

Table of Contents

1	INTRODUCTION	4
1.1	General.....	4
1.2	Basic Requirements	5
1.3	The Sites	9
1.4	Installation Works	10
1.5	Service Conditions	12
1.6	Alternatives.....	13
1.7	Provision By CAAS.....	13
1.8	Project Phases.....	13
1.9	Phase 1 scope of works	14
1.10	Phase 2 scope of works	15
1.11	Certificate of Acceptance for System	15
1.12	Project Management.....	16
1.13	IT Security	22
1.14	Options To Purchase.....	23
2	SYSTEM OVERVIEW	25
2.1	Basic Requirements	25
2.2	Integration with External System	25
2.3	Basic Design Objectives.....	28
2.4	Technical Requirements.....	31
2.5	UPS Power Supplies.....	33
3	SYSTEM REQUIREMENTS.....	34
3.1	General Requirements.....	34
3.2	High Reliability and Availability System Architecture.....	34
3.3	Main Data Processor.....	37
3.4	Technical Display	38
3.5	Network.....	39
3.6	Software Development Platform	40
3.7	Software Deliverables	41
4	RECORDING, EVALUATION, STATISTICS GENERATION AND PLAYBACK FACILITY.....	45
4.1	Recording.....	45
4.2	Copying to Removable Media.....	45
4.3	Evaluation Facility	46
4.4	Statistics Generation.....	46
4.5	Playback Facility	47
4.6	Export of Data	48
5	STATUS MONITORING AND REMOTE CONTROL	49
5.1	General.....	49
5.2	System Requirements	50
5.3	Interfaces	53
5.4	Software Requirements	55

PART 7 REQUIREMENT SPECIFICATIONS

5.5	Recovery Facilities	56
5.6	Functional Requirements	57
5.7	Future Expansion Requirements.....	68
6	PORTABLE MONITORING TOOL	70
6.1	General.....	70
6.2	Functionalities of the portable monitoring tool	70
6.3	Interfaces for the Portable Monitoring Tool.....	70
6.4	Design and Availability of the Portable Monitoring Tool.....	70
7	ALARM ALERT SYSTEM.....	71
7.1	System Alerts Notifications	71
7.2	Sensors Alerts Notifications	71
8	ELECTRICAL AND MECHANICAL.....	72
8.1	General.....	72
8.2	Equipment Requirements	72
8.3	Engineering Requirements.....	73
8.4	Room Allocation.....	74
8.5	Electrical	74
8.6	Panels and Distribution	76
8.7	Wiring and Cabling	78
8.8	Metal Trunking System.....	83
8.9	Safety and Protection Requirements.....	85
8.10	Mechanical Requirements.....	87
8.11	Miscellaneous Works and Services	89
9	SYSTEM AVAILABILITY AND PERFORMANCE.....	91
9.1	General.....	91
9.2	Availability.....	91
9.3	Data Handling Capacity	91
9.4	Expansion and Spare Requirements.....	91
10	MAINTAINABILITY	93
10.1	Maintenance Concept	93
10.2	Basic Design Approach.....	93
10.3	Maintenance Provisions	94
10.4	Monitoring And Diagnosis Features	95
10.5	Provision of Update.....	96
10.6	Support and Utility Software.....	97
10.7	Provision of Update.....	99
10.8	Hardware Maintenance.....	99
10.9	Operation and Maintenance Spares.....	99
10.10	Test Equipment And Tools	100
11	DOCUMENTATION	102
11.1	General.....	102
11.2	System Design Document	103
11.3	Installation Document	104
11.4	Technical (Hardware, Network & Interface) Document	106

PART 7 REQUIREMENT SPECIFICATIONS

11.5	Software Document.....	109
11.6	Operational Document	113
11.7	Training Document.....	114
11.8	Test Document.....	115
11.9	Equipment Provisioning List	115
12	ACCEPTANCE TEST	117
12.1	General.....	117
12.2	Factory Acceptance Test (FAT).....	118
12.3	Site Acceptance Test (SAT).....	119
12.4	Reliability Acceptance Test (RAT).....	121
12.5	Test Plans and Procedures	121
12.6	Test Reports.....	122
13	TRAINING.....	123
13.1	General.....	123
13.2	Technical Training.....	125
13.3	Software Training	126
13.4	Training Materials and Facilities	127
13.5	CAAS' Training Personnel	128
13.6	Contractor's Training Personnel	128
14	AFTER-SALE SUPPORT	129
14.1	After-Sale Support Agreement	129
14.2	After-sale Support with OEM	129
14.3	Future Orders.....	129
14.4	Related Works.....	130
14.5	Option on Hardware Support Service	131
14.6	Option on Software Support Service	131
14.7	Provision of Hardware and Software Support Services	132

1 INTRODUCTION

1.1 General

- 1.1.1 The Civil Aviation Authority of Singapore (hereinafter referred to as the CAAS) is responsible for the provision of civil air traffic services in the Singapore Flight Information Region (FIR) including the airspace delegated to Singapore.
- 1.1.2 This Specification sets out the requirements to be met by the Contractor for the design, manufacture, supply, delivery, installation, testing and commissioning on a turn-key basis of the following:
- (a) a Surveillance Monitoring System to monitor the performance of our existing and future surveillance systems, to be install at the vicinity of LORADS-III Building situated in SATCC Complex, Biggin Hill Road, off Upper Changi Road, which is 12 km away from Changi Airport (alternative sites may be proposed);
 - (b) a Portable Monitoring Tool to monitor the performance of our existing and future surveillance systems.

for the Civil Aviation Authority of Singapore. In this Specification, the successful Tenderer of the Contract or part thereof is referred to as the Contractor.

- 1.1.3 The Surveillance Monitoring System shall provide the equipment and facilities for the comparison of the data received from the sensors. Such sensors may be located within SATCC or other locations in Singapore.
- 1.1.4 In this Specification, Section 1 gives an introduction of the scope of works for this tender; Section 2 provides an overview of the system requirements, Section 3 detailed the complete Surveillance Monitoring System requirement. Section 4 states the detailed requirements of the recording and playback facility. Section 5 states the detailed requirements of the status monitoring and remote control. Section 6 states the detailed requirements of the portable monitoring tool. Section 7 states the requirements of the alarms and alerts. The remaining Sections (8 to 14) state the electrical requirements, system performance, maintainability, documentation, acceptance test, training and after-sale support required for the Surveillance Monitoring System.
- 1.1.5 The Tenderer shall state, in his tender submission, how his equipment could be interfaced with the various systems. In addition, the Tenderer shall allow

CAAS to release whatever information necessary for the interfacing with other systems even prior to the tender award.

- 1.1.6 The requirements of the Surveillance Monitoring System shall be in conformity with the relevant International Civil Aviation Organisation (ICAO's) publications as stated in Reference Documents as well as other internationally accepted industry standards. All amendments of the publications up to the date on which the Factory Acceptance Test is conducted shall also be included. The final proposal at point of freezing of final design review shall be better or at least be in conformity with ICAO's standards and recommendations.
- 1.1.7 During the installation and testing of the Surveillance Monitoring System, the Contractor shall ensure that there will be no interference and /or interruption to the operations of existing facilities as well as all other existing equipments defined in this Specification. The Contractor shall provide plans prior to installation and testing to ensure the above.

1.2 Basic Requirements

- 1.2.1 The basic functions of the Surveillance Monitoring System shall be, but not limited to, the following:
- (a) Life recording of sensor/s data to a database;
 - (b) Exporting of selected sensor/s data to an external storage or program to assist in the analysis of the data;
 - (c) Replaying of selected sensor/s data to the Technical Display, allowing overlay of the data from the database, without any interruption to the operations of the system;
 - (d) Generation and display of the performance of the selected sensor/s in the forms of graphs (For e.g. scattergraphs), diagrams (For e.g. horizontal and vertical polar diagrams, maps (For e.g. overlaying of the coverage diagram over the air situational picture) and reports(For e.g. in tabular format in excel sheet. The outputs for the above should also allow selection based on an user selectable field such as callsign.
 - (e) Real-time monitoring of sensor/s, providing both visual and audio alert when the sensor/s is not performing up to the user definable thresholds. This shall be based on, but not limited to, the following parameters
 - (i) Coverage,

PART 7 REQUIREMENT SPECIFICATIONS

- (ii) Accuracy,
 - (iii) Systematic Errors,
 - (iv) Random Errors,
 - (v) Probability of Detection,
 - (vi) Probability of Mode A Code Detection,
 - (vii) Probability of Mode C Code Detection,
 - (viii) Resolution and
 - (ix) Any other parameters shall be listed;
- (f) Real-time display of selected sensor/s data, allowing overlaying of data, to a Technical Display. For e.g. radar tracks, MLAT and/or ADS-B reports, etc in Air Situational Display, coverage diagrams;
- (g) Detection of the accuracy for each and every sensor, providing both visual and audio alert if it falls below the user definable thresholds. Tenderers shall advise on the alarms that will be generated and the type of threshold that users will be able to set for e.g. a value from 1 to 10;
- (h) Derivation of probability of detection for each and every sensor, providing both visual and audio alert if any reduction of detection is detected based on user definable thresholds;
- (i) Detection of coverage for each and every sensor, providing both visual and audio alert if any reduction of coverage is detected based on user definable thresholds;
- (j) Determination of number of spurious (false) plots for each and every sensor, providing both visual and audio alert if the number exceeds the user definable thresholds;
- (k) Detection of systematic / bias errors (i.e. slant range, azimuth, etc);
- (l) Detection of random errors for each and every sensor, providing visual and audio alert if the number of occurrence exceeds a user definable value or thresholds;
- (m) Detection of inconsistency in the reports between any 2 or more similar sensors (for e.g. between PSR, SSR and ADS-B reports, etc) and providing both visual and audio alert if any inconsistency is detected;
- (n) Cross Detection of inconsistency in the reports between any 2 or more sensors sharing similar data (for e.g. between SSR mode C and ADS-B declared height, etc) and providing both visual and audio alert if any inconsistency is detected. Such alerts shall be based on a user definable

PART 7 REQUIREMENT SPECIFICATIONS

value such as difference of more than 100ft for the above mentioned example;

- (o) Detection of the resolution for each and every sensor, providing both visual and audio alert if the number exceeds the user definable thresholds; and
- (p) Any other capability may be proposed.

1.2.2 The Contractor shall be responsible principally for, but not limited to the following in accordance with this Specification:

- (a) To attend a site survey and briefing to determine the suitability of the various sites and to gain a better understanding of the scope of work;
- (b) supplying and laying all cables necessary for the operations of all the equipment;
- (c) to verify the accuracy of the Interface Control Documents, where available, to confirm the format, protocol, interfacing, availability and integrity of the sensors output.
- (d) to explain and elaborate on the methodology and process of performing the evaluation of the functions listed under Clause 1.2.1. Samples of the diagrams, graphs, tables and charts that could be generated shall be provided to assist in the explanation.
- (e) to list and defined the kind of alarms that will be generated based on the functions listed in Clause 1.2.1 above and the type of the user definable threshold proposed. Such user threshold type may be based on a numeric value or by percentage, etc.
- (f) designing, supplying, manufacturing, carrying out factory inspection and testing, packing, delivery to the site, temporary storage before installation, installation and integration including provision of all necessary manpower, equipment and materials, testing including the provision of all test equipment, test procedures and commissioning of the Surveillance Monitoring System. The design shall take into account all environmental factors and IT Security;
- (g) supplying of suitable surge and lightning protection systems to all the equipment at the various sites for the lightning protection, whenever necessary, for the Surveillance Monitoring System;

PART 7 REQUIREMENT SPECIFICATIONS

- (h) supplying of all special tools and test equipment for maintenance of the Surveillance Monitoring System;
- (i) supplying of all computer software necessary for the operation, maintenance, updating, modification and provision for future expansion of the Surveillance Monitoring System;
- (j) supplying of documentation for all software and hardware;
- (k) training of staff nominated by CAAS on the installation, operation and maintenance of the Surveillance Monitoring System;
- (l) supplying of all information required in this Specification and the associated tender documents;
- (m) supplying of operational and maintenance spares;
- (n) all other requirements specified in this Specification and the associated tender documents.

1.2.3 The Surveillance Monitoring System shall be of proven design and manufacture in both hardware and software. The Contractor shall possess considerable in-house expertise in both hardware and software. All the Managers namely Project Manager, Software Manager, Hardware Manager, Installation Manager and Site Project Managers and key technical personnel namely Software, Hardware and Network Engineers are expected to have the following knowledge and experience:

- (a) Possess at least 5 years of good project management and relevant technical skills for Managers and at least 3 years for Engineers;
- (b) The application software, in particular, shall be the responsibility of the Contractor offering the Surveillance Monitoring System. In the tender submission, a statement of the number and calibre of staff (excluding factory production staff) to be employed on the project shall be given together with their experiences and scope of responsibilities in the fields of Surveillance Monitoring and computer system/network.

1.2.4 The works under the Contract shall be performed by workmen skilled in the particular trades involved and shall include all works necessary to complete the installation in a professional manner so as to present a neat and finished appearance.

PART 7 REQUIREMENT SPECIFICATIONS

- 1.2.5 All works shall be completed to the satisfaction of the CAAS. If any portion of the work has not been properly carried out in accordance with the details specified herein and/or shown on the drawings, the Contractor shall replace or make good where required in a manner satisfactory to CAAS at his own cost.
- 1.2.6 The hardware and software proposed in the tender submission shall fully meet the requirements of this Specification. Any additional facilities required by the Contractor to fulfill the Specification during the implementation phase shall be provided by the Contractor at his own cost (including the necessary spares and maintenance).
- 1.2.7 No change or modification shall be made to the manufactured or documented System offered at the time of submission of the Contractor's Tender and thereafter unless the prior written agreement of CAAS has been obtained.
- 1.2.8 The Contractor shall provide written procedures and details of System changes or modifications which may have to be implemented during the various stages of the Contract, up to the expiry of all Warranty Periods. Such changes or modifications shall not be implemented unless the prior written agreement of CAAS has been obtained.

1.3 The Sites

- 1.3.1 The LORADS III Building situated in SATCC Complex, Biggin Hill Road, off Upper Changi Road, which is 12 km away from Changi Airport, will be used to house the Surveillance Monitoring System.
- 1.3.2 Prior to submitting the tender proposal, the Tenderer shall study and survey the sites on top of any site visit conducted by CAAS, if any, at his own cost, in order to ensure that the installation and testing of Surveillance Monitoring System shall not, in any way, interfere or affect the operation and performance of existing equipment in the near vicinity of these sites.
- 1.3.3 The Contractor shall be responsible for taking appropriate measures necessary to protect the Surveillance Monitoring System and associated equipment against interference from other systems.
- 1.3.4 The Tenderer shall be deemed to have visited the sites, and to have made himself acquainted with his own independent observations and enquiries with the nature, positions, extent, and practicability of the works, means of access, storage rooms for materials and all other matters.

PART 7 REQUIREMENT SPECIFICATIONS

- 1.3.5 The use of the identified site and building to be provided shall in no way relieve the Contractor from compliance with the Contract or any requirement of the Specifications.

1.4 Installation Works

- 1.4.1 The Contractor shall be required to submit the installation plan or revision to this plan for CAAS' approval at least one month before the commencement of installation works. The plan shall also include the type of cables and/or cable trays to facilitate a smoother approval process.

- 1.4.2 In relation to the control of installation works for the Surveillance Monitoring System, the Contractor's attention is particularly drawn to the following:

- (a) Except for those items which are specifically mentioned in this Specification as being provided by CAAS, all works, services and materials required at the sites for and associated with the installation and testing of the Surveillance Monitoring System shall be the Contractor's sole responsibility. To illustrate, these requirements shall include the provision and running of all interconnecting cables and cable trays, etc within SATCC Complex (including LORADS II Building, LORADS III Building and LSR building); transportation and haulage arrangements to bring the various Surveillance Monitoring System equipment to their respective locations; provision of temporary table tops for placing displays & equipment (if any); electrical power required for installation at the various locations of the building; and all other requirements as stated in this Specification and associated tender document.

Extra precautions shall be taken by the Contractor to prevent disruption to other services sharing the same cable routing in the Control Tower(s) or other locations when the work is being carried out.

- (b) All works, services and tests associated with the parts of the Surveillance Monitoring System which might affect the operations and performance of the existing systems or affect/disrupt the operation at SATCC, shall be scheduled between 0200 and 0600 local times. The Contractor shall obtain the prior approval of CAAS for each test and thoroughly brief CAAS and its assigned agent on each aspect of the test prior to it being carried out.
- (c) CAAS will provide electrical power. It shall be the Contractor's responsibility to further distribute the power supply to the individual devices. Other electrical works required for installation (e.g. drilling or

PART 7 REQUIREMENT SPECIFICATIONS

welding) at the various locations and any iron works shall be the Contractor's responsibility.

- (d) The Contractor shall be responsible for ensuring that all equipment, mountings, etc are adequately protected against damage from dust, drilling, welding or iron works and acid fumes from cleaning agent.
- (e) Permission for installation works affecting any part of the building shall be subjected to strict control by the CAAS in all building works. The Contractor shall be responsible, but not limited to the following installation works related to the building:
 - (i) cable tray mounting arrangements, mounting arrangements, cabling arrangements, colour scheme, appearances (subject to the CAAS's approval), etc., for equipment items distributed within the various sites and buildings;
 - (ii) layout of the computer rooms and equipment rooms, electrical supply consumption, special flooring or lighting, equipment earthing, lightning protection, equipment load-balancing on 3-phase supply, etc.;
 - (iii) provision of weight and dimensions of each equipment to be transported and delivered in its entire unit to the Site(s) and haulage arrangements. CAAS will not be responsible for providing cranes, hoists, lifts, escalators and the like for the horizontal and vertical transportation and haulage of equipment to the exact location of each equipment;
 - (iv) to ensure that all individual equipment, such as server racks, delivered must be certified to be able to meet the floor loading requirements.
- (f) For security of equipment, the Contractor's attention is drawn to the fact that the sites are virtually unguarded and there may be workers of different trades who will have free access to all the equipment. The Contractor shall note that until the final acceptance of the complete Surveillance Monitoring System, he is fully responsible for the security of his equipment.
- (g) The Contractor shall be fully responsible for reinstatement, repair, rectification and making good of all damages, malfunctioning, spoilage, interruptions, tarnishing of the buildings and other facilities (e.g. lifts, wall, ceilings, lights, escalators, floorings and carpets, doors, carparks,

PART 7 REQUIREMENT SPECIFICATIONS

roads, etc.) incurred in connection with the Surveillance Monitoring System installation and testing works. All such works shall be done to the entire satisfaction of the CAAS.

- (h) Any re-design, addition, variation, change, modification or alteration of any part of the buildings caused by the Contractor's requirement for the Surveillance Monitoring System during the execution of the works shall be at the expense of the Contractor and shall require the prior approval of the CAAS.

1.5 Service Conditions

- 1.5.1 The Surveillance Monitoring System shall be capable of continuous operations under the following service conditions throughout its service life without degradation in system performance:

- (a) Indoor equipment

- (i) Ambient temperature : up to +45° C
- (ii) Relative humidity : up to 90%
- (iii) Dust control : filtered air-conditioning system
- (iv) Power supply : AC mains, three phase, 4 wires, 400V/230V (+10%, -15% from nominal) at 50Hz (±3Hz)

- 1.5.2 The audible noise generated by any indoor equipment shall not be greater than 60db (A weighted) measured 1 metre away from any equipment in any direction.

- 1.5.3 All the equipment shall be fully tropicalised and shall be resistant against fungus growth.

- 1.5.4 The Tenderer shall supply information as to the measures to be taken to operate the equipment under the extreme conditions specified in Para. 1.5.1.

- 1.5.5 The Contractor shall be responsible for taking appropriate measures, if necessary, to protect the Surveillance Monitoring System computers and other equipment (e.g. displays) against any interferences caused by the operation of the electrical machineries or control equipment in the various sites (e.g. unsuppressed interference from lift motors, control relays, surges/transients due to starting of the electrical machineries, e.g. generators, air conditioning equipment, escalators, etc.). Measures such as EMI/EMC shielding of equipment and cables shall also be taken to prevent interference from natural sources.

PART 7 REQUIREMENT SPECIFICATIONS

1.5.6 The Surveillance Monitoring System shall be designed to operate continuously 24 hours a day throughout its lifespan. It is required that the Surveillance Monitoring System under the service conditions specified in para 1.5.1, shall have a useful service life of at least 10 years, without degradation in system performance.

1.6 Alternatives

1.6.1 The Tenderer is free to offer any design of equipment which in his opinion, will be equal to or better and more cost-effective than that required in the Specification. The Tenderer shall enumerate their merits. Where an alternative offer is proposed, the Tenderer shall furnish full details of such alternative to enable its merits to be assessed. The Tenderer shall indicate the extent to which the requirements of the Specification will be met or exceeded with the alternative offer and shall state the performance standards he is prepared to guarantee.

1.6.2 The Specification sets out the requirements to be met by the Tenderer. The Tenderer may consider that some of the requirements stipulated would lead to an unnecessary increase in cost. In such cases the Tenderer may submit alternative proposals but the additional costs which could be involved in meeting the stipulated requirements should be stated unless the requirements cannot be provided.

1.7 Provision By CAAS

1.7.1 The CAAS will provide the following items:-

- (a) LORADS III Building to house the Surveillance Monitoring System;
- (b) Air-conditioning in the buildings;
- (c) Main power supply;
- (d) Earthing points;
- (e) Leased lines or WAN for communication links between the SATCC complex and other sites, as well as between sites other than SATCC complex;

1.8 Project Phases

PART 7 REQUIREMENT SPECIFICATIONS

1.8.1 The Contractor shall undertake to supply, deliver, install and commission the System in the project phases stated below. The Tenderer may propose shorter completion dates if feasible.

1.8.2 The Contractor shall implement the Surveillance Monitoring System in the following phases.

Phase 1

- (a) To Commission Phase 1 of the Surveillance Monitoring System within **8 months** from the award of tender. The Surveillance Monitoring System will be Commissioned when all Acceptance Tests have been successfully completed and accepted by CAAS.
- (b) To Complete Phase 1 of the Surveillance Monitoring System within **2 months** from the Phase 1 Commissioning date. The Surveillance Monitoring System will be Completed when all Works have been successfully completed and accepted by CAAS.

Phase 2

- (c) To Commission Phase 2 of the Surveillance Monitoring System within **12 months** from the Phase 1 Commissioning date. The Surveillance Monitoring System will be Commissioned when all Acceptance Tests have been successfully completed and accepted by CAAS.
- (d) To Complete Phase 2 of the Surveillance Monitoring System within **2 months** from the commissioning date. The Surveillance Monitoring System will be Completed when all Works have been successfully completed and accepted by CAAS.

1.8.3 The submitted PERT chart and system implementation programme (GANTT CHART) of the complete or part(s) of the Surveillance Monitoring System shall give the duration of each activity in weeks for design, manufacture, delivery, site preparation works, installation, testing, commissioning, training, etc. The activities associated with the development and implementation of the phases of Surveillance Monitoring System shall be clearly depicted in the PERT chart and GANTT chart.

1.9 Phase 1 scope of works

1.9.1 The scope of works for Phase 1 shall be as stated in the Requirements Specifications, less the following:

- a) Integration with Approach Surveillance Radar (ASR 3);
- b) Integration with Long Range Surveillance Radar (LSR 2);

PART 7 REQUIREMENT SPECIFICATIONS

- c) Integration with LORADS III ATC System. This shall include MSTP, MSTs and individual Radar Tracker outputs;
- d) Integration with External Fault Management System.

1.10 Phase 2 scope of works

- 1.10.1 The scope of works for Phase 2 shall be the integration of the remaining external systems that was not integrated in Phase 1.
- 1.10.2 The Contract shall note that the external interfaces for the external systems might not be made available together at one time. The Contractor shall cater for the need to return to site several times for the integration of various external systems.
- 1.10.3 In the event that CAAS is unable to make available any external system by Phase 2. The Contractor shall demonstrate to CAAS' satisfaction, by simulated data or other means, that the Surveillance Monitoring System is ready to interface with the said external system.
- 1.10.4 The Contractor shall also ensure that the training will include the steps necessary to interface any new sensors to the Surveillance Monitoring System.

1.11 Certificate of Acceptance for System

- 1.11.1 Within **thirty (30)** calendar days after the satisfactory compliance of Clause 1.11.3 below by the Contractor, CAAS will issue and deliver to the Contractor the Certificate of Acceptance accepting the completion of the System.
- 1.11.2 This Certificate of Acceptance issued herein, when signed by CAAS, signifies acceptance by CAAS of the System and is, subject to such reservations as may be endorsed thereon by CAAS, final and binding in respect of all matters covered by that Contract.
- 1.11.3 Prior to the acceptance of the System, the Contractor shall complete the delivery of the following Goods and Works to the satisfaction of CAAS:-
 - (a) Successfully passed all the Acceptance Tests;
 - (b) Complete all training requirement specified in the Requirement Specifications;
 - (c) Delivery of all Goods including spares, tools, test equipment and the like;

PART 7 REQUIREMENT SPECIFICATIONS

- (d) Submission of test reports in respect of Factory Acceptance Tests, Site Acceptance Tests and Reliability Acceptance Tests;
- (e) Delivery of all documents as specified in the Requirement Specifications;
- (f) Fulfillment of all requirements under the Specifications and any other supplementary Agreements.

1.12 Project Management

1.12.1 As part of the overall management of the project, the Contractor shall also develop and implement the following management plans for the execution of works during the implementation of the project:-

- (a) Project Management Plan;
- (b) Project Risk Management Plan; and
- (c) Problem Analysis, Resolution and Management Plan.

1.12.2 Project Management Plan

1.12.2.1 The Contractor shall develop and implement a Project Management Plan for identifying, managing, prioritizing, and coordinating the overall implementation of the project. The Project Management Plan will facilitate project management that is forward-looking, structured, informative, and continuous. To support the effort, planning should be performed as early as possible in the project life cycle to ensure successful completion of project.

1.12.2.2 The Project Management Plan shall include but not be limited to the following:-

- (a) Project Organization (including list of persons involved in this project, their roles and responsibilities;
- (b) Project Schedule (including milestones, tasks, scheduled dates of completion, effort needed);
- (c) Update of project schedule vs. baseline project schedule;
- (d) Resources Requirements;
- (e) Implementation strategies;
- (f) Monitoring, Reporting, and Control Mechanisms;
- (g) Standards and Procedures (e.g Quality Management Systems, Change Control.)

