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Type 23 - Power Generation and MCAS Update (PGMU) – Machinery Control and Surveillance System (MCAS)

**CONTRACT SSA/004/04**

**ANNEX A TO SCHEDULE A**

**TECHNICAL EQUIPMENT SPECIFICATION**

Issue: 2.1

Date: January 2016

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| **Record of changes** | | |
| Issue | Date | Detail of Changes |
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| 1.1 | 07 July 2014 | Rectification of low-level component obsolescence issues. |
| 2.0 | 21 Jan 2015 | Updated to new issue following negotiations with Rolls Royce |
| 2.1 | 10 Jun 2015 | Update to wording in Sections 3.3.7.b and 3.21.2.b |

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# Introduction

## Purpose

Technical Equipment Specifications (TES) have been produced by the Naval Design Partnering (NDP) team to define the technical requirements and performance specification for procurable equipment within the Type 23 Frigate (T23) Power Generation and MCAS Update (PGMU) programme.

This TES defines the requirements for the update of the existing T23 Machinery Control and Surveillance (MCAS) system.

## Document Description

This document is divided into the following sections:

Section 1 (this section);

Section 2 defines the overall scope of the TES including an outline of the technical scope of the equipment;

Section 3 defines the functional and performance requirements of the equipment;

Section 4 defines any transverse requirements for the equipment that are in addition to or are tailored from those specified in the General Technical Requirements (GTR) document;

Section 5 defines the functional and physical interfaces associated with the equipment and any ship installation constraints that apply;

Section 6 lists applicable standards and reference documents;

Section 7 contains the definitions of acronyms, abbreviations and terms used in this TES.

## Conventions

Unless otherwise indicated, all quantities stated in this specification are per-ship.

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

## Relationship to Other Documents

The TES should be considered in context with the following related documents:

The T23 PGMU System Requirements Document (SRD);

The T23 PGMU GTR;

The T23 PGMU MCAS Statement of Work (SOW);

Other T23 PGMU TES documents;

The Type 23 Frigate Build Contract Definition documents (BCD). The BCD documents have been referenced to allow the Contractor to understand the original design intent of the MCAS.

Linking between the requirements in this TES and the original System Requirements (SR) in the SRD has been provided where appropriate (shown as (SR-xxx) within the TES paragraphs).

The document hierarchy is detailed within the T23 PGMU MCAS Invitation to Tender (ITT) pack and in the AWARD assessment package.

## Engineering Standards

Certain requirements within this TES may be specified in terms of ‘Engineering Standards’. In such cases, the relevant requirements, where included throughout this document, specify how the Engineering Standard is to be applied to the equipment and Section 7 provides details relating to the identity, configuration status, part/section applicability of the relevant standard and an indication of its ‘Non Tradable’, ‘Tradable’ or ‘For Design Guidance’ categorisation.

# Scope of Supply

## Background to the PGMU Project

The PGMU project has been 2 separate projects, highly dependent on each other, which have been combined to reduce risk and costs associated with integration. The driver for the PGMU project is the decision to extend the working life of the T23. To enable the life extension (LIFEX), PGMU is aiming to increase the amount of power available, accounting for the systems added since the original design and those currently planned as well as restoring a growth margin to ensure that power is available for future systems until the Out of Service Date (OSD). To enable the LIFEX programme, PGMU will also overcome potential hardware obsolescence and software supportability issues in the MCAS system.

Central to all Ministry of Defence (MOD) procurement is the need to be affordable. A consequence of this is the assertion that PGMU is an update project that seeks to replace like-for-like capability. Whilst improvements in capability are expected in some areas due to the replacement of old technology by newer systems, outright improvements are not funded. However, the project is expected to consider every opportunity to lever-out advantages during the update process and the Contractor is encouraged to propose solutions that illustrate where added value can be achieved.

A common threshold Measure of Performance (MOP) throughout the SRD is "No worse than the current capability" which does not constrain the solution to being exactly equal to the current capability but enshrines the intention of update rather than upgrade. Similarly, many system requirements lack an objective MOP because an update project is not funded to provide more capability than the threshold acceptable level.

The priorities of system requirements were devolved from the User Requirements Document (URD) where applicable and confirmed during stakeholder workshops. Arguably, any trading out of requirements in an update project would lead to a degradation of capability. However, another consequence of the centrality of affordability is that trading of requirements is still a possibility.

