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**LETTER OF INTEREST**  
**LETTRE D'INTÉRÊT**

Comments - Commentaires

Vendor/Firm Name and Address  
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Issuing Office - Bureau de distribution  
Security and Information Operations Division/Division de  
la sécurité et des opérations d'information  
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Gatineau  
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K1A 0S5

<b>Title - Sujet</b> REPLACEMENT HF MONITOR RECEIVERS	
<b>Solicitation No. - N° de l'invitation</b> W8474-136566/B	<b>Date</b> 2013-11-22
<b>Client Reference No. - N° de référence du client</b> W8474-136566	<b>GETS Ref. No. - N° de réf. de SEAG</b> PW-\$\$QE-450-24137
<b>File No. - N° de dossier</b> 450qe.W8474-136566	<b>CCC No./N° CCC - FMS No./N° VME</b>
<b>Solicitation Closes - L'invitation prend fin</b> <b>at - à 02:00 PM</b> <b>on - le 2013-12-16</b>	
<b>F.O.B. - F.A.B.</b> <b>Plant-Usine:</b> <input type="checkbox"/> <b>Destination:</b> <input checked="" type="checkbox"/> <b>Other-Autre:</b> <input type="checkbox"/>	
<b>Address Enquiries to: - Adresser toutes questions à:</b> Guilderson, Greg	<b>Buyer Id - Id de l'acheteur</b> 450qe
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<b>Destination - of Goods, Services, and Construction:</b> <b>Destination - des biens, services et construction:</b> N/A	

Instructions: See Herein

Instructions: Voir aux présentes

<b>Delivery Required - Livraison exigée</b>	<b>Delivery Offered - Livraison proposée</b>
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<b>Name and title of person authorized to sign on behalf of Vendor/Firm</b> <b>(type or print)</b> <b>Nom et titre de la personne autorisée à signer au nom du fournisseur/</b> <b>de l'entrepreneur ( taper ou écrire en caractères d'imprimerie)</b>	
<b>Signature</b>	<b>Date</b>

Solicitation No. - N° de l'invitation

W8474-136566/B

Amd. No. - N° de la modif.

File No. - N° du dossier

450qeW8474-136566

Buyer ID - Id de l'acheteur

450qe

CCC No./N° CCC - FMS No/ N° VME

W8474-136566

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## TABLE OF CONTENTS

1. Purpose
2. Background
3. Project Scope
4. Security
5. Additional Information Requests
6. Enquiries
7. PWGSC Contracting Authority
8. Notes to Interested Respondents
9. LOI Closing Date and Submission of Respondent Information Packages

### List of Annexes:

Annex A Statement of Work  
Annex A, Appendix 1 Specifications for HF Monitor  
Annex A, Appendix 2 Drawings for HF Monitor

## 1. Purpose

The Department of National Defence (DND) has a potential requirement to acquire HF Military Monitor Receivers.

The objective of this Letter of Interest (LOI) is to:

- a) advise industry of this potential requirement and provide industry with general and draft technical information;
- b) provide industry with a preliminary set of high level specifications, deliverables, schedule, and project scope information;
- c) enable Canada to engage industry and obtain information regarding solutions, including indicative, non-binding cost information for project planning purposes; and
- d) allow Industry to assess and comment on the adequacy and clarity of the requirements as currently expressed; offer suggestions regarding potential alternative solutions that would meet requirements.

## 2. Background

The Department of National Defence (DND) has a requirement for HF Monitor Receivers off the shelf (MOTS) and associated ancillaries to replace the legacy systems which are currently in use.

The HF Monitor Receivers and associated network interfaces are components of the Military Aeronautical Communications System (MACS), the MARCOM AGA systems located at the Naval Radio Stations (NRSs), the Joint Task Force North (JTFN) HQ HF system, and in three HF system support facilities.

## 3. Project Scope

Should a Request for Proposal (RFP) be released in the future, the following represents the potential project scope:

Contractor is capable of delivering a complete solution from definition to implementation phase to final delivery stage with minimal disruption and downtime;

It has the technical expertise and manpower to visit DND Sites define and deliver the solutions;

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It has following minimum capabilities:

- System Design and Development;
- On-Site System Installation experience including the requirements relating to conduit, space, power, power wiring and cabling;
- System Testing and Quality Assurance;
- System Maintenance and Support;
- Manufacture and deliver spare parts;
- Training personnel on software/infrastructure;
- It is financially capable to undertake and deliver this Program;
- It is capable of delivering all aspects of the requirements listed under technical requirements of this document;
- It has carried out similar work in the last 5 years successfully.

Overall, the contractor shall perform the activities (manufacture, assemble, integrate, interconnect, deliver, install, test, in-service support and train) necessary to provide fully operational systems that fully comply with the technical specifications attached..

#### **4. Security**

No security requirements are anticipated for any subsequent RFP.

#### **5. Additional Information Requests**

After review of all information packages, additional information, clarifications, and/or demonstrations of systems may be requested by DND via the Contracting Authority identified in Section 7.

#### **6. Enquiries**

All enquiries and other communications related to this Letter of Interest shall be directed exclusively to the PWGSC Contracting Authority. All enquiries must be submitted to the Contracting Authority no later than five (5) calendar days before the closing date of this Letter of Interest. Enquiries received after that time may not be answered.

Care should be taken by Respondents to explain each question in sufficient detail in order to enable Canada to provide an accurate answer. Technical enquiries that are of a proprietary nature must be clearly marked proprietary at each relevant item. Items identified as proprietary will be treated as such except where Canada determines that the enquiry is not of a proprietary nature. Canada may edit the questions or may request that the Respondent do so, so that the proprietary nature of the question is eliminated, and the enquiry can be answered with copies to all Respondents. Enquiries not submitted in a form that can be distributed to all Respondents may not be answered by Canada.

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Changes to this Letter of Interest may occur and will be advertised on the Government Electronic Tendering Systems (GETS). It is each Respondents responsibility to verify changes, if any, on <https://buyandsell.gc.ca/procurement-data/tenders>

## 7. PWGSC Contracting Authority

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Defence and Major Projects Sector (DMPS)  
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## 8. Notes to Interested Respondents

This is neither a call for tender nor a request for Proposal (RFP), and no agreement or contract for the procurement or the equipment stated above will be entered into solely as a result of this LOI. This announcement does not constitute a commitment by Canada. Canada does not intend to award a contract on the basis of the notice or otherwise pay for the information solicited. Any and all expenses incurred by Industry in pursuing opportunity, including the provision of information and any potential visits, are at Respondents sole risk and expense.

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Any discussions on this subject with project staff representing DND or PWGSC, or any other Government of Canada representative, or other personnel involved in project activities, shall not be construed as an offer to purchase or as a commitment by DND, PWGSC or Government of Canada as a whole.