1.12.3 Contractor's Project Manager

PART 7 REQUIREMENT SPECIFICATIONS

1.12.3.1 For the purpose of monitoring the overall implementation of the project, the Contractor is to appoint one (1) Project Manager who shall be the single point of contact for all activities within the scope of this Tender. The appointed Project Manager shall possess the relevant experience, attitude and skill sets to ensure effective resource planning and successful project completion.

1.12.3.2 The Project Manager is expected to have the following knowledge and experience:

- (a) Possess at least 5 years of good and relevant project management skills;
- (b) Prior experience in managing and implementing project of such nature, scope and scale;
- (c) Possess good communication skills in English; and
- (d) Conversant with the total solution proposed for the Surveillance Monitoring System.

1.12.3.3 The main responsibilities of the Project Manager shall include, but not limited to, as follows:

- (a) Ensure that all deliverables are in accordance with the specifications and schedule stated in this Tender document. He shall undertake full responsibility for the quality of work produced by his team and the Subcontractor(s). This includes ensuring that there is consistency and uniformity in the different work produced by his team and the Subcontractor(s);
- (b) Be contactable at all times for the entire duration of the project;
- (c) Coordinate the various activities and CAAS and document the progress of the project. The Project Manager shall maintain records of all development activities performed during the Contract;
- (d) Maintain records of all activities including proper accounting and administrative records of all Works performed during the Contract;
- (e) Produce and submit all minutes of meetings for the project progress reviews or requirement meetings, within two (2) working days, to CAAS for approval. CAAS shall reserve the rights to change the format of the minutes of meetings proposed by the Project Manager;
- (f) Ensure adequate planning for all activities required for the project is carried out throughout the project life cycle, with the aim to optimize

PART 7 REQUIREMENT SPECIFICATIONS

the effectiveness of each meeting, and maximize the quality and consistency for the project at all times;

- (g) Ensure all plans are well phrased and clearly communicated to all parties involved; and
- (h) Ensure that all queries raised by CAAS are answered promptly and all communications are recorded and submitted to CAAS for reference.

1.12.3.4 If the performance of the Project Manager is below expectations, CAAS shall reserve the right to escalate to the Contractor's appropriate higher management for necessary actions to replace the Project Manager at no additional cost.

1.12.3.5 Progress review and implementation meetings shall be convened regularly in Singapore. There shall be quarterly progress meetings throughout the whole project to be held either in Singapore or at the Contractor's premises overseas. CAAS will decide the location of the quarterly progress meeting during the system implementation phase. The Tenderer shall quote for the reduction in cost in attending the quarterly progress meeting at the Contractor's premises overseas for each quarterly progress meeting.

1.12.3.6 The Project Manager shall produce and submit bi-weekly progress reports by the Monday of each week for the duration of the Contract and submit to CAAS for review.

1.12.3.7 The progress report shall cover, but not limited to, the following:

- (a) Status of all tasks and deliverables which are in progress or which were scheduled to begin or end that week;
- (b) Status of problems reported by phases and activities, and corresponding resolutions;
- (c) Progress on tasks and services requested, or are scheduled to begin and end that month;
- (d) Overall progress in meeting scheduled timeframe and milestones achieved; and
- (e) Any other information requested by CAAS.

1.12.3.8 The Project Manager shall produce reports for CAAS, which include monthly status reports of all problems reported. Details should minimally include date of problem reporting, date of problem resolution, status of the problem, cause and description of the problem and corrective actions taken.

PART 7 REQUIREMENT SPECIFICATIONS

1.12.3.9 The Contractor shall not re-deploy or remove personnel from the project team without prior consent from CAAS before the completion of the project.

1.12.3.10 In the event of personnel replacement, the Contractor shall be responsible for training the successor to be fully competent to carry out the Works.

1.12.3.11 CAAS reserves the right to accept or reject the proposed replacement personnel.

1.12.4 Project Risk Management Plan

1.12.4.1 The Contractor shall develop and implement a Project Risk Management Plan for identifying, analyzing, prioritizing and managing project risk factors. The Plan will facilitate risk management that is forward-looking, structured, informative, and continuous. To support the effort, assessments should be performed as early as possible in the implementation life cycle to ensure that critical technical, schedule, and cost risks are addressed with mitigation actions incorporated into project planning.

1.12.4.2 The Project Risk Management Plan shall include but not be limited to the following:-

- (a) Risk Management Strategy and Approach;
- (b) Organisation;
- (c) Risk Management Process and Procedure;
- (d) Risk Planning;
- (e) Risk Assessment;
- (f) Risk Handling;
- (g) Risk Monitoring; and
- (h) Risk Management Information System, Documentation and Reports.

1.12.4.3 The Project Risk Management Plan shall involve the entire project team and includes inputs from outside experts knowledgeable in critical risk areas (e.g., threat, technology, design, manufacturing, schedule, and cost). In addition, the risk management process should cover hardware, software, the human element, and integration issues. Outside experts may include representatives from CAAS as the user, consultants on behalf of the CAAS, and industry experts. User participation in the assessment process is essential to reach an acceptable balance among cost, schedule, performance, and risk.

1.12.4.4 The Project Risk Management Plan shall also take into account the following considerations:-

PART 7 REQUIREMENT SPECIFICATIONS

- (a) Assess project risks, using a structured process, and develop strategies to manage these risks throughout the implementation life cycle;
- (b) Identify early and intensively manage those design parameters that critically affect cost, capability, or readiness;
- (c) Use mock-up, modelling, simulation and prototyping to reduce risks;
- (d) Use test and evaluation as a means of quantifying the results of the risk-handling process;
- (e) Perform regular risk assessment reviews to evaluate the effectiveness of risk handling against clearly defined success criteria;
- (f) Establish the means and format to communicate risk information;
- (g) Identify software risk early and estimate the time and resources required to develop new software, and identify potential risks in cost and schedule; and
- (h) Test software completely for all possible paths that can be followed in the logic of the software.

1.12.5 Problem Analysis, Resolution And Management Plan

1.12.5.1 The Contractor shall develop and implement a Problem Analysis, Resolution and Management Plan for identifying, analyzing, prioritizing and managing problems faced in the project. The Plan will facilitate problem management that is forward-looking, structured, informative, and continuous. The Contractor shall provide CAAS with a set of Problem Management Procedure which shall be subjected to the acceptance and approval by CAAS.

1.12.5.2 The Contractor shall provide CAAS with a list of the support personnel and ensure the personnel on the list are contactable at all times during project implementation phase, testing and acceptance phase, commission and completion phase and warranty phase for problem analysis and resolution.

1.12.5.3 All problems inclusive of any bugs or defects shall be classified according to the criteria below:

- (a) Severity Level 1 – Users are unable to perform the desired operations and no workarounds are possible. Bugs/Defects are critical, affect normal operations and must be resolved immediately;

PART 7 REQUIREMENT SPECIFICATIONS

- (b) Severity Level 2 – Users are unable to perform the desired operations. The bugs/defects affect normal operations but users are able to workaround;
 - (c) Severity Level 3 – Users are able to perform desired operations. The bugs/defects are minor and do not affect normal operations.
- 1.12.5.4 For severity level 1 and 2 problems, the Contractor shall resolve the problem or provide a workaround in the shortest time possible. The Contractor shall provide, at no additional costs, changes to the Surveillance Monitoring System and ensure the problem does not recur.
- 1.12.5.5 The Contractor shall perform a thorough analysis of the problem, which includes identification of the cause of problem, the components of the Surveillance Monitoring System affected, data or any loss suffered and the recommended solution.
- 1.12.5.6 For all problems, the Contractor shall provide in writing a preliminary report to explain the incident the following working day. Subsequently the Contractor shall provide a post incident review report to explain in detail the cause of the incident, the corrective actions taken and the solutions to prevent the incident from recurring, within five (5) working days after the incident has been rectified.
- 1.12.5.7 The Contractor shall provide a mechanism to log, update and track the status of all reported defects and problems that arise. The Contractor shall be responsible to ensure that CAAS is kept updated on the latest status of the reported defects or problems without being prompted. The Contractor shall work with all parties designated by CAAS and take whatever actions to resolve all problems. The problem log shall record at least the date, time, details of the fault or problem, corrective and follow-up action, and the service personnel. The format of the problem log shall be subject to the CAAS approval.
- 1.12.5.8 In the event of any dispute on the cause of the problem, the Contractor shall demonstrate and prove the services rendered within the scope of this Tender are not the cause of the problem. The Contractor shall continue to work with the relevant parties to resolve the problem.
- 1.12.5.9 The Contractor shall schedule problem reviews to track unresolved problems and provide rectification effort to prevent problem from recurring. CAAS shall specify the frequency of such reviews.

1.12.5.10 The Contractor shall manage effectively its' sub-contractors working on the project. All matters that require interface between the sub-contractor shall be coordinated by the Contractor to ensure harmony in the relationship among all parties concerned and to establish a common understanding of the CAAS requirements.

1.12.5.11 The Contractor shall provide a Problem Escalation Plan which includes the steps to take by CAAS and Contractor for each problem or defect, personnel to notify, support numbers to call, and escalation flow chart. This plan is subjected to the acceptance and approval by CAAS.

1.13 IT Security

1.13.1 The Contractor shall implement strict security controls and measures to protect the integrity, confidentiality, availability and performance of the System in accordance with the Information Technology security requirements stipulated in the Government Instruction Manual 8 (IM8), Info-comm Development Authority (IDA) Information Technology Security Best Practices and the CAAS Infocomm Technology (ICT) Manual.

1.13.2 The Contractor shall observe the Information Technology security requirements throughout the entire system life cycle, including implementation and operations of the Complete System and must take the security requirements into consideration in planning and carrying out the project schedule.

1.13.3 The Contractor shall, forthwith, at no additional cost to CAAS and prior to CAAS' actual operational use of the Complete System, implement all recommendations made by an independent security consultant or auditor, who may be appointed by CAAS to conduct a security audit to verify that the Complete System, including the design, complies with the Government Instruction Manual 8 (IM8), Info-comm Development Authority (IDA) Information Technology Security Best Practices and the CAAS ICT Manual. The Contractor shall implement the recommendations to the satisfaction of the independent consultant or auditor and CAAS.

1.13.4 Contractor's Obligations

1.13.5 The Contractor shall with due care and diligence:

- (a) carry out its obligations to CAAS under this Contract;
- (b) ensure that the Surveillance Monitoring System meets the requirements as set out in the Requirement Specifications;

PART 7 REQUIREMENT SPECIFICATIONS

- (c) provide all hardware and software necessary for the operation of the System and the applications as set out in the Requirement Specifications; and
- (d) do all things which are necessary or reasonably to be inferred from the Contract.

1.13.6 If the Contractor delays progress on any part of this Contract, for any reason not attributable to CAAS, and thereby reduces any scheduled duration of activities to be carried out by CAAS under this Contract, CAAS shall be entitled to a corresponding time extension for completion of such activities at no additional cost to CAAS, and without prejudice to the Contractor's obligation to complete the Contract in accordance with the Implementation Plan.

1.13.7 In the performance of this Contract, the Contractor shall at its own expense within a reasonable period of time, clear away and remove from the Site all surplus materials, rubbish and work of every kind and leave the whole of the Site clean and in workman-like condition to the satisfaction of CAAS.

1.13.8 The Contractor unconditionally guarantees the System to be free from defects including defects arising out of faulty design, inferior materials, faulty and inferior workmanship. The Surveillance Monitoring System shall be of high quality and fit for the purposes for which it is intended as set out in the Requirement Specifications.

1.14 Options To Purchase

1.14.1 With reference to Clause 28 of the Conditions of Contract, the Tenderer shall quote, as an option, individually for the items provided and the price quoted for each item shall remain valid for the Option Validity Date specified below.

Option Item	Descriptions	References	Expiry Date of Validity
(a)	Ten Year Hardware Support Service under the After-Sale Support Agreement	Section 14.5 of the Requirements Specifications	Completion Date of Phase 1 of Surveillance Monitoring System

PART 7 REQUIREMENT SPECIFICATIONS

(b)	Ten Year Software Support Service under the After-Sale Support Agreement	Section 14.6 of the Requirements Specifications	Completion Date of Phase 1 of Surveillance Monitoring System
-----	--	---	--

2 SYSTEM OVERVIEW

2.1 Basic Requirements

2.1.1 The Surveillance Monitoring System called for in this tender shall consist of several major subsystems and the interfaces between these subsystems and other existing or planned equipment or systems. These subsystems shall include: Recording, Evaluation, Statistics Generation & Playback System, Status Monitoring & Remote Control (SMRC), Alarm Alert System and Portable Monitoring Tool. Hardware and Software requirements in the Specifications refer to all subsystems unless otherwise specified.

2.1.2 Detailed descriptions of these subsystems are covered in the following chapters:-

- (a) Recording, Evaluation, Statistics Generation and Playback System – Section 4;
- (b) Status Monitoring & Remote Control (SMRC) – Section 5
- (c) Portable Monitoring Tool – Section 6;

2.1.3 Descriptions of operational and system functionalities are further covered in the following chapters:-

- (a) Alarm Alert System – Section 7;
- (b) Surveillance Monitoring System Performance Standards – Section 9;

2.2 Integration with External System

2.2.1 The Surveillance Monitoring System shall interface with the following external systems. These external systems may not be available, either physically and/or operationally, at the point of Surveillance Monitoring System Commissioning. The Contractor shall work with the respective system representatives and agents to perform the integration.

2.2.2 Where the Interface Control Documents (ICD) are available, CAAS will provide the information to the Contractor. However, the Contractor is to take note that such ICDs provided may or may not be proven at that point in time. As such, the Contractor would be required to verify the accuracy and reliability of the sensor outputs and ICD (For e.g. by performing data recording). Where the ICDs are not available, the ICD shall be provided by the Contractor for the purpose of performing the interface successfully.

2.2.3 The Contractor shall also be responsible to provide all hardware requires for interfacing which includes, but not limited to, routers, firewalls, multiplexer,

PART 7 REQUIREMENT SPECIFICATIONS

switches, repeaters, splitters, protocols converters, etc. The Contractor shall also take note that the data of the sensors may come separately (for e.g. plots in a port and tracks in another port) or together (for e.g. both plots and tracks in a single port).

2.2.3.1 The input interfaces are as follows:

(a) Long Range Surveillance Radar One (LSR1)

Real-time data (PSR, SSR and combined plots and/or tracks) shall be received from the LSR1. The boundary of hardware provision shall be up to and including the connection up to the serial port of the LSR1. The location of the port will be at LORADS II equipment room.

(b) Long Range Surveillance Radar Two (LSR2)

Real-time data (PSR, SSR and combined plots and/or tracks) shall be received from the future Long Range Surveillance Radar namely LSR2. The boundary of hardware provision shall be up to and including the connection up to the ethernet/serial port of the Long Range Surveillance Radar (LSR2) output port. The port will be located at the Radar Auxiliary Rack located within the same equipment room.

(c) Approach Surveillance Radar One (ASR1)

Real-time data (PSR, SSR and combined plots and/or tracks) shall be received from ASR1. The boundary of hardware provision shall be up to and including the connection up to the serial port of the ASR1. The location of the port will be at LORADS II equipment room.

(d) Approach Surveillance Radar Two (ASR2)

Real-time data (PSR, SSR and combined plots and/or tracks) shall be received from ASR2. The boundary of hardware provision shall be up to and including the connection up to the ethernet/serial port of the ASR2 output port. The port is currently located at LORADS II equipment room and will be relocated at the Radar Auxiliary Rack located within the same equipment room in the future.

(e) Approach Surveillance Radar Three (ASR3)

Real-time data (PSR, SSR and combined plots and/or tracks) shall be received from the future Approach Surveillance Radar namely ASR3. The boundary of hardware provision shall be up to and including the connection up to the ethernet/serial port of the ASR3 output port. The port will be located at the Radar Auxiliary Rack located within the same equipment room.

(f) MLAT System

Real-time ADS-B data (fused) shall be received from the MLAT System. The boundary of hardware provision shall be up to and including the connection up to

PART 7 REQUIREMENT SPECIFICATIONS

the designated ethernet port of the switch to be determined at a later stage. The port will be located at the MLAT server room located at Changi Airport Terminal 1.

(g) ADS-B System

Real-time ADS-B data shall be received from the ADS-B Stations. Such Stations may be installed in Singapore and or other countries. (data from multiple stations will be streamed through the link.) The boundary of hardware provision shall be up to and including the connection up to the ethernet port of the ADS-B System. The location of the ports shall be at both LORADS II equipment room and MLAT server room located at Changi Airport Terminal 1.

(h) LORADS III MSTs (Multi Sensor Tracking System)

Real time system tracks shall be received from the MSTs. The boundary of hardware provision shall be up to and including the connection up to the ethernet port of the MSTs. The location of the port shall be at the same equipment room.

(i) LORADS III MSTP (Multi Sensor Tracking Processor)

Real time system tracks shall be received from the MSTP. The boundary of hardware provision shall be up to and including the connection up to the ethernet port of the MSTP. The location of the port shall be at the same equipment room.

(j) LORADS III Radar Tracker

Real time radar tracks from ASR2, ASR3 and LSR2 shall be received from the Radar Tracker separately. The boundary of hardware provision shall be up to and including the connection up to the ethernet port of the router or any other equipment to be determined at a later stage. The location of the ports shall be at the same equipment room.

(k) ASDE (Airport Surface Detection Equipment)

Real time primary plots and/or tracks shall be received from the ASDE. The boundary of hardware provision shall be up to and including the connection up to the ethernet port of the ASDE system. The location of the port shall be at Changi Tower.

(l) ASMGCS (Advanced-Surface Movement and Control System)

Real time data (fused) shall be received from the ASMGCS. The boundary of hardware provision shall be up to and including the connection up to the ethernet port of the ASMGCS. The location of the port shall be Changi Tower

(m) Other Sensors

The Contractor shall provide the necessary hardware to cater for the integration of at least 10 more surveillance sensors, on top of the sensors mentioned above. The Contractor shall assume that these additional 10 sensors are to be

interfaced via Ethernet. The boundary of hardware provisions shall be up to and including the connection up to the ethernet port of the Surveillance Monitoring System.

2.2.3.2 The Tenderer shall state in his proposal how the input interface could be converted from Ethernet to Serial, for e.g RS232, and other standard interfaces and vice versa.

2.2.3.3 The output interfaces are as follows:

(a) External Fault Management System (EFMS)

Real-time alarms generated by the Alarm Alert System shall be send to the EFMS, preferably utilising SNMP. The boundary of hardware provisions shall be up to and including the connection up to the ethernet port of the Surveillance Monitoring System.

2.2.3.3 The other interfaces are as follows:

(a) GPS Master Clock (located at LORADS II Building)

All the processors in the Surveillance Monitoring System shall be synchronized with time synchronized with the GPS master clock system. The boundary of hardware provision shall be up to and including the connection up to the ethernet port of the GPS Master Clock.

2.2.4 The Contractor shall implement the links according to Interface Control Documents that specify the interface details such as the physical and electrical link characteristics, the data format and message protocol, for each of the above Integrations. If the ICDs are not available, the Contractor shall define the ICDs with close consultation with CAAS. It shall be the Contractor's responsibility to confirm that the information on the ICDs are correct and to ensure the successful integration with the external systems.

2.3 Basic Design Objectives

2.3.1 The Surveillance Monitoring System shall meet the following basic objectives in the design and construction.

2.3.2 Presentation of Information

2.3.2.1 In fulfilling its basic functions, the Surveillance Monitoring System shall provide timely, relevant and unambiguous information to its users. The displayed information shall be legible, taking into consideration the environmental conditions. It is important that the Surveillance Monitoring System proposed shall be able to meet the response time requirements.

2.3.3 Automatic Operation

2.3.3.1 The Surveillance Monitoring System shall be designed to minimise human interventions in acquiring, inputting, processing, distributing and displaying the information concerned.

2.3.4 Operational Availability and Reliability

2.3.4.1 The Surveillance Monitoring System shall have high operational availability and reliability. The Surveillance Monitoring System shall achieve system availability of at least 99.95%.

2.3.4.2 Where possible, the Surveillance Monitoring System shall use hardware and software which are proven, off-the-shelf and commercially available at the time of system implementation in order to achieve high operational availability and reliability.

2.3.4.3 The Contractor shall provide proven methodology and procedures for deploying major software updates without shutting down the System / affecting the operations.

2.3.5 Modularity and Expandability

2.3.5.1 The Surveillance Monitoring System shall be modular in design and construction in both software and hardware. It shall permit expansion in capacity and functional capability mainly by adding modules rather than by modifying or substituting hardware and software already implemented.

2.3.5.2 Similar equipment units shall be interchangeable as far as practicable. Future expansion of the Surveillance Monitoring System shall be possible without rewiring of the installation, and major software changes and expansion shall be possible without interruption to the operations of the Surveillance Monitoring System after commissioning.

2.3.6 Flexibility and Capacity

2.3.6.1 Notwithstanding the specified input and output terminal designations and processing requirements, changes in operational requirements are unavoidable in future. The Surveillance Monitoring System shall be designed and constructed to meet the requirements as regards to flexibility by permitting: -

- (a) changes only in offline data adaptation rather than system software due to revision in working methods and/or procedures;

- (b) re-configuration of the Surveillance Monitoring System in order to adapt the number of inputs and outputs of the Surveillance Monitoring System to meet the operational needs;
- (c) provisions for addition of modules to make possible increases in system capacity, storage capacity, display capacity and introduction of new functions and equipment and addition of external interfaces;
- (d) similar equipment to be interchangeable as far as practicable.

2.3.7 Redundancy

2.3.7.1 Dual redundancy shall be provided to ensure high system availability. This means that under normal operation condition, one set of the equipment shall be in operation whilst the other set of equipment shall operate in the hot-standby mode. System performance shall not be affected when one set of equipment failed resulting in switchover.

2.3.7.2 It shall be possible for redundant equipment to be configured for off-line processing or maintenance mode to provide for maintenance and support functions.

2.3.7.3 There shall be at least one to one redundancy for all equipment.

2.3.7.4 The Surveillance Monitoring System shall be designed such that it is possible for relocation to be carried out without affecting the Surveillance Monitoring System operation.

2.3.8 Latest Technologies

2.3.8.1 Where possible, the hardware and/or software facilities used shall employ commercially available state-of-the-art technologies. The technologies chosen shall be proven and have high operational availability and reliability. The Contractor shall ensure that the software/hardware used at the time of commissioning are of the latest reliable technology.

2.3.9 Ease of Maintenance

2.3.9.1 The design, construction and installation shall be of the highest engineering standards. The equipment shall be readily accessible for maintenance and so designed that alignment, adjustments, performance monitoring and replacement of components, units or parts can be performed in a straightforward manner.

2.3.9.2 All software of the Surveillance Monitoring System, including the SMRC shall be developed in High Order Language(s) like C++.

2.4 Technical Requirements

2.4.1 The Tenderer shall, as far as possible, use hardware that are the most up-to-date off-the-shelf, proven and commercially available. Hardware modules used in the Surveillance Monitoring System that does not meet these criteria shall be clearly stated in the tender submission.

2.4.2 The Surveillance Monitoring System shall have adequate equipment, devices, peripherals, software and firmware to meet the requirements of the Specification. The design philosophy of the Surveillance Monitoring System shall be that of a fault-tolerant, fail-safe and fail-soft system which operates with redundancy and maintainability provisions.

2.4.3 To achieve the high reliability and availability required, critical equipment, such as computers, etc shall be at least duplicated with on-line hot standby redundant unit and automatic reconfiguration capability. Power supply of both a.c. and d.c. shall be fully backed up to enable continuous operation of the Surveillance Monitoring System when there is a mains power failure.

2.4.4 The Surveillance Monitoring System shall be of modular and flexible design and shall have the built-in capacity for the ease of future expansion. By the addition of hardware and /or software elements, the Surveillance Monitoring System shall be readily expandable to accommodate all future systems expansion requirements as stated in the relevant portions of this Specification.

2.4.5 The hardware of the Surveillance Monitoring System shall be orderly laid out and cables shall be neatly laced to prevent accidents, which will cause disruption to the service. Facility to provide access to all parts of the Surveillance Monitoring System for maintenance personnel shall be provided.

2.4.6 The Surveillance Monitoring System shall be designed to minimise human error which otherwise can cause the failure of the hardware and the Surveillance Monitoring System. Precautions such as ensuring that the printed circuit boards can only be installed in one way only, edge connectors with key to prevent maintenance personnel from inserting wrongly, clearly labelled equipment and racks and such similar precautionary measures shall be taken care of in the manufacture of the Surveillance Monitoring System.

2.4.7 The Surveillance Monitoring System hardware shall comprise identical sub-assemblies, modules and same type of equipment to be used while serving the

same function. This is to simplify logistic support throughout the service life of the Surveillance Monitoring System.

2.4.8 All equipment supplied shall conform to the best current engineering practices and shall fulfill the following requirements/design criteria:

- (a) The life-span of the equipment, displays and their associated facilities shall be at least 10 years, based on a continuous 24-hour operational schedule. Tenderer shall state the life-span of the equipment, displays and associated facilities.
- (b) Equipment shall have self-diagnostic functions or built-in-test-equipment (BITE) to enhance troubleshooting and preventive maintenance capabilities.
- (c) Off-line detailed fault diagnostics shall be available for determining the faulty device at least up to card or least replaceable unit (LRU) level.
- (d) All similar parts shall be interchangeable.
- (e) All technical interfaces with external systems shall as far as practicable conform to the standards of the recognised and / or commercial bodies e.g. ITU, ISO and IEEE.
- (f) All the requirements shall be in conformity with the relevant ICAO's standards and recommendations.
- (g) All the requirements shall be in conformity with the relevant security measures of recognised and/or commercial bodies eg IDA.
- (h) The equipment shall have adequate protection against over-voltage, over-current and lightning strike.
- (i) All equipment supplied shall be provided with easily accessible test points and adjustment controls for maintenance.
- (j) The equipment shall operate without undue vibration with the least possible amount of noise.
- (k) Adequate protection against ingress of vermin, dust and accidental contact with live parts shall be provided.
- (l) The equipment shall have adequate protection against overheating and overloading. Temperature alarms shall also be provided.

2.4.9 The Tenderer is required to include in his submission a detailed description of how his system design offered will ensure that the Surveillance Monitoring System installed will meet the specified performance requirements. This description shall be supported by theoretical and practical data including those derived from actual measurements made in other installations, factory or laboratory. Formulas used or sources of any data quoted shall also be included in the description.

2.4.10 Equipment and materials shall be new at delivery and shall be the products of the manufacturers regularly engaged in the manufacture of such products.

2.4.11 The Tenderer shall give information regarding the maximum and equipped capacity for each equipment, where appropriate, and the estimated capacity used to fulfill this Specification, and also to give a full understanding of the Surveillance Monitoring System's flexibility to increase both the input/output data handling capability and hardware quantity.