The interfaces between the PGMU project and the T23 ship’s systems are shown in Figure 1. The equipment contained within the PGMU boundary is shown in Figure 2.

Figure 1 – PGMU Equipment Interface Diagram

Figure 2 – PGMU Equipment Boundary Diagram

## Existing Machinery Control and Surveillance System Overview

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Table 1 - Location of DCU and CDCU racks

A deck plan of the T23 Frigate showing the major compartments containing MCAS DCU and CDCU racks is provided in Figure 3.

Figure 3 – Deck Plan of Major Compartments Containing MCAS Racks

A block diagram of the current MCAS secondary surveillance system is shown in Figure 4.

Figure 4 – Current MCAS Secondary Surveillance System Block Diagram

## MCAS Update

## Scope of Supply

# Functional and Performance Requirements

## MCAS Architecture

## MCAS DCUs and CDCUs

## MCAS Software

## MCAS Consoles

## MCAS – General

## Out of Limits Operation - Alarms and Warnings

## Electrical Power Generation

## Electrical Power Distribution

## Load Shedding

## Propulsion Equipment

## Telegraph System

## Gas Turbines

## Gearboxes

## Propulsion Converter Regulators

## Shaft Brakes

## Auxiliary Equipment

## Chilled Water Plants

## Support Service systems

## Shipwide Alarms and Warnings

## MCAS Data - Analyse Data

## MCAS Data - Record Data

## MCAS Data - Export Data

## MCAS Data - Display Data

|  | **SR Ref** | **Number of Parameters** | **Data Collection Rate** | **Record data and retain for** | **Export** | **VDU Display** | **Trend Graphs** |
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Table 2 - Summary of Record, Export and Display Requirements

## MCAS Data - Modify Data

## Energy Assessment Systems

## Operator Interfaces

## Self-diagnostic Facility

# Transversal Requirements

## Safety

Diesel Generators installed in the FAMR of T23 Frigates are each contained within an acoustic enclosure. Diesel Generators installed in the UAMR are not currently contained within an acoustic enclosure. The PGMU project will replace the acoustic enclosures containing the DGs in the FAMR. Further work to determine the replacement of the acoustic enclosures in the FAMR will be conducted during the detail design phase.

DG acoustic enclosures are required to satisfy noise attenuation requirements, and fire suppression is required as a measure to mitigate the risk from fire damage. Currently, Batch 1 and Batch 2 T23 Ships use a manually operated, twin-bottle, gas fire suppression system for the FAMR DG acoustic enclosures, providing for the release of one gas bottle from a remote position (the SCC via MCAS) and a further gas bottle from a local position. Activation of the fire suppression system also closes the acoustic enclosure ventilation flaps.

The fire suppression systems fitted to the acoustic enclosures of Batch 1 and Batch 2 FAMR DGs are in the process of being modified to correct a number of design issues, and will be replaced by new fire suppression systems when the FAMR DG acoustic enclosures are replaced during the PGMU project.

The Contractor shall obtain details of the type of fire suppression systems to be installed in the DG acoustic enclosures and the methods of controlling and monitoring these systems from the suppliers of the diesel generators.

The Contractor shall utilise the information obtained from the suppliers of the diesel generators to ensure the methods of controlling and monitoring these systems can be implemented within MCAS.

GT Modules also use a fire suppression system. Batch 1 Ships use a manually operated, twin-bottle, gas fire suppression system for the GT Modules, providing for the release of one gas bottle from a remote position (the SCC via MCAS) and a further gas bottle from a local position. Batch 2 Ships use a system that provides for the automatic release of one gas bottle and the manual release of a further gas bottle from a local position – the gas is not released from a remote (i.e. SCC) position, and the automatic release of the first gas bottle is provided by the fire suppression system. Activation of both manual and automatic systems also closes the acoustic enclosure ventilation flaps.

The MCAS System shall be able to operate fire suppression systems fitted to DG acoustic enclosures and GT Modules (SR-262):

Fire Suppression systems fitted to DG acoustic enclosures in the FAMR shall be operable from the remote (SCC Operators Console) operating positions using MCAS;

Fire Suppression systems fitted to Batch 1 GT Modules shall be operable from the remote (SCC Operators Console) operating positions using MCAS;

Fire Suppression systems operable from the remote (SCC Operators Console) position shall utilise hardwired connections.

