:

Section 1 Introduction

Section 2 Scope Of Supply

Section 3 Safety, Environmental and Materials Requirements

Section 4 Signature Management Requirements

Section 5 Shock Requirements

Section 6 Human Factors Engineering Requirements

Section 7 Supportability Requirements

Section 8 Operational Environment Requirements

Section 9 Preventing Damage to Equipment

Section 10 Production Requirements

Section 11 General Electrical Requirements

Section 12 General Mechanical Requirements

Section 13 General Engineering Requirements

Section 14 Control and Instrumentation Requirements

Section 15 Security Requirements

Section 16 Referenced Documents and Standards

1.3 Conventions

- 1.3.1 Statements in this specification using the term “shall” indicate mandatory or essential requirements. Statements in this specification using the term “should” indicate desirable requirements.

1.4 Relationship with Other Documents

1.4.1 Precedence

- a. The GTR underpins each Technical Equipment Specification (TES) document; in the event of any inconsistency, requirements specified in the relevant TES for the Equipment shall take precedence over requirements in the GTR.

1.4.2 Relationship

- a. The GTR requirements are additional to those specified in the TES for each Equipment. If a GTR requirement requires tailoring for particular Equipment, an Equipment specific requirement is specified in the "Transverse Requirements" section of each TES document;
- b. Certain aspects covered in the GTR may apply differently to different items of Equipment in the scope of supply. Where this is the case, each TES provides the amplification necessary to relate the GTR requirement to the scope of supply items.

- 1.4.3 The GTR should be read in conjunction with the other contract pack documents, in particular:

- a. Statement Of Work (SOW);
- b. TES for each Equipment;
- c. PGMU System Requirements Document (SRD).

1.4.4 Applicability and Compliance

- a. The requirements applicable to the Equipment and any software contained therein are identified by the Authority in the GTR Applicability and Contractor Compliance Matrices, which are included within the Assessment Package.

1.5 Engineering Standards

- 1.5.1 Certain requirements within this GTR may be referenced to defined engineering standards. The relevant requirements specify the standard that is to be applied to the Equipment and Section 17 provides details relating to the identity, configuration status, applicability of the relevant standard and an indication of its 'Non Tradable', 'Tradable' or 'For Design Guidance' categorisation.

2 SCOPE OF SUPPLY

2.1 Background



Figure 1 – PGMU Equipment Interface Diagram

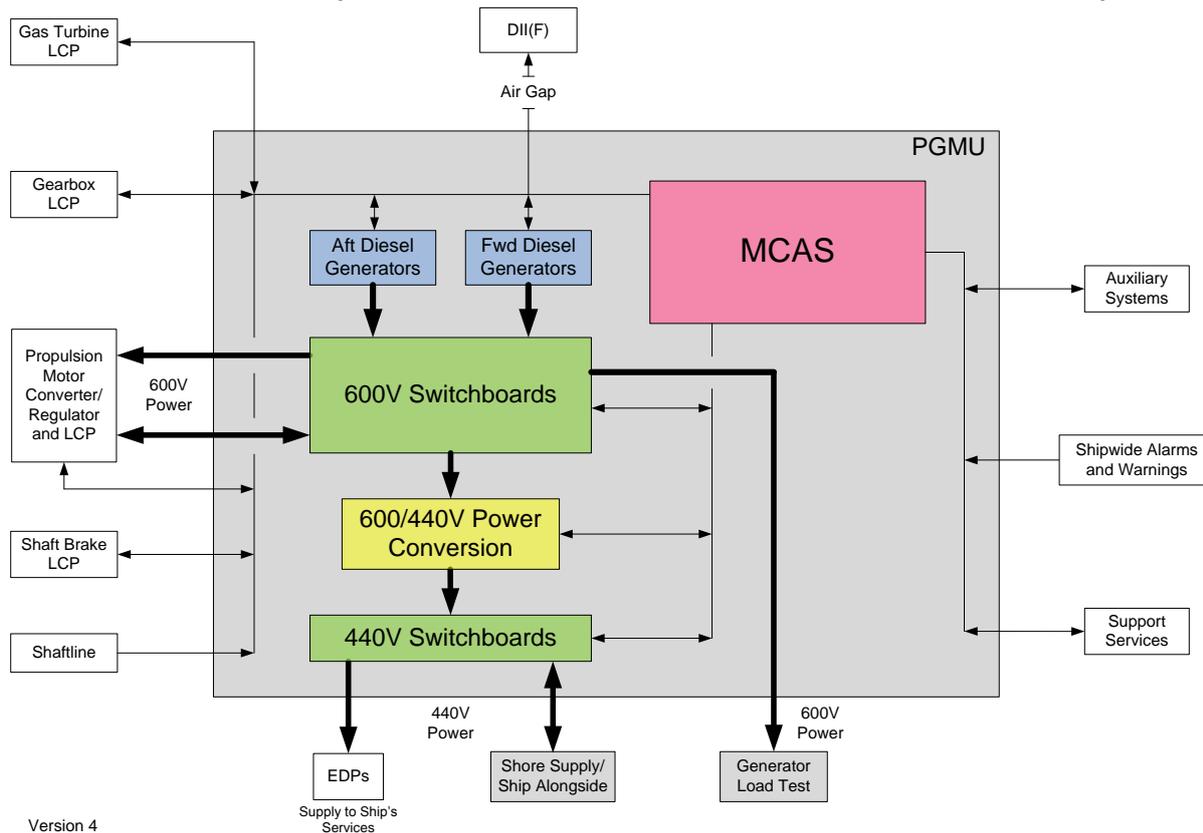


Figure 2 – PGMU Equipment Boundary Diagram

2.2 PGMU Equipment Overview

2.2.1 Within the scope of PGMU, Equipment contracts have been divided into four key lots comprising: Diesel Generators, Motor Generators, Switchboards and MCAS Components.

2.2.2 Diesel Generators



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3 SAFETY, ENVIRONMENTAL AND MATERIALS REQUIREMENTS

3.1 Product Safety and Environmental Management

- 3.1.1 All Equipment shall present an acceptable level of Risk. This is deemed to be that the Risk, both intrinsic and functional have been demonstrated to have been reduced to a level that is As Low As Reasonably Practicable (ALARP) and broadly acceptable, or tolerable, and relevant prescriptive safety requirements have been met, for a system in a given application in a given operating environment.
- 3.1.2 Standards, legislation, and other prescriptive design constraints that could be considered as 'Engineering' safety or environmental requirements are defined in other sections of the GTR.
- 3.1.3 Equipment and components shall meet appropriate provisions of relevant legislation; including, but not limited to:
- a. CE marked or equivalent;
 - b. Machinery Directive;
 - c. Low Voltage Directive (LVD) 2006/95/EC (*);
 - d. Electromagnetic Compatibility (EMC) Directive 2004/108/EC;
 - e. The Supply of Machinery (Safety) Regulations 1992 as amended 2008;
 - f. Electrical Equipment (Safety) Regulations 1994;
 - g. The Electromagnetic Compatibility Regulations 2006;
 - h. Pressure Equipment Regulations 1999;
 - i. Safety Signs and Signals Regulations 1996;
 - j. Control of Noise at Work 2005;
 - k. Marine Equipment Directive (DG Module fire fighting system);
 - l. SOLAS Particularly Ch.II-2/Reg.4 – reduction of hazards presented by pressurised fuel pipe work and hot surfaces;
 - m. IEC 62061 Safety of Machinery.

3.2 Overriding Constraints

- 3.2.1 Equipment dimensions form an overriding constraint to the PGMU project. Dimensions of proposed Equipment should be no greater than that of the Equipment that it is intended to replace.
- 3.2.2 Where existing Equipment dimensions are exceeded this shall be made clear in the tender response and full justification provided.

- 3.2.3 The maintenance space envelope should not present a requirement in excess of the space that is currently available in the current Equipment locations taking into account adjacent Equipment.
- 3.2.4 Where appropriate the tender response should include references to any surveys onboard that may have been carried out in support of the Equipment proposal.

3.3 Material Selection Requirements

- 3.3.1 This section specifies requirements for the selection of materials, used in the Equipment, these shall:
- a. Be suitable for the intended use and environmental conditions in which they are sited;
 - b. Reduce hazards to people to be justifiable as tolerable and ALARP;
 - c. Comply with MOD Hazardous Substance Guidance;
 - d. Reduce potential for harm to the environment so as to be justifiable as tolerable and ALARP;
 - e. Support the Ships through to revised platform OSD;
 - f. Support the goal of cost reduction through minimum maintenance/husbandry;
 - g. Support an interval of at least 6 years between Ship dockings;
 - h. Not be likely to be subject to restriction in use or supply during the Ship's life.
- 3.3.2 All new materials shall be justified in their use.
- 3.3.3 All materials shall be safe when exposed to fire; these should be Low Fire Risk and have fire retardant qualities and in accordance with Section 3.8.
- 3.3.4 The materials shall comply with all relevant legislation as per Section 3.1.3.
- 3.3.5 Where military parts are used these shall carry appropriate traceability to prove they are to military specification and not standard specification parts.
- 3.3.6 The Contractor shall prepare, deliver and maintain List of Materials for review by the Authority [DRL E17].

3.4 Materials New to RN Warship Service

- 3.4.1 Prior to the use of a material that is new to Royal Navy (RN) Warship service, the acceptability of the material(s) shall be confirmed with the Customer in terms of their:

- a. Fire characteristics;
 - b. Impact on Occupational health.
- 3.4.2 As both the type of material and the total quantity to be fitted to the Ship needs to be assessed, the Contractor shall liaise direct with the Authority on these materials matters.
- 3.4.3 The Contractor shall prepare, deliver and maintain a List of Materials for review by the Authority who will advise the Contractor of those materials that are new to RN Warship service.