2.4.12 For maintenance, modifications, testing and evaluation purposes, it shall be possible to run redundant parts of the Surveillance Monitoring Processor in an off-line mode while normal operational activities are going on simultaneously. It shall be possible to select any equipment in the operational partition for off-line mode operation. In addition, it shall be possible to inject real-time surveillance data into the off-line system for maintenance and testing.

2.5 UPS Power Supplies

2.5.1 UPS systems and batteries and power modules shall be provided by CAAS.

2.5.2 To avoid as far as possible a single point of failure, the Surveillance Monitoring System shall be able to take in the power from different circuit breakers for equipments or sub-systems that is performing the same or similar functions or which is providing the dual redundancy function. Tenderers shall advised such sub-systems if present. Tenderers shall also be responsible to provide a distribution board to further distribute the power based on the requirements of the different sub-systems.

2.5.3 The Surveillance Monitoring System shall be powered by the UPS systems so as to enhance the reliability and increase the availability of the system.

3 SYSTEM REQUIREMENTS

3.1 General Requirements

- 3.1.1 This Section specifies the system requirements pertaining to the Surveillance Monitoring System. The Section not only covers the hardware requirements for the entire Surveillance Monitoring System and the technical/software implementation aspects of the Surveillance Monitoring System in fulfilling the various functional requirements as detailed in subsequent Sections, but also the system facilities, tools and services for the system performance monitoring and management, as well as software development and benchmarking facilities for in-house system (hardware/software) maintenance and future enhancements.
- 3.1.2 The Tenderer shall have the liberty to propose better technical or software solutions that can meet or exceed the requirements specified. Detailed description on the system architecture shall be provided in the tender submission to facilitate tender evaluation. Enhanced features in the Surveillance Monitoring System shall be highlighted by the Tenderer.
- 3.1.3 The Surveillance Monitoring System shall employ well-proven, open standards, leading edge and forward-looking technologies and shall be built upon a high performance, high availability, scalability, manageability, compatibility, portability, upgradeable and robust platform and operating system(s). The Tenderer shall describe in details on how the above requirements are met in the proposed Surveillance Monitoring System in his tender submission.
- 3.1.4 The Surveillance Monitoring System shall fully exploit the ease of use, ease of expansion, ease of migration and application availability of the advanced and well proven Commercial Off-the-shelf (COTS) computer systems, peripherals and third-party standardized software tools and packages in the system design, and yet retain the real-time critical performance.

3.2 High Reliability and Availability System Architecture

3.2.1 General

- 3.2.1.1 To meet high demand for reliability and availability, the Surveillance Monitoring System shall maximize system uptime, minimize operational interruption and system degradation including duration of degraded operational mode due to unavoidable hardware equipment failures, as well as eliminate possibility of complete system failure.
- 3.2.1.2 No single-points-of-failure shall exist in the entire hardware configuration, including the computer server configuration, network communications

facilities, Input/Output (I/O) interfaces for external systems etc., as well as in the software configuration.

- 3.2.1.3 Fully integrated online diagnostic services and runtime performance monitoring services shall detect failures, manage the recovery process automatically, or facilitate responsive manual recovery/repair process.

3.2.2 Computer Server Platform Requirements

- 3.2.2.1 Well-evaluated commercial off-the-shelf (COTS) computer server platform(s) shall be adopted to realize the computing resource requirements of the entire Surveillance Monitoring System.

- 3.2.2.2 The computer server platform adopted shall preferably consist of electrically hot pluggable and hot swappable hardware (such as cooling units, power supply units and hard disks), which facilitate safe insertion and removal of system components into/from a powered-up system. With reconfiguration software, the adopted operating system shall enable changes to system's hardware resources (e.g., reallocation of I/O and CPUs) while the Surveillance Monitoring System is up and running, without a system reboot.

- 3.2.2.3 The following redundant & high availability features shall be included as parts of the computer server configuration in order to eliminate any single-points-of-failure: -

- (a) Two-nodes server-pairs with appropriate design and implementation on dual-redundant processing in the Surveillance Monitoring System;
- (b) Multiple I/O in order to achieve better diversity;
- (c) Multiple CPUs per CPU Board;
- (d) Dual network connections with an appropriate dual-redundant network configuration;
- (e) Dual heart-beat connections between the two nodes of the two-nodes server pairs, in the case where supervision of counterpart node of the dual-redundant pair is achieved through heart-beat connection;
- (f) Redundant power and cooling modules;

- 3.2.2.4 The latest but well-proven version of the COTS OS during system implementation phase shall be utilized for the Surveillance Monitoring System.

- 3.2.2.5 To facilitate tender evaluation, the Tenderer shall provide details on how the proposed computer server platform and the operating environment will contribute to improvement in the system reliability, serviceability, availability, performance and scalability.
- 3.2.2.6 The Contractor shall use a suitable middleware that enables the distributed and functionally disparate computer systems, subsystems and applications in the proposed Surveillance Monitoring System to exchange real-time information and interoperate. The proposed middleware shall incorporate high performance and high availability software services that are able to fulfill real-time criticalness performance expected of an air traffic control system. The software services rendered by the proposed middleware shall be able to hide or minimize the complexities of the network protocol, direct interfaces to operating system services, data representation, computer security implementation details and other services that are required in a real-time critical engineering system.
- 3.2.2.7 The Tenderer shall furnish full details of the middleware proposed for use in the Surveillance Monitoring System. The information to be provided shall include, but not be limited to, the following: -
- (a) Middleware architecture;
 - (b) Well proven platforms/OS version used;
 - (c) Components recommended as parts of the Surveillance Monitoring System;
 - (d) Estimated performance and reliability figures;
 - (e) Extent of customization;
 - (f) Estimated duration of development;
 - (g) Commitment to upward compatibility;
 - (h) Any other useful details.
- 3.2.2.8 Regardless of whether the above middleware requirements will be fully complied with or an alternative or equivalent proposed. The Tenderer shall provide full details in his tender submission on how the proposed middleware was derived and selected, the functionalities incorporated into the middleware, and how the middleware is architect to fulfill the reliability, high availability and real-time critical system performance. The details provided shall be sufficient to facilitate a thorough assessment for tender evaluation purpose.
- 3.2.2.9 The Contractor shall ensure that good engineering practices are being employed in the design, development and deployment phases involving computer server and operating system installation and configuration, middleware and software development or enhancement, etc.

3.2.3 Functional Organization of System Facilities

3.2.3.1 The operational services provided by the Surveillance Monitoring System are classified into the following facilities:

- (a) The Main Data Processor to perform the processing of the data from different sensors and to compare and output the data.
- (b) The Input Interfaces to handle the interface between the Sensors and the Main Data Processor;
- (c) The Output Interfaces to manage the interface between the Main Data Processor and the clients

3.2.3.2 The support services provided by the Surveillance Monitoring System shall be classified into the following facilities:

- (a) The Technical Display for the maintenance contractor to assess configuration menus and to view the air situational pictures or performance graphs/diagrams/charts based on the live and stored data for the various surveillance sensors;
- (b) Recording, Evaluation, Statistics Generation and Playback Facility to store and playback the air situational picture and after evaluation, to generate graphs/charts, diagrams and data for analysis. It shall also generate statistics based on the collected data from the sensor/s;
- (c) Status Monitoring & Remote Control (SMRC) to provide an overall view of the active and standby status of each server in each of the locations.

3.3 **Main Data Processor**

3.3.1 Main Data Processor

3.3.1.1 The Main Data Processor shall receive surveillance data (including radar tracks and/or radar plots, ADS-B reports, etc) via the Input Interfaces.

3.3.1.2 The Main Data Processor shall perform the processing, comparison and monitoring of the data from the different sensors and present the data in a form, which includes but is not limited to, diagrams, charts, tables, etc. This should be easily interpreted by our maintenance contractors to identify the sensor/s which is not performing up to the required expectation.

3.3.1.3 The Main Data Processor shall perform all other necessary processing to achieve the desired output required in the Requirements Specifications.

3.3.1.4 The Main Data Processor shall export the results of the comparisons to the EFMS, via the Output Interface.

3.3.1.5 The Tenderer shall list down in detail the various processes performed by the Main Data Processor.

3.3.2 Input Interfaces

3.3.2.1 The Input Interfaces shall be used to handle the interfaces between the existing and future surveillance systems and the Main Data Processor.

3.3.2.2 The Input Interfaces be able to handle all existing protocols such as HDLC, X.25, UDP-IP, TCP-IP and other known Protocols and in AIRCAT500 and various ASTERIX format such as Cat 1, 2, 8, 10, 21, 34, 48 and 62 and any other standards, including all amendments available at the point of Factory Acceptance Test.

3.3.2.3 The Input Interface shall interface with the existing and future systems via Serial and/or Ethernet and/or other standard interfaces.

3.3.2.4 All the inputs shall be dual redundant and in dual homing configuration?. The design shall ensure that any failure or error at any of the input ports will not cause failure to the other parts of the Main Data Processor.

3.3.3 Output Interfaces

3.3.3.1 The Output Interfaces shall handle the interface between the Main Data Processor and the clients (i.e. EFMS.)

3.3.3.2 The Output Interfaces shall be able to send the necessary data to the EFMS preferably via SNMP. The Contractor shall advise the format, protocols and all information necessary for the interfacing to future systems.

3.3.3.3 The Output Interfaces shall be fully dual redundant. The design shall ensure that any failure or error at any of the output ports will not cause failure to the other parts of the Surveillance Monitoring System.

3.4 **Technical Display**

3.4.1 The Contractor shall provide two Technical Displays.

3.4.2 The Technical Display shall be used to display the followings:

- (a) Comparison charts, graphs, diagrams, situational display and reports of the data from the various sensors based on selection by user;
- (b) Technical and Maintenance information;
- (c) System health of individual nodes within the Surveillance Monitoring System;
- (d) Replay from harddisk or archives;
- (e) Any other outputs proposed by the Tenderer.

3.4.3 Failure of Technical Display shall not affect the normal operation of the Surveillance Monitoring System equipment.

3.4.4 Display filtering facility shall be provided so that the equipment operator can choose to display or filter certain information based on certain requirements. Such requirements include display of selected data from one or more sensors, display of PSR, SSR and/or ADS-B data, etc and display of performance chart, etc.

3.4.5 The monitor shall be flat screen display with at least 22 inch with a minimum resolution of 1920 x 1080.

3.4.6 The Technical Display shall be housed at the LORADS III equipment room. The exact locations shall be finalized during the implementation phase.

3.4.7 The Tenderer shall list down any other capabilities.

3.4.8 Technical and Maintenance Information

3.4.8.1 The Technical and Maintenance Information shall include the menus for the various configurations.

3.5 **Network**

3.5.1 All internal network within the Surveillance Monitoring System shall be physically dual redundant.

3.5.2 The lines from the existing and future systems to the Surveillance Monitoring System Data Processor shall be dual redundant.

PART 7 REQUIREMENT SPECIFICATIONS

- 3.5.3 The Contractor shall be responsible for all the lines within the LORADS II, LORADS III and SAA buildings.
- 3.5.4 If the Tenderer's proposal requires leased lines to be provided by CAAS, the Tenderer shall recommend the bandwidth of the leased lines such that the performance standards stated in this Requirements Specifications can be met. The cost of providing these leased lines will be taken into account for the cost effectiveness evaluation.
- 3.5.5 Tenderer shall be responsible to terminate the lines at the Main Distribution Frame (MDF) if leased lines are required.

3.6 Software Development Platform

- 3.6.1 CAAS, together with the appointed maintenance agent(s), intend to be self-sufficient with their in-house capabilities in carrying out the daily system maintenance operations and, wherever possible, extending and upgrading parts of the Surveillance Monitoring System. In particular, at a minimum, the Contractor shall provide the necessary facilities for CAAS to modify the Surveillance Monitoring System input interface software, the Surveillance Monitoring System output interface software and the Graphical User Interface (GUI). To facilitate fulfillment of such requirement, the Tenderer shall propose adequate offline development systems with facilities for the purpose of offline software development, modification, enhancement, testing, diagnosis and maintenance by the software and technical maintenance personnel. The Software Development Platform shall be installed at the LORADS III Approach Control Equipment Room.
- 3.6.2 The Software Development Platform shall consist of an adequate set of computer systems with the necessary peripheral equipment which shall be sufficient to perform a fruitful partial system integration tests (including maximum load tests) or non-regression tests in order to ensure the functional workability and reliability of the modified or enhanced software version prior to online transition and operational commissioning. The proposed Software Development Platform shall at least consist of the following computer systems:
- (a) One (1) unit each of all the processors in the Surveillance Monitoring System;
 - (b) At least one (1) unit of Simulation Unit (SU) for simulation of data sources and external interfaces;
 - (c) One (1) unit of user workstation;

- 3.6.3 The Tenderer shall provide details on the proposed Software Development Platform, which shall aim to fulfill the safety management requirements of thorough validation and qualification tests for any system/software enhancements to be performed during the life cycle of the Surveillance Monitoring System.
- 3.6.4 The Simulation Unit(s) (SU) to be included in Software Development Platform shall be equipped with appropriate interface hardware and facilities for hosting the simulation test tools for simulating the external interfaces.
- 3.6.5 The Software Development Platform shall be able to perform switch over test. For this purpose, the Tenderer may propose to make use of the stand-by servers of the Surveillance Monitoring System. The performance of the main system shall not be degraded.

3.7 Software Deliverables

- 3.7.1 Subsequent paragraphs in this section specify the software tools and facilities that are required to be included in the Software Development Platform.
- 3.7.2 Software deliverables for the proposed Surveillance Monitoring System shall be complete. The Contractor shall provide all the necessary software for the operations, administration and maintenance of the Surveillance Monitoring System. The software deliverables shall consist of all the computer programs (applications and reusable middleware) developed for the Surveillance Monitoring System, associated third-party software including middleware, development software tools and benchmarking/testing/simulation software necessary for the operation, development, testing and maintenance of the entire system software, including the simulation test programs for all the external interfaces and data sources as well as the SMRC subsystem. The Tenderer shall note that the server/workstation/PC software stated in the specifications shall also include the associated operating system(s), firmware and PC/workstation software.
- 3.7.3 In the tender submission, the Tenderer shall furnish full details of the software to be provided for the Surveillance Monitoring System. Full details of the software to be provided shall include, but not be limited to, all details with respect to system architecture and configuration, capacity and performance figures, features and capability.
- 3.7.4 The Tenderer shall furnish a complete list of software deliverables, which shall be delivered with full documentation. The list shall include, but not be limited to the following: -

PART 7 REQUIREMENT SPECIFICATIONS

- (a) Comprehensive system application, support, test and development software packages;
- (b) Assembler and/or compilers for conversion of source program modules to object codes;
- (c) Linker and loader for the linkage of relocatable object codes to produce machine executable programs;
- (d) Utility programs capable of replicating/duplicating source and object, listing of data records, deletion, addition and amendments of data record etc.;
- (e) Absolute and/or Symbolic Debugging Tools capable of initializing and viewing specific blocks of memory, inserting program breakpoints and stepping through of program etc. during program execution;
- (f) Operations, data and user actions recording and logging facilities, including software programs for processing the above stated facilities with accounting and/or traffic data derived from the Surveillance Monitoring System for outputting to files/printers. Sorting of data based on data types/data filters shall be possible;
- (g) Text editor for normal editing functions;
- (h) Administration, security (e.g., Firewall) and maintenance tools;
- (i) Diagnostic programs for the verification of the correct operation of computers and hardware facilities;
- (j) Performance measurement programs for real-time monitoring of system performance;
- (k) Operating system for operating the above programs.

3.7.5 All programs in this package shall be well proven Commercial Off-The-Shelf (COTS) products.

3.7.6 A COTS Integrated Development Environment (IDE), suitable for use with the computer language(s) and operating system used for the Surveillance Monitoring System, shall also be proposed for automating the software development process. The proposed IDE shall be equipped with, but not limited to the following tools and facilities: -

- (a) Software development tools supporting software project management, source file search and editing, make, unit testing, debugging, deployment, etc.;
- (b) Automatic code generation, especially for Graphical User Interface (GUI) based human-machine interface facilities;
- (c) Documentation generation from automatic extraction of annotated inline information from source codes with customizable document templates;
- (d) Software analysis diagramming tools, capable of supporting object-oriented analysis and design, as well as generating the various UML diagrams for inclusion into the software design document, etc.;
- (e) Other tools/facilities in the modern IDEs.

3.7.7 The Tenderer shall provide details on the Integrated Development Environment (IDE) to be supplied.

3.7.8 The Contractor shall provide all software including softcopy of program codes, hardcopy and softcopy of documentation necessary for the operation, maintenance, modification, updating, expansion and evolution during the life span of the Surveillance Monitoring System. All software documentation and inline comments contained in the source program codes shall be in English. The Tenderer shall refer to Section 11 for the full requirements on documentation.

3.7.9 It is a mandatory requirement for the Contractor to deliver, at a minimum, all software source program codes of the Surveillance Monitoring System input interfaces and Surveillance Monitoring System output interface in softcopy format, together with the necessary development and test environment.

3.7.10 CAAS and its appointed maintenance agent(s) will undertake to ensure safe custody and limit the use of the supplied software on Surveillance Monitoring System and its future enhancements.

3.7.11 For tender evaluation purpose, the Tenderer shall state clearly, together with the furnished list of software deliverables, the software packages for which source program codes will not be delivered.

3.7.12 The Tenderer shall propose a viable and suitable, COTS Software Configuration Management System (SCMS) in the tender submission. The proposed SCMS shall be able to support a shared development environment with multiple developers. It shall also be able to support a well-defined

deployment scheme for software executables, configuration and operational data files with version check mechanism using checksum in order to ensure system-wide consistency for all the deployed software modules. The proposed SCMS shall be able to facilitate the change management procedures (to be recommended by the Contractor) to be applied for source code enhancements by CAAS or CAAS' appointed maintenance vendor during the warranty period or throughout the lifecycle of Surveillance Monitoring System. Full details of the proposed SMCS shall be provided in the tender submission.

- 3.7.13 Moreover, the SCMS shall also be able to support instantiations and management of multiple versions simultaneously within the Software Development Platform. In addition to a 'Reference Version' for the currently running version on the operational system, and an 'Archive Version' for capturing all the code histories, it shall also be possible to clone one or more 'Development Version' for managing the continuous modifications by the software developers, and one or more 'Integration Version' for versions undergoing system integration tests.
- 3.7.14 In order to ensure that the source program codes supplied and installed in the Software Development Platform, CAAS shall have the rights to request that Contract compile the source program code and install the complied software into the Surveillance Monitoring System. The subsequent tests shall be conducted using the said compiled software.

4 RECORDING, EVALUATION, STATISTICS GENERATION AND PLAYBACK FACILITY

4.1 Recording

4.1.1 Facilities shall be provided by the Contractor to record the data from the Surveillance Monitoring Processor on a continuous basis without interruption i.e. 24 hours a day and 7 days a week. Data recordings shall be produced as specified and shall be sufficient for playback and offline analysis.

4.1.2 The following types of recordings shall be provided:

- (a) Recent recordings available for immediate retrieval and played back using the technical display;
- (b) Archive recordings on low-cost removable media such as tapes/compact discs/DVD-Rs,

4.1.3 The recording service shall at least be available to record the following:

- (a) Real-time Data from all sensors individually;
- (b) Performance graphs for all sensors individually;

4.1.4 A quantity of removable volumes sufficient for archiving 60 days' recordings in duplicate shall be delivered with the system.

4.1.5 At least the most recent 48 hours' recordings shall be available on sufficiently reliable bulk storage devices for the following purposes:

- (a) Facilitate immediate playback for urgent incident investigation
- (b) Provide sufficient time and data buffering for re-attempting archiving

4.1.6 The Tenderer shall provide details which includes but not limited to the following:

- (a) How a recorder will be implemented?
- (b) Storage media, e.g. tape cartridges, compact discs, small removable drives, DVD-R, to be used for storing different types of recordings.

4.2 Copying to Removable Media

PART 7 REQUIREMENT SPECIFICATIONS

- 4.2.1 The recent recordings shall be copied to removable media as archive recordings automatically and not more frequently than once a month at an Adjustable System Parameter (ASP)-defined hour.
- 4.2.2 It shall be possible to replicate a given set of recent recordings files on any number of removable media. The operator shall be alerted when more than an ASP-defined number of hours' recent recordings have not been copied out as archive recordings, e.g. because a blank tape cartridge/compact disc is not available.
- 4.2.3 Every archive media shall have sufficient identification information. The media label/initialization file written by the recorder shall include identification, time/date, media number, archive period, etc. The detailed identification information shall be finalized with CAAS during implementation.

4.3 Evaluation Facility

- 4.3.1 Evaluation facility shall be provided based on the functions listed or provided by the Tenderers under Clause 1.2.1. The facility shall be used to evaluate the performance of the sensors by analyzing the input data from the sensors.
- 4.3.2 Such facilities shall be made available for both the online monitoring and during playback of the sensor/s input data.
- 4.3.3 The Evaluation Facility shall produce charts, diagrams, tables, etc as listed in Clause 1.2.1(d) after evaluation.

4.4 Statistics Generation

- 4.4.1 The Surveillance Monitoring System shall include the facilities to plot the footprint of targets based on the input from one or more sensors.
- 4.4.2 The Surveillance Monitoring System shall include the facilities to generate the statistics on the number of targets detected within a definable geographical area for both surface and airborne targets. Such statistic shall include, but not limited to the following:
 - a) Number of targets detected;
 - b) Number of targets equipped with mode A/C transponders;
 - c) Number of targets equipped with mode S transponders;
 - d) Number of targets equipped with mode S extended squitters;

- e) Number of targets not equipped with transponders;
- f) Any other statistics to be listed.

4.4.3 The Surveillance Monitoring System shall include the facilities to generate specific statistics on the targets detected within a definable geographical area. Such statistic shall include, but not limited to the following:

- a) Number of targets with the Navigation Uncertainty Category (NUC) above a certain definable value at more than a certain definable percentage of the time;
- b) Number of targets with less than a certain definable probability of detection from each sensor;
- c) Number of targets which display excessive acceleration (i.e. showing drastic velocity changes which may be caused by data inaccuracy);
- d) Number of targets with less than or more than a certain definable update rate;
- e) Any other statistics to be listed.

4.4.4 The Surveillance Monitoring System shall include the facilities to generate other statistics on the targets detected within a definable geographical area. Such statistic shall include, but not limited to the following:

- a) Number of targets within various flight levels.

4.4.5 The Surveillance Monitoring System shall include the facilities to generate the above statistics (para 4.4.1 to 4.4.4) using a filtered set of aircraft. This shall be based on, but not limited to, the 24-bit ICAO address. It may include other parameters which shall be defined by the Tenderer.

4.5 Playback Facility

4.5.1 The Air Situation Playback (APSB) Facility shall be provided at the Technical Display.

4.5.2 The ASPB facility shall be designed for use by the equipment operator for investigative, analysis as well as for testing purposes.

4.5.3 The ASPB facility shall be able to play back from any of the recordings types described in para. 4.1.2.

PART 7 REQUIREMENT SPECIFICATIONS

4.5.4 The Tenderer shall describe the steps to be taken by the operator to make the recent recordings or replicates available to the ASPB facility.

4.5.5 The ASPB facility shall allow the equipment operation to select the playback forward/backward at normal speed, fast forward/backward up to 10 times the actual speed as well as to freeze.

4.6 **Export of Data**

4.6.1 The Surveillance Monitoring Processor shall provide the facility to export the real time data stated in Para 4.1.3 to a standard database application.

4.6.2 The exporting of data shall not affect the performance of the Surveillance Monitoring System.

4.6.3 The database system shall allow the recorded information to be copied to CD-R/CD-RW/DVD discs. Tenderers shall also state the various methods to archive the recorded data.

5 STATUS MONITORING AND REMOTE CONTROL

5.1 General

- 5.1.1 This chapter specifies the minimum requirements to be met by the Tenderer in the Status Monitoring and Remote Control (SMRC) Subsystem. An SNMP-compliant SMRC Subsystem shall be proposed by the Tenderer for real-time status monitoring as well as remote control of the Surveillance Monitoring System. The proposed SMRC Subsystem shall fulfill the requirements as specified herein.
- 5.1.2 For Status Monitoring, the SMRC shall fulfill, but not limited to the following requirements: -
- (a) Provide centralized monitoring of the hardware, software and operational statuses of the Surveillance Monitoring System;
 - (b) Present the status, measurement and configuration parameters which are gathered in real-time from the various subsystems and/or equipment;
 - (c) Provide audio-visual warnings or alarms immediately upon any deviations from the specified operational capabilities;
 - (d) Provide an indication of the location and nature of failure. For hardware, the monitored points in the equipment shall facilitate identification of failure down to the line replacement unit. For software, the computing node and the identification down to subsystem level, if not individual process level, shall be identified and presented;
 - (e) Maintain event logging in its database of any events that affect the Surveillance Monitoring System, in parallel to loggings performed by the Surveillance Monitoring System. These events shall include but not limited to reconfiguration and control actions, hardware and software malfunctions, changes in status, measurement and configuration parameters, etc;
 - (f) Perform collection, transfer, storage, display and printout of measurement results and/or statuses;
 - (g) Provide status, alarm and information display in tabular and/or graphical mimic diagrams;

- (h) Disseminate in real-time the hardware, software and operational statuses to the External Fault Management System (envisaged to be available in 2010).

5.1.3 For control, the SMRC shall fulfill, but not limited to the following requirements: -

- (a) Provide facilities in centralized locations for remote control of the Surveillance Monitoring System including the integrations with external systems by the SMRC users;
- (b) Provide authorization control of the remote control facilities by offline adaptable databases, i.e., without software modifications. The authorization shall be defined for each SMRC position and shall depend on the assigned privileges of the login user.

5.1.4 This subsystem shall allow centralized monitoring, management and control of the Surveillance Monitoring System using standard SNMP protocols.

5.1.5 This subsystem shall be highly configurable through offline tools and adaptation databases, in order to easily adapt to expansion and/or modification of the supervised subsystems or equipment without modification of SMRC software.

5.1.6 This subsystem shall be designed and implemented with sufficient redundant facilities such that any single failure in SMRC shall not incapacitate its monitoring and control capabilities.

5.1.7 Comprehensive online 'HELP' facilities shall be provided to assist the SMRC users in dealing with the online monitoring and control facilities, as well as the offline tools and adaptation facilities of the SMRC.

5.1.8 Failures in the SMRC Subsystem shall not affect the systems and/or equipment that are being monitored and controlled.

