RETURN BIDS TO:
RETOURNER LES SOUMISSIONS À:

Bid Receiving - PWGSC / Réception des soumissions - TPSGC
11 Laurier St. / 11, rue Laurier
Place du Portage , Phase III
Core 0A1 / Noyau 0A1
Gatineau
Québec
K1A 0S5
Bid Fax: (819) 997-9776

SOLICITATION AMENDMENT
MODIFICATION DE L'INVITATION

The referenced document is hereby revised; unless otherwise indicated, all other terms and conditions of the Solicitation remain the same.

Ce document est par la présente révisé; sauf indication contraire, les modalités de l'invitation demeurent les mêmes.

Comments - Commentaires
This document contains a security requirement.

Issuing Office - Bureau de distribution
Marine Machinery and Services / Machineries et services maritimes
11 Laurier St. / 11, rue Laurier
6C2, Place du Portage
Gatineau
Québec
K1A 0S5

Title - Sujet SYTÈME DE PILOTAGE AUTOMATIQUE	
Solicitation No. - N° de l'invitation W8483-117051/C	**Amendment No. - N° modif.** 002
Client Reference No. - N° de référence du client W8483-117051	**Date** 2012-10-29
GETS Reference No. - N° de référence de SEAG PW-$$ML-034-23232	
File No. - N° de dossier 034ml.W8483-117051	**CCC No./N° CCC - FMS No./N° VME**
Solicitation Closes - L'invitation prend fin **at - à 02:00 PM** **on - le 2012-11-16**	**Time Zone** **Fuseau horaire** Eastern Standard Time EST
F.O.B. - F.A.B. **Plant-Usine:** ☐ **Destination:** ☐ **Other-Autre:** ☐	
Address Enquiries to: - Adresser toutes questions à: Clément, Gérard	**Buyer Id - Id de l'acheteur** 034ml
Telephone No. - N° de téléphone (819) 956-6233 ( )	**FAX No. - N° de FAX** (819) 956-0897
Destination - of Goods, Services, and Construction: **Destination - des biens, services et construction:**	

Instructions: See Herein

Instructions: Voir aux présentes

Delivery Required - Livraison exigée	**Delivery Offered - Livraison proposée**

Vendor/Firm Name and Address
Raison sociale et adresse du fournisseur/de l'entrepreneur

Telephone No. - N° de téléphone
Facsimile No. - N° de télécopieur

Name and title of person authorized to sign on behalf of Vendor/Firm (type or print)
Nom et titre de la personne autorisée à signer au nom du fournisseur/ de l'entrepreneur (taper ou écrire en caractères d'imprimerie)

Signature **Date**

VEUILLEZ CONSULTER LA VERSION ANGLAISE DE L’INVITATION W8483-117051/C.

ANNEX A

STATEMENT OF WORK (SOW) FOR THE AUTOPILOT SYSTEM (AS) FOR THE VICTORIA CLASS SUBMARINES (VCS)

NOTICE

This documentation has been reviewed by the technical authority and does not contain controlled goods. Disclosure notices and handling instructions originally received with the document shall continue to apply.

AVIS

Cette documentation a été révisée par l'autorité technique et ne contient pas de marchandises contrôlées. Les avis de divulgation et les instructions de manutention reçues originalement doivent continuer de s'appliquer.

LIST OF EFFECTIVE PAGES

Insert latest changed pages, dispose of superseded pages In Accordance With (IAW) applicable orders.

NOTE

On a changed page, the portion of the text affected by the latest change is indicated by a vertical line in the margin of the page.

Date of issue for original and changed pages are:

Change	…1.0…	03 August 2012
Change	…1.1...	26 Oct 2012

A zero in Change No. column indicates an original page. The Total number of pages in this SOW is 73 consisting of the following:

Page No.	**Change No.**
1 to 66	1.0
7, 8, 11, 12, 14, 15, 16, 17, 19, 24, 25, 26 27, 30	1.1

TABLE OF CONTENTS

LIST OF FIGURES

List of Tables

1 Scope

1.1 Purpose

This Statement of Work (SOW) defines the work requirements for the replacement of the Autopilot System (AS) on the VICTORIA Class Submarines (VCS), four in total, SSK 876 VICTORIA, SSK 877 WINDSOR, SSK 878 CORNER BROOK and SSK 879 CHICOUTIMI. There are two submarines located in Halifax and two in Esquimalt. This SOW also details the upgrade work for the associated shore based trainers, Submarine Control Trainer (SCT) and Maintenance Trainer (MT); and the new an Onboard Trainer (OBT). The shore based trainers are located at the Canadian Forces Base (CFB) Halifax.

The AS consists of a One Man Console (OMC), Computers and three (3) electronic enclosures distributed throughout the submarine. The AS replacement shall be accomplished by customization of Commercial Off The Shelf (COTS) components and or by design, integration, system test, installation, set to work, training, integrated logistics support, and documentation. The AS technical and performance requirements are specified in the Technical Statement of Requirements TSOR, section 2, Table 1 and item 1.

1.2 Background

The Victoria Class Submarine (VCS) is fitted with the Ferranti design based AS that implements the automatic control, the manual control and numerous combinations of these controls. Due to obsolescence the AS is no longer supportable.

It is a Canada's plan to replace the AS with a fully supportable system that provides the same core functionality as the existing system. Block diagram of the existing system and a conceptual block diagram of the replacement system are provided in Figure 1 and Figure 2 . All the existing AS components including, OMC Keyboard and Display, Computers, Electronics Enclosures, Monitoring and Mode Selection Unit and Maintenance Panel shall be replaced with new components that fit into the existing space envelopes and having the same or less weights of the legacy system. A new OBT shall be designed and the SCT and the MT shall be upgraded to use the new submarine AS hardware, software and the new user interfaces. Due to the design information not being available of the SCT simulation software, the Contractor shall not be responsible for the upgrade (integrate) of SCT using the new AS hardware and software. The interface software development for the new AS hardware and software and the upgrade of the SCT shall be carried out in a separate contract.

1.3 Objectives of the AS Replacement

The fundamental objectives of the AS replacement system is to:

1. Sustain the existing AS functions, their functionality and their performance as per the AS TSOR, section 2.1, Table 1 and Item 1 by replacing the AS equipment enclosures and all components contained therein with modern,

fully supportable technology within the same space envelopes currently occupied by the existing AS equipment enclosures;

2. Implement the AS to interoperate with the existing Electrical Ethernet Local Area Network (LAN) installed as part of the Fire Detection System (FDS) and the Central Surveillance System (CSS) projects;

3. Retain to the maximum extent possible the existing field cabling between the AS components, the field devices and the external systems/panels with which the AS interfaces;

4. Provide the SCT upgrade kit using the submarine AS hardware and software to represent the same man machine interface as on board the submarine;

5. Enhance the existing shore-based MT to include the complete functionality of the AS. The MT shall be used to facilitate training on the conduct of preventive maintenance, trouble-shooting and defect rectification of the AS; and

6. Document the technical details of the control algorithm and provide the AS software as both source code developed for the AS project and not any background or off the shelf software and a linkable executable for research, computer simulation, and free-swimming scale model simulation purposes.