Although the documents / information / data collected may be provided as commercial-in-confidence and will not be provided to a third party outside of Canada, Canada reserves the right to use the information to assist them in drafting performance specifications and for budgetary purposes. Requirements are subject to change, which may be as a result of information provided in response to this LOI. Respondents are advised that any information submitted to Canada in response to this LOI may, or may not, be used by Canada in the development of the potential subsequent RFP. The issuance of this LOI does not create an obligation for Canada to issue a subsequent RFP, and does not bind Canada legally or otherwise, to enter into any agreement or to accept or reject any suggestions.

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There will be no short-listing of Respondents for the purposes of undertaking any future work as a result of this LOI. Similarly, participation in this LOI is not a condition or prerequisite for the participation to any RFP.

Respondents to this LOI should identify any submitted information that is to be considered as either company confidential, proprietary and if the response contains controlled goods.

## **9. LOI Closing Date and Submission of Respondent Information Packages**

Respondents must submit their information package to the PWGSC Contracting Authority identified in Section 7 of this LOI document, **on or before December 16th, 2014 at 14:00 EST (LOI Closing date).**

Two (2) hard copies and one (1) soft copy of the information packages are requested.

Respondent point of contact information must be included in the package.

DEPARTMENT OF NATIONAL DEFENCE

**STATEMENT OF WORK**

**TO REPLACE THE**

**HIGH FREQUENCY MONITOR RECEIVER  
SYSTEMS AT MILITARY AERONAUTICAL  
COMMUNICATIONS SYSTEM LOCATIONS,  
MARITIME COMMAND LOCATIONS, AND  
SUPPORT FACILITY LOCATIONS**

TABLE OF CONTENTS

<u>PARAGRAPH</u>	<u>TITLE</u>	<u>PAGE</u>
	LIST OF ACRONYMS AND ABBREVIATIONS.....	3
1.	INTRODUCTION .....	5
1.1	Purpose .....	5
2.	HF MONITOR RECEIVER SYSTEM.....	5
2.1	Existing Operational Capability .....	5
3.	HF MONITOR RECEIVER SYSTEM REPLACEMENT PROGRAM	6
3.1	Scope of Work .....	6
3.2	Replacement HF Monitor Receiver System Design Concept .....	6
3.3	Factory Acceptance Testing (FAT) .....	11
3.4	Transition Plan.....	12
3.5	Progress Review Meeting.....	12
3.6	Shipping .....	13
3.7	Installation .....	13
3.8	Equipment Spares .....	14
3.9	Existing Equipment Removal and Disposal.....	14
3.10	Training .....	14
4.	PROGRAM ADMINISTRATION.....	15
4.1	DND Technical Authority (TA) .....	15
4.2	Contractor Project Manager (CPM).....	15
4.3	Contractor Installation Team Supervisor .....	16
4.4	Contractor Instructor .....	16
4.5	Right of Access.....	16
4.6	Summary of Deliverables.....	16

APPENDICES

APPENDIX 1: TECHNICAL SPECIFICATION  
APPENDIX 2: BLOCK DIAGRAMS

LIST OF ACRONYMS AND ABBREVIATIONS

The following acronyms and abbreviations are used in this statement of work:

ACAS	Any Console-Any Station.
AG	Air-Ground
AGA	Air-Ground–Air
AGC	Automatic Gain Control
BITE	Built In Test Equipment
BLER	Block Error Rate
C	Centigrade
CDR	Critical Design Review
CAF	Canadian Armed Forces
CFB	Canadian Forces Base
CFSCE	Canadian Forces School of Communications and Electronics
COTS	Commercial Off The Shelf
CPM	Contractor Project Manager
CSA	Canadian Standards Association
CTL	Control
c/w	Complete With
DA	Direct Access
DC	Direct Current
dB	Decibel
dBm	Decibel/Milliwatt
DCE	Data Circuit Terminating Equipment
DJSCS	Directorate of Joint Strategic Communications Support
DND	Department of National Defence
DSL	Digital Subscriber Line
DTE	Data Terminal Equipment
E & M	Earth and Magneto
FAT	Factory Acceptance Test
FTP	File Transfer Protocol
GDNS	Global Defence Network Services
GFE	Government Furnished Equipment
GG	Ground Ground
GND	Ground
GP	General Purpose
GUI	Graphical User Interface
HF	High Frequency
HQ	Headquarters
Hz	Hertz
IASCS	Integrated Audio Switching Communication System
I/O	Input/Output
IP	Internet Protocol
IRR	Instant Recall Recorder
JOC	Joint Operations Centre
JSCSS	Joint Strategic Communications Support Services
JTFN	Joint Task Force North
KVM	Keyboard, Video, Mouse
LAN	Local Area Network

LCMM	Life Cycle Material Manager
LED	Light Emitting Diode
LRU	Lowest Replaceable Unit
MACS	Military Aeronautical Communications System
MARCOM	Maritime Command
MFIT	Mean Fault Isolation Time
MHz	Megahertz
MPLS	Multiprotocol Label Switching
MS	Microsoft
MTBF	Mean Time Between Failures
MTTR	Mean Time to Repair
MOS	Mean Opinion Score
NDHQ	National Defence Headquarters
NRS	Naval Radio Station
NT	Northwest Territories
ON	Ontario
PC	Personal Computer
PESQ	Perceptual Evaluation of Speech Quality
PTT	Press To Talk
R & O	Repair and Overhaul
RC	Receive Controller
RLPA	Rotatable Log Periodic Antenna
RMS	Root Mean Square
RX	Receive
RTP	Real Time Protocol
SAT	Site Acceptance Test
SATCOM	Satellite Communication
SFDR	Spurious Free Dynamic Range
SIN	Social Insurance Number
SOW	Statement of Work
SQ	Squelch
SSB	Single Sideband
SSN	Social Security Number
TA	Technical Authority
TC	Transmit Controller
TMSC	Technical Monitoring and Control System
TX	Transmit
UHF	Ultra High Frequency
UDP	User Datagram Protocol
UPS	Uninterruptable Power Supply
USB	Upper Side Band
V	Volts
VHF	Very High Frequency
VOIP	Voice Over Internet Protocol
VOX	Voice Operated Switch
W	Watt
WAN	Wide Area Network

## 1. INTRODUCTION

### 1.1 Purpose

The purpose of this SOW is to define the work to be performed by the contractor to deliver, install and replace the HF Monitor Receiver system with a new system of digital HF Monitor Receivers and operations and control processors. The work includes provision of operator, technician and instructor training on the new HF Monitor Receiver system. This SOW provides an overview of the HF Monitor Receiver system functionality within the CAF Strategic HF Systems, describes the equipment and work required to replace the HF Monitor Receiver system, describes the elements of the HF Monitor Receiver system Replacement Program, and defines the administrative details of the program. The HF Monitor Receivers and associated network interfaces are components of the Military Aeronautical Communications System (MACS), the MARCOM AGA systems located at the Naval Radio Stations (NRSs), the Joint Task Force North (JTFN) HQ HF system, and in three HF system support facilities.