## MCAS Software Safety

## Shock

# Functional and Physical Interfaces

## Functional Interfaces

## Physical Interfaces

# NON FUNCTIONAL REQUIREMENTS

## Reliability and Maintainability

# References

## Books of Reference

|  |  |  |  |
| --- | --- | --- | --- |
| **Reference Number** | **Document Number** | **Document Details** | **Category** |
| Ref. 1 | BR6500(109) | Main Electrical Power System, Type 23 Frigates, Edition 96\_05 Amendment 02. | For Design Guidance |
| Ref. 2 | BR6500(110) | Main Electrical Power System (FIDA), Type 23 Frigates, Edition 97\_03 Amendment 02. | For Design Guidance |
| Ref. 3 | BR6500(112) | Main Electrical Power System, Control Equipment, Type 23 Frigates, Edition 95\_05 Amendment 05. | For Design Guidance |
| Ref. 4 | BR6500(113) | Main Electrical Power System, Distribution Equipment, Type 23 Frigates, Edition 95\_04 Amendment 02. | For Design Guidance |
| Ref. 5 | BR6505(006) | Machinery Control and Surveillance System, Type 23 Frigate, Edition 97\_02 Amendment 03. | For Design Guidance |
| Ref. 6 | BR6505(007) | Propulsion Machinery Control and Surveillance System, Type 23 Frigate, Edition 97\_04 Amendment 0. | For Design Guidance |
| Ref. 7 | BR6505(008) | Propulsion Machinery Control and Surveillance System (FIDA), Type 23 Frigate, Edition 97\_11 Amendment 03. | For Design Guidance |
| Ref. 8 | BR6505(009) | Auxiliary Machinery Control and Surveillance System, Type 23 Frigate, Edition 98\_01 Amendment 02. | For Design Guidance |
| Ref. 9 | BR6505(010) | MCAS Operators Console Type 23 Frigate, Edition 95\_07 Amendment 03. | For Design Guidance |
| Ref. 10 | BR6505(011) | MCAS Supervisors Desk Type 23 Frigate, Edition 95\_06 Amendment 03. | For Design Guidance |
| Ref. 11 | BR6505(012) | MCAS/MEPS CDCU/DCU Cabinets Type 23 Frigate, Edition 95\_10 Amendment 03. | For Design Guidance |
| Ref. 12 | BRF4516(002) | Propulsion and Engine Order System and VCS Unit - Type 903, Edition 89\_02 Amendment 01. | For Design Guidance |
| Ref. 13 | BRF6563(001) | Electric Propulsion Thyristor Converter and Regulator Type 23 Frigates, Edition 05\_06 Amendment 07. | For Design Guidance |
| Ref. 14 | BR6620(001) | Marine Engineering Systems and Machinery, Description, Principles of Operation, Limitations and Emergency Procedures, Type 23 Frigates, Edition 98\_10 Amendment 02. | For Design Guidance |
| Ref. 15 | BR6620(002) | Marine Engineering Systems and Machinery, Operating Procedures, Type 23 Frigates, Edition 00\_07 Amendment 01. | For Design Guidance |
| Ref. 16 | DBR6620(503) | Chilled Water Local Control Panel, Edition 07\_07 Amendment 01. | For Design Guidance |
| Ref. 17 | DBR6620(503)1 | York Chilled Water Local Control Panel, Edition 08\_01 Amendment 01. | For Design Guidance |
| Ref. 18 | BR7704 (Volumes 1 – 3) | RN D86 PECs and Auxiliary Equipment, Edition 01\_10 Amendment 01. | For Design Guidance |
| Ref. 19 | BR6620(004) | Machinery Operating Instructions, Machinery Drills T23 Frigates. | For Design Guidance |