3.5 Qualification of New Materials

- 3.5.1 The Contractor shall prepare, deliver and maintain an Initial Qualification of Materials report for those materials that the Authority has advised are new to RN Warship service.
- 3.5.2 Where a material is new to RN Warship service, then the following shall apply:
- a. Fire Tests:
 - 1. If the Equipment contains a quantity of material that is greater than 50Kg per ship, the Contractor shall submit the materials for fire testing at a fire test establishment approved by the Authority;
 - 2. Any necessary fire tests (including those of the test establishment) shall be included within the tender submission with an associated cost;
 - 3. On completion of the fire tests, the Contractor shall update and deliver the Initial Qualification of Materials report as defined above;
 - 4. Where the use of the same material is proposed by additional Contractors (and each has quantity greater than 50Kg), it may be cost effective for the Authority to centrally fund and arrange for the fire testing. If this situation arises the Authority will notify the Contractor and an appropriate Change Request will be issued to remove the obligation on the Contractor and associated cost.
 - b. Occupational health:
 - 1. The Authority will arrange for the assessment of the material by the Institute of Naval Medicine, and will advise the Contractor of the information required to conduct an assessment;
 - 2. The Contractor shall provide this information (which may include details of the composition of the material). If the information is commercially sensitive, the Contractor should submit the information direct to the Institute of Naval Medicine;
 - 3. On completion of the assessment, the Contractor shall update and deliver the Initial Qualification of Materials report.

3.5.3 If the material is deemed unacceptable, then the Contractor shall propose an alternate material.

3.6 Personnel Safety

3.6.1 The Equipment shall minimise potential hazards to personnel at all times from delivery through to OSD and disposal.

3.6.2 The Equipment shall comply with the provisions of the Health and Safety at Work Act 1974 and all relevant safety regulations.

3.6.3 The Equipment shall comply with Control of Substances Hazardous to Health (COSHH) legislation (Ref. F01).

3.6.4 The Equipment shall apply HSE Occupational Exposure Limits (Ref. F02).

3.6.5 The Equipment shall not use cadmium, with the exception of cadmium plating for electrical contacts to ensure the reliability required of the Equipment or component on which they are installed.

Note: This is permitted by Annex XVII of the REACH Regulations 2011 (Ref. F03).

The use of cadmium in brazing materials, although also permitted in certain applications in Annex XVII, is not permitted in RN warships.

3.6.6 The Equipment shall not use asbestos or asbestos derivatives in accordance with the Control of Asbestos Regulations (Ref. F04).

3.6.7 For all Equipment, where any residual risk exists, this shall have detailed, permanent warning labels, in accordance with the following, fitted on the Equipment prior to delivery:

- a. Health and Safety (Safety Signs and Signals) Regulations (Ref. F05);
- b. Defence Standard (Def Stan) 02-784 (Ref. F06) (Note: This being important for any cadmium, beryllium oxide or thallium present in the scope of supply).

3.6.8 The Equipment shall not use hexavalent chromium, polychlorinated biphenyls (PCB), polybrominated biphenyls (PBB), polybrominated diphenyl ethers (PBDE), polychlorinated naphthalenes (more than 3 chlorine atoms), and certain short chain chlorinated paraffins (alkanes, C10-C13, chloro).

3.6.9 The List of Materials shall include reference to each of the above with regards to Personnel Safety.

3.7 Arc-Flash

- 3.7.1 The Equipment shall be suitably designed and have appropriate safeguards in place to minimise the risk of Arc-flash and to reduce any risk to personnel to ALARP, taking account of the guidance in IEEE 1584 (Ref. F56).
- 3.7.2 The contractor shall compile and report on an Arc Flash Hazard Risk Assessment and Mitigation [DRL E19].

3.8 Low Fire Hazard Materials

- 3.8.1 The Equipment shall not introduce any unjustifiable sources of ignition.
- 3.8.2 The Equipment shall not introduce any unjustifiable either flammable or combustible materials.
- 3.8.3 The Equipment shall not be a fire hazard:
- Under normal conditions;
 - After accidental damage;
 - During maintenance and disposal activities.
- 3.8.4 The Equipment should not be a fire hazard:
- Under combat conditions;
 - After combat-related damage;
 - During any Flag Officer Sea Training (FOST)/Damage Control Scenarios.
- 3.8.5 Any non-metallic materials (including coatings), used in the Equipment, shall have been successfully fire tested for the intended application in accordance with Def Stan 07-247 (Ref. F07) or the over-riding specific fire acceptance criteria cited in the material and/or product standards tabulated therein.
- 3.8.6 The Equipment should use non-metallic materials (including coatings) with a Def Stan 07-247 Category of 'A1' and 'A2' , in preference to Category 'B' materials.
- 3.8.7 The Equipment shall comply with the restrictions on the use of non-metallic materials (including coatings) with a Def Stan 07-247 Category of 'B' in accordance with Def Stan 07-247 (Ref. F07).
- 3.8.8 Any material with a Def Stan 07-247 Category of 'C' shall require justification for use.
- 3.8.9 Any material with a Def Stan 07-247 Category of 'D' shall require full fire testing and categorisation, in accordance with Def Stan 07-247 (Ref. F07).

- 3.8.10 The Equipment shall use cabling with limited fire hazard outer sheath materials to Def Stan 61-12 Part 31 (Ref. F08).
- 3.8.11 The Equipment shall only use timber and plywood where there is no feasible alternative and its use is approved by the Authority.
- 3.8.12 The Equipment shall not use aluminium alloys where loss of strength and/or melting may cause a hazard to life.
- 3.8.13 The List of Materials shall include reference to each of the above with regards to Fire Hazard.

3.9 Preventing Damage to the Environment

- 3.9.1 Joint Service Publication (JSP) 815 (Ref. F09) provides guidance on Defence Environment and Safety Management. This publication is applicable to all defence activities; compliance with it will ensure consistent implementation of the policy statement on Safety, Health, Environmental Protection and Sustainable Development.
- 3.9.2 The Equipment shall not damage the environment:
- a. Under normal conditions;
 - b. After accidental damage;
 - c. During maintenance and disposal activities.
- 3.9.3 The Equipment should not damage the environment:
- a. Under combat conditions;
 - b. After combat-related damage;
 - c. During any FOST/Damage Control Scenarios.
- 3.9.4 The Equipment shall not use any ozone depleting substances specified in the Montreal Protocol (Ref. F10) and EC Regulation 1005/2009 (Ref. F11).
- 3.9.5 The Equipment shall not use any substances identified as Substances of Very High Concern (SVHCs) or candidate SVHCs in Reach Regulations (Ref. F12). Note: This requirement also addresses the potential hazards these substances pose to personnel.
- 3.9.6 The Equipment should not use materials specified in the EU critical raw materials list (Ref. G13) or in the British Geological Survey Risk List (Ref. G14):
- a. If these materials are required then the Contractor shall prepare, deliver and maintain a Use of Critical Raw Materials Report detailing its use and justification.

- 3.9.7 The Equipment should not use any of the additional substances that are specified in the 'Substitute it now' list (SIN List) of possible future REACH SVHC (Ref. T15).
Note: This requirement also addresses the potential hazards these substances pose to personnel.
- 3.9.8 The Equipment should use paint coatings that do not exceed the maximum Volatile Organic Compound (VOC) target limits specified in WARPAIN (Ref. F16).
- 3.9.9 The Equipment shall not use any materials on the UK Red List specified in SI 2000 No.1973 (Ref. F17).
- 3.9.10 The Equipment should not use any materials on the Grey List specified in SI 2000 No.1973 (Ref. G17).
- 3.9.11 The Equipment shall not use any substances prohibited under the Hong Kong Convention for the Safe and Environmentally Sound Recycling of Ships (Ref. F18).
- 3.9.12 The Equipment shall not use any substances prohibited under the Biocidal Products Regulations (Ref. F19).
- 3.9.13 The List of Materials shall include reference to each of the above with regards to Environmental Protection.

3.10 Paint Selection and Application

- 3.10.1 The selection of materials for the preservation or protection of the Equipment shall take into account the suitability for the intended use and environmental constraints.
- 3.10.2 Paint shall be applied in accordance with the coating Contractors' specifications.

3.11 Paints Applied to Equipment in Manufacturer's Works

- 3.11.1 Paint types should be in accordance with Def Stan 21-05 (Ref. F20).
- 3.11.2 Paints should be low VOC types as defined in Section 3.9.8.
- 3.11.3 Cured paints containing lead based pigments, chromate based pigments, bitumen, coal tar epoxy and chlorinated rubber shall not be used.
- 3.11.4 For internal Equipments, cured paints containing isocyanates, including polyurethane paints, shall not be used.
- 3.11.5 Any required touch up painting, using a paint requiring justification, shall not be carried out onboard the Ship but in the Equipment manufacturer's works.

3.12 Paint Applied to Equipment Onboard Ship

- 3.12.1 Paints containing lead based pigments, chromate based pigments, bitumen, coal tar, chlorinated rubber, and isocyanates shall not be used; in accordance with WARPAIN (Ref. F16).
- 3.12.2 Polyurethane paints shall not be used.
- 3.12.3 Any touch up paint should be specified with the Equipment.
- 3.12.4 Any touch up paint should be a low VOC type.
- 3.12.5 Any touch up paint should be compatible with the original paint applied to the Equipment.

3.13 Substrate Preparation

- 3.13.1 The preparation of Equipment substrates shall be in accordance with the coating Contractor's specifications.

Note: This applies to the substrate preparation required for paint, rubber, plastic and any other types of coating.

- 3.13.2 Documentary evidence of substrate preparation shall be provided for all items that use a coating system to protect against corrosion, wear, surface oxidation or for the purpose of maintaining resilience to degradation.

3.14 Materials - Resistance to Corrosion

- 3.14.1 The selection of materials for the Equipment shall take into account the suitability for the intended use and environmental constraints by ensuring that the materials have the necessary resistance to corrosion including:
 - a. Salt water;
 - b. Corrosive products associated with effluxes and exhausts (see Section 8.9);
 - c. Corrosive materials associated with solvents and contaminants (see Section 9);
 - d. Galvanic and electrochemical reactions at all dissimilar metal joints or interfaces e.g. in seawater systems, chilled or grey water systems, underwater and weather deck items of Equipment.
- 3.14.2 Equipment materials immersed in or containing seawater shall not include naval brass and brasses similar to naval brass, aluminium nickel silicon brass, HT brass (manganese bronze), aluminium bronze (material not containing nickel), bare carbon steel, stainless steel with less than 6% molybdenum, soft lead-tin solders or other materials known to degrade rapidly in sea water.

3.14.3 The Equipment shall use materials that are selected so as to minimise any environmental impact of corrosion deposits where these may be deemed to occur.

3.15 Materials - Shock Resistance

3.15.1 Equipment materials shall be selected to withstand the shock levels defined in Section 5.

3.15.2 Equipment components that have a shock management requirement should not use metals with an elongation of less than 10% to failure or non-metallic materials, unless the components have been qualified by shock testing or by other means agreed with the Authority.