## 2. HF MONITOR RECEIVER SYSTEM

### 2.1 Existing Operational Capability

#### 2.1.1 MACS

The MACS system provides HF strategic air-ground-air communications used for command and control of Canadian military aircraft and Search and Rescue operations. It uses HF monitor receivers to provide continuous monitoring of key HF radio channels. It is distributed in the regional areas of Edmonton, Trenton and Debert. The stations use a split-site HF station architecture, having receive and transmit sites at the following locations: Riverbend (RX) and Cardiff (TX) for Edmonton, Carrying Place (RX) and Point Petre (TX) for Trenton, and Masstown (RX) and Great Village (TX) for Debert. Under normal operations both the Edmonton and Debert systems are remotely controlled from operator consoles at the Trenton RX site.

#### 2.1.2 MARCOM AGA

The MARCOM AGA system also provides HF strategic air-ground-air communications used for command and control of Canadian military aircraft and Search and Rescue operations, however this system supports maritime flight operations. It also uses HF monitor receivers to provide continuous monitoring of key HF radio channels. The MARCOM AGA HF system use a split-site HF station architecture, located in the regional areas of Esquimalt and Halifax, distributing operations, receive and transmit sites at the following locations: the Esquimalt operations centre uses Aldergrove (RX) and Matsqui (TX) and the Halifax Trinity operations centre uses Mill Cove (RX) and Newport Corners (TX).

#### 2.1.3 JTFN HQ

This JTFN HQ system also provides HF strategic communications used for command and control of Canadian military units and Search and Rescue operations in the Arctic. This network is based at the control site in the JOC in the HQ building in Yellowknife and employs the Ptarmigan Lake (RX) and Kam Lake (TX).

#### 2.1.4 HF System Support Facilities

The operational stations are supported by DND facilities at the CFSCE HF Training Facility in CFB Kingston, and the HF Development Laboratory at DND's Uplands site, in Ottawa. The CFSCE HF Training Facility contains identical equipment to the MACS and NRS radio stations to replicate their operations for technician and operator training provided by senior military instructors. The HF Development Laboratory contains identical equipment to the MACS and NRS radio stations to develop system modification prototypes in a non-operational setting prior to system integration, and also to provide control and messaging software fault-finding capability.

#### 2.1.5 HF Monitor Receiver Sites

The HF Monitor Receiver Sites are:

- a. The MACS system receive site, Carrying Place, ON;
- b. The MACS system receive site, Riverbend, AB;
- c. The MACS system receive site, Masstown, NS;
- d. The MARCOM AGA system receive site, Aldergrove, BC;
- e. The MARCOM AGA system receive site, Mill Cove, NS;
- f. The JTFN HQ system receive site, Ptarmigan Lake, NT;
- g. The CFSCE HF Training Facility, CFB Kingston, Kingston, ON;
- h. The HF Development Laboratory, DND Uplands Site, Ottawa, ON.

### 3. HF MONITOR RECEIVER SYSTEM REPLACEMENT PROGRAM

#### 3.1 Scope of Work

The contractor shall perform the activities (manufacture, assemble, integrate, interconnect, deliver, install, test, and train) necessary to provide fully operational systems that fully comply with the technical specifications attached in Appendix 1. These activities shall meet the tasks of this monitor receiver replacement SOW. The contractor shall procure or manufacture all necessary equipment, not specifically identified as GFE or in-service operational systems provided by Canada, to accomplish or meet all requirements specified in Appendix 1. All hardware and software provided by the contractor shall be the most recent version of COTS items available.

#### 3.2 Replacement HF Monitor Receiver System Design Concept

##### 3.2.1 Design Concept Overview

The design concept for the replacement HF monitor receiver system covers HF receiver equipment, system servers, technician control software, signal processing and routing software, operator console processors, and operator control software. At each of the listed receive sites, the HF monitor receiver system shall be connected to a minimum of nine (9) coaxial feeds fed from a receive antenna matrix, and shall directly digitize thirty-six (36) outputs of narrowband frequency channel information over a USB interface. This data will be forwarded to a control and data server which runs the multichannel receiver software. The control and data server will provide technician and operator access setting capability, and it

shall have a keyboard, video and mouse (KVM) for local technician access to the set-up of multi-channel digital receiver server and for diagnostics. The control and data server software shall process the receiver data and then frame the resultant voice audio data and associated metadata before passing it over an Ethernet local area network (LAN) interface to operator consoles in the operations centres. Once the audio data is on the LAN it shall also be accessible by a local backup operator console which is used in the event of network failure at the associated main operator site. However, under normal operations, the data will be routed over standard T1 data links on public telecommunications infrastructure to operators who are, in most cases, physically remote from the receiving equipment. The radio operators shall be provided the capability to route audio and data message traffic between different arrays of radio station operator positions, audio or data message input or output systems and HF station receive or transmit equipment. That will provide them with the capability to operate any receiver console from any station. The new radio equipment shall interoperate with existing system equipment without causing changes to be required to the configuration or operation of the existing equipment other than those described in this SOW. No changes will be required to the antenna switch matrix or how it is controlled.

### 3.2.2 Replacement HF Monitor Receiver System Requirements

The replacement HF Monitor Receiver system shall:

- a. Replace HF monitor receivers at each of the above listed eight (8) Rx sites with HF monitor receiver systems that can simultaneously receive 18 single sideband (SSB) frequency channels at each site;
- b. Be designed to enable remote operations by off-site operators;
- c. Be designed to enable multiple operator consoles at each Rx site;
- d. Be designed to use the GDNS network for all data and control communications between sites;
- e. Provide appropriate filtering and conversion to digital format and compression for each frequency channel;
- f. Be designed to suitably scale, compress, rate convert and encapsulate the audio data for transport over the public telecommunications network;
- g. Be designed to enable transportation of signals/information in digital format, compatible with IP networks, between all sites;
- h. Be designed to enable the operator software applications to select any MACS, MARCOM AGA or the JTFN HQ RX site as the source for monitor receiver signals at any other MACS, MARCOM AGA or the JTFN HQ operator position;
- i. Provide a dedicated audio output to the operator selected from any of the 18 voice channels;
- j. Provide a summary audio output to the operator which consists of a selectable mix of any of the 18 voice channels;
- k. Provide operator controlled squelch for the dedicated and summary audio channels;
- l. Provide signal presence indicators for all 18 frequency channels;
- m. Provide a simple graphical user interface (GUI); and
- n. Include software for technician access for equipment set-up, diagnostics and status reporting.