## Defence Standards

|  |  |  |  |
| --- | --- | --- | --- |
| **Reference Number** | **Document Number** | **Document Details** | **Category** |
| Ref. 21 | Def Stan 00-250 Part 2 | Human Factors for Designers of Systems, Particular People-Related Requirements, Issue 01 dated 23 May 2008. | Tradable |
| Ref. 22 | Def Stan 00-250 Part 3 Section 15 | Human Factors for Designers of Systems, Technical Guidance: Work Equipment, Issue 01 dated 23 May 2008. | Tradable |
| Ref. 23 | Def Stan 02-521 | Guide to Versatile Console System Units, Issue 2 dated 13 April 2004. | For Design Guidance |
| Ref. 24 | Def Stan 02-522 | Versatile Console System Engineering Manual, Issue 2 dated 13 April 2004. | For Design Guidance |
| Ref. 25 | Def Stan 21-43 Part 2 | Data Recording & Analysis for Maritime Platforms, Systems & Equipments, Issue 06 dated 24 February 2012. | Tradable |

## MOD Documents

|  |  |  |  |
| --- | --- | --- | --- |
| **Reference Number** | **Document Number** | **Document Details** | **Category** |
| Ref. 31 | NDP/27/R54 | Guidance Document for the Design of Warship Command and Control Spaces, Issue 02 dated 19 Mar 2012. | Tradable |
| Ref. 32 | MOD12J48R08 | RN IPMS HCI Style Guide - Draft B - 1 April 2011 | Tradable |

## Joint Service Publications

|  |  |  |  |
| --- | --- | --- | --- |
| **Reference Number** | **Document Number** | **Document Details** | **Category** |
| Ref. 41 | JSP 430 | Management of Ship Safety and Environmental Protection, Part 3, Chapter 14. (Available from: http://www.nakmo.co.uk/default.aspx ) | Not Tradable |
| Ref. 42 | JSP 440 | The Defence Manual of Security, Part 8 (Communications & ICT Security), which may be accessed via the DE&S restricted access website. | Not Tradable |

## Miscellaneous

|  |  |  |  |
| --- | --- | --- | --- |
| **Reference Number** | **Document Number** | **Document Details** | **Category** |
| Ref. 51 | IEC 61508 | Functional Safety of Programmable Electrical Components. | Tradable |

## Build Contract Definition (BCD) Documents

|  |  |  |  |
| --- | --- | --- | --- |
| **Reference Number** | **Document Number** | **Document Details** | **Category** |
| Ref. 61 | BCD-06 TES L1101/4 | Main Electrical Power System Annex A issue 01 dated July 1993. | For Design Guidance |
| Ref. 62 | BCD-06 TES L1101/4 | Main Electrical Power System Annex B (Volumes 1 to 5) issue 01 dated July 1993. | For Design Guidance |
| Ref. 63 | BCD-06 TES MCON/17 Part 1 Volume 1 | MCAS Overall System Requirements issue 01 dated July 1993. | For Design Guidance |
| Ref. 64 | BCD-06 TES MCON/17 Part 1 Volume 2 | Propulsion Machinery Control and Surveillance issue 01 dated July 1993. | For Design Guidance |
| Ref. 65 | BCD-06 TES MCON/17 Part 1 Volume 3 | Auxiliary Machinery Control and Surveillance issue 01 dated July 1993. | For Design Guidance |
| Ref. 66 | BCD-06 TES MCON/17 Part 2 Volume 2 | Propulsion Machinery Control and Surveillance issue 01 dated July 1993. | For Design Guidance |
| Ref. 67 | BCD-06 TES MCON/17 Part 2 Volume 3 | Auxiliary Machinery Control and Surveillance issue 01 dated July 1993. | For Design Guidance |
| Ref. 68 | BCD-06 TES MCON/17 Part 2 Volume 5 | SCC Consoles issue 01 dated July 1993. | For Design Guidance |