3.16 Materials Suitability

3.16.1 In addition to requirements specified elsewhere in Section 3 of the GTR that relate to use of materials requiring justification, the Equipment shall not use the following materials, unless a material justification is agreed with the Authority:

- a. Radioactive substances;
- b. Lead in batteries;
- c. Beryllium in any form;
- d. Mercury in any form;
- e. Low flash-point flammable liquids;
- f. Halogenated polymers, e.g. Viton, PVC;
- g. Carbon Fibre Reinforced Plastics (CFRPs).

3.16.2 Where the Equipment incorporates a hazardous or normally unsuitable material (and no suitable alternative is available), the Contractor shall prepare, deliver and maintain a justification statement for use of material as a supplement to the Materials List.

3.16.3 For sealing of removable covers, solid nitrile rubber should be used in preference to cellular neoprene rubber for gasket material.

3.16.4 Any jointing compound used for sealing bearing cap joints should be stated on approval drawings.

4 SIGNATURE MANAGEMENT REQUIREMENTS**4.1 General**

- 4.1.1 Signature management with regards to PGMU shall concern:
- a. Infrared;
 - b. Magnetic;
 - c. Acoustic (Noise and Vibration);
 - d. Radar Cross Section (RCS) and Visual.
- 4.1.2 The Contractor shall provide appropriate documentary evidence that the Equipment solution meets the requirements set out in this section concerning signature management.
- 4.1.3 The Equipment shall be designed and integrated into the platform so as to minimise the impact on the above-water and below-water signatures.
- 4.1.4 The Equipment contribution to the platform acoustic signature shall be no worse than that of the current performance. The Equipment TES specifies how the contractor is to provide evidence to demonstrate he has understood and meets this requirement for the specific Equipment.
- 4.1.5 The contribution of the PGMU Equipment to the environmental noise and vibration aboard and external to the Type 23 platform shall be minimised for reasons of health and safety, the ability to communicate verbally and habitability.
- 4.1.6 The noise and vibration limits are presented in Equipment TESs for major Equipment items: DGs and MGs.
- 4.1.7 Any stated noise and vibration requirements shall apply under the full range of normal operation including start up and shut down.

4.2 Radar Cross Section and Visual Signature

- 4.2.1 The Equipment shall not compromise the ship's RCS signature or visual signature: this is a pertinent consideration wherever Equipment has an external presence.
- 4.2.2 The Equipment contribution to the platform RCS signature shall be no worse post PGMU than that of the current capability.
- 4.2.3 The Equipment contribution to the platform visual signature shall be no worse post PGMU than that of the current capability.

4.3 Infrared Signature

- 4.3.1 The Equipment shall not compromise the ship's Infrared (IR) signature.
- 4.3.2 The Equipment contribution to the platform IR signature shall be no worse post PGMU than that of the current capability.

4.4 Magnetic Signature

- 4.4.1 The Equipment shall not compromise the ship's magnetic signature.
- 4.4.2 The Equipment contribution to the platform magnetic signature shall be no worse post PGMU than that of the current capability.
- 4.4.3 Design guidance for achieving a low magnetic signature is found in Def Stan 02-617 (Ref. G54)

4.5 Control of Noise and Vibration

- 4.5.1 The Contractor shall prepare, deliver and maintain a Noise and Vibration Control Document. [DRL E5]
- 4.5.2 The Noise and Vibration Control Document shall identify, where appropriate, proposals to reduce the noise and vibration levels from the Equipment and supporting systems.

4.6 Noise and Vibration Measurement

- 4.6.1 Measurements shall be made in accordance with the following:
 - a. Where the Equipment is resiliently mounted in the proposed design, vibration data shall be provided below each resilient mount location;
 - b. Where the Equipment is solidly mounted onto a foundation in the proposed design, vibration data shall be provided at the Equipment foot;
 - c. In addition to vibration the Contractor shall provide measured data for the effective dynamic stiffness of the test foundation with the Equipment attached.
- 4.6.2 The Contractor shall prepare, deliver and maintain a Noise and Vibration Measurement and Analysis report that documents the results of these measurements. [DRL E6]
 - a. The Contractor shall include the dynamic stiffness of the test foundation in the report.

4.7 Vibration Limits

- [REDACTED]
- 4.7.2 Where vibration limits are stated in the Equipment TES document, these levels shall not be exceeded.

4.8 Interfaces

- 4.8.1 The Contractor shall ensure that all Equipment is mounted as defined in the shock section.
- 4.8.2 All connections between the Equipment and ships services shall be designed so that they do not compromise the noise and shock reduction features of mounted systems.
- 4.8.3 The Contractor shall liaise with the Authority to ensure that major Equipment excitation frequencies are not coincident with any foundation structural resonances.
- 4.8.4 Average dynamic stiffness of the foundations has been measured for existing principle machines and is available on request.

4.9 Airborne Noise Limits

- 4.9.1 The Equipment shall limit its contribution of external airborne noise such that the total platform steady state noise to the external environment is below the stated levels:

- [REDACTED]
- [REDACTED]
- 4.9.2 The Contractor shall produce a report which presents the acoustic analysis performed in pursuit of these requirements and demonstrates compliance of the design with the presented limits.

4.10 Equipment Noise Mounts

- 4.10.1 The Contractor shall prepare, deliver and maintain a Mounting System Design Description [DRL E7] which is to provide details of how the Equipment complies with paragraphs 4.10.2 through 4.10.6.

- 4.10.2 Equipment requiring noise reduction mounts, as specified in each TES document, shall be mounted on standard RN and UK MoD approved noise reducing mounts of a type to be agreed with the Authority.
- 4.10.3 The list of approved mounts is contained within MAP 01-473 (Ref. F22), from which mounts with status “Approved and Suggested” shall be selected by the Contractor.
- 4.10.4 The overall mounting system design shall take account of the vibration attenuation and shock requirements.
- 4.10.5 The type of Equipment mount selected shall take into account the requirements for vibration attenuation and shock performance (see also Section 5).
- 4.10.6 The mounting system shall not excite at resonant frequencies that are coincident with the Equipment vibration modes of the mounted Equipment.

4.11 Factory Acceptance Tests (FAT)

- 4.11.1 The Contractor shall conduct measurements of Equipment vibration and airborne noise in accordance with Def Stan 02-813 (Ref. F57).
- 4.11.2 The Contractor shall use the measured data combined with appropriate calculations to demonstrate compliance with the noise and vibration requirements.
- 4.11.3 The Contractor shall demonstrate compliance through delivery of an appropriate update to the Noise and Vibration Measurement and Analysis Report [DRL E6] detailing the analysis that has been carried out for the Equipment during and in support of FATs.
- 4.11.4 The Authority will assess the performance of the Mounting System Design under static loading, seaway motion, shock loading and vibration. The Authority will advise the Contractor of any observations and/or critical deficiencies.
- 4.11.5 The Contractor shall assess these observations and/or critical deficiencies and resubmit the mounting system design accordingly.
- 4.11.6 The Contractor should not deem that the absence of observations and critical deficiencies implies the Authority’s endorsement of the mounting system design.

5 SHOCK REQUIREMENTS

5.1 General

- 5.1.1 The Contractor shall provide appropriate documentary evidence that the Equipment solution meets the requirements set out in this section concerning shock.
- 5.1.2 All Equipment shall be shock qualified.
- 5.1.3 Documentary evidence in the form of the Equipment Shock Qualification List and supporting documents shall be supplied for all equipment.
- 5.1.4 The Equipment shall be sufficiently rugged to enable it to survive, and continue operating, following a shock event which induces the parameter fraction loading stated in Section 5.4.
- 5.1.5 Equipment shall be:
- a. Shock hardened if hard mounted; or
 - b. Resiliently mounted.
Note: Equipment that is resiliently mounted may also require shock hardening.
- 5.1.6 In a Shock event the Equipment will be subjected to high displacement phenomenon, termed whipping. The requirement to survive whipping has an impact on the specification of individual Equipment.
- 5.1.7 The shock performance specification is dependent on:
- a. The criticality of the Equipment to Ship capability (as per Section 5.3);
 - b. Location of the Equipment in the Ship (as specified in the TESs).

5.2 Shock Mounting Design

- 5.2.1 If resiliently mounted, the Equipment mounting system shall comply with the shock requirements for the Equipment, specified in this section.
- 5.2.2 Equipment mount type selection shall take into account the requirements for both URN and shock performance (see also Section 4).
- 5.2.3 The Equipment shall be mounted on standard RN and UK MoD approved shock mounts of a type to be agreed with the Authority.
- 5.2.4 The list of approved mounts is contained within MAP 01-473 (Ref. F22), from which mounts with status “Approved and Suggested” shall be selected by the Contractor.

5.2.5 The mounting system shall survive the displacement induced by the whipping loads commensurate with the shock grade zone and parameter fraction.

5.3 Equipment Shock Class

5.3.1 For shock performance specification, all Equipment within the scope of PGMU shall be considered as Class 2 Equipment: “Functions essential to support the primary functions of the vessel” (Ref. F23).

5.4 Shock Capability Requirement

5.4.1 The Equipment shall function without degradation in performance when subjected to the shock motions at the foundation (i.e. Ship structure) described in MAP 01-470 (Ref. F24) for their applicable Shock Grade and Essentiality Class as modified by the following Parameter Fractions:



5.5 Shock Captivity Requirement

5.5.1 The Equipment subjected to the shock motions shall:

- a. Remain captive;
- b. Not pose a hazard (fragment injury/damage) to personnel or other Equipment.

5.6 Shock Recoverability Requirement

5.6.1 The Equipment shall function before and after the shock event specified in Section 5.4.

5.6.2 The Equipment should function continuously before, during and after the shock event specified in Section 5.4.

5.6.3 Operational function is defined as “without degradation in performance”. Qualification following delays in system availability due to “nuisance failures” during shock testing, such as the reacquisition of essential data or the resetting of trips, will be considered by the Authority on a case by case basis.