5.2 System Requirements

5.2.1 Hardware Requirements

5.2.1.1 The SMRC hardware shall consist of, but not limited to, the following: -

- (a) Redundant computer servers for processing such as rendering of centralized SMRC functions, safe-keeping of SMRC databases and loggings, etc.;

- (b) Redundant computer servers for handling the interface with the Surveillance Monitoring System for control and monitoring purposes, and the interface with the GPS-Based Master Clock System and External Fault Management System for centralized monitoring;
- (c) Two (2) SMRC console, each consisting of a Visual Display Unit (VDU) and the associated computer workstation, input and output devices;
- (d) Two (2) printers;
- (e) Local area network (LAN) and accessories; and
- (f) Interfaces to the Surveillance Monitoring System, the GPS-Based Master Clock System and the External Fault Management System.

5.2.1.2 All the computer servers and workstations shall be equipped with standard input and output devices.

5.2.2 Computer and Network

5.2.2.1 A suitable number of computer servers and workstations shall be proposed for providing interface to the Surveillance Monitoring System for monitoring and control by the SMRC subsystem, status display and control, human-machine interface and dialogue, database storage and retrieval, and interfacing with the GPS-Based Master Clock System and the External Fault Management System.

5.2.2.2 The proposed computer servers and workstations shall be flexible for future expansion and modifications of controlled and monitored points. The Tenderer shall provide details of the SMRC system architecture and how the expansion is catered for.

5.2.2.3 The main computer servers, in which the centralized database is hosted, shall be provided with full redundancy. The computer servers handling the interfaces with the Surveillance Monitoring System, the GPS-Based Master Clock System and the External Fault Management System shall also be fully redundant. The failure of one computer server shall trigger the standby server to takeover the operational roles automatically. Indication of changeover and the operational server shall be displayed on the VDUs. The switchover shall be seamless and shall not cause any interruptions to the monitoring and control functions.

PART 7 REQUIREMENT SPECIFICATIONS

5.2.2.4 Commercial Off-the-shelves (COTS) computer servers and workstations from well-established computer vendor(s) shall be proposed for the SMRC subsystem. COTS Operating System shall be proposed for these computer servers and workstations.

5.2.2.5 The main computer servers shall be equipped with reliable, high speed online disk storage equipment with disk based storage backup facility.

5.2.2.6 It shall be designed to accommodate easy future expansion or modification in hardware, firmware and software.

5.2.2.7 Safeguards to exclude undesirable data corruption during power on, power off and switchovers shall be provided.

5.2.2.8 Failure on SMRC subsystem shall not in any way affect the overall availability of the Surveillance Monitoring System connected to the SMRC subsystem.

5.2.2.9 An SMRC Local Area Network (LAN) shall be provided for interconnecting the computer servers, workstations and peripherals of the SMRC subsystem.

5.2.2.10 The SMRC LAN shall be appropriately interfaced to the underlying network of the Surveillance Monitoring System.

5.2.2.11 The SMRC LAN shall also be appropriately interfaced to the GPS-Based Master Clock System.

5.2.2.12 The SMRC LAN shall also be appropriately interfaced to the External Fault Management System.

5.2.2.13 The Tenderer shall provide a detailed network topology diagram depicting the proposed network architecture and detailed description of the network design in his tender submission.

5.2.3 SMRC console

5.2.3.1 The SMRC subsystem shall have two (2) consoles, each equipped with sufficient and suitable facilities required for technical control, fault monitoring and maintenance of the Surveillance Monitoring System. The console is designated as Status Monitoring and Remote Control (SMRC) Console and shall be manned by SMRC users responsible for the proper functioning, efficient operation and fault rectification of both the software and hardware of the Surveillance Monitoring System.

5.2.3.2 Surveillance Monitoring System configuration, and all the system and operational status of the Surveillance Monitoring System shall be clearly displayed at the SMRC console to indicate diagrammatically the technical status (e.g., faulty, online, offline, etc.) and the operational status (e.g., online, offline, master, slave, etc.) of all the critical subsystems and/or equipment, and their external interfaces/links including that of the SMRC subsystem.

5.2.3.3 In addition, the SMRC Console shall be provided with means to control the Surveillance Monitoring System remotely, if performed by the authorized SMRC users on the authorized SMRC Consoles. The Tenderer shall provide full details to explain how this requirement could be achieved and state in his proposal the system design, control procedures, format of status displays, alarm arrangements, fault or failure detection and indication provisions etc. Tenderer shall propose additional monitoring and control parameters/points within the Surveillance Monitoring System.

5.2.3.4 The Tenderer shall propose the type of console (e.g., low/medium profile) to be used. Each console shall be equipped with at least, but not limited to, the following items: -

- (a) One VDU with the associated computer workstation, input and output devices;
- (b) One (1) printer;
- (c) Network interfaces.

5.2.3.5 The two (2) SMRC consoles shall be located at the LORADS III Approach Centre Equipment Room.

5.2.4 Visual Display Unit (VDU) and Printers

5.2.4.1 Each Visual Display Unit (VDU) shall comprise of a flat screen color LCD display of at least 22" with at least a resolution of 1680 x 1050 pixels, a computer workstation as display processor, and input/output devices.

5.2.4.2 The printers shall be able to perform letter quality printing of reports, high speed printing capability and low noise. The Tenderer shall provide details of the specification of the proposed printers.

5.3 **Interfaces**

5.3.1 The SMRC subsystem shall be interfaced to the following systems: -

- (a) Surveillance Monitoring System;
- (b) GPS-Based Master Clock System;
- (c) External Fault Management System.

5.3.2 The interfaces to the Surveillance Monitoring System, the GPS-Based Master Clock System and the External Fault Management System shall be fully redundant, i.e. without any single point of failure. The Tenderer shall provide detailed interface information of these interfaces in his tender submission.

5.3.3 The Contractor shall establish, in close consultation with the vendors or/and maintenance agents, an Interface Control Document (ICD) for the interfaces.

5.3.4 Surveillance Monitoring System

5.3.4.1 For the interface between the SMRC subsystem and the Surveillance Monitoring System, standard SNMP protocol shall be utilized. Through this interface, monitoring and remote control including acquisition of measurements and configuration information shall be achieved.

5.3.4.2 The SMRC subsystem shall be updated in real-time with the most up-to-date system and operational statuses of the Surveillance Monitoring System.

5.3.4.3 The Tenderer shall provide full details on how these BITE facilities in the Surveillance Monitoring System are fully exploited by the SMRC subsystem for the purpose of monitoring and remote control.

5.3.4.4 The network interface design shall ensure that SMRC data traffic in the SMRC network, except those data exchanges for acquiring status and measurement information from the Surveillance Monitoring System for the purpose of monitoring and for effecting remote control, shall be segregated from the network of the Surveillance Monitoring System.

5.3.5 GPS-Based Master Clock System

5.3.5.1 The time system in SMRC subsystem shall be real-time synchronized to the GPS-Based Master Clock System. The Tenderer shall state the maximum deviation of the SMRC time from the master clock.

5.3.5.2 For time synchronization, standard Network Time Protocol (NTP) or its variation shall be utilized.

5.3.5.3 Notwithstanding the automatic time synchronization to the master clock, the system administrators of the SMRC subsystem shall be able to manually and centrally set the SMRC time.

5.3.5.4 All the necessary software, network interfaces, cables and connections required for interfacing with the GPS-Based Master Clock System shall be provided by the Contractor.

5.3.6 External Fault Management System

5.3.6.1 The Tenderer shall propose an interface to an External Fault Management System, which will be acquired by CAAS via a separate tender. For this interface, the standard SNMP protocol shall be utilized.

5.3.6.2 All the necessary software required for interfacing with the External Fault Management System shall be provided by the Contractor.

5.3.6.3 The SMRC subsystem shall output in real-time the most up-to-date system and operational status of the Surveillance Monitoring System to the External Fault Management System.

5.3.6.4 The network interface design shall ensure that the performance of the SMRC subsystem shall not be significantly impacted by the interface with the External Fault Management System. Data exchanges between the SMRC subsystem and the External Fault Management System shall be limited to disseminating and/or acquiring the real-time system and operational status information.

5.4 Software Requirements

5.4.1 The design objective of the SMRC software shall be to ensure that the SMRC subsystem provides continuous and reliable service throughout the entire system life cycle.

5.4.2 The operational/application software of the SMRC subsystem shall provide at least, but not limited to, the following functions: -

- (a) Surveillance Monitoring System monitoring;
- (b) Surveillance Monitoring System control;
- (c) Operation and maintenance; and
- (d) Supervisory and data recording.

5.4.3 The SMRC software shall be designed with a well-proven architecture, which shall cater for future enhancements/modifications in the subsystems and/or equipment of the Surveillance Monitoring System being monitored or controlled without the need of software modifications. The software design shall also allow easy software maintenance, future program development and growth.

5.4.4 Online and offline adjustable system parameters shall be widely used in order to cater for fine-tuning, adaptation and expansion of the SMRC functionalities. These system parameters shall be changeable by CAAS' maintenance agents.

- 5.4.5 Modification on the SMRC subsystem, resulting from reconfiguration and/or future enhancements (including hardware expansion) of the Surveillance Monitoring System, shall be capable of being undertaken by CAAS/assigned maintenance agent(s) without having in-depth knowledge of the SMRC software. These modifications shall be done by changing the offline adaptation databases affected only.
- 5.4.6 The organization of the software shall be functionally modular, with each module having well-defined functions and precise definitions of software interfaces for intercommunication between modules, sub-routines, etc. The SMRC software shall be designed to fulfill, but not limited to, the following objectives: -
- (a) Reliable and highly available, 24x7 continuous operations;
 - (b) Easy understanding and learning;
 - (c) Easy expansion of the SMRC subsystem;
 - (d) Easy incorporation of future enhancements/modifications of the Surveillance Monitoring System;
 - (e) Efficient and effective maintenance and operation;
 - (f) Prompt functional additions and modifications, with minimum interference to the existing functions; and
 - (g) Efficient debugging capability.

5.5 Recovery Facilities

- 5.5.1 The integrity of the SMRC subsystem shall be ensured by hardware and software redundancy. As a result, standby computer server(s) shall be made available with the most recent updated data to be ready to take over the online operation should the main computer server fails.
- 5.5.2 The Contractor shall provide comprehensive technical procedures for operating and maintaining the SMRC subsystem. The technical procedures shall include, but not limited to, program and database reload, initial system startup, restart, reconfiguration and recovery.
- 5.5.3 The SMRC subsystem shall be updated with the current statuses and the most up-to-date measurements and configurations of the monitored subsystem and/or equipment upon recovery.
- 5.5.4 The serviceability of the SMRC subsystem shall always be indicated to the SMRC users during normal operations and failure as well as after a recovery.
- 5.5.5 Failure Recovery

5.5.5.1 In the event of a hardware failure, SMRC recovery shall be achieved by automatic changeover with the standby SMRC's computer servers and/or peripherals to takeover the online operations.

5.5.5.2 When a software abnormality in SMRC subsystem is detected, the SMRC subsystem shall try to recover depending on the severity of the problem. Fail-soft and fail-safe features shall be incorporated in SMRC design in order to achieve software failure recovery. For instance, the transaction data where the anomaly is detected may be discarded; errors in one SMRC module are not propagated to other modules, etc. The Tenderer shall provide details on these features in his tender submission.

5.5.6 System Level Access Control

5.5.6.1 At system level, several levels of access control shall be defined for the day-to-day management and maintenance of the SMRC subsystem, depending on the criticality of the control actions and their influence/impact to the performance of the SMRC subsystem.

5.5.6.2 All system level users of the SMRC subsystem shall be assigned with individual user identification and password.

5.5.6.3 Upon successful user login, only authorized functions executable by the login user shall be enabled. All unauthorized functions shall be indicated as non-executable by an appropriate mechanism, e.g., displayed in grey.

5.5.6.4 For audit trail purpose, details of every login session including the user ID, the date/time of logging in, the date/time of logging out and the details of the user actions performed shall be recorded in on-disk recordings. Operational facility shall be provided to interactively and selectively retrieve the recordings.

5.6 **Functional Requirements**

5.6.1 General

5.6.1.1 The functional requirements of the SMRC subsystem shall consist of, but not be limited to, the following: -

- (a) Surveillance Monitoring System status display;
- (b) Control, monitoring and switching functions;
- (c) Alarm reporting;
- (d) Station logs and trend logs;
- (e) Fault diagnosis;
- (f) Human-machine interface;

- (g) Database management;
- (h) Report generation capability.

5.6.1.2 SMRC inputs shall be carried out using mouse and/or alphanumeric keyboard. All inputs shall be subjected to reasonableness checks, in addition to check on authorization of the position and the user performing the input. Error messages for rejected inputs shall be precise and meaningful in stating the reason(s) for rejection. The error messages shall be immediately presented to the position performing the input.

5.6.1.3 Full details of functional requirements especially on the Human-Machine Interface (e.g. choice of colors for display items or statuses, the window sizes, etc.) shall be finalized during the system implementation phase.

5.6.2 Surveillance Monitoring System Status Display

5.6.2.1 Surveillance Monitoring System status display shall be presented on the VDUs at the SMRC Consoles.

5.6.2.2 All the VDUs will be used to simultaneously handling multiple real-time status display windows/pages on single screen. In the events of information overlap, an appropriate display hierarchy shall be defined and incorporated in the SMRC subsystem, especially for the status display windows/pages with critical alarms.

5.6.2.3 The status display windows shall be equipped with standard facilities that are normally provided with a commercial off-the-shelf windowing system. These facilities shall include, but not be limited to, the following: -

- (a) Navigation and designation;
- (b) Horizontal and vertical scrolling for window, sub-window as well as individual data fields wherever necessary; and
- (c) Window control facilities such as resize, move, minimize/maximize, tiled, stacked, etc.

5.6.2.4 Information displayed shall be automatically refreshed upon any updates, without the need of manual refresh by the SMRC users.

5.6.3 Status Display Features

5.6.3.1 The Surveillance Monitoring System Status display shall have the following features:-

- (a) Alarm messages shall be displayed on the VDUs with first-in-first-out concept. The displayed alarm message shall disappear when the message is acknowledged or when the alarm is cleared.
- (b) The local time and the UTC time shall be permanently displayed on a real-time basis on all display pages.
- (c) Information (including diagrams, messages and statistics etc.) that is too large to capture on the screen shall be fully displayed by "paging" or "scrolling" whichever is appropriate.
- (d) Status display shall be presented in multiple layer hierarchical order. Facilities shall be provided for the SMRC users to navigate hierarchically into more detailed displays by means of mouse clicks.

5.6.4 Normal Operation Status

5.6.4.1 Upon SMRC initiation, the VDUs shall display a general block diagram of the Surveillance Monitoring System. Such a mimic diagram of the general block diagram of the Surveillance Monitoring System shall present the technical and operational statuses of all the equipment and/or subsystems of the Surveillance Monitoring System using different kinds of indication for different statuses. For instance, color 'red' shall indicate individual subsystem failure, while color 'green' shall indicate working subsystem. The Tenderer shall propose the detailed configuration that would be displayed on the mimic diagram.

5.6.4.2 Status displayed on status display pages shall include technical statuses (e.g., 'faulty', 'offline', 'online', etc.) and operational statuses (e.g., 'online', 'offline', 'master', 'standby', etc.). Each of the status display page shall be possible to be independently called by command entry or mouse selection of the link in its previous relevant pages. The Tenderer shall propose detailed configuration of each status display page.

5.6.4.3 The SMRC users shall be able to see detailed display through either icon click, selection panel on screen or command input. At anytime, the general block diagram of the Surveillance Monitoring System shall be able to be returned on the screen by depressing a programmed function key and/or mouse click.

5.6.4.4 Each detailed status display diagram shall also be able to link to the database where configuration, measurement or status of the subsystems and/or equipment can be called upon and displayed in the form of text on the VDU when requested through command input.

5.6.4.5 After the input of a command of switchover/ in-service/ out-of-service, the relevant detailed status display page(s) of the equipment and/or subsystems shall be automatically updated.

5.6.5 Major Alarm Conditions

5.6.5.1 Major alarm occurring in any of the subsystems shall cause the particular subsystem block in the general block diagram display to blink red and at the same time, audio alarm shall sound to alert the SMRC users. The VDU shall thereafter be able to access other pages to obtain details of the fault report.

5.6.5.2 In addition, alarm message describing the fault shall be displayed on the VDU. The displayed message shall blink to alert the attention of the SMRC users. Detailed information of the alarm shall also be recorded in the database for subsequent retrieval or report generation.

5.6.5.3 By depressing the 'Acknowledge' key on the VDU keyboard (programmed in function key) or on-screen panel with mouse, the audio alarm and the blinking action on the VDU shall cease. Details of the fault message including the physical location of the faulty equipment and/or subsystem shall be displayed on the VDU.

5.6.5.4 The SMRC subsystem shall automatically update the relevant pages of the detailed display diagrams.

5.6.5.5 When the fault is cleared or the faulty equipment is put into a maintenance condition, the associated alarm message displayed on the VDU shall disappear.

5.6.6 Minor Alarm and Operator Alarm Conditions

5.6.6.1 Alarm message shall be displayed with blinking on the VDU and thereafter sound audio alarm so as to alert the SMRC users. The affected equipment and/or subsystems shall be displayed in orange for minor alarms and in white for operator alarms on the block diagrams.

5.6.6.2 By depressing the 'Acknowledge' key on the VDU keyboard (programmed in function key) or on-screen panel with mouse, the audio alarm and the blinking action on the VDU shall cease. Details of the fault message including the physical location of the faulty equipment and/or subsystem shall be displayed on the VDU.

5.6.6.3 If the alarm is recovered before a specified duration and before the acknowledgement by the SMRC user, the audio alarm and the blinking action of the VDU shall stop automatically. Such a specified duration shall be changeable by the SMRC user on command.

5.6.6.4 The SMRC subsystem shall automatically update the relevant pages of the detailed display diagram.

5.6.6.5 When the fault is cleared, or the faulty equipment is put to maintenance condition, the associated message displayed on the VDU shall disappear.

5.6.7 Multiple Alarm Conditions

5.6.7.1 The SMRC subsystem shall have priority display feature, i.e. major, minor and operator alarm categories. Where multiple faults occurred in one or more categories, such display feature shall take effect based on the pre-assigned priority of these alarms.

5.6.7.2 When more than one alarm occur concurrently, the page containing the alarm bearing the highest priority shall be displayed first during the first depression of the 'Acknowledge' key on the VDU keyboard or on-screen panel. Subsequent alarm pages shall follow their own priority in the order of major, minor and operator alarms.

5.6.7.3 When more than one alarm occurs concurrently, the SMRC subsystem shall also output the most probable alarm on the VDU. The SMRC subsystem shall generate event logs containing the information of all the failures.

5.6.8 Control, Monitoring and Switching Functions

5.6.8.1 The SMRC subsystem shall control and monitor the important parameters and status/alarm information of the subsystems and/or equipment of the Surveillance Monitoring System periodically and accurately so as to increase the operational availability and efficiency of the overall performance.

5.6.8.2 The Tenderer shall state the extent of monitoring and control of the Surveillance Monitoring System based on the following levels: -

- (a) System level (e.g. interconnections between the ADS-B Processor and Surveillance Monitoring Stations);
- (b) Subsystem level (e.g. Interfaces, main processing system, etc.);
- (c) Equipment level (e.g. computer servers, network equipment, etc.);
- (d) Line replaceable unit level (e.g. cards within the computer server, power supply unit, etc.).

5.6.8.3 The maximum handling capability and maximum capacity in terms of control and monitoring points shall be specified and submitted by the Tenderer in his tender submission.

- 5.6.8.4 All command inputs to the SMRC subsystem and responses of the SMRC subsystem shall be automatically and immediately recorded on on-disk recordings for maintenance record.
- 5.6.8.5 All event logs of control and monitoring shall be maintained and made available on demand by SMRC user for display on VDUs or printout on the printer for recording purpose. These records shall be stored in the SMRC subsystem for a minimum of ninety (90) days. Operational facilities shall be provided for archiving these data recordings to a secondary storage media (e.g. Compact Disc).
- 5.6.8.6 The control of the subsystem and/or equipment shall either be done by operator command or automatically upon detection of a failure in the subsystem or equipment by the SMRC subsystem.
- 5.6.8.7 The remote control functions of the SMRC subsystem shall be definable per SMRC Console using offline adaptation database, i.e. without software modification. A system administrator function shall also be provided in the SMRC subsystem to enable or disable the remote control functions system-wide. Remote control from SMRC subsystem shall be only possible when the function is enabled.

5.6.9 Switching Functions

- 5.6.9.1 The SMRC subsystem shall initiate the subsystem and/or equipment changeover upon receipt of a changeover command from the SMRC user. The SMRC subsystem shall immediately reflect the resulting status of the subsystem or equipment after successful changeover.
- 5.6.9.2 The changeover of any subsystem and/or equipment shall immediately be recorded on on-disk recording.

5.6.10 User-Friendly Features

- 5.6.10.1 Online 'HELP' facilities shall be provided to assist the SMRC users in the efficient and reliable control and switching of the subsystem and/or equipment of the Surveillance Monitoring System.
- 5.6.10.2 The user-friendly interactive command facilities shall be made available for all the functions of SMRC subsystem.

5.6.11 Alarm Reporting

PART 7 REQUIREMENT SPECIFICATIONS

- 5.6.11.1 The Tenderer shall provide the necessary reporting mechanisms for reporting incidents or faults that may occur within the Surveillance Monitoring System. This is to ensure that best practices are provided for incident response typically within an Air Traffic Control environment.
- 5.6.11.2 The SMRC subsystem shall record all events automatically on occurrence of alarms, equipment changeovers, fault clearance, monitored parameters exceeding preset limits and others.
- 5.6.11.3 When a failure occurs, the SMRC users shall be notified through the VDU by visual alarms. In addition, audible alarm shall also be activated upon failure detection. It shall be possible to vary the volume, frequency and the pitch of these audible alarms.
- 5.6.11.4 Software commands shall be provided to disable/enable any of the alarms from the display and/or being recorded on the disk.
- 5.6.11.5 Under equipment fault condition, fault reports shall be automatically stored in the disk with timestamps and also output on VDU screens.
- 5.6.11.6 The audio and visual alarm indications can be divided into major, minor and operator alarms. They can be classified as follows:-
- (a) Major Alarm: for serious fault conditions related to software or hardware where system failure will be the result. Other fault conditions that require immediate attention shall also be classified in this category.
 - (b) Minor Alarm: for minor fault conditions (software or hardware) which require the attention of the SMRC user.
 - (c) Operator Alarm: for fault conditions related to input/output devices demanding the SMRC user's action for alarm clearance, e.g. alarm when paper out signal on printer etc.
- 5.6.11.7 An alarm classification for all the subsystems and/or equipment of the Surveillance Monitoring System shall be provided by the Contractor. A list of all alarms available shall be supplied and each alarm shall be classified under one of the three categories mentioned above.
- 5.6.11.8 Means shall be provided to indicate whether the alarm message is of major, minor or operator type. It shall be possible to classify/re-classify each alarm as major, minor or operator via offline tools and adaptation database.

5.6.11.9 The SMRC subsystem shall be able to handle and capture network events and communicate with all network devices used in the Surveillance Monitoring System for the purpose of monitoring and control.

5.6.12 Station Logs and Trend Logs

5.6.12.1 Basing on operational requirements, loggings performed by the SMRC subsystem shall be classified into two categories, namely 'Station Logs' and 'Trend Logs'.

5.6.12.2 Station Logs are logs pertaining to the day-to-day operations on the SMRC subsystem. Station Logs shall be provided to capture all the monitoring and control actions performed either automatically by the SMRC subsystem or manually by the SMRC users. The Station Logs shall include, but not limited to, the following: -

- (a) Alarm logs arising from equipment failure, alarm conditions and/or automatic changeovers or reconfigurations.
- (b) Command logs generated from operator initiated changeovers or reconfigurations.

5.6.12.3 Station Logs shall be generated automatically by the SMRC subsystem at the occurrence of the alarm or at the successful execution of a command.

5.6.12.4 Trend Logs are logs initiated for specific monitoring and recording of selected parameters of one or more subsystems or equipment. The trend logs shall allow the SMRC user to assess the trend of parameter associated with the performance of the subsystem or equipment at any time. Examples of trend log parameters to be measured include processing load of the computer servers, etc.

5.6.12.5 In the trend log requirements, the statistical values (e.g. maximum, minimum and mean) shall be updated each time a new measurement is obtained. This is to provide the SMRC user with a form of interim report before the end time of a long measurement.

5.6.12.6 Both Station Logs and Trend Logs shall be generated and recorded on a real-time basis. At the instance of the occurrence of alarm at command input from the SMRC user, a log with a UTC timestamp (in HH:MM:SS) shall be generated automatically.

5.6.12.7 All the Station Logs and Trend Logs shall carry sufficient and informative data, and shall convey a clear picture of the incident reported on.

- 5.6.12.8 The detailed formats of the logs shall vary according to their specific needs. However, some common features shall be incorporated such that the retrieval of past records can be based on the category of date, time, device name, fault type, measured parameter, etc. The information captured in standardized format shall provide ease in database management and shall facilitate easy report generation.
- 5.6.12.9 The format of the Station Logs and Trend Logs shall be proposed by the Tenderer but essential details to be reported and recorded shall include, but not limited to, the following: -
- (a) Date & Time in UTC;
 - (b) Parameter under measurement (for Trend Log);
 - (c) Equipment identification;
 - (d) Command;
 - (e) User ID;
 - (f) Fault description and Alarms condition.
- 5.6.12.10 The format shall be such that the information contained therein can be easily interpreted without the use of external references for codes.
- 5.6.12.11 Comprehensive searching and sorting functions shall be provided for all the logs and records in the SMRC subsystem. Searching/Sorting commands shall consist of multiple and/or single search/sort parameter(s). The results obtained from the search/sort command shall be presented in a proper format. The Contractor shall propose the resultant formats for each search/sort command for consideration and adoption by CAAS/assigned agent(s).
- 5.6.12.12 Online 'HELP' facilities shall also be provided to assist the SMRC users in inputting a search/sort command.
- 5.6.12.13 The SMRC subsystem shall receive and analyze the security loggings performed by the Operating System and/or applications of the Surveillance Monitoring System and the SMRC subsystem. Upon detection of actual or potential security breaches, the SMRC subsystem shall immediately transmit to the External Fault Management System such security alerts.
- 5.6.13 Fault Diagnosis
- 5.6.13.1 The Tenderer shall provide a detailed description of the fault diagnosis facilities available to maintain continuous, efficient and reliable operation and maintenance for all the subsystems and/or equipment of the Surveillance Monitoring System. These fault diagnosis facilities shall enable localization of

PART 7 REQUIREMENT SPECIFICATIONS

faults on the Surveillance Monitoring System, in addition to those BIT and diagnostics facilities provided within the Surveillance Monitoring System. The capabilities of the fault diagnostic shall be specified by the Tenderer.