1.4 Acronyms and Abbreviations

For acronyms and abbreviations, refer to section 9.

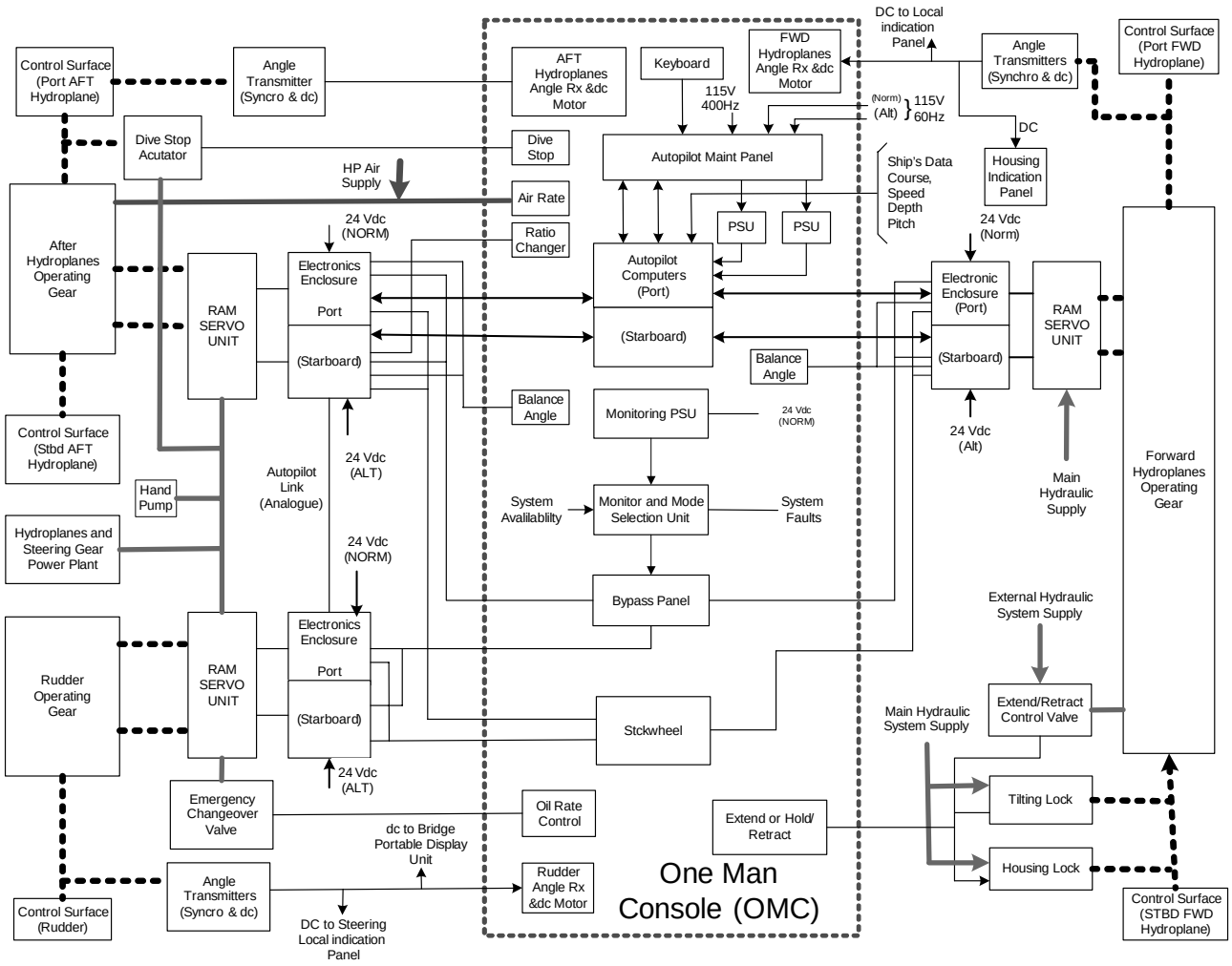

Figure 1: Block Diagram of the Existing AS

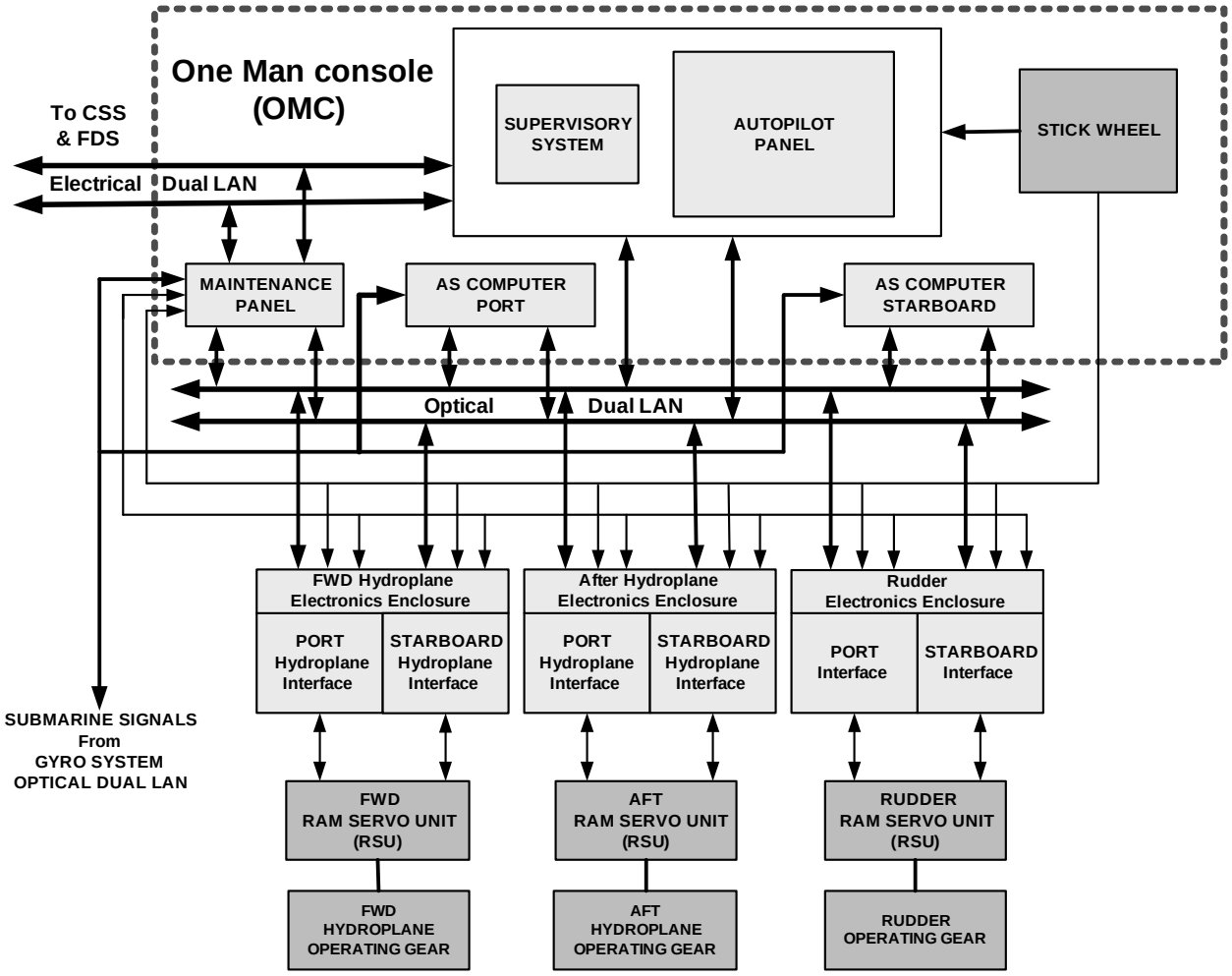

Figure 2: Conceptual Block Diagram of Replacement AS

2 Government Documents

The prescribed versions of the following documents are to form a part of this specification to the extent specified herein.

2.1 Government Documents

Table 1: List of Government Documents

Item	Document Number	Title
1.	Annex B Version 1.0	AS TSOR
2.	C-03-007-000/AG-001	Guide to development of Engineering Change Installation package
3.	A-EN-007-000/FP-001	Canadian Environment Assessment Act (CEAA)
4.	D-01-100-214/SF-000	Preparation of Provisioning Documentation
5.	A-LM-505-001/AG-001	Guidance Manual, Integrated Logistics Support
6.	A-LM-505-001/AG-002	Guidance Manual, Logistics Support Analysis
7.	A-P9-050-000/PT-003	Canadian Forces Individual Training and Education System (CFITES) Series
8.	C-01-000-102/AG-000	National Defence Index of Documentation System
9.	C-01-100-100/AG-006	Writing, Format, and Production of Technical Publications
10.	C-03-005-012/AM-001	Naval Maintenance Management System Manual Volume 1 NaMMS Policy and Procedures
11.	D-LM-008-002/SF-001	Specification For Marking For Storage And Shipment
12.	D-01-400-001/SG-000	Engineering Drawing Practices for Class Drawing and Technical Data List
13.	C-03-000-000/NQ-001	Treasury Board hazmat policy & HFX Class G-1 spec (see paras 33,41 & 42)
14.	DSSP50 Build 0909 Documentation,: Part 1: Guide and Tutorial	http://cradpdf.drdc-rddc.gc.ca/PDFS/unc101/p533617_A1b.pdf
15.	DSSP50 Build 090910 Documentation: Part 2: Input Reference	http://cradpdf.drdc-rddc.gc.ca/PDFS/unc101/p533618_A1b.pdf
16.	DSSP50 Build 090910 Documentation: Part 3: Algorithm Description	http://cradpdf.drdc-rddc.gc.ca/PDFS/unc101/p533619_A1b.pdf

2.2 Non-Government Documents

Where Standards are referenced in this document, the whole standard shall not apply unless specifically directed. The reference will indicate what tailoring is required by the Technical Authority. If no tailoring is specified, then the Bidder shall specify the extent of his compliance to the referenced standard in his proposal. If any referenced Mil standard in Table 2 has been superseded by a new revision or it has become obsolete and it has been replaced by a new standard or it has not been replaced, then the Contractor shall use the latest revision or replaced standard or an equivalent standard respectively.

Table 2: List of Non-Government Documents

Item	**Standard**	**Title**
1.	MIL HDBK 502	Logistic Support Analysis
2.	MIL-STD-1388 2B 30 May 1997	DOD Requirements for a Logistic Support Analysis Record
3.	MIL-HDBK-881A 30 July 2005	Department of Defence Handbook Work Breakdown structures for Defence Materials Items
4.	ANSI-649-A, 2004	Configuration Management
5.	MIL-STD-1521B	Technical Review and Audits for Systems, Equipment and Computer Software