5.7 Equipment Shock Qualification Data

- 5.7.1 The Contractor shall supply Equipment that is shock qualified as appropriate for use in the specified locations onboard the T23 vessels:
- a. Equipment items shall be documented in the Equipment Shock Qualification List [DRL E3].
- 5.7.2 The Contractor shall prepare, deliver and maintain an Equipment Shock Qualification Plan [DRL E2] to define processes for qualifying Equipment and to record and document shock qualification data.
- 5.7.3 When qualification evidence becomes available, the Contractor shall prepare, deliver and maintain a System/Equipment Shock Qualification Report. It is recognised that this report may be ongoing, and that certain sections of the document will not be fully populated until necessary evidence has been produced.
- 5.7.4 The shock strength of Equipment should be determined as necessary in accordance with Def Stan 08-120 (Ref. F25) and suitable documentation as above shall be provided.
- 5.7.5 A detailed assessment shall be provided for each Equipment item indicating the following:
- a. Whether the Equipment is Shock Mounted and if so the proposed mounting system;
 - b. The Shock Grade of the Equipment location - detailed in the Equipment TESs;
 - c. The Shock Classification - Class 2 only (for information, this shall be included for consistency with other ships documentation);
 - d. The Shock Qualification Method - by Test or Extension (as defined in Def Stan 08-120, Ref. F25);
 - e. The current qualification status - either qualified or to be qualified;
 - f. Details of by whom the shock analysis has been carried out and details of the Shock Test Authority.
- 5.7.6 Except where the Contractor can provide justification that considerations of Equipment size, and/or weight, or otherwise excessive cost prevent it, shock qualification shall be achieved by test.
- 5.7.7 Qualification by Test:
- a. The Equipment shall be tested in a manner that is representative of the proposed installed configuration;
 - b. The Equipment should be operating during the test;

HANDLING INSTRUCTION – COMMERCIAL IN CONFIDENCE

Power Generation & MCAS Update

SSA004/01 General Technical Requirements

- c. Where this is not practical, the Contractor shall ensure that checks are made prior to and after the shock test to determine correct functionality.
- 5.7.8 Where the Contractor wishes to propose an alternative to test, they must note:
 - a. Shock qualification by extension is only permissible for any Class of Equipment if the article is sufficiently similar to the item an extension is claimed from and has been qualified under comparable loading;
 - b. For items which are Class 2 or higher, qualification by either review or analysis will not be acceptable.
- 5.7.9 Equipment proposals shall use approved mount types as detailed in Section 5.2.
- 5.7.10 Both Shock Analysis documents and Shock Test documents shall be supplied in support of item e in Section 5.7.5.
- 5.7.11 Detail of shock qualification should be made with reference to the T23 Shock Policy Paper (Ref. F26).

6 HUMAN FACTORS ENGINEERING REQUIREMENTS**6.1 General Requirements**

- 6.1.1 Def Stan 00-250 (Ref. F27) provides guidance on the MoD Human Factors Integration (HFI) 'process' which should be used in managing the people related considerations in both new systems and enhancements to existing systems.
- 6.1.2 This document shall be applied and referenced through submission of a Human Factors Integration Plan [DRL S32].
- 6.1.3 The Equipment shall be capable of being operated and maintained by the 5th percentile female through to the 95th percentile male as defined in accordance with Def Stan 00-250 (Ref. F27).
- 6.1.4 The Equipment shall be capable of being operated and maintained by personnel wearing Action Working Dress
- 6.1.5 The Equipment shall be capable of being operated by personnel wearing CBRN protective clothing.
- 6.1.6 The PGMU Equipment should enable maintainers to complete essential maintenance whilst wearing CBRN protective Equipment.

6.2 Human Environment - Noise

- 6.2.1 Air Bourne Noise levels for individual Equipment are defined in Section 4 to permit noise limits in compartments to comply with Control of Noise at Work Regulations (Ref. F21) for human exposure to noise.
- 6.2.2 The Contractor shall advise the Authority on becoming aware that noise exposure values exceed the lower action values, specified in the Control of Noise at Work Regulations (Ref. F21).

6.3 Human Environment - Vibration

- 6.3.1 Under normal operation, the Equipment shall enable compliance with the Control of Vibration at Work Regulations (Ref. F28).
- 6.3.2 The vibration exposure limit is dependent upon the duration of operator exposure to Equipment vibration under normal use.
- 6.3.3 The Contractor shall advise the Authority on becoming aware that vibration exposure values exceed 80% of the limit values, specified in the Control of Vibration at Work Regulations (Ref. F28).

7 SUPPORTABILITY REQUIREMENTS

7.1 General

- 7.1.1 It is MOD policy that Integrated Logistics Support (ILS) shall be applied to all product procurement.
- 7.1.2 Support and supportability shall be optimized through the application of the ILS process, as laid down in Def Stan 00-600 (Ref. F29).
- 7.1.3 Reference is to be made to the PGMU ILS Plan (ILSP) for further supportability requirements and clarification.

7.2 Design Life and Operating Cycle

- 7.2.1 The Equipment, components and the associated support deliverables shall be sustainable until at least the OSD of the host platform.
- 7.2.2 Given the OSD, the contractor shall actively ensure that Equipment and software is supportable throughout in-service life, even if obsolescence might present an issue.
- 7.2.3 Components subject to wear and tear or degradation and which are subject to planned or condition based maintenance activity should be specified in Equipment Maintenance Schedules and associated Provisioning Lists for the Equipment.
- 7.2.4 In addition to the requirements for maintenance activities specified in Section 7.7, the Equipment shall be capable of being operated and maintained within the manning constraints specified in Section 7.6.

7.3 Availability

- 7.3.1 PGMU is expected to improve the availability and reliability of the power generation and MCAS Equipment.
- 7.3.2 The inherent availability figures of the Equipment shall be made clear in the tender response.

7.4 Standardisation of Equipment and Components

- 7.4.1 The Equipment should use components and LRUs that are readily available from commercial sources if the Equipment meets the requirements of the Contract, using such items.
- 7.4.2 Where applicable, items that carry Lloyd's Type approval shall be clearly identified in the tender response.

- 7.4.3 The Equipment should utilise, without operational degradation, fuel, lubricants and associated products that are interoperable with the Joint Supply Chain in accordance with STANAG 1414 (Ref. F30) and STANAG 4362 (Ref. F31) if the Equipment meets the requirements of the Contract, using such fuel, lubricants and associated products.
- 7.4.4 Items of Equipment and components required for the support of the Equipment, including planned and reasonably foreseeable corrective maintenance, shall be air portable in accordance with Def Stan 00-3 (Ref. F32).

7.5 Reliability

- 7.5.1 The Equipment shall use components that have inherent reliability and are derated, if necessary, to achieve Equipment performance and design life requirements, together with any Equipment reliability requirements specified in each TES document, taking into account the operating environment of the component.
- 7.5.2 The Equipment shall include levels of redundancy, including "graceful degradation", consistent with the outcome of any FMECA or other design activity, to ensure that any specified or reasonably anticipated levels of AR&M requirements are achieved. This is to include those layers of protection given to any critical control function.
- 7.5.3 Reliability data is required for all Equipment, including software, and should be provided as part of the tender response as defined in the ILSP.
- 7.5.4 The Contractor should indicate whether Accelerated Reliability Tests (ART) have been carried out and detail any provision for these to be conducted.

7.6 Manning

- 7.6.1 The Equipment shall not cause any increase to either overall manning levels or numbers of operator-maintainers under any operational state.
- 7.6.2 The Equipment shall not have any impact on the rank range of personnel involved in the training, operation, maintenance and support of the capability it replaces.

7.7 Maintenance

- 7.7.1 Reliability Centred Maintenance (RCM) shall be carried out in accordance with the ILSP.
- 7.7.2 The Contractor shall work with the Unit Maintenance Management System (UMMS) team to produce Maintenance Task Instructions as necessary during the course of the PGMU project.

7.8 Maintenance Burden and Operating Profile

- 7.8.1 Preventative maintenance is required to enable high availability. However, the maintenance burden of the Equipment shall not be worse than the current maintenance requirement.
- 7.8.2 All planned maintenance items and all reasonably foreseeable corrective maintenance shall be capable of being undertaken by Ships Staff as assigned maintainers.

7.9 Space and Removal Requirements

- 7.9.1 All planned and reasonably foreseeable corrective maintenance shall be capable of being undertaken without the removal of an Equipment item from the Ship, unless the item is either designated by the Contractor as an upkeep by exchange item, or is a spare part listed in the Equipment Maintenance Schedule/Provisioning List; and is capable of being removed from the Ship through a designated removal route.
- 7.9.2 For items to be removed through the designated removal route, these should have:
- a. Envelope dimensions less than 750mm x 750mm x 750mm; and
 - b. A weight of less than 40kg.
- 7.9.3 If the item to be removed from the Ship does not conform to the criteria specified above, the removal procedure shall be agreed with the Authority.
- 7.9.4 Diesel and Motor Generator sets should be capable of being split into component parts of a suitable size to be lifted into the ship through the existing soft patches.
- 7.9.5 The limiting dimensions of the soft patches are 3.05m x 2.00m. Where Equipment component packages exceed these dimensions, these shall be agreed with the Authority.

- 7.9.6 Items requiring removal from their installed location shall be fitted with lifting points or provision for attachment of transporting slings, spreaders and protective packaging as required for installation and removal.
- 7.9.7 The Contractor shall supply full CAD drawings of lifting arrangements and associated Equipment.
- 7.9.8 All planned and reasonably foreseeable corrective maintenance that is required to be undertaken on board the Ship shall be capable of being undertaken within the maintenance envelopes defined on the Interface Drawings.

7.10 Maintainability Features

- 7.10.1 The Equipment shall incorporate the following features to facilitate planned and reasonably foreseeable corrective maintenance activities:
- a. Hinged or removable doors, panels etc., fitted with retaining stays to hold the door or panel open and permit access to the parts that need to be maintained in situ, removed or replaced;
 - b. Roll out runners and flexible wiring and piping used to assist in the maintenance, removal or replacement of items;
 - c. Software loading points to enable loading of authorised software updates by ships staff.
- 7.10.2 Subject to meeting safety requirements, items which require removal for planned or reasonably foreseeable corrective maintenance should incorporate the following features to facilitate such removal:
- a. Pipe couplings and flanges that are easy to access and remove;
 - b. Hand tightened or push fit connectors, such as those fitted to flexible hoses or electrical wiring harnesses.
- 7.10.3 The Equipment shall be fitted with condition monitoring Equipment and test points which provide the data to implement all maintenance and test routines, specified in the Equipment Maintenance Schedules.
- 7.10.4 The Equipment shall be capable of isolating faults to the lowest single LRU using General Purpose Test and Measurement Equipment, together with Built in Test features.
- 7.10.5 All diagnostic indications and maintainer information generated within the Equipment shall be accessible from the boundary of the Equipment and interpretable by onboard maintainers, trained in accordance with the Contractor's

training deliverables, and using the Support and Test Equipment (S&TE) and Technical Data and Documentation supplied by the Contractor.