5.6.13.2 The SMRC subsystem shall be capable of running diagnostics at both system and subsystem levels. The purpose of the system level checks is to establish confidence and validation checks on the operational readiness and to isolate failures in subsystem.

5.6.13.3 Online 'HELP' facilities shall be provided to assist the SMRC Users in fault localization when utilizing the diagnostic functions.

5.6.13.4 Diagnostics facilities shall also be made available for the testing of the SMRC subsystem.

5.6.13.5 The SMRC subsystem shall provide fault localization function in the subsystem and/or equipment of the ADS-B System through automatic online fault diagnosis. The Tenderer shall specify the accuracy of the diagnostic programs.

5.6.13.6 Online fault diagnosis shall, upon detection of a fault, alert the SMRC users by audible alarm and displaying on the VDU fault details for use in trouble shooting.

5.6.13.7 Offline fault diagnostics shall be available for execution through operator initiated command.

5.6.13.8 The offline fault diagnostic shall be capable of determining the faulty device at least up to card or Line Replaceable Unit (LRU) level.

5.6.14 Human-Machine Interface

5.6.14.1 All VDUs shall have color graphics displays for easy identification of messages and text.

5.6.14.2 All VDUs shall allow multiple window displays on screen and enable different text to be displayed simultaneously and scrolled separately.

5.6.14.3 The software for the SMRC subsystem shall be written as 'user-friendly' as possible so as to encourage and guide the SMRC users in the use of this Subsystem. Online 'HELP' facilities shall be provided for the purpose.

5.6.14.4 Operator command formats shall be as simple as possible and a minimal number of keystrokes entries shall be used. Special programmed function keys

and/or on-screen selection panels shall be used where feasible to allow direct selection of display pages, mode selections etc. The Tenderer shall also ensure the design is efficient and fast in retrieving the status display pages.

5.6.14.5 Commands entered via the keyboard or selected by mouse shall automatically be recorded on on-disk recording. A list containing all the commands entered/selected shall be displayed on the screen as and when required.

5.6.15 Database Management

5.6.15.1 In the design of the SMRC database, the following requirements shall be fulfilled:-

- (a) Use of commercial off-the-shelf Database Management System (DBMS) which is suitable to provide 24x7 operations;
- (b) Provide for capacity for future expansion. The SMRC database shall have a spare capacity of 50% or more at the time of commissioning;
- (c) Ensure accuracy and integrity in the information captured;
- (d) Ease in statistical analysis and report generation;
- (e) Security in data accessing.

5.6.15.2 The SMRC database shall provide, but not limited to, the following facilities: -

- (a) Database open (open a database);
- (b) Database update (add, delete and change items);
- (c) Database delete (erasing of a database);
- (d) Database backup (to backup media);
- (e) Database restore (from backup media);
- (f) Database get (display and present on the VDU);
- (g) Database close (to prevent further update and access).

5.6.15.3 To prevent database corruption in the event of a crash, the SMRC subsystem shall provide for restoration of the database to a physically consistent state current to the last successfully completed addition, modification or deletion.

5.6.16 Report Generation Facilities

5.6.16.1 A user-friendly report generation facility shall be provided for the SMRC users to interactively design and prepare flexible and informative reports such as system availability report, fault incident report, fault statistics, user command summary report, security report, etc. from the SMRC logs. In

PART 7 REQUIREMENT SPECIFICATIONS

addition to display on the VDU screen, it shall be possible to request for hardcopy printout of the report at designated printer.

5.6.16.2 A COTS third-party software package such as Crystal Reports shall be adopted and adapted for implementing the report generation facility.

5.6.16.3 The content of system availability report shall include, but not limited to, system availability, subsystem availability, equipment uptime, maintenance downtime, fault downtime etc. The SMRC subsystem shall aid in the preparation of such reports.

5.6.16.4 Word processing capability shall be incorporated for preparation of reports such as fault incident report. This will enable adjustments and/or changes in reporting text and/or data in report presentation in order to improve the readability of the report.

5.6.16.5 Graphical presentation capability shall also be included for report generation for reinforcing the presentation on the data display, such as generation of pie charts, bar graphs, histograms and line graphs.

5.6.16.6 For statistic computation, the report generation facilities shall support data retrieval using a flexible querying facility, as well as rearrangement and sorting of data to be presented in alphabetical, numerical or chronological order.

5.6.16.7 The Contractor shall also develop and deliver predefined reports with predefined formats and contents. The reports shall be presented on the VDU with predefined blank fields for the SMRC user to input the variable data and/or text prior to requesting for hardcopy printout at the designated printer. A list of predefined reports shall be provided by the Tenderer. The list shall be finalized only during system implementation phase.

5.6.16.8 A generic query engine for specifying the data selection criteria for retrieving reporting data from any SMRC logs for presentation on VDU and/or designated printer shall also be provided.

5.7 Future Expansion Requirements

5.7.1 The SMRC subsystem shall have features incorporated for easy expansion and/or modifications of monitoring and controlling facilities. Such expansion and modifications shall be achieved by the SMRC users using offline tools and/or adaptation database changes, i.e., without software modifications.

PART 7 REQUIREMENT SPECIFICATIONS

- 5.7.2 Provisions shall also be made in software design such that future expansion that is not achievable via offline tools or databases will not require the complete redesign of the SMRC software.
- 5.7.3 In addition, the SMRC subsystem shall be capable of expansion through the use of expansion boards, addition of co-processors of such similar enhancements. Software developed for the installed SMRC subsystem shall be used for such expanded subsystem with minimum modifications.
- 5.7.4 The Tenderer shall describe in detail on how the SMRC subsystem can accommodate additional I/O devices such as VDUs, printers etc. The Tenderer shall also indicate the maximum number of such devices that can be attached to this Subsystem.
- 5.7.5 The response time for the increased capacity shall remain within the limits as stated in this Specification.
- 5.7.6 The proposed SMRC subsystem shall allow future software modifications be tested without interrupting the operational SMRC subsystem, and the subsystems and equipment of the ADS-B System that are monitored and controlled.

6 PORTABLE MONITORING TOOL

6.1 General

- 6.1.1 Other than a monitoring system that centrally monitors the various surveillance sensors, CAAS also requires a portable set which will be used to evaluate the performance of a surveillance sensor at the source.

6.2 Functionalities of the portable monitoring tool

- 6.2.1 The Portable Monitoring Tool shall analyse the following when connected to a surveillance sensor. This shall include but not limited to;

- a) Analyse the surveillance coverage of the sensor;
- b) Analyse the probability of detection for the sensor;
- c) Analyse the accuracy of the sensor;
- d) Analyse the resolution of the sensor;
- e) Any other analysis functions to be listed.

- 6.2.2 The Portable Monitoring Tool shall display the results of the various analyses via a user-friendly GUI.

- 6.2.3 The Portable Monitoring Tool shall have the functionality to record the data from the sensor for at least 24 hours so that the recorded data can be used for further evaluation at the main Surveillance Monitoring System.

6.3 Interfaces for the Portable Monitoring Tool

- 6.3.1 The Portable Monitoring Tool shall support Serial, Ethernet and other standard interfaces.

- 6.3.2 The Portable Monitoring Tool shall handle all existing protocols such as HDLC, X.25, UDP-IP, TCP-IP and other known Protocols and in AIRCAT500 and various ASTERIX format such as Cat 1, 2, 8, 10, 21, 34, 48 and 62 and any other standards, including all amendments available at the point of Factory Acceptance Test.

6.4 Design and Availability of the Portable Monitoring Tool

- 6.4.1 Unlike the components of the Surveillance Monitoring System which have to be dual redundant, the components of the Portable Monitoring Tool need not be dual redundant. However, the availability of the Portable Monitoring Tool shall be at least 99.95%.

7 ALARM ALERT SYSTEM

7.1 System Alerts Notifications

7.1.1 Alerts shall be send to the EFMS when any part of the Surveillance Monitoring System is down. This shall includes, but not limited to, the following;

- a. UPS is running on batteries,
- b. Either one or both Main Data Processor is not operating,
- c. Either one or both Input Interface is not operating,
- d. Either one or both Output Interface is not operating,
- e. When no data is detected for a user definable period from each and every individual sensor on either one or both ports of the Input Interface,
- f. Any other alerts shall be listed.

7.2 Sensors Alerts Notifications

7.2.1 Alerts shall be send to the EFMS when any sensor/s performance are detected to be dropping. This shall includes, but not limited to, the following;

- a. When any sensor coverage drops,
- b. When any sensor PD drops,
- c. When any sensor accuracy drops,
- d. When the systematic errors increases by 5% or a figure to be stipulated by the Tenderers,
- e. When the random errors occurs too frequently by a figure to be stipulated by the Tenderers,
- f. When any sensor resolution degraded,
- g. When the data between the two inputs from a single sensor appears to be different regularly,
- h. Any other alerts shall be listed.

8 ELECTRICAL AND MECHANICAL

8.1 General

8.1.1 This chapter specifies the minimum requirements to be met by the Tenderer in the area of equipment and engineering requirements, electrical criteria and functions, cabling installation works, safety, mechanical aspects, shop drawing and work services for the Surveillance Monitoring System.

8.1.2 While some of the infrastructure is provided by CAAS, the remaining necessary infrastructure shall be provided by the Contractor, in accordance to the Requirements Specifications.

8.2 Equipment Requirements

8.2.1 All equipment and materials supplied shall be new and shall not be employed in any previous operational use or for development purposes. Use of the equipment for system integration testing, custom software development and minor hardware modification is considered acceptable provided that all the work carried out shall be solely for the purchaser and shall be subjected to acceptance inspection and testing by CAAS/assigned agent(s).

8.2.2 The Tenderer shall, on the basis of the specified requirements in this Specification, propose the most suitable equipment to be used in the Surveillance Monitoring System. The adequacy of each item offered for the Surveillance Monitoring System in terms of quantity, input/output speed and commercial compatibility for consumable spares shall be the responsibility of the Contractor.

8.2.3 Details of the proposed equipment shall be described in the Tender offer. The Contractor shall, as far as possible, use hardware that is off-the-shelf, proven, latest model and commercially available. Hardware used in the Surveillance Monitoring System that does not meet the criteria shall be clearly stated in the Tender submission.

8.2.4 All equipment supplied under this Contract shall conform to the best current engineering practice, fully meet or even exceed the relevant prevailing international, industry and local standards, and shall fulfill the following requirements and design criteria: -

- (a) The life span of the equipment and their associated facilities shall be at least 10 years, based on continuous 24-hours operation schedule and operating at the most stringent local environmental conditions;

- (b) The equipment shall have comprehensive self-diagnostic functions to enhance trouble-shooting and preventive maintenance capabilities;
- (c) The equipment shall be heavy duty, high quality, reliable and easy to operate and maintain. The equipment shall also be readily equipped to take in dual power supply feeds. The Tenderer shall list down clearly all proposed equipment for the Surveillance Monitoring System which does have the capability to accept dual power supply feeds in his submission. For this group of equipment, the Contractor shall provide such capability at the rack, cabinet or console which they are to be installed.

8.3 Engineering Requirements

- 8.3.1 The design, workmanship, materials and finishing of all equipment supplied shall embody good engineering practices including fully complying with the relevant prevailing international, industry and local standards and, unless otherwise stated, all equipment used and the quality of construction of the complete Surveillance Monitoring System shall conform to the commonly accepted standards such as the ISO, ITU, etc as appropriate.
- 8.3.2 The Tenderer shall state the relevant standards adopted in their system design and shall use proven state-of-the-art technology for maximum reliability, ease of maintenance, safety to personnel, and high availability for operational use.
- 8.3.3 Each module of the equipment shall be clearly labelled in English, in accordance with its function, and shall include a type number and serial number for identification purpose. Each component shall be readily identifiable by having its circuit diagram identification code clearly marked on it or in its proximity, and by component layout drawings supplied with the handbooks.
- 8.3.4 The equipment supplied shall not cause any radio interference to other electronic equipment at any premises, and shall be able to withstand radio interference in an airport environment where strong radio and radar signals including those from electrical and air-conditioning plants will be present. The Contractor shall state in the Proposal the standard(s) of electromagnetic interference/compatibility its equipment is designed, and shall state the guaranteed maximum amount of external electromagnetic radiation, in the frequency range up to 16 GHz, that will not affect the equipment.
- 8.3.5 The Contractor shall be responsible for obtaining all approval types of any equipment from the relevant agencies and/or authorities such as IDA, BCA, CAAS, etc. For example to connect to public network provided by any Singapore network provider, the Contractor shall obtain approval from IDA.

PART 7 REQUIREMENT SPECIFICATIONS

8.4 Room Allocation

- 8.4.1 Exact room allocation details for Surveillance Monitoring System or incoming mains isolator/termination will be supplied by the CAAS at a later date.
- 8.4.2 The Tenderer shall furnish in his tender submission a list of equipment rooms required for Surveillance Monitoring System equipment if different from the given plans, and floor plans showing disposition of equipment racks, consoles and equipment. The heat load and essential dimensions of the cabinets and consoles e.g. height, width, depth, weight, etc. shall be detailed.

8.5 Electrical

8.5.1 Alternating Current Power Supply

- 8.5.1.1 If any portion of the equipment requires a primary source of AC power supply, it shall be designed to operate from a single phase AC mains supply of 230 volts at 50 Hertz. Equipment that requires three-phase current shall be designed to operate from AC mains supply of 400V, 3-phase, 4-wire at 50 Hz.
- 8.5.1.2 Equipment with primary source of AC power supply shall continue to operate without any degradation in performance in the presence of instantaneous and slow variations within +10%, -15% of the primary input voltage.
- 8.5.1.3 In addition they shall also continue to operate without any degradation in performance during rapid and slow variations in the AC mains frequency of ± 3 Hertz.

8.5.2 Power Failure Indication

- 8.5.2.1 There shall be power failure indication on the failure or removal of the AC mains input to each separate portion of the equipment. The affected equipment shall be installed with a power on/off switch.

8.5.3 Direct Current Power Supply

- 8.5.3.1 The DC power supplies for all devices shall be designed for maximum efficiency.
- 8.5.3.2 The supply shall feature good regulation for satisfactory operation over the specified fluctuation. It shall have adequate load regulation as demanded by the devices used.

PART 7 REQUIREMENT SPECIFICATIONS

8.5.3.3A high-speed over-voltage protection circuit shall protect the load in the event of the regulator failure. Adequate current limiting shall protect the power supply against current overload caused by any load circuit failure and short-circuit protection shall be used.

8.5.3.4Good design practice shall be used with regard to housing, fusing, heat sinking, etc.

8.5.3.5The supply shall be installed with power on/off switch and visual indication to show the operating conditions.

8.5.3.6The equipment shall be modular in design to facilitate maintenance.

8.5.3.7The estimated capacity to be used shall not exceed 70% of the rated maximum capacity.

8.5.4 Incoming Mains Supply and Distribution

8.5.4.1A mains of three-phase, four-wire power supply at 400V, 50 Hz will be provided at one point. From this point, the Contractor shall be responsible for all electrical installations, cabling, trunking, ducting, distributions, connections, terminations and associated works and services for distributing the electrical power to the equipment. Dual feed power distribution shall be provided for the Surveillance Monitoring System.

8.5.4.2The Tenderer shall indicate the total normal, peak and transient power capacity required at this point.

8.5.5 Electrical Works

8.5.5.1All electrical wirings shall be concealed in metal trunkings.

8.5.5.2The contractor shall provide the temporary lighting and power supplies required for the installation of the System.

8.5.5.3The electrical installations shall comply with the regulations of the Energy Market Authority of Singapore and other relevant prevailing international, industry and local such as Singapore Codes of Practices and IEEE Regulations.

8.5.5.4The works for the Contractor shall be undertaken by an engineer duly registered with the Singapore Professional Engineers (PE) Board and licensed by the Energy Market Authority (EMA), Singapore for the appropriate type of electrical installations.

PART 7 REQUIREMENT SPECIFICATIONS

8.5.5.5A single line diagram of all electrical distributions for the Surveillance Monitoring System requirements shall be submitted at least one month prior to the installation.

8.5.5.6The Contractor shall submit details of electrical design. These include the maximum capacity of equipment used, cable sizes, insulation, trunkings, dustings, switches, circuit breakers and over-current/over-voltage protective devices. These designs shall be signed by a duly registered/licensed Professional Engineer.

8.6 Panels and Distribution

8.6.1 Distribution Boards

8.6.1.1All power distribution boards shall be metal-clad with hinged covers suitable for surface mounting.

8.6.1.2The critical system equipment shall be distributed among multiple power distribution boards, with maximum redundancy, such that servicing of one distribution board will not cause interruption to the operation of the Surveillance Monitoring System.

8.6.1.3For single-phase supply, double pole isolating switch shall be incorporated for the purpose of interrupting the incoming supply. Final sub-circuit shall be protected by means of double pole MCBs and ELCBs capable of carrying their full rated current without tripping over.

8.6.1.4For 3-phase appliances, triple pole circuit breakers shall be used. A multiple pole switch shall be incorporated for the purpose of interrupting the incoming supply.

8.6.1.5Each distribution board shall be fully wired internally and wiring shall be neatly run and taped. All wire shall be colour coded and labelled at both ends.

8.6.1.6Phase identification colour shall be provided for all distribution boards. In addition, the Contractor shall provide a label, within the cover of each distribution board, with details of circuit controlled by the circuit breakers.

8.6.1.7An input ammeter and voltmeter shall be provided at each board where the expected load is above 30 Amps total.

8.6.1.8The distribution boards shall be provided with spare MCBs of not less than 50% of its total usage at point of commissioning.

PART 7 REQUIREMENT SPECIFICATIONS

8.6.1.9 The design of the power distribution shall be certified by a Licensed Professional Engineer

8.6.1.10 Full details of each distribution board shall be submitted to CAAS/assigned agent(s) prior to installation.

8.6.2 Circuit Breakers

8.6.2.1 All circuit breakers shall be of the current limiting type.

8.6.2.2 All breakers shall have inverse time tripping characteristics with thermal magnetic trip elements and shall be able to isolate the fault instantaneously for short circuit currents.

8.6.2.3 The breakers shall be operated by a toggle type handle having quick-break, quick-make mechanism and shall be mechanically trip free from the handle to ensure the contacts cannot be held closed against short circuit and abnormal current.

8.6.2.4 All breakers shall employ silver tungsten contacts of the butt type, high pressure ensuring cool operation at full load and shall be equipped with de-ionizing arc chutes for rapid extinction of arcing occurring during overload operation.

8.6.2.5 Visual indication of OFF, TRIPPED and ON positions, phase identification colours and appropriate labels shall be provided and auxiliary switch for under voltage trips should be incorporated if required.

8.6.2.6 The Contractor shall submit full details and samples of proposed current breakers to CAAS/assigned agent(s) prior to installation.

8.6.3 Protective and Control Relays

8.6.3.1 Relays required for various purposes such as contactor operation, tripping, etc shall be grouped conveniently in dust proof cases finished in enamel with removable covers giving access for adjustments, replacement, testing, etc. Relay of manual reset type shall be capable of being reset without opening the case.

8.6.3.2 All relays shall be of heavy duty, fully tropicalised and designed so that they will not be affected by external vibration, or external magnetic field during shipment and shall be of such construction that lamination noise is eliminated.

8.6.3.3 Relays shall be provided with clearly inscribed labels describing their

PART 7 REQUIREMENT SPECIFICATIONS

application and rating in addition to the general-purpose labels.

8.6.3.4 Means shall be provided on the relay panels for testing of relays. Plug-in type facilities are preferred.

8.6.3.5 Full details and samples of these relays shall be submitted to CAAS/assigned agent(s) at least one month prior to installation.

8.6.4 Control Switches and Pushbuttons

8.6.4.1 All control switches and pushbuttons shall be fully tropicalised and the double break contacts shall be strong, silver plated with self-cleaning action when operated so as to provide a reliable low resistance path even at low voltages.

8.6.4.2 Labels shall be provided to indicate the operation of the devices.

8.6.4.3 Samples and full details of these switches shall be submitted to CAAS/assigned agent(s) prior to installation.

8.6.5 Indicating Instruments

8.6.5.1 Indicating instruments of appropriate type and size (such as voltmeter, ammeter, etc) shall be flush mounted on the panel and shall be clearly marked by materials such that aging, peeling or discoloration of these materials will not take place under tropical conditions.

8.6.5.2 Instruments shall be hermetically sealed in anodized aluminum, sand blasted brass or any durable casing furnished in a specified colour. Instruments shall be of industrial grade with zero adjustment.

8.6.5.3 Current transformer shall be used for all ranges over 50A. Current transformer secondary windings shall be closed circuited at all times.

8.7 **Wiring and Cabling**

8.7.1 General requirements

8.7.1.1 The Contractor shall submit detailed wiring plans for all the devices and peripherals indicating clearly the proposed location of equipment cabinets, cable route and cable length for each of these devices.

8.7.1.2 The electrical work shall be executed by an Energy Market Authority (EMA) licensed electrical contractor. This work shall be executed in accordance to the Energy Market Authority (EMA) by-laws as well as best practices, standards

PART 7 REQUIREMENT SPECIFICATIONS

and regulations of the appropriate international, industry and local bodies and if his work is not satisfactory in any aspect, the Contractor shall rectify the defects at his own cost.

8.7.1.3A cable tray system inclusive of cable ladders and risers has been planned for some of the sites. The drawings, if available, will be presented for inspection by the Contractor. The Contractor can make use of these trays and trunkings if there are sufficient excess capacities with permission from CAAS.

8.7.1.4The Contractor shall provide all necessary cable trays and trunking system at the equipment rooms and the remote sites. The Tenderer shall provide full details of their equipments in order that sufficient spaces are allocated for the systems needs. The Contractor shall be responsible for additional cable trays that were not installed at the sites.

8.7.1.5For connections between SATCC complex and from sites outside the SATCC Complex, Telco service providers' communication infrastructure will be provided by CAAS. Tenderers shall propose to use only standard types of interface provided by the local Telco services providers' communication infrastructure and must be the most optimal and appropriate type for the Surveillance Monitoring System.

8.7.1.6For any underground cabling, the Contractor is required to bunch full quantity of cables permitted per duct and install at one go. The breaking and plumbing of the duct seals will be undertaken by the Contractor. The Tenderer shall also specify the sizes and types of cables to be provided in his tender submission.

8.7.1.7All wiring and cabling carrying primary AC power shall be separated from other control or signal wiring and cabling and be separately supported and formed. All such power wiring and cabling shall be insulated by high-grade insulating material. The termination of all power wiring and cabling shall be supported such that, in the event of a failure or fracture of cable or any other event which dislodges the cable, the conductor so dislodged cannot come into contact with any other circuit of the equipment.

8.7.1.8Distribution of electrical power to the various component, equipment racks and cabinets, etc comprising the Surveillance Monitoring System shall be supplied by the Contractor. Steps including, but not be limited to, diverse cable routing and proper protection shall be employed to ensure that the reliability of the Surveillance Monitoring System is not sensibly degraded in normal operation or maintenance. The Contractor shall supply the distribution boards to terminate the mains provided and to distribute power to the equipment.

8.7.1.9The Contractor shall include in the costing, the erection and connection of all

cables.

- 8.7.1.10 The erection of cables, the positions of support and the actual cable routes shall be agreed with CAAS/assigned agent(s) at the time of erection, having due regard for the accessibility of such routes and cable ducts. CAAS/assigned agent(s) reserves the right to inspect all cables prior to the installations.
- 8.7.1.11 All wiring panels and wiring of circuit breakers and the like shall be carried out in a neat and systematic manner with cables supported clear of the panels and other surfaces at all points to obtain free circulation of air. In all cases the sequence of wiring terminals shall be such that all junctions between cables and terminals are effected without cross over.
- 8.7.1.12 The types of cables used shall be selected with due consideration to transmission requirements, physical security and protection against extraneous interference. This should be especially so for underground and exposed data and signal cables. These cables shall be properly screened with the screen being grounded at both ends. Protection against lightning induced ground currents shall be an essential feature for the cabling system. They shall use effective devices such as spark gaps, varistors, lightning surge arrester etc., for elimination of surge damage to the line components.
- 8.7.1.13 All cables shall as far as practicable be fitted with cable connectors of plug-and-socket type at both ends. The Contractor shall list all cables, which will not be practical to have plug and socket type connectors.
- 8.7.1.14 All cable connectors must have suitable cable unloading devices to prevent the cables from mechanical exertion.
- 8.7.1.15 If it is necessary for more than one cable to be fed to one connector, the cables shall be tied together in an approved way.
- 8.7.1.16 All cables shall be properly labelled in accordance to its relevant circuit diagram. It is desired that cable-terminating points be labelled in conjunction with the equipment termination assemblies so that any terminal may be readily identified. The labels must remain legible after being subjected to continuous handling. Details of all terminations shall be specified in the Proposal.
- 8.7.1.17 All cabling shall be properly concealed with cable trunkings, ductings, overhead cable trays/ladders above false ceilings, cavity raised-floor, etc. The Contractor shall provide the cable trunkings, conduits, cable ladders etc. within equipment rooms. The type of trunking, conduits, cable trays, etc. shall be of acceptable appearance and colours approved by CAAS/assigned agent(s).

PART 7 REQUIREMENT SPECIFICATIONS

- 8.7.1.18 Conduits for internal cables shall be made of galvanised steel and trunking shall be made of mild steel and anti-rust treated. All conduits and trunking shall be earthed.
- 8.7.1.19 All cable entrances and exits shall be neatly designed. Separate entrances and exits shall be used for signals/control cables and power carrying cables. All cable entrances and exits shall be sealed with fire-stop compound after cables are installed.
- 8.7.1.20 Appropriate terminal boards, panels, boxes, cable distribution frames and strips shall be provided and installed by the Contractor to receive, transmit and distribute all data, control signals, etc. These distribution points shall be located in the equipment rooms.
- 8.7.1.21 All cable interconnection between units of equipment of the complete Surveillance Monitoring System shall be provided and installed by the Contractor. Cable route shall be subject to the approval of CAAS/assigned agent(s) prior to the commencement of work.
- 8.7.1.22 The minimum length between joints shall be 500 metres. The joints shall be made with approved jointing kit and shall be waterproof and maintenance free for the life of the equipment. Adequate spares jointing kits shall be provided to enable emergency repair of damaged cables.
- 8.7.1.23 For maintenance purposes, there must remain a fair amount of good, unused cables within a cable core. For each cable core having 10 and above cable pairs, there shall be at least 25% of good cable pair unused at the time of commission. For each cable core below 10 cable pairs, at least 2 spare pairs shall be provided.
- 8.7.1.24 All intra-equipment rack wirings shall be fully pre-wired before delivery. 13-ampere square pin power sockets shall be provided on a front panel at the bottom of the equipment cabinets for test equipment and tools.