6.	IEEE/EIA 12207	IEEE Standard for Software Life Cycle Processes

2.3 Order of Precedence

In the event of a conflict between the contents of this document and the applicable portions of the referenced documents, the contractor shall inform the Technical Authority (TA) of the differences and request for a resolution.

3 AS Delivery

3.1 General

The Contractor shall procure/design, customize, manufacture, integrate, test, deliver and set to work hardware and software as required to satisfy the requirements of this SOW and the TSOR.

3.1.1 Project Management Services

The Contractor shall provide Project Management services as detailed in section 4.

3.1.2 Design Engineering

The design engineering shall be IAW the TSOR (section 2, Table 1 and item 1).

3.2 Deliverables

The Contractor shall produce and deliver four (4) sets of AS including OBT for the Victoria Class Submarines, Victoria, Windsor, Corner Brook and Chicoutimi IAW Table 3, one (1) set of SBT trainers and Cadre Training IAW Table 4, four (4) sets of spares line replaceable components for the four (4) submarines IAW Table 5 and one (1) set of the spares line replaceable components for the shore based trainers IAW Table 5, one (1) set of AS Installation Support Components IAW Table 6, three (3) sets of Special Purpose Tools and Test equipment IAW Table 7 and a list of COTS Tools and Test Equipment IAW Table 7 and documentation IAW

Table 8 and section 11.

Table 3: List of AS Components per Submarine Set

Unit	Qty	Locations and or Comments
AP with 17" LCD and keyboard with protective cover	1	Control Room
SS with 13.3" LCD and keyboard protective cover	1	Control Room
AS computers	2	Control Room
Maintenance Panel	1	Control Room
Electronic Enclosures	3	Forward and After Hydroplanes and Rudder
OBT	1	Software
	1	PC

Unit	Qty	Locations and or Comments
Cables and all the necessary hardware	1	New and Modified existing field cables and or patch cables to interface with all the AS equipment
	1	Electrical and Optical LAN cables and accessories

Table 4: List of Shore based Trainers Set and Cadre Training

SHORE BASED TRAINING SYSTEMS (SBTs)		Qty	Locations and or Comments
Submarine Control Trainer (SCT)	AP with 17" LCD and keyboard with protective cover	1	Control Room
	SS with 13.3" LCD and keyboard protective cover	1	Control Room
	Cables and necessary hardware	1	Network cables for the SCT console and SCT host computer
Maintenance Trainer (MT) Upgrade	AP with 17" LCD and keyboard with protective cover	1	
	SS with 13.3" LCD and keyboard protective cover	1	
	AS Computer	1	
	Maintenance Panel	1	
	Electronic Enclosure	1	If three EEs are identical, if not then include one of each different type
	Cables and necessary hardware to insert and monitor faults and Special Purpose Tools and Test Equipment) (SPTATE)	1	A set of cables for power and for networking the two LANs, hardware for fault insertion and monitoring and SPTATE for isolating faults