### 3.2.3 MACS Site Requirements

The MACS audio voice data and associated metadata from Riverbend and Masstown will converge at the operations centre in Carrying Place, together with data from the Carrying Place Rx equipment. It shall be transferred via the Ethernet LAN to a bank of six (6) operator consoles/PCs. The operator controlled software shall have a simple GUI which only permits the control of essential features. Most importantly, the software shall permit the operator to select which audio to listen to in the dedicated and summary audio channels. The technician controlled software shall permit remote administration and diagnostics of the multichannel receivers.

### 3.2.4 MARCOM AGA Site Requirements

The MARCOM AGA system will be similar to the MACS system but the audio voice data and associated metadata from each of the stations shall be routed over the public telecommunications infrastructure to the respective coastal operations centres. Standard T1 data links will be provided for all wide area networking (WAN). In the operations centres the audio voice data and associated metadata shall be transferred via the Ethernet LAN to a bank of three (3) operator consoles/PCs. The operator controlled software shall be adapted and customized from the MACS software design, permitting the operator to select which audio to listen to in the dedicated and summary audio channels. The technician controlled software shall also be adapted and customized from the MACS software design, permitting remote administration and diagnostics of the multichannel receivers.

### 3.2.5 JTFN HQ Site Requirements

The JTFN HQ system will be similar to the MARCOM AGA system, in the sense that the audio voice data and associated metadata from the Ptarmigan Lake receive site shall be routed over the public telecommunications infrastructure to the JTFN HQ operations centre. Standard T1 data links will be provided for all wide area networking (WAN). In the operations centre the audio voice data and associated metadata shall be transferred via the Ethernet LAN to a bank of three (3) operator consoles/PCs. The operator controlled software shall be adapted and customized from the MACS software design, permitting the operator to select which audio to listen to in the dedicated and summary audio channels. The technician controlled software shall also be adapted and customized from the MACS software design, permitting remote administration and diagnostics of the multichannel receivers.

### 3.2.6 HF System Support Facility Site Requirements

Each site of the HF system support facilities at CFSCE, and the HF Development Laboratory will be similar to the Carrying Place site of the MACS system, in the sense that the operator console will be co-located with the receive equipment and control and data server. The CFSCE site will require the audio voice data and associated metadata to be transferred via Ethernet LAN to three (3) operator console/PCs. The HF Development Laboratory will only require one operator position each. The CFSCE HF Training Facility shall be capable of replicating MACS and MARCOM AGA operations for technician and operator training provided by senior military instructors. The HF Development Laboratory shall be capable of replicating MACS and MARCOM AGA operations to permit system modification prototype

development in a non-operational setting prior to system integration, and also to provide control and messaging software fault-finding capability.

### 3.2.7 Replacement HF Monitor Receiver System Design Concept And Block Diagrams

The technical specification for the HF Monitor Receiver system is attached as Appendix 1. Generic schematics showing the connectivity required for the MACS and MARCOM locations, (the configuration shown in the individual MARCOM systems will be installed at JTFN HQ and the listed non-operational sites) is attached as Appendix 2.

### 3.2.8 System Design Constraints

In the development of the overall system the following operational conditions apply:

- a. The existing RX antennas will be used;
- b. One T1 link per RX site will be available for data networking;
- c. Each T1 link provides a useable data rate of at least 1.544 Mbits;
- d. The network routers support UDP multicast operation; and
- e. A separate network management link is available for remote configuration of the routers and switches at unmanned RX sites.

### 3.2.9 System Design Exceptions

This program does not require the contractor to:

- a. provide control of the TX equipment;
- b. provide control of the existing GP receivers;
- c. provide control of the TX and RX Antenna matrices; or
- d. provide control of the RLPA's and Beverage Antenna.

### 3.2.10 Proprietary and Customised Software Requirements

The complexity of the systems/networks to be delivered by the contractor will necessitate the use of both COTS and customised equipment and software. The Government of Canada acknowledges that the contractor will retain all rights to their proprietary software. The Government of Canada, and DND in particular, require that the contractor provide full details, including any developed code, of all customised software developed for this procurement. The contractor shall be responsible to provide DND with the requisite quantity of software licences for all aspects of the new components of the overall system at all locations.

### 3.2.11 Equipment Spares Requirement

The contractor shall include a list of Recommended Spares, including quantities of each individual equipment, on a per site basis as well as recommended quantities to be held at the DND central depot in their proposal. The contractor shall include in their list of Recommended Spares sufficient quantities to replace any unique system module within one hour in the event of module failure. The contractor shall also supply a complement of depot spares equal to the site spares required for the largest site in terms of this program. The

contractor shall make an optional standing offer for the cost of acquiring additional spares as required.

### 3.2.12 System In-Service Support

The contractor shall make an optional in-service support proposal to repair faulty spares returned to them as a result of first-line maintenance, fault-finding and replacement activities. Repair turn-around time will be specified to maintain the overall system availability at 99.9999%.

### 3.2.13 Critical Design Review (CDR)

Within sixty (60) days of contract award, the contractor shall host a Critical Design Review Meeting to re-affirm that the Replacement HF Monitor Receiver system design meets the requirements specified in this SOW. The timing and location of this meeting, shall be recommended by the contractor and agreed to by DND. The contractor shall be represented by the designated Contractor Project Manager, and contractor staff such as managers for the equipment design, system design and integration, production, logistics and/or contracting. The CDR shall be attended by the DND Technical Authority, and Requisitioning Authority, the PWGSC Contracting Authority, and support staff as required. The CDR shall include contractors presentations, including supporting documentation, for all aspects (hardware, software, system interfaces and ancillary elements, etc) of the proposed system design. In addition, the contractor shall confirm the anticipated development and delivery schedules including all testing phases. Agenda items shall include:

- a. Introduction of participants;
- b. SOW review;
- c. RFP response review;
- d. HF Monitor Receiver Replacement Program project planning, including work package review, project schedule, confirmation of milestone satisfaction criteria and payment schedule;
- e. FAT test plan, test schedule and result sign-off;
- f. GFE requirements to permit system design, integration and testing;
- g. System Integration Responsibility Matrix for both the contractor and DND personnel for physical rack layouts, power requirements, RF and control connectivity requirements, facility infrastructure requirements; contractor/DND manpower requirements and POCs;
- h. Transition Plan for old HF Monitor Receiver system operations concurrent to replacement HF Monitor Receiver system installation;
- i. Tentative Installation schedule;
- j. SAT conceptual test plan and result sign-off;
- k. Technician and Operator Training Concept (including content and duration) and tentative schedule;
- l. System sparing concept and standing offer for additional spares;
- m. System warranty;
- n. System O&M support options and concepts (out-of-scope for this SOW);
- o. Any other outstanding contractual issues; and
- p. Contract close-out.