8.7.2 Cables

8.7.2.1 The wiring covered under this contract shall include but not be limited to the following:-

- (a) Low voltage distribution cables
- (b) Multicore cables
- (c) Control cables
- (d) Signal cables

PART 7 REQUIREMENT SPECIFICATIONS

8.7.2.2 Metric size cables shall be used in all wiring works. The cable size shall be selected to ensure that they have adequate current carrying capacity and the voltage drop at the apparatus served will not be excessive.

8.7.3 Cable identification

8.7.3.1 Wherever possible, 10mm² and smaller wires shall be colour coded by the colour of insulation. Colour coding of wires larger than 10mm² shall be by means of wrap-around type marker.

8.7.3.2 Three phase power cables and equipment ground shall be colour coded based on the prevailing requirements from the Energy Market Authority (EMA). For e.g., four core power cables shall be coded with appropriate phase colour brown, black, grey and blue and equipment ground shall be colour coded green or green/yellow.

8.7.3.3 Every cable shall be identified with number markings in PVC label holders attached to it at the location:-

- (a) Power cables at fixtures, outlets, etc shall be identified to indicate originating panel and have the conductors tagged as to phase identification.
- (b) Control and signal wires at all cabinets, terminal strips, equipment racks, control panels, consoles and all other terminal, shall be identified at all termination points as to the origin and destination of the cable.

8.7.3.4 Cables shall be marked with legend in accordance to its relevant circuit diagram and embossed on the outer sheath of cables. All makers' identification including voltage grade shall also be marked clearly on the cables.

8.7.4 Cable Accessories

8.7.4.1 All jointing and terminating accessories shall be forwarded to CAAS/assigned agent(s) for approval prior to installation. A set of jointing and terminating accessories shall be provided to CAAS/assigned agent(s) as repair tools.

8.7.4.2 No straight through joint shall be allowed without prior written authority of CAAS/assigned agent(s). All jointing shall employ only standard accessories according to the cable manufacturer's recommendation.

8.7.4.3 Solder-less connector shall be used for connecting wire where practicable and shall be made only in junction boxes, conduit boxes, outlets or cabinets.

8.7.4.4 Terminal connections of all stranded conductors shall be made using connectors in which all strands are properly clamped in position.

8.8 Metal Trunking System

8.8.1 Metal Cable Trunking and Fittings

8.8.1.1 Cable trunking shall be fabricated from sheet steel 1.2mm thick for trunking sizes up to and including 100mm x 100mm.

8.8.1.2 Manufacturers' standard fitting shall be used. Only where these are inadequate to meet special local situations will fabricated fitting be accepted. Where special fittings or sections of trunking are fabricated, they shall be prepared and finished to the same standard as manufacturer's standard items.

8.8.1.3 Metal partitions in trunkings and fitting shall be provided as required by the Energy Market Authority (EMA) and the IEEE Regulation. They shall be of the same material and finish as those of the trunking and shall be of thickness 0.5mm less than that of the trunking, with minimum of 1mm.

8.8.1.4 Standard flanged coupling shall be used to terminate trunking at apparatus, at adaptable boxes and at points, where it is desired to connect one section of trunking to another. Lengths of trunking shall be jointed together by means of fixed sleeve type coupling. The practice of cutting and bending the internal of the trunking to form flange attachments will not be acceptable.

8.8.2 Trunking Installation

8.8.2.1 Trunking shall be run neatly on the surface of the buildings and truly vertical, horizontal or parallel with the features of the building. Trunking shall be at least 150mm clear of plumbing and mechanical services.

8.8.2.2 Individual pieces of trunking shall be independently supported. Appropriate purpose made metal brackets shall be used to support the trunking, at regular spacing not exceeding 2m.

8.8.2.3 All wall mounting brackets to support trunking shall be secured with metal thread studs complete with washer and two lock nuts.

8.8.2.4 All trunking shall be mechanically and electrically continuous throughout.

8.8.2.5 Conduit entry to trunking shall be by means of a coupling and a hexagon make brass bush.

PART 7 REQUIREMENT SPECIFICATIONS

8.8.2.6 When the trunking is installed in a vertical position, insulated cable supports shall be provided and packing shall be used at positions that go through floors. In the case of horizontal trunking runs, cable retaining straps and cable separators shall be used respectively where trunking covers are fixed underneath.

8.8.2.7 Trunking system shall be erected complete and shall be thoroughly cleaned out before any cable are drawn in.

8.8.3 Cable Ladders

8.8.3.1 Cable Ladders' characteristics

- (a) Cable ladders shall be manufactured of 2.0mm thick galvanized steel with the coupling manufactured of 3.0mm thick galvanized steel cable ladders.
- (b) The ladder side channels shall be strengthened by reinforcing inserts to increase the torsional rigidity.
- (c) The ladder shall be completed with rung slots of 50mm width spaced at maximum 300mm at the straight run.

8.8.3.2 The ladder shall be supported not more than 2m intervals by hangers or brackets of acceptable quality.

8.8.3.3 All couplers, bends, risers, interconnection clamps and other fittings shall be of manufacturer's standard product and shall be supported such that it will carry the designed load.

8.8.3.4 The cable shall be neatly secured on the ladder by cable ties after the ladders installation has been completed.

8.8.4 Cable Installation Works

8.8.4.1 The Contractor shall include in the costing the erection and connection of all cables.

8.8.4.2 The erection of cables, the positions of support and the actual cable routes shall be agreed with CAAS/assigned agent(s) at the time of erection, having due regard for the accessibility of all such routes and cable ducts. CAAS/assigned agent(s) reserves the right to inspect all cables prior to the installation. If CAAS/assigned agent(s) is not satisfied after inspection, contractor is required to re-do at no addition cost.

8.8.4.3 All panel wiring and wiring of circuit breakers and the like shall be carried out

PART 7 REQUIREMENT SPECIFICATIONS

in a neat and systematic manner with cables supported clear of the panels and other surfaces at all points to obtain free circulation of air. In all cases the sequence of wiring terminals shall be such that all junctions between cables and terminals are effected without cross over.

8.8.5 Installation in conduits

8.8.5.1 Cables shall not be pulled into conduit until the conduits system has been completed, cleaned and free from obstructions and sharp corners.

8.8.5.2 A clean rag or brush shall be drawn through each conduit before cable is drawn in. Cable shall be installed in such a manner that there will be no cuts or abrasion in the insulation. There shall be no kinks in the conductor.

8.8.5.3 The lead and return conductors and earth conductor of the same circuit or circuits shall be in all cases being drawn into the same conduit.

8.8.5.4 Grease or other injurious lubricants shall not be used in pulling cables. The use of talc or non-injurious lubricants is desirable.

8.8.6 Terminal Blocks

8.8.6.1 All terminal blocks shall be mounted at accessible positions in equipment rooms, the adjacent block shall be spaced not less than 100mm and bottom of the block shall not be less than 200mm above the cable gland plate. Separate terminals shall be provided with strip for the cores of incoming and outgoing cables including spare cables and all internal wiring.

8.8.6.2 Label holders shall be incorporated to all terminal blocks for fixing indelible number markers. All terminal blocks shall be correctly labelled.

8.8.6.3 Samples and full details of terminal blocks shall be submitted to CAAS/assigned agent(s) prior to installation.

8.9 **Safety and Protection Requirements**

8.9.1 The Surveillance Monitoring System shall be provided with adequate overload protection devices against damages or malfunctioning caused by starting, switching on/off or fault conditions.

8.9.2 All equipment shall have protection against over-voltage and over-current.

8.9.3 All equipment outlets of the Surveillance Monitoring System shall be protected against external short-circuiting. The equipment shall be designed to prevent

PART 7 REQUIREMENT SPECIFICATIONS

from being damaged caused by external short-circuiting.

- 8.9.4 The equipment shall be protected against overheating and overloading.
- 8.9.5 The Surveillance Monitoring System shall be adequately protected against interference from the mains supply.
- 8.9.6 A mains interference suppression filter shall be provided with each separate item of equipment using an AC or DC supply. Mains borne interference shall be suppressed so that if any item of equipment is repeatedly switched on and off, other items will function normally.
- 8.9.7 Electrical and/or magnetic fields can cause errors. Measures shall be taken to screen against extraneous electromagnetic influences. The Tenderer shall state if the computer rooms require screening and shall include this item in their cost calculation. The Tenderer, in submitting his proposal, is deemed to have taken due account of possible radio frequency interference. Further he shall ensure that any spurious emissions from his equipment will not cause interference to any other nearby facilities.
- 8.9.8 The Surveillance Monitoring System equipment, which interfaces with other systems/equipment, shall have incorporated all precautionary measures to prevent interferences to these systems/equipment.
- 8.9.9 A common system grounding design criterion shall be used for all subsystems to be delivered. The design shall be submitted as part of the proposal. Line filters, if used, shall not introduce currents in the signal grounding system.
- 8.9.10 The signal and cabinet return grounds shall be isolated from the power ground.
- 8.9.11 The Contractor shall connect all accessible metal parts such as front panels, etc to a ground terminal by a cabinet conductor.
- 8.9.12 The Surveillance Monitoring System channel interfaces that connect to external circuits shall be safeguarded against any high voltages, transients or noise induced from the external communication lines, and any external line interference shall not affect the normal operation or cause damage to the Surveillance Monitoring System.
- 8.9.13 Fuses shall be adequately provided and shall be easily accessible.
- 8.9.14 There shall be adequate precautionary provisions/measures against fire hazards.

PART 7 REQUIREMENT SPECIFICATIONS

- 8.9.15 The Tenderer shall ensure that all equipment offered will not contain any hazardous chemicals or materials. The Tenderer shall fully inform CAAS/assigned agent(s) of the use of any such chemicals or materials in the Surveillance Monitoring System in the proposal.
- 8.9.16 The Tenderer shall ensure an X-ray radiation-free operation for all equipment. The Tenderer shall ensure that all equipment offered will not contain any radioactive materials. The Tenderer shall fully inform CAAS/assigned agent(s) of the use of any X-ray generating and/or radioactive materials in the Surveillance Monitoring System in the proposal. The level of ionising radiation leakage from the workstation shall conform to the relevant prevailing British Safety Standards or equivalent and shall be stated in terms of mr/hr in the Proposal.
- 8.9.17 Provision shall be made to protect operational and maintenance personnel from inadvertent contact with hazardous voltages on any parts of the equipment. Precautionary measures shall include the provision of interlocks and protective covers over conductors, terminals or components carrying dangerous voltages with a cautionary notice attached.
- 8.9.18 All HV equipment likely to maintain a stored charge even when the power is removed shall be provided with a grounding rod to discharge such charges.
- 8.9.19 The equipment shall be protected against ingress of dust, acidic fumes, moisture or insects.

8.10 Mechanical Requirements

- 8.10.1 The equipment shall be mounted in consoles, cabinets, frames or racks, as the case may be, and shall be capable of being arranged to present a pleasing and uniform appearance. Equipment intended for operator working shall be mechanically robust and of modular construction for ease of subsequent expansion or modification. Tenderer shall state the standards of construction proposed and all equipment racks shall conform to the following requirements:-

- (a) Height must be of 42RU (~2040mm)
- (b) Width be of preferably 600mm
- (c) Depth be of preferably 1000mm
- (d) Colour must be Light Grey to RAL 7035 or of a similar type.

PART 7 REQUIREMENT SPECIFICATIONS

- 8.10.2 Central equipment shall be arranged so that it can be conveniently operated. The mechanical design of all controls shall be such as to minimize the risk of accidental movement or inadvertent operation. All controls shall be labelled in English.
- 8.10.3 The equipment layout in a cabinet, rack, frame, etc shall be designed to permit quick access to all units inside and permit ease of maintenance.
- 8.10.4 All equipment (including components) used and the quality of construction of the complete equipment shall conform to the commonly acceptable Standards, e.g. ISO, etc as appropriate.
- 8.10.5 The cooling systems for all equipment units shall be designed to take full advantage of the various natural phenomena involved in thermal systems. Where convection needs to be supplemented by forced air-cooling, fans shall be installed. The environment at the LORADS-III Operations Centre and Equipment Rooms shall be as noise-free as possible.
- 8.10.6 All equipment that is to be installed in the respective sites shall be cooled by convection only without the use of fans or blowers. This is to minimize noise in the enclosed space of the equipment rooms.
- 8.10.7 To prevent rust and corrosion, all metal work shall be permanently and effectively treated prior to finishing by metal spray, galvanizing, plating or other approved treatment and shall be primed or otherwise treated to provide a durable finish.
- 8.10.8 All items, components, cables, etc shall be suitably designated in English, either by labels or silk screened on the panel, chassis or framework adjacent to the component or by suitably designated photographs forming part of the instruction book, in such a manner as to facilitate the identification of any component with its graphic symbol on the relevant circuit diagrams.
- 8.10.9 Where components themselves have terminals, the terminals shall be numbered or coded both on the circuit drawing and the component terminal assembly so that any particular terminal may be readily identified. Warning shall be displayed wherever necessary.
- 8.10.10 The Tenderer shall take precautionary measures to overcome any environmental restrictions such as dust infiltration and electrostatic discharge.
- 8.10.11 All equipment including motors, blowers and other rotating machinery are required to be as silent as possible in operation. Moving mechanical parts shall be designed and housed so as to reduce any acoustic noise to an

PART 7 REQUIREMENT SPECIFICATIONS

acceptable level from the point of view of both operational and maintenance staff. Equipment such as printers and disk drives shall be fitted with sound reducing covers or cabinets to reduce the noise level to that acceptable in an office environment.

8.10.12 The total noise level generated by the equipment with motors, blowers and all other sources of acoustic noise in full operation shall not exceed 65 dB and all the other rooms that house the Surveillance Monitoring System equipment and peripherals.

8.10.13 The dimensions, weights and floor loading of each equipment unit and main modules according to the Tenderer's recommended layout shall be stated.

8.10.14 All equipment shall be designed to prevent ingress of dust and moisture and shall be resistant against fungus growth.

8.11 Miscellaneous Works and Services

8.11.1 The Contractor shall be responsible for all site works and services in connection with the pre-installation, preparation and installation of the Surveillance Monitoring System equipment.

8.11.2 The Contractor shall be fully responsible for the reinstatement, repair, rectification and making good of all damages, malfunctioning, spoilage, interruptions of services, building and other facilities (e.g. lifts, ceilings, walls, flooring, lights, escalators, doors, cables, etc) incurred in connection with the installation works.

8.11.3 If the Contractor in the course of his equipment installation or testing of the Surveillance Monitoring System requires any re-design, addition, change, modification or alteration of any part of the sites and other facilities, he shall seek the approval of CAAS/assigned agent(s) prior to the works, and be responsible for the expenses incurred.

8.11.4 All site works shall be designed by qualified and duly registered professional engineers acceptable to CAAS/assigned agent(s). Implementation of works shall be supervised by qualified personnel for the types of works required.

8.11.5 The Tenderer shall, basing on the rooms dimensions obtainable from CAAS, submit a recommended scaled layout drawing of all the equipment rooms indicating the positions of the cabinets, racks, cable distribution frames interconnecting cable routes, etc. The layout shall make provisions for expansion requirements in dotted lines on the drawings.

PART 7 REQUIREMENT SPECIFICATIONS

- 8.11.6 All site works as well as installation of the Surveillance Monitoring System shall be subject to the co-ordination and phasing arrangements of all other works within the sites which are carried out during the same period. The control shall be exercised by CAAS/assigned agent(s) in consultation with other authorities concerned.
- 8.11.7 All climbing ladders, supports, scaffoldings, etc required for the installation shall be provided by the Contractor.

9 SYSTEM AVAILABILITY AND PERFORMANCE**9.1 General**

9.1.1 The Surveillance Monitoring System shall have operational availability and system reliability such that the services can be provided for 24 hours a day for 7 days a week throughout its service lifespan.

9.2 Availability

9.2.1 The availability of the Surveillance Monitoring System shall be at least 99.95%.

9.3 Data Handling Capacity

9.3.1 The data handling capacity of the Surveillance Monitoring System shall be as follows:

- a) For radars:
 - (i) At least 800 PSR targets;
 - (ii) At least 800 SSR targets;
 - (iii) At least 800 combined targets;
- b) For ADS-B: At least 2000 ADS-B targets.
- c) For other sensors: At least 2000 targets.

9.4 Expansion and Spare Requirements

9.4.1 Expansion capacity is defined as additional capacity which can be catered by the addition of extra equipment, modules or boards.

9.4.2 The number of Sensors inputs that the Surveillance Monitoring System can handle shall be expandable by 100% of that stated in Para 2.2.3.1

9.4.3 The number of interfaces between the Surveillance Monitoring System and the clients shall be expandable by 100% of that stated in Para 2.2.3.2.

9.4.4 The Tenderer shall state the additional equipment and software change required to expand the capacity.

9.4.5 Spare capacity is defined as delivered capacity which is reserved for future use.

9.4.6 Surveillance Monitoring System shall meet the spare capacity requirements inclusive of full loading of interfaces to external equipment, as follows:-

PART 7 REQUIREMENT SPECIFICATIONS

- (a) at least 50% spare CPU time;
- (b) at least 50% spare memory capacity measured on individual processor basis;
- (c) at least 100% spare secondary storage;
- (d) network bandwidth occupancy of not more than 20%
- (e) under the maximum capacity load (inclusive of full loading of all interfaces to external equipment).

10 MAINTAINABILITY**10.1 Maintenance Concept**

- 10.1.1 The key requirement for addressing maintainability is to ensure that CAAS and its assigned maintenance agent are equipped with the capability to be self-sufficient in the maintenance of all the hardware, firmware and software associated with the Surveillance Monitoring System. All documentation, training and other hardware and software facilities that are necessary for CAAS and its assigned maintenance agent to maintain the Surveillance Monitoring System shall also be included in the offer.
- 10.1.2 The software training, documentation and programming facilities shall be fully provided to enable CAAS and its assigned maintenance agent to maintain, update, modify, enhance and expand the Surveillance Monitoring System based on the requirements as stated in this Specification to meet future development / operational requirements.
- 10.1.3 The hardware training, updated documentation and support facilities, such as tools, test equipment, spares, diagnostics/test programs, shall also be fully provided. This will enable CAAS and its assigned maintenance agent to meet the performance standard of hardware maintenance through diagnostic, integrity checks, modular replacement and /or repair of modules to component level etc.
- 10.1.4 The Tenderer may propose specific maintainability concept or base the maintenance concept on aviation industry practice to provide support for the Surveillance Monitoring System. Tenderer is expected to elaborate on the methodology, processes, suitability and advantages, and indicate the related Industries/companies that adopted it.
- 10.1.5 All operational activities, such as backup and job scheduling are automated as much as possible to aid in execution of repeatable operations, minimise mistakes and prevent security incidents from occurring. Tenderer shall provide details in his tender submission how the above requirement can be met by the proposed maintenance concept.

10.2 Basic Design Approach

- 10.2.1 The Surveillance Monitoring System shall incorporate on-line monitoring of all elements and detection of failure.
- 10.2.2 A conservative worst-case design philosophy shall be adopted for electronic equipment to achieve high reliability. This category of equipment shall include

PART 7 REQUIREMENT SPECIFICATIONS

at least the following: computers, displays and network equipment. Extensive monitoring features shall also be incorporated to track continual operating condition of critical components.

- 10.2.3 The design shall also allow access to all modules, printed circuit card units or sub-assemblies. This is to facilitate maintenance, servicing and system reconfiguration on the SubSystem where necessary.
- 10.2.4 Test points, where applicable, for testing the major waveforms and voltages used for the equipment shall be provided and easily assessable. Connections for test equipment required for maintenance shall be provided and easily assessable. Surveillance Monitoring System operation shall not be degraded as a result of connection of test equipment to any test point.
- 10.2.5 Service manuals provided by the Contractor shall at least specify the periodicity and the procedures of the preventive and adjustment maintenance so as to achieve the desired performance standard for the Surveillance Monitoring System. High level of tolerances and stability of components at unit level shall be provided to minimize the maintenance manpower requirement.
- 10.2.6 In the design of the equipment, special care shall be taken to ensure ease of preventive maintenance, testing, fault isolation, change of units and repair. It shall be possible to carry out the maintenance work on the equipment without any hazards to the maintenance personnel.
- 10.2.7 It shall be possible for units that are found to be faulty to be taken off-line for trouble-shooting and repair with no impact to the Surveillance Monitoring System operation. The Contractor shall provide all special tools and test equipment required for preventive and corrective maintenance of the Surveillance Monitoring System. The Tenderer is requested to include in his tender submission a detailed description of how this objective could be met.
- 10.2.8 The processor(s) shall be modular in design so that any possible desired increase in processing capability can be accomplished by adding more memory modules and/or computing modules and/or input and output modules.

10.3 Maintenance Provisions

- 10.3.1 In the design of the equipment, consideration shall be given to assure ease of preventive maintenance, testing, fault location, change of units and repairs. Fault clearance for all equipment shall preferably be by means of plug-in units, which may be replaced by non-specialist technician without further alignment. For the Surveillance Monitoring System to continue operation in all

PART 7 REQUIREMENT SPECIFICATIONS

contingencies, it shall be preferable to allow each unit to be plugged in or out without affecting the Surveillance Monitoring System on-line operation.

- 10.3.2 Automatic or manual switching facilities shall be provided to permit replacement of faulty units with spare equipment. In this regard, equipment status indicators clearly indicating the on-line or off-line status of Subsystem or units shall be supplied.
- 10.3.3 Facilities shall be provided to permit the carrying out of maintenance routines to check the operation of working and standby equipment without interruption to the normal service operation.
- 10.3.4 All units, if applicable, shall be fitted with indicators or alarms to facilitate rapid identification of a failure and with assessable test points for the connection to test equipment for monitoring and adjustment of essential circuit parameters.
- 10.3.5 System and software configuration changes and system commands shall be accomplished by ease-to-use and unambiguous command facilities. These facilities shall provide immediate reports (e.g. via message prompts) for the maintenance agent to readily check the status of command execution and the resulting system status.
- 10.3.6 All current system programs and databases shall be backed up in appropriate storage media (e.g. magnetic tapes) periodically. There shall be more than one medium of system programs and database back-up storage. The time duration as well as recovery procedures required for a complete restoration of Surveillance Monitoring System from these back-up storages to operative state shall be given in the proposal by the Tenderer.

10.4 Monitoring And Diagnosis Features

- 10.4.1 System performance monitoring and diagnosis utilizing hardware and software techniques shall be provided. Monitoring shall detect failure or out-of-tolerance operation of all equipment from major Subsystem to minor modules and from remote station equipment to equipment housed in the respective Sites. The Tenderer shall describe in full details, together with diagrams, as to how this requirement can be met.
- 10.4.2 Surveillance Monitoring System shall incorporate automatic failure detection functions involving features and facilities to supervise all its hardware and software under normal operation conditions continuously. Fault detectors (either hardware or software) used for the supervision functions shall be capable of initiating fault processing facilities for fault identification,

localisation, isolation and restoration of Surveillance Monitoring System operation automatically.

- 10.4.3 The continuous supervision function shall have built-in test facilities to detect any fault in Surveillance Monitoring System. The hardware supervised shall include, at least, all the PCBs and modules in processors (centralised or distributed), memories, data channels, peripheral units, multiplexers, data links, display units and power supplies i.e. down to PCBs level, field replaceable modules or assemblies.
- 10.4.4 Upon alarm indication from a supervision function or from the fault detectors, the Surveillance Monitoring System shall automatically execute the built-in diagnostic functions to provide useful and accurate reports to the maintenance personnel. The built-in diagnostic functions shall analyse and identify faults down to field replaceable modules, and then initiate reconfiguration and restoration of Surveillance Monitoring System operation automatically. In addition to automatic execution, it shall be possible to manually invoke or repeat the built-in diagnostic functions.

10.5 Provision of Update

- 10.5.1 Software maintenance has to be facilitated into the Surveillance Monitoring System design to ensure the Surveillance Monitoring System's software continues to operate satisfactorily after its implementation. The training, documentation and other facilities provided by Contractor shall allow CAAS and its assigned maintenance agent to modify, update, enhance, and expand any part of the software to accommodate all future changes in operational and technical requirements without further assistance from the Contractor.
- 10.5.2 The main areas of maintenance activities to be carried out by CAAS and its assigned maintenance agent will be as follows:
- (a) Corrective maintenance - This includes the basic support tasks of fault investigation and the regeneration of corrupted program/data files. For this purpose, the Contractor shall provide to CAAS/assigned maintenance agent, all the facilities required to debug, modify, recompile/re-assemble, re-link, test and implement the corrected software. These requirements shall apply to all software for the Surveillance Monitoring System, such as the servers, minicomputer or microprocessor, without any restriction to the delivered format or software version (i.e. firmware on PROM, ROM or source versions on function modules, PAL fuse maps, etc.)

- (b) Adaptive/perfective maintenance - Adaptive maintenance will be carried out to cater for, amongst others, future expansion involving more Subsystem or data storage, enhancement and/or addition of service functions and to accommodate changes in ICAO requirements and other international standards. Perfective maintenance, on the other hand, will be performed for the purpose of correcting processor inefficiency, performance and maintainability enhancement.

10.6 Support and Utility Software

- 10.6.1 A comprehensive support software package including full documentation shall be supplied for the maintenance of the Surveillance Monitoring System. All programs in this support software package shall be commercially proven and shall operate in all system configuration(s). All programs in this package shall also operate on the Software Development Platform.
- 10.6.2 The requirements for the support and utility software shall apply to each and every element of the Surveillance Monitoring System where software/firmware is used, such as server, storage, network or processor.
- 10.6.3 The software package to be provided shall include, but not limited to, those listed below:
 - (a) Language processors including an assembler at macro level and/or compilers, interpreters for conversion of source program modules to object codes.
 - (b) A Linker and loader for the linkage of relocatable object codes to produce and load into memory an absolute machine executable program.
 - (c) Debugging aids capable of initializing specified blocks of memory to any selected values, dumping specific blocks of memory to tape, disc, printer, making corrections to specified memory locations, inserting program breakpoints, performing true functions on addresses and branch instructions and printing contents of hardware registers and selected memory snapshots during program execution
 - (d) Editor programs for the editing of source texts, library files etc.
 - (e) Operational data recording editor capable of processing the recorded data on magnetic tapes and discs for output to a line printer including sorting of data based on data types and data filters.
 - (f) All relevant system library routines.
 - (g) Additional utility programs for duplicating source and object codes for programs/data on magnetic tape/disc, listing of files on printer and other file handling facilities.