SHORE BASED TRAINING SYSTEMS (SBTs)		Qty	Locations and or Comments
	Field Sensors and Hardware	TBD	Number of field sensors to stimulate the AS equipment, to be recommended by the contractor and approved by TA
	Trainer Console	0	The existing Maintenance trainer console shall be used
Cadre Training for operators and maintainers on MT		2	Fifteen (15) students per Cadre training session

Table 5: AS Spares Line Replaceable Components Set for Each Submarine and for Each Trainer

Maintenance Support	Qty	Comments
On board submarine Spares for 1st and 2nd level maintenance support on board submarine	1	Components types and quantities set for each submarine and for each coast shall be proposed by the Contractor and approved by TA to support the 1st and 2nd level maintenance on board the submarine for five (5) years
SCT and MT trainers spares for 1st and 2nd level maintenance support at the fleet training schools	1	Components types and quantities set for each trainer shall be proposed by the Contractor and approved by TA to support the 1st and 2nd level maintenance for five (5) years

Table 6:AS Installation Support EC Specifications

Installation Support	Qty	Comments
Submarine EC Specifications	1 4	One (1) baseline EC specification Particularized EC specifications (one for each submarine)
Trainers EC Specifications	2	An EC specification for each trainer: SCT and MT

Table 7: Special Purpose Tools and Test Equipment Set and Recommended List of COTS Tools and Test Equipment

Installation Support	Qty	Comments
Special Purpose Tools and Test Equipment (SPTATE)	2	To be designed/developed/tested and provided by the Contractor and approved by the TA. One kit for each coast.
A list of COTS Tools and Test Equipment	1	To be recommended by the Contractor and approved by the TA

Table 8: Documentation Set

Documentation	Qty	Comments
Documentation	1	As per Section 11 - Contract Deliverable Requirements List (CDRL) and Data Item Description (DID)

3.2.1 Set-To-Work (STW)

The Contractor shall carry out the AS Set-To-Work (STW) on each submarine IAW the requirements defined in this section.

3.2.1.1 Field Wiring Verification

As part of the STW, the Contractor shall be responsible to ensure that all the Legacy Wiring (LW) and cables are tested and verified prior to start of the STW. Any field wiring issues found by the Contractor during testing and verification, Canada will be responsible for addressing the issue.

3.2.1.2 AS I/O Hook Up

As part of the STW, the Contractor shall connect all wiring to and from the AS including all Input/Output (I/O) and all electrical power connections defined in the TSOR (section 2, Table 1 and item 1). The commencement of wiring connection by the Contractor shall be as stipulated by TA.

3.2.1.3 Harbour Acceptance Testing

The Contractor shall perform the Harbour Acceptance Testing (HAT) as detailed in Section 6.

3.2.1.4 Sea Acceptance Trials

The Contractor shall perform the Sea Acceptance Trials (SAT) as detailed in Section 6.

3.2.2 Engineering Change Specifications

The Contractor shall provide a baseline Engineering Change (EC) specification for the four submarine installations IAW CDRL Item CDRL-EN-06 and DID-EN-06. The baseline specification, if required, shall then be particularized to four (4) individual ECs to address any variations amongst the four (4) submarines. The contractor shall also provide the two (2) ECs, one EC for each of the trainers, SCT and the MT.

3.2.3 Onboard and Shore Based Trainers

3.2.3.1 Onboard Trainer (OBT)

The onboard trainer is an enhancement to the replacement AS. The OBT shall be a software based trainer which shall reside on a standalone PC on board the submarine.

3.2.3.2 Shore Based Trainers Overview

The existing Shore Based Trainers (SBTs) are located at the East coast training facility in Canadian Forces Base Halifax to provide training to the operators and the maintainers. The training requirements vary considerably and are targeted to persons with varying technical backgrounds that require different levels of system knowledge.

The Submarine Control Trainer (SCT) provides the AS operator training. This trainer shall be upgraded to meet the requirements as described in the AS TSOR, (section 2, Table 1 and item 1). The existing Maintenance Trainer (MT) provides only the Fire Detection System (FDS) and the Central Surveillance System (CSS) maintenance training to conduct 1st and 2nd level maintenance activities. The MT shall be enhanced to include the AS operator training and the 1st and 2nd level maintenance training.

3.2.3.3 Submarine Control Trainer (SCT)

The Contractor shall provide the SCT kit using submarine equipment where necessary to implement the same user man machine interface as on board the submarine, e.g. AP with LCD and keyboard and the SS with LCD and keyboard.

3.2.3.4 Maintenance Trainer (MT)

The existing MT currently provides the operator and maintenance training for the Fire Detection System (FDS) and the Central Surveillance System (CSS). The contractor shall upgrade the MT to include the new AS hardware and software to provide the AS operator and maintenance training.

3.2.4 AS Cadre Training

The Contractor shall provide Cadre training at the Halifax Fleet School. The cadre training shall be IAW section 7.5.

3.2.5 AS Documentation

The contractor shall deliver the AS documentation IAW section 7.7.

4 Project Management

4.1 Organization

The Contractor shall have a named Project Manager responsible to carry out the work required for the AS production program.

4.1.1 Project Manager

The Contractor's Project Manager shall have the authority to plan, direct, control and make decisions for the Contract.

4.1.2

The Contractor's Project Manager shall be the main point of contact with Canada.

4.2 Project Management Plan

The Contractor shall prepare and deliver a Project Management Plan (PMP) IAW CDRL Item CDRL-PM-01 and DID-PM-01 to identify how the Contractor intends to fulfill the project management requirements of this SOW.

4.2.1 Contents of PMP

The Contractor shall include in the PMP a Work Breakdown Structure (WBS), a Project Schedule (PS), a Risk Management Plan (RMP), a Configuration Management Plan (CMP), an Integrated Logistics Supports (ILS) plan, a Hardware Development Plan, a Software Development Plan, a STW plan, Harbour Acceptance Plan, Sea Acceptance Trials Plan and a Quality Assurance (QA) Plan.

4.2.2 Work Breakdown Structure (WBS)

The Contractor shall structure the WBS IAW MIL-HDBK-881A (section 2.2, Table 2 and item 3).

4.2.3 Risk Management Plan

The Contractor shall prepare a Risk Management Plan that establishes procedures for identification, assessment, management, reporting, tracking, reduction and elimination of risks arising from the performance of work.

4.2.4 Risk Management Program

The Contractor shall conduct its Risk Management Program IAW the approved Risk Management Plan.

4.2.5 Configuration Management Plan

The Contractor shall structure the configuration Management plan to show all the details of the hardware and software components of all the subsystems of the AS.

4.2.6 Integrated Logistic Support (ILS) Plan

The Contractor shall structure the WBS IAW section 2.1, Table 1 and items 5 and 6.

4.2.7 Hardware Development Plan

The Contractor shall structure the hardware development plan to clearly show the AS hardware requirements analysis including the Special Purpose Test and Test Equipment (SPTATE) and the trainers design, development, test and integration activities.