### 3.3 Factory Acceptance Testing (FAT)

#### 3.3.1 Factory Acceptance Test Plan and Procedures

The contractor shall submit FAT Test Plans and Test procedures for approval by DND as part of their proposal. The Test Plan shall be capable of confirming conformance with the equipment specifications of each type of equipment to be supplied. The Test Plan shall also be capable of confirming conformance with the system specifications of an integrated HF monitor receiver system that is as complex of the CFSCE configuration or higher.

#### 3.3.2 Government Furnished Equipment (GFE)

DND will provide the contractor with Government Furnished Equipment (GFE), itemized as a minimum below, within one (1) month following award of contract, that will be required to allow the contractor to test and integrate complete systems in-factory. DND will provide one (1) complete set of GFE that will be used throughout the factory test and integration of each individual system. Following completion of all factory testing the contractor shall be responsible to return all GFE equipment to DND at a location to be determined by DND. The contractor's proposal shall identify the quantities of each piece of GFE equipment that they require to be provided for the Factory Testing.

- a. Ethernet Switches;
- b. Cisco Routers;
- c. Cisco T1 WIC cards;
- d. UPS for all equipment;
- e. Additional equipment, to that listed above, determined by the contractor to be required for the Factory Testing shall be identified in their proposal.

#### 3.3.3 Factory Acceptance Tests, Results and Reports

The contractor shall perform a FAT at the contractor's facilities that is in accordance with the test plan. The contractor shall conduct these performance tests on a sample of each type of equipment to be supplied. The contractor shall also conduct functional performance tests on an integrated HF monitor receiver system that is as complex of the CFSCE configuration or higher. Such testing shall establish whether or not the equipment is suitable for acceptance by the Government of Canada. As such, all testing shall be subject to Government of Canada witness and approval. The Government of Canada will not approve the system, sub-system, or equipment item for delivery until it has successfully passed all FATs. The contractor shall not ship systems, sub-systems, or equipment items until approved by the Government of Canada. Approval for shipment of production systems does not relieve the contractor of the responsibility of meeting the requirements of this SOW in full. If subsequent on-site tests reveal deviations from the Technical Specification, the changes required for conformance shall be the responsibility of the Contractor. The contractor shall, after successful completion of the FAT, submit a FAT report to the TA within thirty (30) days. This report shall comprise a copy of the acceptance test procedures with in-plant results recorded, TA sign-off, and copies of any test discrepancies or trouble reports.

### 3.4 Transition Plan

The Contractor, in conjunction with the DND TA, are responsible to develop a transition plan to permit installation of the replacement HF Monitor Receiver system concurrent with ongoing operation of the old HF Monitor Receiver system. The initial installation site shall be at the CFSCE HF Training Facility, CFB Kingston, Kingston, ON. The purpose of this installation shall be twofold. The primary purpose of this installation is to make the CFSCE HF Training Facility operational with the replacement HF Monitor Receiver System, but of equal importance, the site operations and maintenance training component following from the installation shall train CFSCE instructors and key CAF operations and maintenance personnel on procedures to operate and maintain the system in a non-operational environment in preparation for the subsequent operational site installations and cut-overs.

### 3.5 Progress Review Meeting

Following successful completion of the initial FAT, the contractor shall host a Progress Review Meeting to re-affirm and update the planned HF Monitor Receiver Replacement Program Implementation. The timing and location of this meeting, shall be recommended by the contractor and agreed to by DND. The contractor shall be represented by the designated Contractor Project Manager, and contractor staff such as managers for the equipment design, system design and integration, installation technicians, logistics and/or contracting. The PMR shall be attended by the DND Technical Authority, and Requisitioning Authority, the PWGSC Contracting Authority, and support staff as required. The PMR shall include contractors presentations, including supporting documentation, for all aspects (hardware, software, system interfaces and ancillary elements, etc) of the proposed system integration. In addition, the contractor shall confirm the anticipated delivery and installation schedules including all testing and training phases. Agenda items shall include:

- a. Introduction of participants;
- b. SOW review;
- c. RFP response review;
- d. HF Monitor Receiver Replacement Program project planning, including outstanding work package review, updated project schedule, confirmation of milestone satisfaction criteria and payment schedule;
- e. Confirmation of infrastructure requirements to permit system integration and testing;
- f. Update to the System Integration Responsibility Matrix for both the contractor and DND personnel for physical rack layouts, power requirements, RF and control connectivity requirements, facility infrastructure requirements; contractor/DND manpower requirements, contractor and DND POCs, and site access and visit clearance requirements;
- g. Update to the Transition Plan for old HF Monitor Receiver system operations concurrent to replacement HF Monitor Receiver system installation;
- h. Installation schedule;
- i. SAT test plan and result sign-off;
- j. Technician and Operator Training Concept (including content and duration) and schedule;
- k. System spares delivery;
- l. System warranty update;
- m. System spare standing offer

- n. System O&M support options and concepts (out-of-scope for this SOW);
- o. Any other outstanding contractual issues; and
- p. Contract close-out.

### 3.6 Shipping

Following completion of the FAT and Progress Review Meeting it is the responsibility of the contractor to organise and facilitate the shipment of systems and spares to each of the individual DND locations.

### 3.7 Installation

#### 3.7.1 Installation Teams

The Contractor is responsible to designate and provide the members of their installation team. Team members shall be suitably qualified to perform the work specified in this SOW, and the installation team supervisor shall meet the minimum qualifications specified in paragraph 4.3.

#### 3.7.2 Additional Hardware Requirements

The Contractor shall provide any additional hardware such as miscellaneous hardware, cables, fasteners, specialized punch-down tools, rack adapter plates, power strips, circuit breakers, fuses as required to complete the installation.

#### 3.7.3 Site Infrastructure and Interfaces – DND Responsibilities

The site infrastructure and cabling interface fixtures will be provided by DND and will include:

- a. Provision and installation of overhead cable raceways;
- b. Provision of AC power outlets (110 volt 15 amp);
- c. Antenna matrix feed cable connectivity; and
- d. Control network connectivity.

#### 3.7.4 Site Access Constraints

The contractor should note that the access to DND facilities or systems may be pre-empted by operations at any time and that due to operational requirements, the contractors times of access could be outside of the period 0800 hours to 1700 hours.