- 7.10.6 The Equipment should provide easy access, from the boundary of the Equipment, to the following without the need for staging or other non-portable aids:
- a. Grease points;
 - b. Test points;
 - c. Other fluid, electrical or mechanical test points; and
 - d. Drain-down or fluid fill points.

7.11 Ship Husbandry

- 7.11.1 The Ship Husbandry Manual (Ref. T58) shall be applied to all PGMU Equipment.
- 7.11.2 The Equipment design shall minimise husbandry tasks and the generation of arisings requiring disposal.
- 7.11.3 The Equipment shall allow access for the cleaning and maintenance tasks proposed by the Contractor and agreed by the Authority.
- 7.11.4 The Equipment materials selection and materials interfaces shall reduce the cleaning and maintenance task by avoiding dust gathering features and by providing easy clean surfaces.
- 7.11.5 The Equipment design shall incorporate the following measures to reduce susceptibility to differential aeration corrosion through the build-up of dirty air, water and dirt:
- a. Avoidance of excessively exposed threads;
 - b. Use of flush mounted items;
 - c. Provision of adequate drainage;
 - d. Elimination of internal or external corrosion traps;
 - e. Use of rounded corners;
 - f. Reduction of dust collecting surface areas.
- 7.11.6 The Equipment shall include appropriate measures to isolate dissimilar metals and ensure adequate earthing, when it is not possible to use materials that avoid galvanic corrosion.

7.11.7 The Equipment design shall prevent paint scheme break-down or corrosion through adjacent component rubbing or abrasion and other measures, including avoidance of sharp corners.

7.12 Ship's Staff Maintenance Tasks

7.12.1 The Equipment shall minimise the need for planned and reasonably foreseeable corrective maintenance whilst still achieving the required availability.

7.12.2 Maximum use of Ships staff engineering capabilities shall be made for all these maintenance tasks.

7.12.3 Planned and reasonably foreseeable corrective maintenance of the Equipment assigned to Ship's staff shall include all maintenance that is conducted while the Ship is at sea, limited to tasks that can be performed by members of Ship's staff. Ship's staff will use onboard repair tools, equipment, maintenance aids and training deliverables, specified in the Equipment Maintenance Schedules, the Technical Data and Documentation and Training Data and Documentation.

7.13 Base Staff Maintenance Tasks

7.13.1 New Equipment should minimise changes to the existing skill set of Naval Base Staff.

7.13.2 The repair tools, equipment, spares, maintenance aids and training deliverables provided under this Contract shall be sufficient to enable Naval Base Staff to undertake the maintenance tasks assigned to them.

7.14 Support and Test Equipment

7.14.1 The Equipment should use General Purpose Test and Measurement Equipment.

7.14.2 Where possible the Equipment should allow standardisation with existing support and test equipment already in MOD use.

7.14.3 Special To Type Equipment (STTE) required for maintenance conducted by the Authority or end user of the Equipment, during its planned in service life shall be minimised.

7.14.4 Where STTE is required for planned maintenance tasks and foreseeable corrective maintenance, this Equipment shall be made available to the Authority.

7.14.5 The provision of STTE to be held onboard or at base shall be agreed.

7.14.6 Details of necessary STTE training shall be supplied.

7.14.7 Test and maintenance equipment should utilise approved Ships power distribution networks as detailed in Section 11.6.

7.15 Fire Suppression Ports

7.15.1 Electronic equipment cabinets shall be fitted with inlet socket NSN 4210-99-529-3637 for connection of existing portable CO2 fire extinguishers.

7.15.2 The socket should be sited at the top of the front face of cabinets whenever possible.

7.15.3 Equipment cabinets shall be designed such that CO2 can be retained within the enclosure when necessary in the event of an equipment fire.

7.15.4 Simple ducting within electronic cabinets should be fitted to ensure effective distribution of the CO2 gas if deemed necessary.

7.15.5 Details of the above mentioned CO2 socket are given in Section 15 of Def Stan 08-204 Part 3 (Ref. F59).

8 OPERATIONAL ENVIRONMENT REQUIREMENTS

8.1 Introduction

- 8.1.1 This section specifies the range of environments that the Type 23 Frigate is required to operate in. The conditions experienced by PGMU affected systems and Equipment will differ based on where they are installed on the ship.
- 8.1.2 The T23 Equipment shall be capable of providing operational capability in a CBRN environment.
- 8.1.3 The Equipment shall be able to operate in specified climatic conditions, including sea states, commensurate with the world-wide role of the host platform.
- 8.1.4 The Equipment shall be capable of operation in the following categories as defined in the Environmental Handbook for Defence Materiel (Ref. F55):
 - a. A1, A2, A3, B1, B2, B3, C0, C1, M1, M2, M3.

8.2 Climate - External Conditions

[REDACTED]

8.3 Internal Conditions

[REDACTED]

- 8.3.3 For Equipment located in mechanically ventilated Main Machinery and Auxiliary Spaces the Contractor shall provide documentation defining the degradation to failure of Equipment performance across all temperature ranges.
- 8.3.4 Equipment installed or replaced as part of PGMU should not cause any net increase of wild heat into any compartment in which it is installed.

8.4 Ship Angles

[REDACTED]

8.5 Ship Motions

[REDACTED]

8.6 Vibration Levels

8.6.1 The Equipment shall be designed to withstand levels and comply with the provisions detailed in Def Stan 08-123 (Ref. F57) for all vibration generated both internally and externally to the Equipment.

8.7 Electromagnetic Environmental Effects

[REDACTED]

8.8 Magnetic Fields

- 8.8.1 The Contractor shall compile and deliver a report on an Electromagnetic Field Strength Prediction [DRL E16].

8.9 Effluxes and Exhausts

[REDACTED]

8.10 Provision of Ships Services

- 8.10.1 Where supporting services are required the Equipment shall use readily available services in use onboard the Ship.
- 8.10.2 The Equipment should not make use of services additional to those utilised by the Equipment which it is intended to replace.

9 PREVENTING DAMAGE TO EQUIPMENT**9.1 Solvents - Cleaning of Equipment**

9.1.1 The Equipment shall withstand, without degradation in performance, any cleaning procedure using solvents specified in the Equipment Maintenance Schedules.

9.2 Solvents - Equipment Packaging

9.2.1 Equipment transportation and storage packaging shall provide protection to the enclosed Equipment when subjected to accidental exposure to any solvents.

9.3 Contaminants - Deliberate Exposure to Equipment

9.3.1 The Equipment finishes, external components and materials shall withstand, without damage or degradation in performance, deliberate exposure to the following contaminants:

- a. Contents of fire extinguishers and Fire Fighting systems;
- b. Insecticides;
- c. Training smokes and similar;
- d. CBRN contaminants.

9.3.2 Reference to Def Stan 00-56 (Ref. F33) may be made where appropriate.

9.4 Contaminants - Accidental Exposure to Equipment

9.4.1 The Equipment finishes, external components and materials should withstand, without damage or degradation, accidental exposure to the following contaminants:

- a. Contents of fire extinguishers and Fire Fighting systems;
- b. Fuels, oils, greases and coolants, as per relevant sections of Def Stan 01-5 (Ref. F60);
- c. Black and Grey Water.

9.4.2 Reference to Def Stan 00-56 (Ref. F33) may be made where appropriate.

9.5 Chemical Compatibility

- 9.5.1 Manufacturer's approved cleaning agents for the Equipment should be documented and supplied for review to confirm that these will not have an adverse effect on other ships systems.
- 9.5.2 Where known, reference should be made to the compatibility with ships SICS/SIRS Equipment.

10 PRODUCTION REQUIREMENTS

10.1 General

- 10.1.1 This section specifies requirements for the design of production features that will aid the Authority's production team when installing the Equipment.

10.2 Packaging

- 10.2.1 The Equipment shall be protected, using packaging that takes into account the handling and installation activities undertaken in the Authority's stores and during Equipment installation onboard the Ship.
- 10.2.2 Packaging materials used to protect the Equipment should be fire retardant and certified by the Loss Prevention Certification Board in accordance with Loss Prevention Standard 1207 (Ref. T34).
- 10.2.3 Reference may be made to the ILSP where appropriate.

10.3 Lifting Points and Lifting Arrangements

- 10.3.1 In addition to the requirements stated in Section 7.9, the Equipment shall:
- a. Be supplied with appropriate certification of all lifting points;
 - b. Bear permanent identification of all lifting points and positions for attachment of lifting equipment;
 - c. Be supplied with documentary evidence of lifting arrangements required for routine maintenance tasks.

10.4 Jigs and Tooling

- 10.4.1 The Equipment should be supplied with bespoke tooling or jigs, if such items are required for installation.

- 10.4.2 Security categorised Equipment or Equipment with more than 6 co-axial cables or multi-pin connectors shall be supplied with a termination jig.
- 10.4.3 This will allow installation to proceed without the need to withdraw the Equipment from the store before it is actually required for set to work activities.
- 10.4.4 Equipment that is installed on a seat should be supplied with a drilling/alignment jig, unless otherwise agreed with the Authority.
- 10.4.5 Equipment that is resiliently mounted with top-steadies or back-steadies should be supplied with a drilling/alignment jig, unless otherwise agreed with the Authority.

10.5 Contractor Modules

- 10.5.1 To reduce installation activity and for ease of maintenance, Equipment components should be grouped together into modules to achieve the minimum number of parts.
- 10.5.2 Equipment components should be mounted on a single support structure with all mechanical and electrical connections made, so that no further work by the Authority is required within the module boundary.
- 10.5.3 The Equipment module design should take into account ease of transportation, including the support structure and lifting attachments, so that the module can be shipped and installed into the Ship as a whole entity.

10.6 Structural Requirements

- 10.6.1 Equipment that is to be welded to the Ship shall be supplied with the weld areas as High Tensile Steel coated only with a weldable primer.
- 10.6.2 Equipment that is to be welded to the Ship should provide access to the weld areas.