4.2.8 Software Development Plan

The Contractor shall structure the software development to clearly show the AS software requirements analysis including the SPTATE and trainers, design, development, test and integration activities.

4.2.9 Set To Work (STW) Plan

The Contractor shall structure the STW plan to show how each AS components shall be installed, integrated and tested on the submarines.

4.2.10 Harbour Acceptance Tests (HAT) Plan

The Contractor shall structure the (HAT) plan to show system level tests that shall be conducted to prove the AS functions on the submarines and meets the SOW and TSOR requirements.

4.2.11 Sea Acceptance Tests (SAT) Plan

The Contractor shall structure the (SAT) plan to show system level tests that shall be conducted to prove the AS functions on the submarines and meets the SOW and TSOR requirements.

4.2.12 Quality Assurance (QA) Plan

The Contractor shall structure the quality assurance plan in accordance with SAC clause D5402C (Quality Plan) dated 2010-01-11.

4.3 Security Management

Requirements for personnel and facilities security clearances are identified in the Security Requirements Check List.

4.3.1 Access to Canada's Facilities

The Contractor may be provided access to Canada's Facilities, on an as required basis and non-interference basis, to allow the Contractor to view systems and obtain relevant data. Site visits may also be used to interview Customer Subject Matter Experts (SMEs) to determine or confirm equipment functionality and operational parameters.

4.3.2 Visit Request Notice

The Contractor shall provide at least four (4) weeks' notice only for any submarine site visits.

4.4 Project Meetings

4.4.1 Project Kick Off Meeting

Within one month of the Contract Award, the contractor shall conduct a project Kick Off Meeting, IAW CDRL Item CDRL-PM-05, at the contractor's facility. The discussion shall include but not limited to, the review of the:

1. The Project Management Plan IAW CDRL Item CDRL-PM-01 and DID-PM-01;
2. Technical Specification;
3. Critical path activities;
4. Plans for activities during the following period;
5. Risk management concerns and mitigation actions: and
6. Any other contractual or programmatic issues associated with the project as manually agreed between the TA, PWGSC CA and the Contractor.

4.4.2 Project Review Meetings

The Contractor shall conduct and coordinate Progress Review Meetings (PRMs) once each month or as mutually agreed between Canada and the Contractor.

4.4.2.1

The Contractor shall hold the first PRM within one month following the Kick-Off Meeting.

4.4.2.2

PRMs shall encompass total project status as of the review date.

4.4.3 Final Project Meeting

A Final Project Review (FPR) meeting is required to provide a complete review of the deliverables.

4.4.3.1

The Contractor shall hold the FPR meeting at a time to be determined by Canada but this meeting shall take place no later than 30 days after acceptance of the last deliverable.

4.4.4 Other Scheduled Meetings

The Contractor may identify through other requirements stipulated in this SOW, and the submission of his various plans the necessity to schedule other meetings.

4.4.4.1

The Contractor shall identify these meetings in the Project Schedule (PS).

4.4.4.2

Canada's approval of the PS will confirm Canada's intention to attend such meetings.

4.4.5 Meeting Arrangements

When the Contractor is tasked to arrange and coordinate a meeting, it shall be done IAW this section.

4.4.5.1 Supporting Documents

4.4.5.1.1

The Contractor shall prepare and submit supporting documents required (in source format and not in Portable Document Format (PDF) or equivalent format) for a meeting at least five (5) working days in advance of each review or meeting.

4.4.5.1.2

The Contractor shall prepare and submit an agenda IAW CDRL Item CDRL-PM-02 and DID-PM-02 at least five (5) working days in advance of each review or meeting except in the case of unscheduled meetings in which case the Contractor shall submit an agenda prior to the meeting.

4.4.5.1.3

Canada and the Contractor shall mutually agree to the contents of the agenda.

4.4.5.2 Meeting support

4.4.5.2.1

The Contractor shall host and attend project reviews and meetings as required by this SOW, at the Contractor's facility or elsewhere as agreed to by Canada.

4.4.5.2.2

For all reviews and meetings hosted by the Contractor, the Contractor shall:

1. Arrange the venue;
2. Co-ordinate with Canada as appropriate;
3. Provide all administrative facilities and presentation equipment;
4. Ensure that qualified Contractor and subcontractor personnel attend the reviews or meetings;
5. Ensure and report that action items and decisions under the control of the Contractor as a result of the various meetings and reviews are implemented where applicable; and,
6. Maintain files, records, documents of all reviews and meetings.

4.4.5.3 Meeting Minutes

4.4.5.3.1

The Contractor shall record, produce, deliver and revise, as required, minutes for all meetings.

4.4.5.3.2

The Contractor shall prepare and distribute an electronic copy of the minutes to the Canada's attendees IAW CDRL Item CDRL-PM-03 and DID-PM-03.

4.4.5.3.3

Meeting minutes are accepted once signed by Canada. Canada will advise the Contractor of any issues within two working days of receiving the minutes.

4.4.5.4 Meeting Cancellations

The TA and CA may cancel PRMs or any other review meetings at their discretion with a minimum of 5 working days' notice. Rescheduling of meetings by the Contractor shall be done only with the explicit agreement of Canada.

4.5 Reporting and Communications

4.5.1 Progress Reports

The Contractor shall monitor progress and deliver monthly Project Status Reports (PSRs) IAW CDRL Item CDRL-PM-04 and DID-PM-04.

4.5.2 Problem Reporting

4.5.2.1

The Contractor shall advise Canada by fax/email within three (3) working days of the date the Contractor determines that there is a schedule alteration or contractual issue.

4.5.2.1

Upon such notification Canada will advise whether an unscheduled meeting or other action is required.

4.5.3 Data Reviews and Revisions

The contractor shall submit all deliverable data in draft form for Canada's review IAW the applicable CDRL.

4.5.3.1

The Contractor shall ensure that the draft document consists of a complete document compliant with the requirements of the SOW and the applicable CDRL and DID.

4.5.3.2

Unless otherwise noted, the Canada's review process will take no more than ten (10) working days from receipt of the data.

4.5.3.3

The provision of comments by the Canada on draft deliverables shall not be construed as approval of the data deliverable.

4.5.3.4

Unless otherwise noted, the Contractor shall address the Canada's comments and resubmit the document within ten (10) working days of reaching agreement on the comments.

4.5.3.5

The Contractor shall ensure that final documents consist of the draft document modified to include changes as authorized by Canada.

4.5.3.6

When revisions and amendments have been made to data deliverables required under this SOW, the Contractor shall submit the revisions/amendments to Canada.

4.6 Action Item List (AIL)

4.6.1

The Contractor shall maintain a historical, chronological and up-to-date list of Action Items resulting from reviews, meetings, or correspondence between the TA and the Contractor in a format acceptable to the TA for the duration of the project.

4.6.2

In the list the Contractor shall record, as a minimum: identification number; title or description, date opened, action required, priority, organization responsible for taking action, brief statement of results in sufficient detail to clearly identify and track the action taken, date closed, and, status (open/closed).