#### 3.7.5 Site Acceptance Test Plan and Procedures

The contractor shall submit SAT Test Plans and Test procedures for approval by DND as part of their proposal. The Test Plan shall be capable of confirming conformance with the system specifications of the integrated HF monitor receiver system at each site.

#### 3.7.6 Site Acceptance Testing

The contractor shall perform a SAT for the monitor receivers and associated interface and control networks following each on-site installation. The TA or his representative will

witness and verify the SAT. The contractor shall establish, via the SAT, whether or not the equipment and the site installation are suitable for acceptance by the Government of Canada. The contractor shall furnish all test equipment required to conduct the SAT. The Government of Canada will provide participating resources for the SAT. The contractor shall provide assistance in the resolution of technical problems associated with system integration. TA written acceptance of SAT test results shall constitute acceptance of the installation. If the SAT cannot be performed because of facility deficiencies, and if the deficiencies cannot be resolved within 48 hours, the physical installation will be accepted if the work is done to industry workmanship standards. However, a contract option to perform the SAT at a later date, once facility deficiencies have been resolved, will be invoked. Once the Government of Canada accepts a SAT, the Contractor shall provide a SAT report to the TA. This report shall comprise a copy of the acceptance test procedures with on-site recorded results, TA sign-off and copies of any test discrepancies or trouble reports. .

### 3.7.7 Installation Documentation

Within thirty (60) days of Government of Canada acceptance of each site SAT, the contractor shall provide the TA with reproducible electronic copies of the following installation documentation:

- a. Overall system end to end configuration of each site;
- b. Basic equipment operating manuals;
- c. Basic equipment maintenance manuals;
- d. Customised GUI description and display layouts for each site;
- e. Customised software descriptions, flow charts and coding; and
- f. As-built site drawings and cross connectivity tables for each site.

### 3.8 Equipment Spares

The contractor and the TA or his representative will witness and verify on-site quantities of spare parts at each site during the site installation. Supply depot personnel will accept the depot spares under the dues in process.

### 3.9 Existing Equipment Removal and Disposal

DND will be responsible for the removal and disposal of all in service equipment that becomes obsolete following the installation of the Monitor Receiver Replacement Program. In addition, DND will be responsible for the removal and disposal of all in service material, cabling and software associated with the equipment to be removed. The availability of modern technology has determined that this replacement program does not necessarily require it to be a “direct one for one” equipment replacement – the design concept is depicted in Appendix 2 of this SOW.

### 3.10 Training

#### 3.10.1 Technician and Operator Training

The contractor shall be responsible for carrying out training of personnel (to be selected by the Government of Canada), for both Technicians and Operators, following installation at each DND location. Based upon the requirement that the control and software capabilities be

provided for each of the above functions, there will be a different requirement for the two (2) independent training course structures and content. The Technician training shall be undertaken at all sites following completion of the installation for a maximum of 10 (10) DND personnel. The Operator training shall be undertaken at CFB Halifax, CFB Trenton and CFB Esquimalt. This training shall be undertaken following completion of the installation for a maximum of ten (10) DND personnel. It is the responsibility of the contractor to provide details of the recommended content and duration for each individual course as part of their proposal, and shall be based upon the criteria detailed in Paragraph 4.11 of this SOW.

### 3.10.2 Training Course Requirements

The contractor shall carry out all the necessary work to deliver a training package to provide the basic theory, safety precautions, site level 1 and 2 maintenance and trouble-shooting procedures to train DND personnel. The contractor shall also carry out all the necessary work to deliver a training package to train military instructors to provide the basic theory, safety precautions, site level 1 and 2 maintenance and trouble-shooting procedures to DND personnel. The contractor shall produce a Training Manual for each student that shall be retained by the student. A copy of all training documentation provided to the students shall be provided to the Technical Authority.

## 4. PROGRAM ADMINISTRATION

### 4.1 DND Technical Authority (TA)

The TA for the HF Monitor Receiver Replacement Program shall be DJSCS. All technical and operational concerns relating to this program shall be directed to:

Mr. Steve Dunnill  
Lead HF Radio and Antenna LCMM  
Department of National Defence  
NDHQ/DJSCS  
101 Col. By Dr.  
Ottawa, ON  
K1A 0K2

Telephone: (613) 991-9393  
Facsimile: (613) 991-2681  
E-Mail: stephen.dunnill@forces.gc.ca

### 4.2 Contractor Project Manager (CPM)

The contractor shall designate an overall point of contact for this contract, hereafter called the Contractor Project Manager (CPM). The contractor shall provide point of contact information and a brief biography outlining the CPM's position in the contractor's organization, and the CPM's professional qualifications and experience pertinent to this program as part of their proposal. The CPM shall demonstrate, in the biography, that he or she has completed a minimum of two multi-site, remote controlled HF Monitor Receiver development, provision, installation and training programs similar to the complexity of the MACS HF Monitor Receiver Replacement component of this SOW. The CPM shall be the primary interface between the contractor and the TA. The CPM shall be fully responsible for successful

completion of HF Monitor Receiver Replacement Program. The CPM shall have full authority within the contractor organization to assign and schedule the resources required to design, manufacture, deliver, install and provide operator and technician training for the HF Monitor Receiver Replacement Program.

#### 4.3 Contractor Installation Team Supervisor

The contractor shall designate the installation team supervisor for each installation site. The contractor shall provide a brief biography outlining the installation team supervisor's position in the contractor's organization, and the installation team supervisor's professional qualifications and experience pertinent to this program as part of their proposal. The installation team supervisor shall demonstrate, in the biography, that he or she has completed a minimum of two multi-site, remote controlled HF Monitor Receiver System installations similar to the complexity of the MACS HF Monitor Receiver System Replacement component of this SOW.

#### 4.4 Contractor Instructor

The contractor shall designate the instructor for the technician and operator training. The contractor shall provide a brief biography outlining the instructor's position in the contractor's organization, and the instructor's professional qualifications and experience pertinent to this program as part of their proposal. The instructor shall demonstrate, in the biography, that he or she has completed a minimum of two multi-site, remote controlled HF Monitor Receiver train the trainer programs similar to the requirement for the CFSCE HF Monitor Receiver training component of this SOW.

#### 4.5 Right of Access

The Government of Canada shall have the right to monitor the work in progress at all times. The contractor shall allow the Government of Canada access to the facilities where the work is being performed at all times. Opportunities for informal technical dialogue between the TA, his designated agents, and the assigned contractor personnel shall be provided on a continual and cooperative basis.

#### 4.6 Summary of Deliverables

##### 4.6.1 General

The CPM shall be responsible for the timely arrival and quality control of all contract deliverables.