PART 7 REQUIREMENT SPECIFICATIONS

- (h) Special support programs that may be required for the purpose of generation and loading of data tables and other facilities for on-line/off-line patching of the Surveillance Monitoring System software.
- (i) Facilities for memory dump and CPU crash analysis.

10.6.4 The memory dump facilities shall be provided so that the memory contents of the failed processor can be obtained for fault analysis purpose. In conjunction with the memory dump facility, utility programs shall be made available for extracting specific information from the memory dump for fault analysis.

10.6.5 Any other support software that is used for simulating, testing, monitoring and evaluating programmable function of any units/elements of the Surveillance Monitoring System shall be provided. For example, program modules for testing and evaluating of network performance and inter-computer interfaces.

10.6.6 In addition to the on-line fault detection and diagnostic functions incorporated in the Surveillance Monitoring System operational program, a comprehensive set of equipment oriented diagnostic and test programs that operate off-line on a manual call basis shall be provided. Diagnostics shall be provided for all the major subsystems including the processors, memories, peripherals and all communication interfaces.

10.6.7 The diagnostics programs shall provide the complete capability of testing, monitoring and evaluating all logical and programmable functions within the equipment under test. Upon detection of a malfunction, isolation of the malfunction to the printed circuit cards or module shall be achieved. For further localisation to the faulty components, source code listings for all the diagnostic and test programs shall be supplied.

10.6.8 The Tenderer shall furnish a complete list of items in the support/utility software package that will be offered. Tenderer shall state clearly what are the input/output devices and mass storage, etc needed for the execution of these programs.

10.6.9 The Tenderer shall also state clearly whether there is any information pertaining to the Surveillance Monitoring System software that will be considered to be proprietary and therefore will not be made available to CAAS. A separate list of such items shall be furnished in the tender submission. If the list is not provided, it means that the information pertaining to all software and related supporting software shall be provided to CAAS.

10.6.10 Software licensing and warranty shall be provided to CAAS where applicable.

10.7 Provision of Update

10.7.1 During the project and warranty periods, all the new versions of software (both the operational and support software) and documentation updates that resulted from debugging or product improvements by the Contractor shall be supplied to CAAS at no cost.

10.7.2 Contractor shall supply the methodology of documentation updates to CAAS at no cost.

10.8 Hardware Maintenance

10.8.1 Hardware maintenance activities shall be performed at level A. Level A maintenance shall be performed mainly with the equipment installed in the Surveillance Monitoring System and shall comprise:

- (a) Preventive maintenance according to Contractor's handbooks.
- (b) Functional and technical monitoring with scheduled measurements.
- (c) Fault location down to changeable units and change of such units.
- (d) Corrective maintenance.
- (e) Repairs of equipment that is not changeable.
- (f) Functional control after repair or replacement of units

10.9 Operation and Maintenance Spares

10.9.1 The Tenderer shall furnish a list of spares including but not be limited to, PCBs, modules, connectors, switches, sub-assemblies, cables, integrated circuits and special components.

10.9.2 The list of spares required shall, at least, consist of the following:

- (e) Computers (PCBs, power supply units, etc);
- (f) Displays (e.g. LCDs, PCBs, switches, etc);
- (g) Power supply units;
- (h) Storage devices;
- (i) Printers;
- (j) Modems (connectors, cables, etc);
- (k) Controllers (PCBs, power supply units, etc);
- (l) Miscellaneous items (e.g. connectors, switches);
- (m) Network equipment/devices;
- (n) Spares for any other peripherals.

10.9.3 The Tenderer shall provide an itemised list of the spares recommended including the quantity suggested for each spare against the total quantity of

PART 7 REQUIREMENT SPECIFICATIONS

each in use in the Surveillance Monitoring System in accordance with the following format.

Item No.	Description	Make/Type/Part Number	Vendor	Qty in Use	Qty as Spare	Unit Price FOB	Unit Price CIF	Total Price (State FOB or CIF)

10.9.4 The Tenderer shall provide, at least, the following quantity for all components for each of the equipment supplied:

Quantity used in the system	Spares quantity
1 - 2	1
3 - 5	2
6 - 10	3
11 - 20	5
21 - 50	7
Exceeding 50	10

10.9.5 The Tenderer must guarantee that spares or suitable equivalents shall be available at short notice for at least 8 years from the Completion Date. If spare parts or equivalent components are currently obtained under licence or agreement from other company or companies, the Tenderer shall state what measures or contractual obligations are in existence to guarantee for the continual supply of such spare parts or components, for at least 10 years.

10.9.6 All spares shall be suitably packed and stored during installation. The Contractor shall provide the storage facilities. The Contractor shall ensure that all spare parts to be supplied under the Contract are stored separate from the installation items for proper handover on acceptance of the Surveillance Monitoring System. All spare modules and PCBs must be tested at site before handover.

10.10 Test Equipment And Tools

10.10.1 The Contractor shall supply the required items of test equipment and tools for operation and maintenance support to the Surveillance Monitoring System.

PART 7 REQUIREMENT SPECIFICATIONS

- 10.10.2 A schedule of such test equipment, accessories and tools shall be provided in the tender submission indicating test functions, applicability to subsystem/unit, make, quantity, price and model for each piece of equipment.
- 10.10.3 All test equipment and tools shall be deemed to be part of the Surveillance Monitoring System and hence, shall comply with all provisions of this Specification wherever applicable e.g. handbooks, extender cards, etc.
- 10.10.4 Special mechanical tools including remote controller for display adjustments (if applicable) required for the maintenance and repair work shall also be supplied and included in the schedule to be submitted by the Tenderer.
- 10.10.5 All test equipment and tools required for installation, testing and commissioning of the Surveillance Monitoring System shall be the Contractor's responsibility.

11 DOCUMENTATION

11.1 General

- 11.1.1 This Section sets out CAAS' requirements on documentation to be provided by the Tenderer on the equipment supplied. Some of the documentation may be progressively revised but the final edition of the documentation shall be up-to-date at the time of acceptance and shall be in full accordance with the System as finally accepted by CAAS. The documentation requirements set out below shall cover both hardware and software, and shall also apply to equipment not manufactured and software not designed by the Tenderer.
- 11.1.2 All documents shall be written in good, simple and concise English employing generally accepted technical terms and nomenclature. This requirement shall also apply to comments contained in the source code listings of the software programs provided by the Contractor.
- 11.1.3 Some of the documentation may be progressively revised but the final edition of the documentation shall be up-to-date at the time of acceptance and shall be in full accordance with the System as finally accepted by CAAS. The requirements set out below shall cover both hardware and software, and shall also apply to equipment not manufactured and software not designed by the Contractor.
- 11.1.4 The text in the documents shall be typewritten and be legibly printed on good quality standard format sized paper. There shall be no incoherence, illegibility or smudging in the text, photographs, drawings, diagrams and illustrations.
- 11.1.5 One copy of the complete set of documentation for the System in CD-ROM, of appropriate format (e.g. Microsoft Word), together with a document describing the format and contents of the CD-ROM shall be supplied prior to final acceptance of the System.
- 11.1.6 Preliminary versions of all documents and any subsequent amendments shall be delivered to CAAS during factory acceptance tests, training and on-site test stages, as appropriate, to train and update CAAS staff and its assigned agents throughout the various stages of the project.
- 11.1.7 The final edition of all the documents shall capture all the amendments up to the point of final acceptance and shall reflect the System as handed over to CAAS. These documents shall be strongly bound with hard, durable covers in accordance with acceptable commercial practice.
- 11.1.8 If modification to any part of the hardware or software of the System is

PART 7 REQUIREMENT SPECIFICATIONS

necessary, as approved by CAAS, the Contractor shall be responsible for updating all the relevant system documentation. Document updating shall be accomplished periodically throughout the project implementation phase to ensure that they reflect the latest information.

11.1.9 Any amendments to either the preliminary or final editions of all the documents shall be delivered at no extra cost to CAAS, if necessary.

11.1.10 CAAS reserves the right to determine whether the information furnished by the Contractor in the documents is adequate and complete and to require any such additional submission by the Contractor as necessary to ensure the documentation is complete and satisfactory.

11.1.11 The following is a summary of the type of documents and number of sets of the final edition required:

Type of document		No. of final sets required
(a)	System Design Document	2
(b)	Installation Document	2
(c)	Technical (Hardware, Network & Interface) Document	2
(d)	Software Document	2
(e)	Operational Document	2
(f)	Training Document	1 set for each trainee. 3 additional sets for CAAS' future training needs.
(g)	Test Document	2
(h)	Equipment Provision List	2

11.1.12 Where appropriate, the Contractor shall provide a sample or draft version of these documents for preview and concurrence prior to production of the documents.

11.2 System Design Document

11.2.1 This document shall define in detail the system design specific to the operational requirements in this Requirement Specifications. In his tender

PART 7 REQUIREMENT SPECIFICATIONS

submission, the Tenderer shall describe the format and content of his system design document.

11.2.2 The Contractor shall include in his system design document, a cross-reference to this Requirement Specifications to facilitate the checking for completeness in design.

11.2.3 In preparing this document, the Contractor shall explicitly draw CAAS' attention to the departure, variation, non-compliance to this Requirement Specifications as agreed upon award of the Tender. This shall be done by way of a separate non-compliance or variation list to be prepared by the Contractor showing explicitly the Sections or Paragraphs which have not been complied with, or which have been offered with an alternative proposal, if any. Any new or variation list shall be subject to CAAS' approval and if approved, the accepted or variation shall form part of the system design document. If the Contractor fails to secure an explicit approval from CAAS to any of his proposed non-compliance or variation in this manner, and if a conflict exists between the system design document and this Requirement Specifications, CAAS shall reserve the right not to accept the version in the system design document and the relevant provisions of this Requirement Specifications shall remain contractually binding.

11.2.4 The system design document shall consist of two editions:

- (a) Preliminary edition comprising **two (2)** sets of system design document shall be prepared by the Contractor, in consultation with CAAS, immediately after the contract award and submitted within **two (2)** calendar months thereafter for CAAS' review and approval.
- (b) Final edition comprising **two (2)** complete bound volumes of the final and updated version shall be supplied prior to final acceptance of the Surveillance Monitoring System.

11.3 Installation Document

11.3.1 This document shall be used to guide the installation works and to serve as a record of all installation details on-site.

11.3.2 The installation document shall consist of two editions:

- (a) **Two (2)** sets of installation document shall be submitted to and approved by CAAS **one (1)** calendar month (or any period agreed by CAAS) prior to commencement of any installation work. The

PART 7 REQUIREMENT SPECIFICATIONS

installation document shall be updated by the Contractor at regular time intervals, e.g. after each progress meeting, for approval by CAAS.

- (b) **Two (2)** complete bound volumes of the final and updated version shall be supplied prior to final acceptance of the Surveillance Monitoring System.

11.3.3 The Contractor shall provide, at a minimum, the installation documents listed below:

- (a) A delivery schedule list, in tabular form, for every item that will be delivered to site throughout the duration of the Contract. The list shall indicate the description, part number, quantity and drawing reference of each item.
- (b) Scaled floor-plan layouts showing the position of all equipment, equipment housing, room location, the occupied floor area and support and mounting details of all the equipment. The dimension, weight, floor-loading of each equipment unit shall also be provided.
- (c) Drawings showing the physical layout of all the equipment in each piece of equipment housing or equipment chassis.
- (d) Mechanical drawings showing the front and rear views of the servers, interface equipment, monitoring panels, equipment chassis, equipment housing and any other associated peripherals for the System. The drawings shall clearly show the external features available on each piece of equipment with control knobs, switches or connectors clearly identified.
- (e) Schematic and circuit diagrams and floor-plan layouts of power distribution for the System, indicating the location of fuses, power points, circuit breakers, distribution boards and their respective ratings and electrical loading.
- (f) Cabling layout diagrams including the floor-plan layout of signal cable routes, power cable routes and earth cable routes for the System. The diagrams shall include the location of cable ducts, location of cable access into rooms and their dimensions, and any other relevant data where applicable.
- (g) Diagrams indicating the cabling connections between subsystems, different chassis and different equipment housing, etc. It shall include the cable terminal types and sizes, cable sizes and insulation type,

number of conductors in each cable and any other relevant data where applicable.

- (h) During the course of installation, the Contractor shall modify his drawings in accordance to the actual site installation with appropriate record-keeping. Modified drawings shall then be re-submitted for approval by CAAS. It is to be understood that approval of the drawings by CAAS shall not relieve the Contractor from any responsibility in connection with the works.
- (i) Each drawing shall bear the date, revision number, name and signature of the Contractor or that of a responsible person under his employment together with the name and address of his firm.

11.4 Technical (Hardware, Network & Interface) Document

11.4.1 The technical document shall be provided as follows:

- (a) **Two (2)** sets of technical document shall be submitted to and approved by CAAS **one (1)** calendar month (or any period agreed by CAAS) prior to commencement of factory acceptance test.
- (b) **Two (2)** complete bound volumes of the final and updated version of the technical document shall be supplied prior to final acceptance of the System.

11.4.2 The technical documents shall meet the following requirements:

- (a) There shall be an introductory volume embracing all topics and aspects of the System, including power supplies and support facilities, written in a non-mathematical descriptive form. It shall include the location of the subsystems and their interface in relation to other equipment to serve as a simple straight-forward insight into the mechanism of the System operation.
- (b) The remaining volumes shall deal clearly and comprehensively with the general description of the Surveillance Monitoring System, detailed theory of operation of equipment and practical operation of equipment. It shall include a Section on equipment maintenance detailing the recommended corrective and preventive maintenance procedures, electrical and mechanical repair procedures, etc.
- (c) The Section on equipment maintenance shall be divided into two main parts. The first part shall deal with corrective maintenance with the aid

of flow-charts. It shall include the fault-finding procedures leading to a faulty unit or component when a failure occurs. The document shall be sufficient for maintenance staff to perform troubleshooting to component level, where possible.

- (d) The second part shall deal with preventive maintenance. It shall include the recommended routine daily, weekly and monthly preventive maintenance procedures to be performed on all equipment.
- (e) A cross-reference system shall be proposed and established by the Contractor for ease of location of items of information from one related volume to another, e.g. each circuit diagram to be cross-referenced with its printed circuit board layout and component part list, etc.

11.4.3 The technical contents in the documents shall include, but not be limited to, the following:

- (a) Introduction with a general description on the operational use of the Surveillance Monitoring System;
- (b) Principle, theory of design, technical specifications and operation of the Surveillance Monitoring System and its subsystems;
- (c) Functional circuit description of all modules with the aid of circuit diagrams;
- (d) Installation, configuration and control, where appropriate, of the relevant subsystems or equipment, including the network equipment;
- (e) Network management description to include the following:
 - (i) Installation, configuration & control
 - (ii) Fault detection, isolation, troubleshoot and recovery;
 - (iii) Performance and status monitoring;
 - (iv) Maintenance of cables, database and software
 - (v) IT security administration
- (f) Installation, setting-up, adjustment, re-alignment, preventive and corrective maintenance procedures with the aid of flow-charts. It shall include complete information on the System initiation and intervention procedures, a complete list of possible fault diagnosis/alarm messages and error halts and the necessary follow-up actions required by the maintenance personnel; and

- (g) Specifications and technical information on customized integrated circuits and modules or parts supplied by other manufacturers.

11.4.4 The circuit / schematic diagrams in the technical documents shall include, but not be limited to, the following:

- (a) Block level diagrams commencing with the overall System down to the individual sub-assemblies;
- (b) Schematic diagrams of each different electrical, electronic, or mechanical circuit of each subsystem;
- (c) Detailed circuit diagrams and component location diagrams of every printed circuit board and module, including locations of test points. Circuit diagrams shall show, adjacent to the test points, the expected waveforms and operating voltages including their limits;
- (d) Interconnection diagrams of internal and external interfaces of the System detailing the function, signal flow direction, method of interfacing between modules, sub-assemblies or subsystems etc, with the technical characteristics of the interfaces clearly stated. It shall include the connection protocol, cable type, signal specifications and any other necessary information to facilitate ease of maintenance and troubleshooting;
- (e) Detailed message protocol and message format including details of data fields, data link load and sizing information, constraints, exception handling, link establishment and shutdown, data synchronization and resynchronization on initial startup or switchover of computer server, IT security implementation etc.;
- (f) A complete set of wiring plans / wiring lists showing all wiring cross-references between units or sub-assemblies; and
- (g) Network topology diagram and description, detailing the entire network design

11.4.5 All parts and components of individual subsystem and sub-assemblies shall be fully and easily identifiable on drawing. Illustrations shall include “exploded” views showing and identifying each and every separate item regardless of significance.

11.4.6 An index shall be included covering all electrical, electronic and mechanical components parts with clear cross-referencing to diagrams and illustrations.

PART 7 REQUIREMENT SPECIFICATIONS

The component part list shall provide details identifying all components and portions of assemblies and sub-assemblies. The part list shall include component description, manufacturer, order reference part number, and equivalents available from other sources.

11.4.7 Any special tools and instruments required to be used in connection with preventive and corrective maintenance of the Surveillance Monitoring System shall be stated. The function and method of use of each special tool and instrument and their associated accessories shall be explained thoroughly. Precautions required in handling of the said items shall be emphasized and the reason for each precautionary measure explained.

11.4.8 All mechanical, electrical and electronic engineering notations and symbols shall conform to universally-accepted engineering conventions. A glossary of all notations and symbols used in the cabling, schematic and circuit diagrams shall be provided. The Metric System of Units shall be used in all diagrams.

11.5 Software Document

11.5.1 The Contractor shall supply all software and firmware documentation for CAAS to operate, maintain, and update the software of the Surveillance Monitoring System.

11.5.2 The software document shall consist of two editions:

- (a) **Two (2)** sets of the software document shall be submitted to and approved by CAAS **one (1)** calendar month (or any period agreed by CAAS) prior to commencement of factory acceptance test.
- (b) **Two (2)** complete bound volumes of the final and updated version of the software document including source code listings and any other programs or related elements constituting the complete software package of the System, shall be supplied prior to final acceptance of the System.
- (c) In addition, **two (2)** copies of the source code listings of all the software to be delivered as required under the Requirements Specifications, in CD-ROM format, shall be supplied prior to final acceptance of the System. Each copy of the CD-ROM shall be supplied together with a document describing the format and contents within.
- (d) The source code listings shall be supplied in both object/absolute version and in source version.

PART 7 REQUIREMENT SPECIFICATIONS

- (e) Each software document in both the hardcopy and CD-ROM format shall reflect its software version. This shall be applicable to the both the preliminary edition, final edition and all their amendments.

11.5.3 In order to provide an efficient means of searching for the desired information, there shall be an introductory volume in the software document with a cross reference system or any other appropriate means for locating the following:

- (a) A list of all the software documents.
- (b) A list of all the software and firmware programs and their associated facilities to be used for the Surveillance Monitoring System operation.
- (c) A list of all the support and utility programs.

11.5.4 The remaining volumes shall deal clearly and comprehensively with, but not limited to, the following software programs:

- (a) Operating system.
- (b) Operational software, application software and firmware.
- (c) Support and utility software (e.g.data-capturing tools and programs for playback of recorded data, etc).
- (d) Software developed by other equipment manufacturers.
- (e) Software developed by the Contractor for the purpose of facilitating the development and modification of any parts of the System.

11.5.5 The software document shall include, but not be limited to, the following details:

- (a) Software System Documentation.
- (b) Program Documentation.
- (c) Data and Storage Structures.
- (d) Program and Data Listings.
- (e) Memory Maps.
- (f) Support and Utility Software.

11.5.6 Software System Documentation

11.5.6.1 The document shall provide an overview of the operational software system including software system description, operational procedures, data structure and formats, data storage layout, data flow-charts and the relationship of the various subsystems, etc.

11.5.6.2 There shall be detailed narrative descriptions illustrated by block diagrams and flow-charts for each of the functional subsystem operational software, program modules and interfaces to allow a simple, straight-forward

insight into the mechanism of the software operation.

11.5.6.3 A block diagram clearly indicating the interaction of the various software elements and the overall data flow within the System shall be provided.

11.5.6.4 A detailed explanation of conventions adopted with respect to flow-charts, table names, data names and calling sequence shall be provided.

11.5.7 Program Documentation

11.5.7.1 This document shall provide detailed program listing, program descriptions and associated program flow-charts and program storage layout for all program modules within each functional subsystem, up to the level of each subroutine entity.

11.5.7.2 Information pertaining to the programming of all the relevant hardware interfaces shall also be included.

11.5.7.3 The program flow-charts shall be closely related to the corresponding program source listings and program descriptions. These shall show all branch points with a clear indication in each branch as to which factor causes entry to that branch. All the symbols and notations shall be clearly defined.

11.5.7.4 The document shall provide, at least, the following information:

- (a) The program identification comprising title, symbolic label, identification code, issue number and date, average execution time and size of memory used.
- (b) Detailed descriptions of the processing function performed and the specific methods adopted by the program.
- (c) Detailed explanations of all the hardware related programming factors such as input and output formats, codes, bit arrangements for control characters, communication sequences and both the normal and error interrupt processing.
- (d) Specifications of program inputs, outputs, a list of all flags, reserved registers, buffers, tables and all the data directly used.

11.5.8 Data and Storage Structures

11.5.8.1 This document shall provide detailed description of data and storage

structures, such as buffers and tables, used in the operational software.

11.5.8.2 All data used by the operational software system, be it permanent, semi-permanent or variable data, shall be described in detail.

11.5.8.3 The document shall provide, at least, the following information:

- (a) Diagrammatic representations of the buffers or tables.
- (b) Descriptions of addressing mechanism for buffers or tables.
- (c) Sizes of buffers and tables.
- (d) Field definition of data.
- (e) Absolute addresses in the main memory and other appropriate runtime information.

11.5.9 Program and Data Listings

11.5.9.1 This document shall provide detailed source code listings for all the program modules (including subroutines and comments) and data modules that are part of the operational software.

11.5.9.2 Detailed description and source code listing for all firmware in PROM and ROM (if applicable), shall also be provided.

11.5.9.3 Each source code listing shall comprise, at least, the following:

- (a) Source language statements.
- (b) Resulting compiled or assembled machine codes.
- (c) Program or data storage allocation maps.
- (d) Comments and explanatory notes to explain each line of code.

11.5.9.4 Comments and explanatory notes in the listings shall be in English and shall be comprehensive, accurate, informative, relevant and where possible, provide references to the relevant parts of the detailed description.

11.5.10 Memory Maps

11.5.10.1 This document shall provide memory maps showing, at least, the following:

- (a) The program and database layout within the mass storage devices.
- (b) The space reserved for each program and data module and the cross-references between the symbolic addresses and actual addresses in memory.

11.5.11 Support and Utility Software

11.5.11.1 This document shall include, at least, the following:

- (a) Utility program reference documents which shall give each of the utility programs (e.g. assembler, compiler, linker, text editor, debugging aids, equipment drivers and loaders), the appropriate narrative description, flow diagrams and instructions on its use.
- (b) Diagnostic and test programs documents which shall include a narrative description, complete source code listings and definition of all inputs and outputs for each diagnostic/test program and the specific methods used.
- (c) Detailed operating instructions on the control of the System such as software initiation, intervention and recovery procedures, including a complete list of possible fault diagnosis/alarm messages and error halts and the necessary follow-up actions required by the maintenance personnel.
- (d) Descriptions on the procedures for on-line updating, back-up operations, system crash analysis and other aspects of the maintenance of operational software.
- (e) All relevant processor and peripheral reference documents and other educational reference manuals to enable the programmer to fully understand the Surveillance Monitoring System and its software and which may be used as part of the training materials for the programmers.
- (f) Programmer reference manuals or user guides providing detailed information on the use of the support and utility software.
- (g) Detailed operating instructions on the version control of source code system.
- (h) Descriptions on the procedures to operate functions of the control and monitoring system, record and replay system, etc.

11.6 Operational Document

11.6.1 The operational document shall contain adequate information on operating instructions regarding the System to enable the operators to operate efficiently. It shall contain the following information in detail:

PART 7 REQUIREMENT SPECIFICATIONS

- (a) The input commands available, including their significance, functions and the procedures required to activate each input command.
- (b) The output messages available, including their significance, functions and the response required by the operators in connection with each output message.
- (c) Initializing, restart and other emergency procedures to be followed in the event of a System halt or failure during operations.
- (d) Any other operational or maintenance procedures required on the part of the operators.

11.6.2 The operational document shall be provided as follows:

- (a) **Two (2)** sets of the operational document shall be submitted to and approved by CAAS **one (1)** calendar month (or any period agreed by CAAS) prior to commencement of factory acceptance test.
- (b) **Two (2)** complete bound volumes of the final and updated version of the operational document shall be supplied prior to final acceptance of the System.

11.7 Training Document

11.7.1 The training document provided for each training course shall be specific to the topics to be covered in each course and shall comprise the relevant technical manuals, software manuals or operational manuals.

11.7.2 The Contractor shall provide an adequate number of training documents and training materials/aids according to the number of trainees specified for each training course.

11.7.3 The training document shall be provided as follows:

- (a) **Two (2)** sets of the training document for each training course shall be submitted to and approved by CAAS **one (1)** calendar month before (or any other period agreed by CAAS) commencement of each training course.
- (b) Each trainee shall be issued **one (1)** complete set of the most up-to-date training document, at the point of commencement of each course, specific to the course that he is attending.

- (c) **Three (3)** complete bound volumes of the final and updated version of the training document and any relevant instructor's notes shall be supplied to CAAS prior to final acceptance of the Surveillance Monitoring System in order for CAAS' assigned agents to conduct future courses in Singapore.

11.8 Test Document

- 11.8.1 The test document shall contain a compilation of all test-related records for both hardware and software tests conducted throughout the project implementation phase. Submission deadlines of the test records for each stage of the project shall be in accordance with the project schedule approved by CAAS.
- 11.8.2 The test document shall incorporate a cross reference to this Requirement Specifications to ensure that the tests are complete and in accordance with the requirements specified.
- 11.8.3 The Contractor shall provide **two (2)** sets of test documents which shall, at a minimum, contain the following:
 - (a) Contractor's internal tests and measurements records which shall describe the Contractor's internal test procedures for all equipment parts including equipment delivered by other manufacturers. It shall contain a record of all internal test results conducted by the Contractor prior to the Factory Acceptance Test.
 - (b) Test plan, test schedule, test procedure and test report for the completed Factory Acceptance Test.
 - (c) Test plan, test schedule, test procedure and test report for the completed Site Acceptance Test.
 - (d) Test schedule and test report for the Reliability Acceptance Test.