4.6.3

The Contractor shall ensure that, once entered, no entry is deleted.

4.6.4

The Contractor shall include a subset of the list containing all open action items as an attachment to the monthly status reports.

4.6.5

The Contractor shall make a copy or reproduction of the most current AIL or any portion thereof available to Canada upon request at any time.

5 Engineering

5.1 General

The Contractor shall implement an Engineering Program that shall include Hardware Engineering; Reliability, Maintainability, Availability, and Testability; Interface Management; Design Qualification and Engineering Reviews to ensure that the customization of the AS conforms to the requirements of the SOW.

5.2 Hardware Engineering

5.2.1 Interface Terminations and reconnections

The Contractor shall be responsible for the reconnections of the new AS, including wire termination repairs or additional wire patches used.

5.3 Reliability, Maintainability, Availability and Testability

5.3.1

The Contractor shall conduct Reliability, Maintainability, Availability and Testability (RMAT) engineering on the AS.

5.3.2

The Contractor shall deliver a RMAT report IAW CDRL Item CDRL-EN-13 and current industry best practices.

5.4 Interface Management

The Contractor shall prepare and submit an Interface Management Plan (IMP) IAW CDRL Item CDRL-EN-11 and current industry best practices; and the AS Interface Control Documents (ICDs) IAW CDRL Item CDRL-EN-12 and current industry best practices for all systems interfacing with the AS. The interfaces are defined in the TSOR (section 2, Table 1 and item 1).

5.5 VCS Dynamic Simulation Software Model and AS Control Algorithm Development

The Contractor shall develop the VCS dynamic simulation software model and the AS control algorithm based on his own 6- Degree of freedom (DOF) numerical model. At the start of the contract, Canada will provide to the Contractor the VCS hydrodynamic coefficients for the 6-DOF numerical model and will provide the VCS dynamic simulation software model, called the "DRDC Submarine Simulation Program" (DSSP). For more information on the DSSP, refer to section 2.1, Table 1, Items 14 to 16.

5.5.1 Canada's DRDC Submarine Simulation Program (DSSP)

The DSSP is a geometry-based hydrodynamic deep manoeuvring model developed by Canada. The hydrodynamic coefficients for coefficient-based models can be generated by DSSP to be used by the Contractor's coefficient-based model. Canada can also supply the contractor with the coefficient-based hydrodynamic deep

manoeuvring and free surface model originally developed by Haslar and provided to Canada by the UK. The Haslar model comes with coefficients and a model description which Canada has not verified as being complete.

The DSSP is currently being further developed to include the near-surface manoeuvring component for the near-surface (free surface) disturbances. Near surface means operating in the depth zone where the surface waves are the primary driver of motion due to the sea state conditions, particularly for periscope operations and snorting operations.

5.6 Design Qualification

The design qualification shall be carried out in numerous steps as described in the following sections.

5.6.1 VCS Simulation Software Model Design Evaluation

The Contactor shall compare the results of its dynamic simulation software model with the results of the DSSP and prepare a report and provide to Canada for review and acceptance. If there are any discrepancies in results between the two software model results, both the Contractor and Canada shall collectively resolve them prior to proceeding to the full scale development of the AS control algorithm.

5.6.2 Preliminary AS Control Algorithm Design Evaluation

The Contractor shall provide to Canada the preliminary control algorithm for review, testing using the DSSP and successful acceptance by TA prior to customizing the control algorithm for the physical Scaled Model.

5.6.3 VCS Scaled Model Control Algorithm Evaluation

The near-surface depth-keeping capability of the AS at snorkel and periscope depths is vital to the VCS operational profile. Due to interaction of the submarine with surface waves, this is a particularly challenging control problem.

The Contractor shall provide to Canada the customised AS control algorithm of the physical scaled model for review and testing at Canada's NRC's test facilities in St. Johns, NL. The criteria for successful acceptance are that the customised control algorithm shall meet or exceed the performance criteria for these manoeuvres as per the AS TSOR, section 2.1, Table 1 and Item 1.

The testing will consist of assessing the depth-keeping capability of the control algorithm in the following conditions:

- Up to sea state 6 in head and following seas;
- At periscope depth in both snorting and non-snorting conditions; and
- At speeds varying from 4 to 14 knots (full scale).

Prior to the Control Algorithm Evaluation, the Contractor shall have an access to the physical model for shakedown and tuning runs of their own choosing for up to one week.

The Contractor shall prepare the acceptance test plan, types of tests and execute the acceptance tests for review and approval by Canada/NRC. The duration of the acceptance tests will be 2 weeks.

Canada's NRC is equipped to perform such testing having tested numerous versions of the VCS including a surface-operating 1:15 scale VCS model. NRC is also equipped with major testing facilities and instruments particularly suited to submarine model testing. The NRC Tow Tank (12m X 200m X 7 m deep) is equipped with wave making capability and a high-speed tow carriage.

Contractor must account for appropriate model scaling laws in their control algorithms. For example, Froude scaling dictates that control update cycle time may need to be $\sqrt{\lambda}$ faster than the full-scale system. The likely model scale factor will be approximately λ=15. The physical model will be free-swimming and all hardware and software necessary to its operation will be provided by Canada to the Contractor. A similar communication interface as used in the simulation will be provided by Canada for the Contractor's control algorithm to be tested.

5.6.4 Full Scale Testing

The Contractor shall be fully responsible for the satisfactory performance of the AS control algorithm in the full scale trials as per the AS TSOR, section 2.1, Table 1 and Item 1.

5.6.5 Environmental Qualification

The AS equipment shall be environmentally tested and qualified to meet the requirements defined in the AS TSOR, section 2.1, Table 1 and Item 1. Any component of the AS, e.g. AP, SS, AS computers and EEs, etc., that has been subjected to environmental testing shall not be part of the AS deliverables. However, the AS deliverables shall be temperature tested prior to FAT.

5.6.6 Design Qualification Report

The Contractor shall prepare a Design Qualification Report to reflect the results of Design Qualification activities IAW CDRL Item CDRL-EN-07 and DID-EN-07.

5.6.7 Control Algorithm Documentation

In the AS proposals, the bidders shall describe the history and attributes of their proposed dynamic model and control algorithm and show that they have been used in the past in successful submarine autopilot installations.

The developed AS control algorithm shall be documented in detail and the final algorithm shall be provided in source and executable codes to Canada as part of the documentation package. The Contractor shall include the documentation details of

any underlying theoretical considerations in the design of state estimators, Kalman filters and embedded models. Canada shall be responsible for the protection of the Contractor's Proprietary information.

5.7 Failure Mode and Effects Analysis Report

Failure Analysis reports shall be submitted to the TA for all equipment and software failures under test IAW CDRL item CDRL-EN-04 and current industry best practices. Also, in lieu of a Material Review Board (MRB) all non-conformances, which affect contractual specifications such as, form, fit, weight, function and interchangeability shall be reported to the TA with a failure analysis report IAW CDRL-EN-04.