##### 4.6.2 Hardware

Unless otherwise stated, the contractor shall provide the hardware items for this HF monitor receiver replacement program. As a minimum the hardware shall be in accordance with the requirements detailed in the HF monitor receiver specification which is an integral part of this SOW. The proposed list of key deliverables is:

- a. Qty 8 x 36 channel digital HF monitor receivers;

- b. HF monitor receiver rack mount control and data processors;
- c. Rack mount KVMs for technicians positions;
- d. Technician PCs
- e. Operator console interface processors; and
- f. Backup operator PC's.

#### 4.6.3 Software

Unless otherwise stated, the contractor shall provide the software items for this HF monitor receiver replacement program. As a minimum the software shall be in accordance with the requirements detailed in the HF monitor receiver specification which is an integral part of this SOW. The proposed list of key deliverables is:

- a. Qty 8 sets x Server Software Applications and associated Licences;
- b. Qty 23 sets x Operator Software Applications and associated Licences; and
- c. Qty 10 sets x Technician Software Applications associated Licences.

#### 4.6.4 Documentation

Unless otherwise indicated, the required reports may be in the contractor's format. Unless otherwise specified, the contractor shall provide electronic copies on MS Office based format and technical drawings in MS Visio format. This documentation shall, as a minimum, include the following:

- a. As part of the proposal a point of contact information and a brief biography outlining the CPM's position in the contractor's organization, and the CPM's professional qualifications and experience pertinent to this program;
- b. As part of the proposal a detailed description of the concept for integration of the HF monitor receiver equipment, c/w schematics identifying the major components of each individual unit, and the concept for integration into the strategic HF radio system;
- c. As part of the proposal a detailed description of the HF monitor receiver equipment c/w schematics identifying the major components of each individual unit. The description shall include details of the proposed equipment BITE capability, details of the LRU replacement capability (e.g. hot switchable, power ON/OFF, etc.), and details of actual and/or calculated MTTR and MTBF values for the proposed equipment;
- d. As part of the proposal a detailed description of the control server processors and the operator console processors, c/w minimum processor requirements and minimum operating system requirements to run the Server Software Applications, Operator Software Applications, and the Technician Software Applications of the HF Monitor Receiver system;
- e. As part of the proposal a detailed specification of the infrastructure requirements to support system integration, testing and operation (e.g RF input specifications, system output connectivity specifications, control system connectivity specifications, input power specifications, physical size, weight and rack space requirements as applicable, and heating/cooling/airflow specifications);
- f. As part of the proposal, a list of recommended spares, including the quantity of each individual equipment, on a per site basis, as well as recommended quantities to be held at the DND central depot;

- g. As part of the proposal a detailed description of the Operator controlled software and the Technician controlled software;
- h. As part of the proposal a detailed Project Plan identifying CDR meeting, software development, monitor receiver hardware production, FAT, Progress Review Meeting(s), system delivery, system installation, SAT, system spares delivery, technician and operator training and closeout;
- i. As part of the proposal advise if an extended warranty period can be provided;
- j. As part of the proposal, an optional standing offer itemizing the cost of acquiring additional spares as required;
- k. FAT Test Plans and Test Procedures and final FAT report(s);
- l. GFE requirements to permit system design, integration and testing;
- m. Transition Plan for old HF Monitor Receiver system operations concurrent to replacement HF Monitor Receiver system installation;
- n. Installation schedule;
- o. Personal information required to request Visit Clearance for contractor personnel on DND sites;
- p. Technician and Operator Training Concept (including content and duration and schedule);
- q. Minutes of the Critical Design Review Meeting;
- r. Minutes of Progress Review Meetings;
- s. SAT Test Plans and Test Procedures and final SAT report(s);
- t. Operator training course content and student work packages;
- u. Technician training course content and student work packages;
- v. Overall system end to end configuration;
- w. Basic equipment operating manuals;
- x. Basic equipment maintenance manuals;
- y. Customised GUI description and display layouts;
- z. Customised software descriptions, flow charts and coding;
- aa. As-built site drawings and cross connectivity tables.

DEPARTMENT OF NATIONAL DEFENCE

**TECHNICAL SPECIFICATION**

**FOR THE REPLACEMENT OF**

**HIGH FREQUENCY MONITOR RECEIVER**

**SYSTEMS AT MILITARY AERONAUTICAL**

**COMMUNICATIONS SYSTEM LOCATIONS,**

**MARITIME COMMAND LOCATIONS, AND**

**SUPPORT FACILITY LOCATIONS**

TECHNICAL SPECIFICATION FOR THE REPLACEMENT OF HIGH FREQUENCY  
MONITOR RECEIVER SYSTEMS AND ASSOCIATED NETWORK INTERFACES AT  
MILITARY AERONAUTICAL COMMUNICATIONS SYSTEM (MACS) LOCATIONS,  
NAVAL RADIO STATION (NRS) MARITIME COMMAND LOCATIONS, AND SUPPORT  
FACILITY

As a minimum, the hardware and software elements within the overall system shall be compliant with the following specifications:

**1. HF Monitor Receiver**

- 1.1 The HF Monitor Receiver equipment shall have a nominal input impedance of 50 Ohms.
- 1.2 The HF Monitor Receiver equipment shall have a minimum of 3 antenna input ports with any required signal distribution having a loss of less than or equal to 0.25 dB.
- 1.3 The HF Monitor Receiver equipment shall have BNC patch leads for easy connection of the antenna switch matrix to the receiver.
- 1.4 The HF Monitor Receiver equipment shall be upgradeable to provide phase coherent signal collection across multiple receivers.
- 1.5 The HF Monitor Receiver equipment shall simultaneously receive a minimum of 18 independently tuneable channels.
- 1.6 The HF Monitor Receiver channels shall each have a configurable bandwidth.
- 1.7 The HF Monitor Receiver channels shall each have a minimum configurable bandwidth of 3 kHz or lower.
- 1.8 The HF Monitor Receiver channels shall each have a maximum configurable bandwidth 25 kHz or greater.
- 1.9 The HF Monitor Receiver equipment shall cover a frequency range of 1.5 MHz to 30 MHz.
- 1.10 The HF Monitor Receiver equipment shall have a tuning frequency resolution of 1 Hz.
- 1.11 The HF Monitor Receiver equipment shall not require an external frequency reference.
- 1.12 The HF Monitor Receiver equipment shall be capable of locking to an external 10 MHz reference oscillator.
- 1.13 The HF Monitor Receiver equipment shall have a maximum input level without any loss of sensitivity greater than or equal to -13 dBm.
- 1.14 The HF Monitor Receiver equipment shall have an AGC providing a minimum of 31 dB of attenuation in 1 dB steps.