10.7 Equipment Coating and Insulation

- 10.7.1 The Equipment shall be supplied with the final finish applied, except in areas where Section 10.6 applies.

11 GENERAL ELECTRICAL REQUIREMENTS**11.1 Conformance**

- 11.1.1 Def Stan 08-107 specifies requirements for design of Electrotechnical Naval Systems. This document is now obsolete; however the information contained may be referenced in that it forms the basis to which the T23 ships were originally built.
- 11.1.2 The Equipment (fixed or portable) shall:
- a. Comply with general electrical standards;
 - b. Use the specified quality of supply and services as applicable;
 - c. Minimise self-generated harmonic distortion of the power supply;
 - d. Comply with the applicable specified standards for enclosure protection, earthing, control gear and motors;
 - e. Be mechanically isolable from all electrical supplies and control and indication signals.
- 11.1.3 The Contractor shall identify the needs of their Equipment regarding electric power.

11.2 General Electrical Standards

- 11.2.1 The Equipment shall comply with:
- a. British Standard (BS) 8450 (Ref. F35);
 - b. Electricity at Work Regulations (Ref. F36);
 - c. Electrical Equipment (Safety) Regulations 1994 (Ref. F61).
- 11.2.2 Additionally Contractors should identify, in the Tender Response, any Equipment and parts that comply with Lloyd's Register Naval Ship Rules or other relevant maritime standards.

11.3 Quality of Electrical Supplies

- 11.3.1 Generated electrical supplies shall meet with quality requirement specified in Def Stan 61-5 (Ref. T37).
- 11.3.2 The Equipment shall not compromise the power supply to which it is connected specified in Def Stan 61-5 (Ref. T37).

11.4 Maintained Supplies - Policy

- 11.4.1 MCAS Systems each have 24V battery backup to support their continued operation in the event of a loss of normal supplies through action or other major damage:
- a. In support of the MCAS system five RTRs are fitted (one in each: Fwd Switchboard room, 2G Passage, SRE Compartment, CER 3J and 1G Passage);
 - b. In support of the MEPS system, two TRUs are fitted (one in each Switchboard room).
- 11.4.2 Where battery back-up is required, all new Equipment installed under PGMU shall be capable of using the existing RTR/TRU systems as defined above.
- 11.4.3 The Equipment shall be designed for minimum power consumption.
- 11.4.4 The Equipment shall draw no more electrical current from the TRUs or RTRs than the existing system. This will allow the existing TRUs and RTRs to provide battery power following the loss of normal and alternative supplies, for the same length of time, or longer, as they do to the existing Equipment.

11.5 Loss of Electrical Supplies

- 11.5.1 MCAS and MEPS Equipment shall utilise the ships TRU and RTR systems as appropriate.
- 11.5.2 The Equipment shall return to a known safe state in the case of loss of supply.
- 11.5.3 Motor loads shall trip so as not to present an excessive load on recovery.
- 11.5.4 Where software related and where concerning data driven systems, any recovery activity shall include recovering the system to an operational state, including the processing of data, such that adequate confidence can be achieved that system outputs are correct.

11.6 Power Supplies - Fixed Equipment

- 11.6.1 Fixed Equipment requiring electrical power supplies shall use any of:
- a. 440V AC, 3 phase, 60Hz;
 - b. 115V AC, 1 phase, 60Hz;
 - c. 24V DC for all control and surveillance systems.

11.7 Power Supplies - Portable Equipment

- 11.7.1 Portable Equipment requiring electrical power supplies shall use 115V, 1 phase, 60Hz (centre tap of transformer secondary to be earthed).
- 11.7.2 Test and maintenance Equipment should utilise approved Ship's power distribution networks as above.
- 11.7.3 Where power supplies in excess of those permitted for portable Equipment are required, full details and justification should be provided.

11.8 Enclosure Protection Rating

- 11.8.1 The Equipment shall have an enclosure protection rating suitable for the environment in which it is to be installed:
 - a. In no instance shall this be less than IP44, as defined in BS EN 60529 (Ref.F38).
- 11.8.2 Equipment enclosures sited in main and auxiliary machinery spaces shall have an ingress protection rating of no less than IP56, as defined in BS EN 60529 (Ref. F38).
- 11.8.3 Where adjacent systems present a foreseeable risk of contamination, the Equipment shall have an ingress protection rating of no less than IP56, as defined in BS EN 60529 (Ref. F38).
- 11.8.4 I/O devices (keyboards and trackballs) should be rated to the benchmark IP65.

11.9 Earthing and Bonding

- 11.9.1 The metal enclosures of electrical Equipment that contain voltages in excess of 35V AC or 50V DC shall be capable of being earthed to adjacent metallic Ship's structure in accordance with Def Stan 08-160 (Ref. F39).
- 11.9.2 The metal parts of electrical Equipment that do not carry current shall make suitable metal-to-metal contact with adjacent enclosure metalwork.

11.10 Use of Solder

- 11.10.1 The use of lead-free solders is increasingly leading to several in-service problems including short circuits from 'tin whiskers', early fatigue fracture and chemical degradation of copper conductors. The Equipment should make maximum use of lead-tin solders wherever practicable and is mandated in safety critical systems.

- 11.10.2 Where lead free solders must be used, IEC GEIA-STD-0005 standard gives guidance for the procurement of Equipment that may contain lead-free solders; this should be referenced wherever relevant for the Equipment supplied.
- 11.10.3 The Contractor shall detail their proposed method to confirm that the Equipment supplied contains only lead-tin solder and does not actually contain other solders:
- a. This shall be done through the use of suitable and independently-auditable techniques;
 - b. Note that lead (as in small cable, not Pb) plating is a particular area where incorrect solders may be found.
- 11.10.4 Where lead-free solders are used, the Contractor shall verify the performance of the Equipment to the Equipment end of life in the system environment.
- 11.10.5 The Contractor shall prepare, deliver and maintain a Lead Free Solder Verification Report [DRL E18].

11.11 Electrical Equipment Terminations and Connections

- 11.11.1 All points of electrical termination and connection within the Equipment shall be clearly and unambiguously identified on the Equipment to prevent incorrect installation.
- 11.11.2 The T23 ships were built to RN standards which, with regards to cable colours, present differences between legacy and current industrial standards.
- 11.11.3 Replacement Equipment should be built to industrial standards with connections clearly marked.

11.12 Anti-Condensation Heaters

- 11.12.1 Anti-Condensation Heaters (ACH) shall be fitted to electronic cabinets, switchboards, electrical panels and control panels that are installed in machinery spaces or to any part of the ship that may have condensation problems in order to protect throughout the range of ambient conditions specified in Section 8 of this document.
- 11.12.2 ACH shall ensure that the system remains free from condensation.
- 11.12.3 ACH shall be provided with a readily accessible means of control or monitoring, such that the Equipment enclosures need not be opened for an operator to monitor that the ACH is both powered and operating or to indicate that it has failed.
- 11.12.4 Access shall be provided to facilitate ease of replacement of the ACH via a removable access panel.
- 11.12.5 ACH units should be designed so as not to present a burn risk.

- 11.12.6 Any residual burn or other risk that may be present in the Equipment should have adequate and appropriate signage warning of this.
- 11.12.7 ACH should be designed so that, when necessary, they automatically disconnect when the Equipment they are protecting powers up.
- 11.12.8 ACH shall be powered from an electrical supply independent of that of other supplies to the Equipment to enable the ACH to operate independently when the Equipment is otherwise isolated and inoperative.
- 11.12.9 Anti-condensation heaters shall be fitted where required to allow operation across the full range of environmental conditions as detailed in Section 8.
- 11.12.10 ACH power supplies shall be capable of isolation to enable maintenance on the parent Equipment to be undertaken safely:
 - a. Should an ACH unit remain live when the equipment in which it is installed is otherwise isolated, this shall be justified; and
 - b. In the above event appropriate signage shall be permanently attached to the equipment.

12 GENERAL MECHANICAL REQUIREMENTS**12.1 Terminal Flanges**

12.1.1 Equipment that has pipework terminal flanges for interface with the Ship's systems shall use flanges at no less than 16bar rating and in accordance with:

- a. BS EN 1092-1 (Ref. F40);
- b. BS EN 1092-2 (Ref. F41);
- c. BS EN 1092-3 (Ref. F42);
- d. BS EN 1092-4 (Ref. F43).

12.2 High Pressure Air services

12.2.1 The Equipment shall comply with:

- a. Pressure Equipment Regulations 1999;
- b. Pressure Systems Safety Regulations 2000.

12.2.2 Equipment requiring high pressure air shall use air supplied:

- a. At up to 276bar (gauge);
- b. With a dew point of less than -64°C at 1.013bar;
- c. With an aerosol oil content of not more than 0.5mg/m³;
- d. With no solid particles greater than 5microns.

12.3 Sea Water Cooling Services

12.3.1 Equipment requiring sea water cooling shall use sea water supplied at up to 3bar (gauge).

12.4 Flooding

12.4.1 Unless specifically identified in the relevant TES document, mechanical Equipment will not be required to remain operational in a flooded environment.

12.4.2 The Equipment should be capable of being returned to full operation with a minimum of remedial action following a flood event.

13 GENERAL ENGINEERING REQUIREMENTS**13.1 Equipment Arrangements**

- 13.1.1 Equipment arrangement information shall be detailed in the tender response, including full breakdown of:
- a. Equipment dimensions;
 - b. General Arrangement;
 - c. Connection and Interface information;
 - d. Component group weights;
 - e. Component Centres of Gravity.

13.2 Metrication

- 13.2.1 Equipment, components and documentation shall use metric terms and units in accordance with BS ISO 80000-1 (Ref. T44).
- 13.2.2 All Equipment software systems shall use metric units which are to be clearly defined wherever input is required.

13.3 Drawings

- 13.3.1 Engineering drawings shall comply with:
- a. BS 8888 (Ref. T45);
 - b. BS 5070 (Ref. T46);
 - c. BS EN 61082 (Ref. T47);
 - d. BS 5536 (Ref. T48).
- 13.3.2 Full engineering drawing packs shall be supplied for all Equipment items including lifting arrangements.
- 13.3.3 All engineering drawings should be supplied in electronic CAD format. File formats to be agreed with the Authority.
- 13.3.4 Three dimensional models of the Equipment solution should be supplied for each package of Equipment components.
- 13.3.5 Three dimensional models shall accurately position all external connection points and lifting arrangements for the Equipment. File formats to be agreed with the Authority.