5.8 Engineering Reviews and Audits

The engineering reviews and audits shall be prepared and conducted IAW MIL-STD-1521B, section 2.2, Table 2 and item 5.

5.8.1 Initial Technical Review

The Contractor shall conduct an Initial Technical Review (ITR) in conjunction with the Project Kick Off Meeting to:

1. Describe the approach to be taken to implement the changes as described in Section 8; and,
2. Describe the Contractor's plans and schedule to test, and qualify these design changes.

5.8.2 System Requirements Review

The Contractor shall conduct a System Requirements Review (SRR) at the Contractor's Facilities, six (6) weeks after contract award. The SRR review meeting will cover all system, hardware and software requirements. The SRR data package shall be IAW CDRL item CDRL-EN-01 and DID-EN-01.

5.8.3 Preliminary Design Review

The Contractor shall conduct a Preliminary Design Review (PDR) at the Contractor facilities, Four months after contract award. The PDR review meeting will cover all system, hardware and software preliminary designs. The PDR data package shall be IAW CDRL item CDRL-EN-02 and DID-EN-02.

5.8.4 Critical Design Review

The Contractor shall conduct a Critical Design Review (CDR) at the Contractor facilities. The CDR shall present the final AS designs for TA review and approval. The CDR data package shall be IAW CDRL item CDRL-EN-03 and DID-EN-03.

5.8.5 Functional Configuration Audit

The Contractor shall organize a Functional Configuration Audit (FCA) and the configuration audit package shall be prepared prior to the FAT IAW CDRL Item CDLR-EN-05 and DID-EN-05 and MIL STD 973. The TA shall conduct the FCA review against the AS design documentation.

5.8.5.1

In accordance with CDRL Item CDRL-EN-09 and DID-EN-09, the Contractor shall prepare a list of software modules, and related documentation necessary to completely define the configuration of the software/firmware system. Exact version and revision numbers of all software modules shall be included for each list item. The "as-built" configuration shall be compared to the documentation contained in the AS Version Description (see CDRL item CDRL-EN-09 and DID-EN-09) to ensure consistency. All discrepancies shall be documented in a "to be named" log and shall be corrected by the Contractor. The Contractor shall issue the "As Built" Configuration Technical Data Package IAW CDRL item CDRL-EN-08 and DID-EN-08 after completion of the functional configuration audit. This document is essentially an update of the AS Version Description document to accommodate inconsistencies found in the functional configuration audit and reflecting the as-built configuration on the submarine.

5.8.6 Physical Configuration Audit

The Contractor shall arrange a Physical Configuration Audit (PCA) and the configuration audit package shall be prepared IAW CDRL Item CDLR-EN-08 and DID-EN-08. The TA shall conduct the PCA review against the as built configuration of the AS design documentation.

5.8.6.1

In accordance with CDRL Item CDRL-EN-08 and DID-EN-08, the Contractor shall prepare list of drawings, documents, parts lists, change notices, and other related documentation necessary to completely define the configuration of the system. Exact version and revision numbers shall be included for each list item. The "as-built" configuration shall be compared and formatted as the documentation contained in the AS Version Description (see CDRL item CDRL-EN-09 and DID-EN-09) to ensure consistency. All discrepancies shall be documented and corrected by the Contractor. The Contractor shall issue the As Built Configuration Technical Data Package IAW CDRL item CDRL-EN-08 and DID-EN-08 after completion of the physical configuration audit. This document is essentially an update of the AS Version Description document to accommodate inconsistencies found in the physical configuration audit and reflecting the as-built configuration on the submarine.

6 Acceptance Testing

6.1 AS Acceptance Testing

The purpose of the acceptance tests is to demonstrate that the AS performance and functional requirements have been satisfactorily met.

6.1.1 Factory Acceptance Testing (FAT)

The Contractor shall perform factory acceptance testing on each of the AS including the OBT for the submarines and the Shore based Trainers. The FAT conduct shall be witnessed and accepted by TA/delegated representative.

6.1.2 First of Class (FoC) Testing

The Contractor shall perform an acceptance testing to prove the AS design on the first submarine in the Victoria Class called the First of Class (FoC). The FoC performance testing shall be witnessed and accepted by TA/delegated representative.

6.1.2.1 Set To Work (STW)

The Contractor shall remove the legacy AS equipment, the necessary field wiring and the cables and install the new AS equipment, install the necessary field wiring and cables onboard the submarine. The Contractor shall check, verify and test that all the AS equipment and all the subsystems that the AS interfaces with is fully functional.

6.1.2.2 Harbor Acceptance Testing (HAT)

Upon successful completion of the STW, the Contractor shall conduct the HAT as per the HAT procedures to prove that the AS meets all the SOW and TSOR requirements including but not limited to the following tests:

1. Ram Servo Unit (RSU) voltage inputs at the:
    a. After RSU;
    b. Forward RSU; and
    c. Rudder RSU.
2. Response time from operator input to Autopilot Computer output to After, Forward and Rudder RSUs;
3. After hydroplane actuator movement limits;
4. Forward hydroplane actuator movement limits;
5. Rudder actuator movement limits; and
6. All control modes testing.

6.1.2.3 Sea Acceptance Trials (SAT)

The Contractor shall be part of the team of operators and TA's representative when sea trials are conducted. The Contractor shall conduct any pre-sea trials tests as per the SAT procedures prior to commencement of the sea trials; to the meet the performance requirements of the AS TSOR section 2.1, Table 1 and Item 1. During the sea trials the Contractor shall be responsible to make any adjustments to meet the AS operational requirements._

6.1.2.3.1 Sea conditions and Manoeuvres

Refer to TSOR for detail on sea conditions and Manoeuvres.

6.1.2.4 The Remaining three (3) ASs Acceptance Testing

The Contractor shall perform acceptance testing on each of the ASs onboard the remaining three (3) submarines. The remaining three ASs performance acceptance testing shall be witnessed and accepted by TA/delegated representative.

6.2 SBT Acceptance Testing

The contractor shall perform the acceptance testing to prove the Shore Based Trainer (SBT), the MT meets the requirements.

6.3 Test Management

6.3.1 Acceptance Test Plan

The Contractor shall produce and deliver Acceptance Test Plans for the FAT, the HAT and the SAT that provide an overall outline of the entire spectrum of test activities of the AS production program; acceptance test plans for the OBT and the MT IAW CDRL Item CDRL-AT-01 and DID-AT-01.

6.3.2 Acceptance Test Procedures

The Contractor shall produce and deliver the AS Acceptance Test Procedures for the FAT, the HAT and the SAT and the Acceptance Test Procedures for the OBT and the MT. The acceptance test procedures shall contain all conditions, precautions, adjustments, expected test results, tolerances, and a list of the tools and test equipment required to verify the correct operation of the entire AS and all the AS interfaces to the existing equipment submarine systems where applicable and the trainers. The ATPs shall be delivered IAW CDRL item CDRL-AT-02 and DID-AT-02.