- 1.15 The HF Monitor Receiver equipment shall have a third order intercept at the receiver input greater than or equal to +22 dBm.
- 1.16 The HF Monitor Receiver equipment shall have a noise figure less than or equal to 14 dB at maximum sensitivity.
- 1.17 The HF Monitor Receiver equipment, with a terminated input, shall have no internally generated spurious signals greater than or equal to -110 dBm referred to the receiver input.
- 1.18 The HF Monitor Receiver equipment shall have a SFDR greater than or equal to 76 dB for a single input tone which is 2 dB below the maximum input level, whilst maintaining maximum sensitivity.
- 1.19 The HF Monitor Receiver equipment, when the bandwidth is 3 kHz, shall have an adjacent channel rejection ratio greater than or equal to 100 dB for a tone offset by 2 kHz from the band centre.
- 1.20 The HF Monitor Receiver equipment shall have a sensitivity of less than or equal to 0.45 uV for a 10 dB SINAD in a 3 kHz bandwidth.
- 1.21 The HF Monitor Receiver equipment shall have an analogue high pass filter with 1.5 MHz cut-off in each receiver.
- 1.22 The HF Monitor Receiver equipment shall interface with a contemporary computer for transport of both digitized received signal data and receiver control information.
- 1.23 The HF Monitor Receiver equipment shall operate from a 110 V, 60 Hz supply.
- 1.24 The HF Monitor Receiver equipment shall operate with a total power consumption for all receiver channels of less than 40 W.
- 1.25 The HF Monitor Receiver equipment shall be passively cooled.
- 1.26 The HF Monitor Receiver equipment shall have a form factor compatible with a 19" rack.
- 1.27 The HF Monitor Receiver equipment shall have a maximum height of 4U.
- 1.28 The HF Monitor Receiver equipment shall control and apply an AGC loop for each narrowband channel independently.
- 1.29 The HF Monitor Receiver equipment shall provide standard AM, LSB and USB demodulators.
- 1.30 The HF Monitor Receiver equipment shall allow demodulation type to be selected independently for each narrowband channel.
- 1.31 The HF Monitor Receiver equipment shall have a squelch capability at the output of the demodulator.

- 1.32 The HF Monitor Receiver equipment shall derive signal presence information from the squelch status.
- 1.33 The HF Monitor Receiver equipment shall be extendable to support other analogue and digital demodulation types.
- 1.34 The HF Monitor Receiver equipment shall apply post-demodulation ALC independently to each audio stream.

## **2 HF Monitor Receiver Network Interface**

- 2.1 The HF Monitor Receiver shall have an interface allowing remote access via an IP network.
- 2.2 The HF Monitor Receiver network interface shall allow control over the receiver hardware.
- 2.3 The HF Monitor Receiver network interface shall allow the tuning frequency to be configured for each receiver channel.
- 2.4 The HF Monitor Receiver network interface shall allow the audio ALC to be configured for each receiver channel.
- 2.5 The HF Monitor Receiver network interface shall allow status / BITE reporting.
- 2.6 The HF Monitor Receiver network interface shall allow the demodulator to be configured for each receiver channel.
- 2.7 The HF Monitor Receiver network interface shall allow the squelch level to be configured for each receiver channel.
- 2.8 The HF Monitor Receiver network interface shall allow a minimum of 8 simultaneous operator remote position connections.
- 2.9 The HF Monitor Receiver network interface shall simultaneously provide up to 18 channels of audio data.
- 2.10 In the HF Monitor Receiver network the combined audio data bandwidth shall be suitable for carriage over a single network connection limited to 512 kbps.
- 2.11 The HF Monitor Receiver audio data shall include signal presence information.
- 2.12 The HF Monitor Receiver network interface shall use a clear text XML format for control messages.
- 2.13 If the HF Monitor Receiver network is allocated more data transport bandwidth then the system shall be scalable to support increased numbers / fidelity of the audio streams.

### **3 Operator Control**

- 3.1 The visual layout of the operator software shall be agreed with DND to ensure it will be familiar to the operators.
- 3.2 The operator software shall be limited to a bar along the top or bottom of the screen to accommodate display of other software.
- 3.3 The operator software shall display signal presence for each channel.
- 3.4 The operator console position shall have a dedicated channel speaker output for a single audio channel.
- 3.5 The operator software shall have a summary channel speaker output.
- 3.6 The operator software shall allow selection of a single audio channel to be sent to the dedicated speaker output.
- 3.7 The operator software shall allow selection of one or more audio channels to be sent to the summary speaker output.
- 3.8 The operator software shall display the receiver frequency of each audio channel.
- 3.9 The operator software shall connect to a pre-configured set of receiver channels.

### **4 Technician Control**

- 4.1 The technician control software shall allow remote configuration of the receiver equipment.
- 4.2 The technician control software shall only be required to connect to any single local receiver at any time.
- 4.3 The technician control software shall be protected from use by untrained personnel.
- 4.4 The technician control software shall display receiver system status / BITE information.
- 4.5 The technician control software shall display a summary of the current receiver configuration.
- 4.6 The technician control software shall allow configuration of the tuning frequency for each receiver channel.
- 4.7 The technician control software shall allow configuration of the bandwidth for each receiver channel.
- 4.8 The technician control software shall allow configuration of the demodulator for each receiver channel.

- 4.9 The technician control software shall allow configuration of which audio channels are output to the network interface.
- 4.10 The technician control software shall allow configuration of the AGC for each receiver.
- 4.11 The technician control software shall allow configuration of the squelch level for each receiver channel.
- 4.12 The technician control software shall allow configuration of the ALC.
- 4.13 The technician control software shall allow settings for one receiver channel to be copied to another receiver channel.
- 4.14 The technician control software shall allow the technician to monitor audio whilst configuring the receiver.
- 4.15 The technician control software shall allow receiver channel settings to be saved as a named profile.
- 4.16 The technician control software shall allow a minimum of 10 named settings profiles to be defined.
- 4.17 The technician control software shall allow receiver channel settings profiles to be exported to a file.
- 4.18 The technician control software shall allow receiver channel settings profiles to be imported from a previously exported file.
- 4.19 The technician control software shall allow a receiver channel settings profile to be applied to a receiver channel.
- 4.20 The technician control software shall allow display of a frequency vs power plot for a single selected receiver channel output prior to demodulation.
- 4.21 The technician control software frequency vs. power plot shall update near real time.
- 4.22 The technician control software frequency vs. power plot shall display power corresponding to absolute power level at the receiver antenna input.

## **5 SYSTEM**

- 5.1 The system shall operate on Windows contemporary 32-bit and 64-bit.
- 5.2 The system software shall be installable on PC hardware.

**MACS**  
 Control is bidirectional  
 Data is one-way