13.4 Lloyd's Notations

- 13.4.1 The Type 23 does not carry Lloyds notation for machinery. The Authority does not require Lloyds notation on supplied Equipment, however, where Equipment holds such notation or those of other relevant maritime standards this should be indicated in the tender response.

13.5 Equipment Handling/Portability

- 13.5.1 Equipment and components that require manual handling shall comply with Def Stan 00-250 (Ref. F49).
- 13.5.2 All Equipment weighing in excess of 40kg net weight as supplied for installation within the Ship shall be fitted with approved and tested lifting points.
- 13.5.3 A lifting point diagram should be supplied as part of the tender response.

14 CONTROL AND INSTRUMENTATION REQUIREMENTS**14.1 General Control & Instrumentation**

- 14.1.1 Suitable control and instrumentation options should include alerts, status and condition monitoring and other controls as specified in the Equipment TESs.
- 14.1.2 Alerts are defined as events detected by the Equipment which are determined as being of interest to the operator whether needing a response or not. 'Alerts' is the generic term for alarms, warnings and events, which are further defined below:
- a. Alarms require immediate and mandatory action in response to an emergency situation endangering the Ship, plant or personnel;
 - b. Warnings are advance warning of a potential alarm, where action can prevent the alarm from arising;
 - c. Events are used to notify the operator that an event of significance has occurred. This does not necessarily require an operator response.

14.2 Status and Condition Monitoring

- 14.2.1 The Equipment should be fitted with sensors and facilities to enable remote operations as required.
- 14.2.2 Equipment condition monitoring should be embedded in the Equipment and software to allow remote status monitoring.

14.3 Software Requirements

- 14.3.1 The Contractor shall comply with the requirements detailed in AQAP 2210 - NATO Supplementary Software Quality Assurance Requirements to AQAP 2110.
- 14.3.2 Software should be produced in accordance with the ISO 9001 TickIT guide.
- 14.3.3 The risks associated with software and its integration under PGMU shall be properly managed with application of the Naval Authority Notice - Software Integration (Ref-F50), thereby providing assurance that the software is safe and fulfils the requirements of JSP 430 (Ref F51):
- a. Guidance notes in support of the Software Integration Policy detailed in the Naval Authority Notice are available upon request.
- 14.3.4 The Contractor shall supply evidence and demonstrate that the software installed in Equipment will be sustainable until the OSD of the T23 Class.
- 14.3.5 The Contractor shall utilise a Software Test Facility (or similar) to enable the testing and demonstration of the software installed in their Equipment.
- 14.3.6 The software system design shall enable authorised updates to be incorporated on-board ship without compromising the software integrity of the system:
- a. The Equipment shall enable trained on-board personnel to install authorised updates to software;
- b. There should be no requirement for contractor personnel to conduct software updates on-board.
- 14.3.7 The Contractor shall ensure that any software modifications are incorporated into updates and are proven safe and effective before incorporation on-board as an authorised software update.
- 14.3.8 The Equipment shall provide means of easily determining the current software version and information regarding the last installed update.
- 14.3.9 The Equipment should be isolable during software updates to prevent any failure or errors in updating from being passed to other connected software systems.
- 14.3.10 The Equipment design shall indicate when a software modification has been successfully loaded.
- 14.3.11 The Contractor shall make clear in their tender response the anticipated boot time of any software system.

14.4 Software Safety

- 14.4.1 All safety functions in the Equipment implemented in whole or in part by software or Complex Electronic Elements (CEE) shall be identified and analysis conducted

- to support the argument that the level of risk has been reduced to a level that is ALARP and either tolerable or broadly acceptable.
- 14.4.2 The safety functions shall be documented and accepted by the MOD Surface Combatants Team Leader (SCTL). The MOD Director of Ships (D Ships) Risk Matrix is to be used when assessing the levels of risk and tolerability. Reference: IEC 62061 harmonised as BS EN 62061 (Ref. T62).
- 14.4.3 The Contractor shall identify the functionality, implemented within the Equipment that relates directly to the mitigation of hazards to personnel, the platform or the environment.
- 14.4.4 The Contractor shall identify and record the hazards that are mitigated entirely or in part by these protective functions.
- 14.4.5 Hazards that relate specifically to the Key Hazard Areas shall be annotated and highlighted. The Key Hazard Areas are:
- a. Propulsion and Manoeuvring Systems;
 - b. Fire;
 - c. Escape and Evacuation;
 - d. Stability;
 - e. Structural Strength.
- 14.4.6 The Contractor shall identify and record other hazards that could be further mitigated by MCAS, by other PGMU Equipment or by Installation Solution design.
- 14.4.7 The Contractor shall identify and record other protective functions that could be further implemented by MCAS, by other PGMU Equipment or by Installation Solution design.
- 14.4.8 The Contractor shall conduct a hazard analysis on the identified hazards and protective functions.
- 14.4.9 The Contractor shall record the outputs from the hazard analysis in a Hazard Log [DRL E26].
- 14.4.10 The Contractor shall update the Hazard Log as the project matures.
- 14.4.11 The Contractor shall ensure that protective functions are, or will continue to be, implemented in a manner that will result in a hazard that is considered Tolerable or Broadly Acceptable.
- 14.4.12 The Contractor shall provide the necessary evidence to demonstrate that protective functions have been correctly implemented and proven.
- 14.4.13 The Contractor shall ensure that the new Equipment Software / CEE is not used to implement any new functions which are directly related to safety, without a robust

justification argument that an acceptable level of risk can be achieved, and that this level of risk is ALARP and either Tolerable or Broadly Acceptable.

- 14.4.14 The Contractor shall provide evidence that no new unjustified protective functions have been implemented in Equipment Software / CEE alone, and that existing protective functions have not been removed: this evidence will be required throughout the life of the software, as updates are released.
- 14.4.15 The Contractor shall provide evidence that no new unjustified protective functions have been implemented in Equipment Software / CEE alone, and that existing protective functions have not been removed, through the use of third party independent review and software testing.
- 14.4.16 The Contractor shall provide justification regarding the intrinsic physical hazards related to their Equipment.
- 14.4.17 Physical hazards shall be compliant with all relevant legislation.
- 14.4.18 Physical hazards shall present risks that are ALARP.

15 SECURITY REQUIREMENTS**15.1 General Security Requirements**

- 15.1.1 The programmable elements of the Equipment shall achieve Security Accreditation. The process by which this will be achieved is via the Risk Management Accreditation Document Set (RMADS) Reference JSP 440 (Ref. F52) Part 8 Section 2 Chapter 4 issue 3.9.0, which is available from the DE&S restricted access website.
- 15.1.2 The programmable elements of the Equipment shall deny unauthorised access to protectively marked material held in the System:
- a. Protectively marked material is defined in the Security Grading Guide i.a.w JSP 440. Protectively marked data includes classified hardware, firmware and software (object code and formatted/unformatted material).
- 15.1.3 The programmable elements of the Equipment shall generate and store accounting records for identified security relevant events (such as successful/failed logins by the maintainer or the import/export of new electronic data).
- 15.1.4 Data for accounting records should be of a generic format that can be used without use of proprietary software.
- 15.1.5 The programmable elements of the Equipment shall provide prevention measures against unauthorised introduction of software:
- a. The prevention measures shall be proposed and detailed by the Contractor;
 - b. The prevention measures shall include the need for key or password access controls for trained on-board maintainers when undertaking the authorised introduction of software;
 - c. Operators shall not be required to undertake software maintenance tasks;
 - d. Operators shall not be provided with key or password access to any software maintenance functions, including the introduction of software;
 - e. The prevention measures shall be agreed with the Authority.
- 15.1.6 Any software or firmware updates to the programmable elements of the Equipment shall be checked for the presence of viruses before installation.
- 15.1.7 The programmable elements of the Equipment shall provide appropriate measures to prevent the introduction of viruses both to and from connected systems.
- 15.1.8 If required by JSP 440, the programmable elements of the Equipment shall encrypt protectively marked data stored on removable digital media using an acceptable method in accordance with DIAN/15.

- 15.1.9 The programmable elements of the Equipment shall not compromise the security accreditation status of the host platform and shall conform with Code of Connection (CoCo) or Data Exchange Specification (if no CoCo exists).

16 GLOSSARY**16.1 Abbreviations**

Abbr.	Def.
Abbr.	Abbreviation
ABN	Airborne Noise
AC	Alternating Current
ACH	Anti-Condensation Heater
ALARP	As Low As Reasonably Practicable
AQAP	Allied Quality Assurance Publication
ART	Accelerated Reliability Tests
BS	British Standard
CAD	Computer Aided Design
CBRN	Chemical, Biological, Radiological, and Nuclear
CEE	Complex Electronic Elements
CER	Compartment
CFRP	Carbon Fibre Reinforced Plastics
CoCo	Code of Connection
COSHH	Control of Substances Hazardous to Health
COTS	Commercial Off The Shelf
DC	Direct Current
Def.	Definition
DG	Diesel Generator (set)
DII	Defence Information Infrastructure
EN	European Norm
ESQL	Equipment Shock Qualification List
EU	European Union
FMECA	Failure Modes, Effects and Criticality Analysis
FOC	First Of Class
FOST	Flag Officer Sea Training
GPTME	General Purpose Test and Measurement Equipment
GTR	General Technical Requirements
HFI	Human Factors Integration
HMI	Human Machine Interfaces
IEC	International Electro-technical Commission
ILS	Integrated Logistics Support
ILSP	Integrated Logistics Support Plan
IP	Ingress Protection
ISO	International Organisation for Standardisation
IT	Information Technology
JSP	Joint Service Publication
LCP	Local Control Panel
LRU	Line Replaceable Unit
MAP	Maritime Acquisition Publication
MCAS	Machinery Control And Surveillance