# Abbreviations, Acronyms and definitions

|  |  |
| --- | --- |
| **A** |  |
| A&A | Alteration and Addition |
| ACB | Air Circuit Breaker |
| AQAP | (NATO) Allied Quality Assurance Publication |
| AVR | Automatic Voltage Regulator |
| **B** |  |
| BCD | Build Contract Definition |
| BR | Book of Reference |
| **C** |  |
| CANbus | A serial network data bus standard |
| CEE | Complex Electronic Elements |
| CDCU | Control and Data Collection Unit |
| CODLAG | Combined Diesel Electric and Gas |
| COMMS | Communications |
| CW | Chilled Water |
| CWLCP | Chilled Water Local Control Panel |
| CWP | Chilled Water Plant |
| **D** |  |
| D86 | Existing MCAS microprocessor-based control system |
| DCDRS | Damage Control Data Retrieval System |
| DCU | Data Collection Unit |
| DDR | Dynamic Data Recorder |
| Def Stan | Defence Standard |
| DG | Diesel Generator |
| DGLCP | Diesel Generator Local Control Panel |
| DII(F) | Defence Information Infrastructure (Future) |
| DMESR | Duty Marine Engineering Senior Rate |
| **E** |  |
| EAS | Energy Assessment System |
| EDP | Electrical Distribution Panel |
| EHM | Engine Health Monitoring |
| EM | Electric (Propulsion) Motor |
| **F** |  |
| FAMR | Fwd Auxiliary Machinery Room |
| FEA | Finite Element Analysis |
| Fwd | Forward |
| **G** |  |
| GT | Gas Turbine |
| GTR | Gas Turbine Room |
| GTR | General Technical Requirements document |
| GUI | Graphical User Interface |
| **H** |  |
| HCI | Human Computer Interface |
| HP | High Pressure |
| HPSW | High Pressure Sea Water |
| HQ1 | Headquarters 1 (the ship’s damage control and firefighting operations control centre) |
| **I** |  |
| I2ICE | An integrated circuit emulator, used for software debugging |
| IEC | International Electro-technical Commission |
| I/O | Input/Output |
| IP | Ingress Protection |
| IS | Installation Solution |
| ITT | Invitation to Tender |
| **J** |  |
| JSP | Joint Service Publication |
| **K** |  |
| **L** |  |
| LCP | Local Control Panel |
| LIFEX | Life Extension |
| LP | Low Pressure |
| LPSW | Low Pressure Sea Water |
| LRU | Line Replaceable Unit |
| **M** |  |
| MCAS | Machinery Control and Surveillance System |
| MCCB | Moulded Case Circuit Breaker |
| MCS | Maritime Combat Systems |
| MEOOW | Marine Engineering Officer of the Watch |
| MEPS | Main Electrical Power System |
| MG | Motor Generator |
| MGR | Motor Gear Room |
| MIMIC | A Condition Monitoring software suite |
| MMI | Man Machine Interface |
| MOD | Ministry of Defence |
| MOP | Measure of Performance |
| MTAU | Machinery Trials and Assessment Unit |
| MTBF | Mean Time Between Failures |
| MTTR | Mean Time To Repair |
| **N** |  |
| NATO | North Atlantic Treaty Organisation |
| NBCD | Nuclear, Biological, Chemical and Damage Control |
| NBCDISS | NBCD Incident and Surveillance System |
| NBCPO | NBCD Protection Officer |
| NDP | Naval Design Partnering |
| **O** |  |
| OBT | On-board Training |
| OOW | Officer of the Watch |
| OSD | Out of Service Date |
| OWS | Oily Water Separator |
| **P** |  |
| PEC | Printed Electronic Circuit |
| PECP | Primary Electrical Control Panel |
| PGMU | Power Generation and MCAS Update |
| PROFIBUS | Process Field Bus (A serial network data bus standard) |
| PROM | Programmable Read Only Memory |
| **Q** |  |
| QM | Quartermaster |
| **R** |  |
| RAS | Replenishment at Sea |
| **S** |  |
| SC | Surface Combatants [MOD] |
| SCC | Ship Control Centre |
| SEA | Ship Energy Assessment (Generic) |
| SEAS | Ship Energy Assessment System (BAe proposal) |
| SECP | Secondary Electrical Control Panel |
| SI | System Integrator |
| SMART | Ship Energy Assessment System (BMT SMART Ltd proposal) |
| SOW | Statement of Work |
| SR | System Requirement |
| SRD | System Requirement Document |
| Stbd | Starboard |
| SSS | Synchronous Self Shifting (Clutch) |
| Swbd | Switchboard |
| **T** |  |
| T23 | Type 23 Frigate |
| TES | Technical Equipment Specification |
| **U** |  |
| UAMR | Upper Auxiliary Machinery Room |
| URD | User Requirement Document |
| **V** |  |
| VCS | Versatile Console System |
| VDU | Visual Display Unit |
| V | Volts |
| **W, X, Y, Z** |  |