11.9 Equipment Provisioning List

- 11.9.1 **Two (2)** sets of documents with full and complete list of the equipment, test equipment, tools and any other peripherals to be delivered by the Contractor shall be submitted to CAAS at least one (1) calendar month prior to final acceptance of the Surveillance Monitoring System for the purpose of provisioning check and inventory control.

PART 7 REQUIREMENT SPECIFICATIONS

- 11.9.2 The list shall be categorized into subsystems, assemblies, sub-assemblies, components and classified into electronic, electrical, mechanical and civil engineering pieces of equipment, where applicable. Information on manufacturers' model/part numbers, manufacturers' addresses, unit prices and quantities used shall be included.

12 ACCEPTANCE TEST**12.1 General**

- 12.1.1 The Contractor shall prepare and submit all test plans, procedures and schedules to CAAS in accordance with the requirements in this Requirement Specifications. The tests shall be planned in a manner by which the Contractor shall demonstrate, to the satisfaction of CAAS, that the System installed fulfills all the requirements in this Requirement Specifications.
- 12.1.2 The Contractor shall conduct the acceptance tests in accordance with approved test plans. The System shall be commissioned once it has passed all following tests successfully and satisfactorily as agreed by CAAS:
- (a) Factory Acceptance Test (FAT);
 - (b) Site Acceptance Test (SAT); and
 - (c) Reliability Acceptance Test (RAT).
- 12.1.3 No acceptance test shall be commenced without prior agreement from CAAS on the test plans, procedures and schedules to be followed. In addition, no design change or modification shall be made without the approval of CAAS after the start of any system functional test or the SAT. CAAS shall have the final say in the test procedures and the actual test dates.
- 12.1.4 In the event that an acceptance test is not successful, as deemed by CAAS, the Contractor shall take immediate action to rectify or modify the System appropriately. The Contractor shall be responsible for testing any modification to his design found necessary as a result of the tests.
- 12.1.5 If any modifications are found to be necessary or if any part of the acceptance tests fails, CAAS reserves the right to require any completed test to be re-run to verify its performance again.
- 12.1.6 Any rectification, modification or re-tests required to the System during the acceptance tests, whether hardware or software, to bring it into compliance with the specifications as established shall be performed by the Contractor without any increase in the Contract price. The Contractor shall also be responsible for the supply of the relevant documentation updates at no extra cost to CAAS.
- 12.1.7 Each test failure shall be logged and the Contractor shall be responsible for investigating into the cause of the failure during the acceptance tests. The Contractor shall furnish in the test report, the cause of failure and shall also document any modification made to the System to rectify the failure.

PART 7 REQUIREMENT SPECIFICATIONS

- 12.1.8 The results obtained during each acceptance test shall be recorded by the Contractor in a test report. After each acceptance test, the Contractor shall submit a complete and comprehensive test report to CAAS.
- 12.1.9 Records of all test reports and any test-related reports or documents shall be kept complete and available for CAAS' inspection during the acceptance test period. The test reports and any test-related reports or documents shall form part of the test documents to be delivered to CAAS as spelt out in **Section 11 Documentation**.
- 12.1.10 The Contractor shall provide all test equipment, tools, services and any other necessary test facilities required for the acceptance tests.
- 12.1.11 Notwithstanding any inspection, witnessing or observation of tests by CAAS at any stage of the acceptance tests, the Contractor shall be solely responsible for the quality of the System.
- 12.2 Factory Acceptance Test (FAT)**
- 12.2.1 The Contractor shall perform the FAT at the factory prior to the delivery of the hardware/software to the site. Tenderer shall propose the venue and duration of such tests in their tender proposal. CAAS shall be given free access to the Contractor's production sites for inspection purposes during the FAT.
- 12.2.2 CAAS reserves the right to witness or perform any of the FAT or inspections. The Contractor shall note that only upon satisfactory completion of the FAT will the equipment be delivered to the site.
- 12.2.3 CAAS shall be given at least **one (1)** calendar month's notice before the start of the FAT.
- 12.2.4 The Contractor shall submit a comprehensive test plan with detailed test procedure and test schedule together with preliminary technical, operational and software documents of the FAT and obtain CAAS' approval at least **one (1)** calendar month (or any period agreed by CAAS) before the start of the FAT.
- 12.2.5 Upon completion of the FAT, the Contractor shall submit the FAT test report to CAAS prior to the commencement of the SAT and within **seven (7)** calendar days after successful completion of FAT.
- 12.2.6 The FAT shall include, at least, the following types of tests:
- (a) Functional Test; and
 - (b) Maintainability Test.

PART 7 REQUIREMENT SPECIFICATIONS

12.2.7 Functional Test

12.2.8 Functional tests, which include the physical inspection of equipment, shall be conducted at the System and subsystem levels.

12.2.8.1 All hardware and software functional tests shall be conducted in accordance with the test plans developed by the Contractor and approved by CAAS. The functional tests shall be designed to cover the total System including the operational software program(s) to verify that the performance requirements of this Requirement Specifications have been met. In addition, all off-line functional requirements shall also be tested.

12.2.8.2 The Contractor shall use simulated data, actual data or a combination thereof to achieve the necessary data loads to prove complete compliance with this Requirement Specifications.

12.2.8.3 Subsystem functional tests shall include the testing of equipment combinations and/or equipment and operational software combinations.

12.2.9 Maintainability Test

12.2.9.1 Maintainability tests shall be designed to prove the suitability of the technical and software documents provided by the Contractor for System hardware and software maintenance.

12.2.9.2 The maintainability tests shall also demonstrate the capability of off-line fault isolation, repair and confidence checking to ensure that the malfunction has been corrected and that the unit is available for operational use.

12.2.9.3 In addition, the tests shall include the simulation of faults to test the effective activation of relevant alert messages and audio and visual alarms, as well as the effective cancellation of such messages and alarms upon clearance of the faults.

12.3 **Site Acceptance Test (SAT)**

12.3.1 The Contractor shall perform the SAT with participation from CAAS staff after the complete installation of the System on-site.

12.3.2 CAAS shall be given at least **one (1)** calendar month's notice before the start of the SAT. Tests shall be designed to minimize interference with on-going facility operations.

12.3.3 The Contractor shall submit a comprehensive test plan with detailed test procedure and test schedule together with preliminary technical, operational

PART 7 REQUIREMENT SPECIFICATIONS

and software documents of the SAT for CAAS' approval at least **one (1)** calendar month before the start of the SAT.

12.3.4 Upon completion of the SAT, the Contractor shall submit the SAT test report to CAAS prior to the commencement of the RAT and within **seven (7)** calendar days after successful completion of SAT.

12.3.5 Prior to the SAT, the Tenderer shall supply a re-compiled or assembled operational software program if patches exist. Should changes be necessary to the program or data during the SAT period, the operational program shall be re-compiled or re-assembled by the Contractor again. In this case, CAAS reserves the right to revalidate all the previously completed tests on the new operational program.

12.3.6 The SAT shall be conducted in three stages as listed below. In addition, the Functional Test and Maintainability Test, as defined for the FAT, shall also be performed during each stage of the SAT to verify the full compliance of the System with this Requirement Specifications.

- (a) System Integrity Test
- (b) Integration Test
- (c) Operational Test

12.3.7 System Integrity Test

12.3.7.1 The first stage of the SAT shall verify the basic hardware and software integrity of the System and subsystems. These tests shall be conducted prior to interfacing the System with any external equipment (except for power and internal physical interfaces). It shall include testing of every part of the working system.

12.3.7.2 Measurements shall be made and documented for each part of the working system (e.g. module, unit and PCB) to ensure correct operating parameters and signal levels.

12.3.8 Integration Test

12.3.8.1 During this stage of the SAT, the System shall be integrated with the sensors available at that point of time. Where such external systems are not available, the Contractor shall provide the facilities to simulate such external systems.

12.3.9 Operational Test

PART 7 REQUIREMENT SPECIFICATIONS

12.3.9.1 This stage of test shall utilize the whole System, including its integration with the external systems, for complete testing of the operational functions. The processor load capacity at the Servers and the various terminals as well as the off-line and on-line processing capabilities shall also be tested.

12.3.9.2 Where such external systems are not available, the Contractor shall provide the facilities to simulate such external systems.

12.4 Reliability Acceptance Test (RAT)

12.4.1 A **thirty (30)** calendar days' RAT shall be conducted on the System immediately after a successful SAT. During the RAT, CAAS maintenance and operational staff will observe the performance of the Surveillance Monitoring System in operation to assess whether it meets the reliability requirements of this Requirement Specifications and to obtain the necessary test data to assist in verifying that the Surveillance Monitoring System can operate through a continuous period of **thirty (30)** calendar days without anomalies, defects, stoppage or system failure.

12.4.2 The Surveillance Monitoring System shall be fully manned during RAT, and all operational inputs and responses shall be processed in conformance to the requirements as specified in this Requirement Specifications.

12.4.3 The Surveillance Monitoring System shall be deemed to have satisfactorily fulfilled the RAT when there is:

- (a) no stoppage or System failure whatsoever; and
- (b) no change changeovers in any subsystem or System level.

12.4.4 If the System fails to satisfy all the conditions as specified above, the Contractor shall be required to re-conduct the RAT for another continuous **thirty (30)** calendar day period until all the above-mentioned conditions are satisfied.

12.5 Test Plans and Procedures

12.5.1 The test plans and procedures shall be comprehensive and provide clear and systematic details which shall, at least, include the following:

- (a) Description and objective of the test to be performed. The description shall include a detailed diagram showing the system configuration, test set-up and necessary interface;
- (b) Detailed step-by-step test procedure to ensure that the test will

satisfactorily demonstrate equipment, software, subsystems and system compliance with all requirements specified.

- (c) The necessary test facilities required for each test, including the inputs that are required to test each function and the test equipment required to observe or measure each test output.
- (d) The functional specification or test result to be achieved.
- (e) The time duration required to perform each test.

12.6 Test Reports

12.6.1 The test reports shall contain a complete description of the test results and shall, at least, include the following information:

- (a) Functions that were tested;
- (b) Performance of each equipment, subsystem or Surveillance Monitoring System under test and whether it meets the required/specified performance;
- (c) Information as to whether the results of the test are in agreement with the required reliability of the equipment, subsystem or Surveillance Monitoring System;
- (d) A record of any engineering or program changes found necessary to correct design deficiencies;
- (e) Suggested corrective actions to improve the test results, if any.

13 TRAINING**13.1 General**

- 13.1.1 CAAS attach the utmost importance to the training of their technical, software and operational personnel by the Contractor. The Contractor shall arrange and conduct training by the most efficient and effective techniques and employing training facilities with qualified and experienced personnel.
- 13.1.2 The training to be provided by the Contractor shall accomplish CAAS' objective of being able to operate and maintain the hardware and software of the Surveillance Monitoring System independently without any form of field personnel support from the Contractor after final acceptance of the Surveillance Monitoring System. It shall include every aspect of the Surveillance Monitoring System inclusive of hardware and software components manufactured by other suppliers and which are in the Contract.
- 13.1.3 The training shall be sufficient to allow CAAS staff or its assigned agents to perform integration with any external systems that are due to be commissioned after the System Completion Date, without any form of field personnel support from the Contractor.
- 13.1.4 The training shall be comprehensive so as to enable CAAS staff or its assigned agents to perform the following:
- (a) Technical staff to maintain all parts of the equipment (e.g. units, modules, PCBs, etc.) down to the Last replaceable Unit (LRU), as well as to use diagnostic programs for fault-findings; and
 - (b) Software staff to maintain, update and operate the software according to the requirements stated in this Requirement Specifications, as well as to expand and modify the software according to future operational requirements;
- 13.1.5 The following types of training courses shall be provided by the Contractor in Singapore:
- (a) Technical training; and
 - (b) Software training.
- 13.1.6 The trainings to be conducted shall include, but not be limited to, the following contents:
- (a) Introduction and overview of the Surveillance Monitoring System;

PART 7 REQUIREMENT SPECIFICATIONS

- (b) Description of the Surveillance Monitoring System and its subsystems, inclusive of block, schematic and circuit diagram explanations;
- (c) Operation and Functionality of the Surveillance Monitoring System;
- (d) Administration of the Surveillance Monitoring System;
- (e) Modification of the Database;
- (f) Modification of the Software;
- (g) Maintenance of the Surveillance Monitoring System, up to component level wherever possible;
- (h) Common faults and rectifications; and
- (i) Calibration procedures, if any.

13.1.7 The Tenderer shall, in his tender submission, furnish the following:

- (a) Breakdown of the cost for each type of course to be conducted in Singapore;
- (b) Information on the various levels of maintenance and operational competencies training required for the operation and support of the Surveillance Monitoring System;
- (c) Syllabus for each training course;
- (d) Training program showing the timing and duration of each training course;
- (e) Training documents and materials proposed for each course with a brief description of each training document to be provided;
- (f) Pre-requisite qualifications required for each type of training course.
- (g) Maximum number of trainees that can be accommodated for each training course;

13.1.8 The training shall include theoretical as well as on-the-job training while the Surveillance Monitoring System is being installed, tested and commissioned at the site.

13.1.9 The timing of the training courses shall be appropriately phased into the overall project schedule. The duration of each training course shall be adequate to meet the training objectives in this Requirement Specifications.

13.1.10 The medium of instruction and language used in training shall be in English.

13.1.11 The following shall be submitted to and approved by at least **one (1)** calendar month (or other period agreed by CAAS) prior to the commencement of each training course:

- (a) Detailed description of the course contents including course objectives, syllabus and lesson plans;
- (b) Description of course time allocation and timetable;
- (c) **Two (2)** copies of the preliminary edition of the training document and subsequent amendments.

13.2 Technical Training

13.2.1 The Contractor shall provide comprehensive technical training on the Surveillance Monitoring System for the technical personnel of CAAS or its assigned agents so that they will be able to maintain the equipment to the level of Last Replaceable Unit (LRU) with the use of computer programs for fault diagnosis, wherever possible.

13.2.2 The technical training shall be specific towards the type of equipment, the system design and configurations and the intended operations of the Surveillance Monitoring System to be supplied under this Contract.

13.2.3 The technical training shall comprise both theoretical lessons and thorough specialized practical lessons for, at least, the following:

- (a) System installation procedures;
- (b) System operational procedures;
- (c) System maintenance procedures;
- (d) System test procedures;
- (e) Principles and theory of operation of each individual subsystem and unit of the System down to component level;
- (f) Simulated fault-findings and fault-isolation including interpretation of results with the aid of the source code listings;
- (g) Use of on-line and off-line diagnostic programs;
- (h) Maintenance and use of special test equipment, tools and peripherals;
- (i) Expansion of input and output interfaces;
- (j) Conversion of input format to other;
- (k) System functions.

13.2.4 The equipment installed may be used for practical training, as far as practicable, without affecting the target System Completion Date. The objective of the practical training is to provide maximum exposure and direct involvement in

PART 7 REQUIREMENT SPECIFICATIONS

the installation and testing of the Surveillance Monitoring System by CAAS' nominated staff.

13.2.5 Practical training shall commence from the beginning of Surveillance Monitoring System installation and shall consist of two parts as follows:

- (a) As a supplement to theoretical training, it shall consist of practical demonstration, simulated fault-finding and operation of the Surveillance Monitoring System in the presence of the Contractor's training personnel.
- (b) The participation of CAAS' nominated staff in undertaking, under the Contractor's supervision and responsibility, such tasks as installation, testing and maintenance. This shall involve CAAS' nominated staff as much as possible to enable them to obtain practical hands-on experience on the equipment.

13.2.6 The full program of the practical training shall be submitted to and approved by CAAS one (1) calendar month (or any other periods agreed by CAAS) before commencement of the training, indicating the breakdown of tasks and functions to be undertaken by the trainees.

13.2.7 The number of trainees for the technical training is estimated at six (6).

13.2.8 CAAS' nominated staff shall not be held responsible for any damages or delays as a result of their participation, as full supervision and final responsibility of handing over an error-free, operational System within the project schedule shall lie with the Contractor.

13.3 Software Training

13.3.1 The Contractor shall provide comprehensive training to the software personnel of CAAS or its assigned agents to acquire in-depth experience and knowledge of all software programming of the Surveillance Monitoring System.

13.3.2 The software training shall be specific towards the programming languages, the system design and configurations, the operational program and the intended operations of the Surveillance Monitoring System to be supplied under this Contract.

13.3.3 The software training shall include, at least, the following:

- (a) System overview;

PART 7 REQUIREMENT SPECIFICATIONS

- (b) Theoretical and practical aspects of the computer system (including computer architecture, operating system, system utilities, file management, languages, etc);
- (c) Theoretical and practical aspects of the operational software;
- (d) On-site practical training.

13.3.4 As part of the software training, trainees shall be trained on software trouble-shooting procedures including crash-analysis on memory dump, program debugging and testing, and the restoration of Surveillance Monitoring System operations.

13.3.5 It is intended that each trainee acquires experience and knowledge of all programming aspects (i.e. no sub-division of training without CAAS' approval). Software trainees shall not be used to perform repetitive tasks, such as coding, any longer than necessary during the training period.

13.3.6 The Tenderer shall state if there is any part of the training which may involve proprietary software information which will be excluded from his training offer.

13.3.7 For the Surveillance Monitoring Input Interface software and the Surveillance Monitoring Output Interface Software, trainees shall be trained on the modification of software for at least the following purposes:

- a) To accommodate new standard and non-standard message data formats;
- b) To expand the input and output capacity of the Surveillance Monitoring System;
- c) To convert from one input format to another.

13.3.8 The number of trainees for the software training is estimated at **six (6)**.

13.4 Training Materials and Facilities

13.4.1 To enable maximum value to be derived from the training, all the necessary training documentation and materials (e.g. software documents, equipment handbooks, training manuals), even in their draft forms, shall be made available to CAAS' nominated trainees.

13.4.2 Classroom facilities including whiteboard, furniture and all stationery items required by trainees will be provided by CAAS. Slides and overhead projectors may be provided by CAAS upon due notice given. All other audio-visual aids, film-strips, slides, charts, coding forms and any other training aids required for theoretical training shall be provided by the Contractor and all such aids shall

be handed over to CAAS upon completion of the training program, inclusive of special instructor's manual, if any.

13.5 CAAS' Training Personnel

13.5.1 CAAS staff or its assigned agents nominated to undergo and finally operate, control and maintain the System will consist of:

- (a) Technical Staff - Engineers, Technical Officers.
- (b) Software Staff - System Analysts, Engineers, Technical Officers.

13.5.2 The Tenderer shall provide guidelines on pre-requisite qualifications required for each category of staff.

13.6 Contractor's Training Personnel

13.6.1 A full list detailing the number, qualifications and lecturing experience of the Contractor's training personnel shall be submitted to CAAS.

13.6.2 The calibre of training personnel shall be such that they possess not only the pertinent academic qualifications, but have the proven ability to combine theoretical knowledge with first-hand practical experience in previous implementation of Surveillance Monitoring Systems.

13.6.3 A good grasp of the spoken and written English language shall be a mandatory requirement of the Contractor's training personnel.

13.6.4 In addition to the task of lecturing, the Contractor's training personnel shall maintain a systematic procedure of reporting attendance and monitoring the progress of all trainees.

13.6.5 In the case of theoretical training, the lecturer shall set and mark examination papers, and if necessary, a series of tests shall be made compulsory to be taken by all trainees during each course.

13.6.6 The Contractor's training personnel shall submit the following to CAAS:

- (a) An assessment report on the progress of the trainees nominated by CAAS to undergo the training. He shall assess the difficulties and/or problems encountered by the trainees.
- (b) An end-of-course assessment report on the knowledge acquired and the performance of each trainee.

14 AFTER-SALE SUPPORT

14.1 After-Sale Support Agreement

14.1.1 The Contractor shall enter into a separate agreement with CAAS for the after-sale support of the ADS-B System not later than **sixty (60)** calendar days before the Surveillance Monitoring Tool is Completed (“Completion Date”). The After Sale Support Agreement is at **Annex I**.

14.1.2 If any of the major subsystems of the ADS-B System is not developed and manufactured by the Contractor, then CAAS reserves the right to enter into a separate After Sale Support Agreement with the OEM of the subsystem.

14.1.3 For such separate agreement as specified in Para 14.1.2, the Contractor shall undertake to facilitate the establishment of an After-Sale Support Agreement between CAAS and the OEM not later than **sixty (60)** calendar days before the ADS-B System Completion Date. The terms and condition of this agreement shall be based on the same terms and conditions as specified in **Annex I** and clauses pertaining to the main Contract shall be amended accordingly, where applicable. The establishment of the After-Sale Agreement between CAAS and the OEM shall not result in any additional costs to CAAS.

14.2 After-sale Support with OEM

14.2.1 CAAS may enter into a separate After-Sale Agreement with the OEM. To ensure that the Tenderer has prior arrangement with the OEM, the Tenderer shall submit in his tender proposal a letter of consent from the OEM to assure CAAS that the OEM is agreeable to sign a separate After Sale Support Agreement with CAAS, based on the Statement of Compliance submitted by the Tenderer, upon award of the Contract to the Tenderer, if so requested by CAAS. Tenderer shall submit a separate Statement of Compliance from the OEM if the compliance of the OEM is different from that of the Tenderer’s.

14.2.2 The Tenderer shall provide in his tender submission, a detailed description on how he and/or the OEM would meet the scope of the agreement and other requirements specified under the After-Sale Agreement as specified in **Annex I**.

14.3 Future Orders

14.3.1 The Tenderer shall provide in his tender submission, a duly completed **Schedule of Rate B** for the detailed unit prices of all parts of the System, including components, cards, modules, units, sub-systems (e.g. unit price of one monitor, etc). This **Schedule of Rate B** shall form part of the Contract and under the After-Sale Agreement. CAAS reserves the right to purchase any

PART 7 REQUIREMENT SPECIFICATIONS

number of items listed in the **Schedule of Rate B** on as many occasions as it deems fit before and after the Surveillance Monitoring System is completed.

- 14.3.2 For any purchase before 31 December of the year when Surveillance Monitoring System is Completed, the price(s) to be paid by CAAS for the item(s) purchased shall be the price(s) of the item(s) as stated in the **Schedule of Rate B** without any adjustment. Thereafter, the rates shall not escalate more than **five percent (5%)** per calendar year.

14.4 Related Works

- 14.4.1 The Tenderer shall provide in his tender submission, a duly completed **Schedule of Rate C** for the respective Initial Hourly Manpower Rate of Project Manager, Hardware Engineer, Software Analyst, Technical Support Staff and others staff, who may carry out the Related Works as specified in the After-Sale Support Agreement. The Hourly Manpower Rates quoted shall include all administration costs (e.g. overheads) in performing the Related Works.

- ~~14.4.2~~ The initial Hourly Manpower Rates quoted shall remain valid until 31 December of the year when the System is completed. Thereafter, the rates shall not escalate more than **five percent (5%)** per calendar year. These initial Hourly Manpower Rates shall be applicable to all variation works requested by CAAS under the Contract and the After-Sale Support Agreement

- 14.4.3 The Tenderer shall also provide in his tender submission, a duly completed **Schedule of Rate C** for the performance of “Expansion works” (if any), stated requested in the After-sales Support Agreement.

- 14.4.4 The cost of expansion works quoted in the **Schedule of Rate C** shall remain valid until the System completion. These cost or rates shall be applicable to all variation works awarded by CAAS under the Contract before 31 December of the year when the System is completed.

- 14.4.5 After 31 December of the year when System is Completed, the cost of the expansion works shall not be increased by more than **five percent (5%)** per calendar year from the respective cost of expansion works quoted in the **Schedule of Rate C**. The **Schedule of Rate C** shall form the basis for the Contractor to quote his cost for performing any of the above specified expansion works when responding to CAAS written request.

- 14.4.6 This **Schedule of Rate C** shall be included to form part of the Contract and the After-Sale Agreement.

PART 7 REQUIREMENT SPECIFICATIONS

14.5 Option on Hardware Support Service

- 14.5.1 The Tenderer shall quote, as options, for the provision of Hardware Support Service as defined in the After Sale Support Agreement for a total period of **ten (10)** calendar years from the Phase 1 Completion Date of the System.
- 14.5.2 Tenderer shall provide a detailed description on how he could meet the guarantee “Turn Around Time” and “Spare Provision” requirement specified under the scope of work for Hardware Support Service.
- 14.5.3 The Tenderer shall note that CAAS will return all storage media hardware (e.g. hard-disks) in degaussed state for the exchange of parts, unless otherwise specifically requested by the Contractor to return in other states.
- 14.5.4 Tenderer shall provide in his tender submission a list of hardware that is covered as well as those that are not covered by this Hardware Support Service. Any hardware that are not listed in the list submitted are deemed to be covered under this Hardware Support Service. The Hardware Support Service shall cover the repair and replacement of all parts, modules and subsystems of the System except for user consumable items such as printing paper and ink cartridges, that are to be listed and declared on the tender closing date.

14.6 Option on Software Support Service

- 14.6.1 The Tenderer shall quote, as options, for the provision of Software Support Service as defined in the After Sale Support Agreement for a total period of ten (10) calendar years from the Phase 1 Completion Date of the System.
- 14.6.2 The Tenderer shall provide in his tender submission, a detailed description on how he would meet the requirements specified under the Software Support Service. The detailed description shall include, but not limited to the following:-
- (a) Number and quality of staff allocated for this Software Support Service;
 - (b) Past history of software releases on software updates from 3rd Party suppliers and new developed application software; and
 - (c) A detailed description on how he could meet the guarantee “Response Time for Advice” and “Response Time for Rectification” of defects requirement specified under the scope of work for Software Support Service.

PART 7 REQUIREMENT SPECIFICATIONS

14.7 Provision of Hardware and Software Support Services

14.7.1 The Contractor shall provide the Hardware Support Service and Software Support Service as defined in the After Sale Support Agreement (See **Annex I**) for the period from the day the Phase 1 of Surveillance Monitoring System is commissioned (“Phase 1 Commissioning Date”) to the Phase 1 Completion Date. This provision of support services is to cover the period before the After-Sale Agreement comes into effect and regardless of whether CAAS exercises its options to purchase the Hardware and Software Support Services..

14.7.2 The costs for the provision of the Hardware Support Service and Software Support Services for the period from the Phase 1 Commissioning Date to the Phase 1 Completion Date shall be included in the Contract Price. No additional cost shall be paid by CAAS to the Contractor for such support services.