HANDLING INSTRUCTION – COMMERCIAL IN CONFIDENCE

Power Generation & MCAS Update

SSA004/01 General Technical Requirements

MEPS	Main Electrical Power System
MG	Motor Generator (set)
MOD	Ministry of Defence
NATO	North Atlantic Treaty Organisation
OEM	Original Equipment Manufacturer
OSD	Out of Service Date
PGMU	Power Generation and MCAS Update
PPE	Personal Protective Equipment
PVC	Polyvinyl Chloride
RCM	Reliability Centred Maintenance
REACH	Registration, Evaluation and Authorisation of Chemicals
RMADS	Risk Management Accreditation Document Set
RN	Royal Navy
RTR	Rationalised Transformer Rectifiers
S&TE	Support and Test Equipment
SCC	Ship Control Centre
SI	Statutory Instrument
SICS	Ships Installed Chemical System
SIL	Safety Integrity Level
SIN	Substitute It Now (List)
SIRS	Ships Installed Radiac System
SOW	Statement of Work
SRD	System Requirements Document
SRE	Sound Reproduction Equipment
STANAG	Standardisation Agreement
STTE	Special To Type Equipment
SVHC	Substance of Very High Concern
T23	Type 23 (Frigate)
TES	Technical Equipment Specification
TNA	Training Needs Analysis
TRU	Transformer Rectifier Units
UK	United Kingdom
UMMS	Unit Maintenance Management System
URN	Underwater Radiated Noise
VOC	Volatile Organic Compound

16.1.1 Defined Terms

Term	Definition
Joint Supply Chain	The element of the Support Chain that covers the policies, end-to-end processes and activities associated with receipt of stocks from trade to their delivery to the demanding unit and the return loop for the UK's Armed Forces.
General Purpose Test and Measurement Equipment (GPTME)	<p>Items that are common to more than one main Equipment or main Equipment system, or have been introduced into service to support a single item of Equipment but are capable of supporting other items of Equipment. GPTME may include:</p> <ul style="list-style-type: none"> • Electrical, Electronic, Mechanical, Optical, Physical and Safety Equipment; • Commercial Off The Shelf items (COTS); • Military Off The Shelf items.
Materials New to RN Warship Service	Materials New to RN Warship Service are defined as those materials which have not formerly been used with a total quantity in excess of 50kg on any RN vessel. Such materials will need to be qualified for use.

17 REFERENCED DOCUMENTS AND STANDARDS

17.1.1 This section lists all documents and standards that have been referenced within other sections of this GTR.

17.2 Non-Tradable Engineering Standards

Ref No.	Document Number	Title	Version
Ref. F01	COSHH	HSC Regulations - The Control of Substances Hazardous to Health COSHH Regulations. (SI 2677)	2002
Ref. F02	EH40	Guidance Note Environmental Hygiene - HSE Occupational Exposure Limits.	2005 (as consolidated with amendments October 2007)
Ref. F03	REACH	Annex XVII (Cadmium) of REACH No. 1907/2006, namely EU No.494/2011	20 May 2011
Ref. F04	N/A	Control of Asbestos Regulations	2006
Ref. F05	Statutory Instrument 1996 No. 341	The Health and Safety (Safety Signs and Signals) Regulations	2006
Ref. F06	Def Stan 02-784	Requirements for Safety Signs and Colours	Issue 3, Oct 2008
Ref. F07	Def Stan 07-247	The Selection of Materials on the Basis of their Fire Characteristics, Part 1	Issue 3, Sep 2009
Ref. F08	Def Stan 61-12 Part 31	Wires, Cords, and Cables, Electric. Metric Units. Sheaths. Limited Fire Hazard.	Issue 2, Jan 2006
Ref. F09	JSP 815	Defence Environment and Safety Management	Feb 2009
Ref. F10	Montreal Protocol	Montreal Protocol on Substances that Deplete the Ozone Layer	1985 updated 2006
Ref. F11	1005/2009	EC Regulation on Substances that Deplete the Ozone Layer	Sep 2009
Ref. F12	REACH	EC Regulation No.1907/2006. REACH. European Chemicals Agency Candidate List of Substances of Very High Concern for Authorisation	Jun 2011
Ref. F16	WARPAINT	WARPAINT (Issued every 6 months by DES SESea-MT)	Latest
Ref. F18	Hong Kong Convention	IMO Hong Kong Convention for the Safe and Environmentally Sound Recycling of Ships	2009

HANDLING INSTRUCTION – COMMERCIAL IN CONFIDENCE

Power Generation & MCAS Update

SSA004/01 General Technical Requirements

Ref No.	Document Number	Title	Version
Ref. F19	SI UK 2011/80	The Biocidal Products Regulations	2010 SI745
Ref. F20	Def Stan 21-05	Code of Practice for Protective Finishes	Issue 3, Sep 2009
Ref. F21	Statutory Instrument 2005 No. 1643	Control of Noise at Work Regulations	2005
Ref. F22	MAP 01-473	Mount Data Manual	Issue 1, April 2012
Ref. F23	SEA/502/20/01/1.1	Essential Characteristics for Surface Ship Vulnerability	Nov 2008
Ref. F24	MAP 01-470	Shock Design Manual	Issue 1, April 2012
Ref. F25	Def Stan 08-120	Requirements for determining the shock strength of Equipment	Issue No: 1 dated 01/04/2000
Ref. F26		Type 23 Shock Policy Paper	
Ref. F27	Def Stan 00-250	Human Factors for Designers of Systems	Issue 1, May 2008
Ref. F28	Statutory Instrument 2005 No. 1093	Control of Vibration at Work Regulations	2005
Ref. F29	Def Stan 00-600	Integrated Logistic Support. Requirements for MOD Projects	Issue 2, Nov 2011
Ref. F30	STANAG 1414	Guidelines to Ensure That Contractors Design and Supply New Equipment Capable of Using Standardized Lubricants	Edition 3, 2009
Ref. F31	STANAG 4362	Fuels For Future Ground Equipments Using Compression Ignition Or Turbine Engines	Edition 2, 2006
Ref. F32	Def Stan 00-3	Design Guidance for the Transportability of Equipment	Issue 4, May 2011
Ref. F33	Def Stan 00-56	Safety Management Requirements for Defence Systems	Issue 4, Jun 2007
Ref. F35	BS 8450	Code of Practice for Installation of Electrical and Electronic Equipment in Ships	2006
Ref. F36	N/A	Electricity at Work Regulations	1989
Ref. F38	BS EN 60529	Specification for degrees of protection provided by enclosures (IP code)	1992

HANDLING INSTRUCTION – COMMERCIAL IN CONFIDENCE

Power Generation & MCAS Update

SSA004/01 General Technical Requirements

Ref No.	Document Number	Title	Version
Ref. F39	Def Stan 08-160	Requirements for Electrical Installations (Category 2)	Issue 1, Jun 2003
Ref. F40	BS EN 1092-1	Flanges and their joints - Circular flanges for pipes, valves, fittings and accessories, PN designated. Steel Flanges	2007
Ref. F41	BS EN 1092-2	Flanges and their joints - Circular flanges for pipes, valves, fittings and accessories, PN designated. Steel Flanges	1997
Ref. F42	BS EN 1092-3	Flanges and their joints - Circular flanges for pipes, valves, fittings and accessories, PN designated. Steel Flanges	2003
Ref. F43	BS EN 1092-4	Flanges and their joints - Circular flanges for pipes, valves, fittings and accessories, PN designated. Steel Flanges	2002
Ref. F49	Def Stan 00-250	Human Factors for Designers of Systems, Part 3: Technical Guidance	Issue 1, May 2008
Ref. F50	NAN 09/2012	Naval Authority Notice - Software Integrity	October 2012
Ref. F51	JSP 430	Joint Service Publication - Management of Ship Safety and Environmental Protection	
Ref. F52	JSP 440	Joint Service Publication - Defence manual of Security	
Ref. F55	Def Stan 00-35	Environmental Handbook for Defence Materiel; Part 4: Natural Environment.	Issue 4 dated: 18th Sep 2006
Ref. F56	IEEE Std 1584-2002	Guide for Performing Arc-Flash Hazard Calculations	
Ref. F57	Def Stan 08-123	Requirements for Design and Testing of Equipments to Meet Environmental Conditions (Cat 1)	Issue No: 2 dated 09/11/2012
Ref. F59	Def Stan 08-204 Part 3	Requirements for Damage Control and Fire Protection for the Safety Of HM Surface Ships and Submarines Part 3	Issue 1 Publication Date 31 March 2010
Ref. F60	Def Stan 01-5	Fuels, Lubricants and Associated Products	Issue 17 Date March 2011
Ref. F61	Statutory Instrument 1994 No. 3260	Electrical Equipment (Safety) Regulations	1994

Table 17-1 – Fixed Engineering Standards

17.3 Tradable Engineering Standards

Ref No.	Document Number	Title	Version
Ref. T15	SIN List	REACH. International Chemical Secretariat SIN List. http://w3.chemsec.org	List 2.0 of 3, May 2010
Ref. T34	LPCB LPS 1207	Fire Requirements for the Loss Prevention Certification Board Approval and Listing of Protective Covering Materials	Issue 2.1
Ref. T37	Def Stan 61-5	Low Voltage Electrical Power Supply Systems. Part 4: Quality of Electrical Power Systems in HM Ships	Issue 4, Sep 06
Ref. T44	BS ISO 80000-1	Specification for SI units	2009
Ref. T45	BS 8888	Technical product specification	2008
Ref. T46	BS 5070	Engineering Diagram and Drawing Practices	1988
Ref. T47	BS EN61082-1	Drawing Practices for Engineering Diagrams	2006
Ref. T48	BS 5536	Preparation of Technical Drawings and Diagrams for Data Exchange	1988
Ref. T58	BR 2203	Ship Husbandry Manual	Edition 2, 1999
Ref. T61	Def Stan 02-313	Diesel Engines for Marine Propulsion & Auxiliary Machinery	Issue 1 Publication Date 1 April 2000
Ref. T62	BS EN 62061:2005	Safety of machinery, Functional safety of safety-related electrical, electronic and programmable electronic control systems	Jan 2006

Table 17-2 – Tradable Engineering Standards

17.4 Design Guidance Engineering Standards

Ref No.	Document Number	Title	Version
Ref. G13	Critical Raw Materials for the EU	Report of the Ad-hoc Working Group on defining critical raw materials	Jul 2010
Ref. G14	British Geological Survey Risk List	Current Supply Risk Index for Chemical Elements or Element Groups which are of economic value	2011
Ref. G17	SI 2000 No. 1973	The Pollution Prevention and Control (England and Wales) Regulations	Jul 2000
Ref. G54	Def Stan 02-617	Design Guide and Requirements for Equipment to Achieve a Low Magnetic Signature	Issue 3 dated 11 Oct 2004

Table 17-3 – Design guidance Engineering Standards