Table 3 - Abbreviations and Acronyms

|  |  |
| --- | --- |
| **A** |  |
| Auxiliary Equipment | Auxiliary Equipment includes:  a. Chilled Water System;  b. Ventilation System;  c. Main Lub Oil System;  d. Fuel System;  e. HP Seawater System;  f. LP Seawater System;  g. HP Air System;  h. LP Air System;  i. SS Air System;  j. Steering Gear;  k. Stabilisers. |
| **B** |  |
| Batch 1 | Batch 1 Type 23 Frigates are: |
| Batch 2 | Batch 2 Type 23 Frigates are: |
| **C** |  |
| CODLAG Drive | A combination of EM propulsion motors and Gas Turbines used to deliver propulsive power to the platform. |
| Control | 1. That function of the system that initiates or adjusts operations as needed to achieve the plan, or to maintain variations from system objectives within allowable limits.  2. Types of control are: |
| **D** |  |
| Damage Control State | A ship's posture defining the manning active aboard the ship and the equipment in use. |
| Distribute | Delivering to the intended recipients. |
| **E** |  |
| Electrical/Electronic Interfaces |  |
| EM | Electric Motors used for propulsion. |
| EM Drive | Electric Motors used to deliver propulsive power to the platform. |
| EM Max |  |
| EM Zero |  |
| Essential Equipment |  |
| Events | Events include:  Authorised Maintainer access (Login/Logout);  Telegraph order changes and acknowledgements of engine and revolution settings;  Use of manual inhibits and enabling of warning parameters;  Changes to Modifiable Parameters including coefficients, constants and warning trigger levels;  Resetting of stored information by the operator;  Modification of Log Contents and selection of parameters for recording;  Operation of plant override facilities;  Plant and system configuration changes;  Alarms and alarm status changes;  Warnings and warning status changes;  MCAS system faults including data channel failures and serial data link failures;  Unauthorised attempts to access MCAS. |
| **F** |  |
| **G** |  |
| Generate | To independently produce. |
| **H** |  |
| **I** |  |
| Internal Situational Awareness | The understanding of the state of platform encompassing the running state and state of repair of all equipment, the material state of the ship and the degree to which the platform can sustain a given level of activity given both equipment and personnel limitations. Situational Awareness can be considered in terms of three successive levels. The first is Perception which is an awareness of the environment, the second is Comprehension which is an understanding of the information available and how it affects one's goals, and the third is Projection which is the ability to predict conditions into the future using current conditions and an understanding of system dynamics. |
| **J, K, L** |  |
| **M** |  |
| Monitor | Automatically and continuously compare gathered plant data against pre-set criteria and, where the criteria are exceeded or faults are detected, raise alarm or warning indications to the operator or initiate an automatic control response. |
| **N** |  |
| **O** |  |
| Operate | To put into, or to continue in, operation or activity; as, to operate a machine. |
| Operator | A person who is responsible for operating a system and is defined to be an integral part of the system. |
| Out of Limits Operation | A situation in which the measured parameters from equipment are outside the normal bounds within which the equipment is expected to run. This generally indicates a fault and will produce an alarm or warning. |
| **P** |  |
| Propulsion Equipment | Propulsion Equipment includes: |
| Propulsion Functions | Those systems required to allow the platform to 'Move' in the maritime environment functions. This encompasses all equipment in the propulsion train. |
| Propulsion State | A level of propulsive power on a scale of: Full Ahead, Half Ahead, Stop, Half Astern, Full Astern. |
| **Q** |  |
| **R** |  |
| Running State | Whether equipment is on or off. |
| **S** |  |
| Shaftline Equipment | Shaftline Equipment includes:  a. Plummer Bearings;  b. Torsionmeters;  c. Shaft Speed sensors. |
| Ship Services | All equipment within the platform required for the safe operation of the Ship and the provision of Hotel Services to support both personnel and equipment. |
| Support Services | Support Service systems include:  a. Aviation Fuel System;  b. Sewage System;  c. Refrigeration Plant;  d. DG Lub Oil System;  e. Fresh Water System;  f. Desalination Plant;  g. Bilge and Sullage System. |
| Switchboard Room | A compartment containing a 600V switchboard, a 440V switchboard and a Secondary Electrical Control Panel. |
| **T, U, V, W, X, Y, Z** |  |

Table 4 - Definitions