6.3.2.1 Acceptance Test Reports

The Contractor shall conduct the AS, the OBT and the MT Acceptance Test procedures prepare and submit the acceptance test reports IAW CDRL Item CDRL-AT-03 and DID-AT-03.

6.4 Letter or Certificate of Acceptance

Based on the successful reviews and acceptances of the AS systems for all the submarines, the OBT and the MT, Canada will provide a Letter or Certificate of Acceptance to the contractor.

7 Integrated Logistics Support

7.1 General

The Contractor shall establish, implement and control an Integrated Logistics Support (ILS) Program for the AS and its related logistics support elements IAW Mil-STD 1388 1A and 2B, section 2.2, Table 2 and items 1 and 2 and A-LM-505-001/AG-001, (Section 2, Table 1 and item 5). The Contractor ILS activities shall form an integral part of all AS planning, development, design, production, design qualification test, installation, set to work efforts associated with this SOW.

7.2 Logistic Support Analysis

The Contractor shall perform Logistics Support Analysis (LSA) activities IAW A-LM-505-001/AG-002 (Section 2, Table 1 and item 6).

7.2.1 Logistics Support Analysis Record

The Contractor shall develop and maintain a single storage point for all logistics data. This storage point shall be the Logistics Support Analysis Record (LSAR). The LSAR shall be created and maintained IAW A-LM-505-001/AG-001 and A-LM-505-001/AG-002 (Section 2, Table 1 and items 5 and 6) to allow LSAR data to be uploaded to Canada's current LSAR tool called "Omega PS". The LSAR shall be delivered IAW CDRL-LOG-07.

7.3 Maintenance of AS

7.3.1 Maintenance Concept

The contractor shall coordinate the maintenance task analysis and shall prepare and deliver for approval the Maintenance Concept IAW CDRL item CDRL-LOG-05 and current industry best practices.

7.3.2 Special Purpose Tools and Test Equipment (SPTATE) and a Recommended List of COTS Tools and Test Equipment (RLCTTE)

Based on the Maintenance Task Analysis, the Contractor shall design and develop the SPTATE and identify to Canada a RLCTTE that are required with SPTATE to provide first level maintenance (to be carried out by Submarine Staff) and second level maintenance (to be carried out by Fleet Maintenance Facility personnel) support for both submarine equipment and trainers IAW CDRL item CDRL-LOG-04.

7.4 Version Description Document

The contractor shall prepare and deliver the version description document IAW current industry best practices and IAW CDRL-EN-09 and DID-EN-09 and IEEE/EIA 12207 (section 2.2, Table 2 and item 6).

7.5 Cadre Training

7.5.1 Overview

The AS project for the Victoria Class platform will result in the replacement of the legacy AS. This submarine system replacement will result in a requirement to provide new training to the submarine operational staff, fleet school trainers and the Fleet Maintenance Facility staff (FMF).

7.5.2 Number of Cadre Training Sessions and Students

The contractor shall provide two cadre training sessions on the MT. The trainings shall be provided to the submarine operators, fleet school trainers and FMF staff. Each Cadre training session shall include but not be limited to the AS capabilities, features, and component with a complete set of simulated realistic training scenarios as per Table 4.

7.5.3 Training Material and Content

The Consolidated Training Package (CTP) shall meet both the system operation and system maintenance requirements to a level suitable for operators and the Canada/FMF maintainers. The CTP shall be used by Canada in steady state training. The Contractor shall prepare and produce a CTP for the course IAW the requirements of the Canadian Forces Individual Training and Education System series of document, A-P9-050-000/PT-003 (section 2, Table 1 and item 7). The CTP shall be delivered IAW CDRL item CDRL-LOG-03 and DID-LOG-03. The training material and content shall be reviewed and approved by TA.

7.5.4 Training Location and Training Equipment

7.5.4.1 Training Location

The Contractor shall deliver all the Cadre training sessions at the East coast FMF.

7.5.4.1 Training Systems

The contractor shall use the MT as a training system for the duration of the training period for two (2) training sessions.

7.5.5 Language

All Contractor supplied training and the training material shall be provided in English.

7.6 Supply Support

7.6.1 Provisioning Parts Breakdown

The Contractor shall deliver a Provisioning Parts Breakdown in electronic format required for Canadian Forces Supply System (CFSS) IAW D-01-100-214/SF-000 (section 2, Table 1 and item 4), CDRL item CDRL-LOG-01 and current industrial best practice.

7.7 Documentation

The Contractor shall produce and provide the following documentation in Canada's format IAW CDRL-LOG-06 and IAW C-01-100-100/AG-006, section 2, Table 1 and item 9, with the exception of the items 9 and 10 as listed below:

1. Hardware requirements documents;
2. Hardware designs documents;
3. Software requirements documents;
4. Software designs documents;
5. Circuit cards design descriptions with data path flow;
6. Operations manuals;
7. Software user manual;
8. Maintenance manuals (Test Form format reference document to be provided) including but not be limited to:
   a. Hardware and software maintenance manuals and checklists;
   b. System troubleshooting documentation IAW Section 7.7.1;
   c. Repair instructions; and
9. Illustrated parts breakdowns (IPBs) (as built part list); and
10. Circuit cards and all the internal wiring electrical schematics;

7.7.1 System Troubleshooting Documentation

The Contractor shall provide system-troubleshooting documentation that permits system maintainers to:

1. Correlate AS error messages, faults, and/or Built In Test Equipment (BITE) results with AS and/or equipment automated sequences (both in hardware and software), sensor signal values, sensor I/O locations and field wiring schematics; and
2. Resolve AS fault messages efficiently and effectively.

As a minimum AS troubleshooting shall include the equivalent of the following materials:

1. AS signal interface list IAW CDRL-EN-10;
2. Built In Test (BIT) Investigation - BIT description and troubleshooting; and
3. AS circuit cards schematics and all the internal wiring schematics.

7.8 Technical Documentation

7.8.1 Engineering Data Access

The Contractor shall provide access to all engineering data during the contract.

7.8.2 Technical Publications

The Contractor shall prepare and deliver the Technical Publications IAW C-01-000-102/AG-000, National Defence Index of Documentation System, Section 2, Table 1

and item 8 and C-01-100-100/AG-006, Writing, Format and Production of Technical Publications, Section 2, Table 1 and item 9.

7.8.2.1

The Contractor shall prepare and deliver technical publications in English.

7.8.2.2 Equipment reference Numbering

The Contractor shall use the Equipment Reference Number (ERN) as a basis for numbering and identifying all documentation for the corresponding piece of equipment. Part 5 of C-03-005-012/AM-001 (section 2, Table 1 and item 10), provides guidance on using the ERN.

7.8.2.3

The Contractor shall make maximum use of existing OEM technical publications. The Contractor shall modify existing OEM technical publications to reflect Canadian-specific equipment, nomenclature, part numbers, modifications, and maintenance procedures using current industrial best practices.

7.9 Health and Safety

7.9.1 Dangerous/Hazardous Items and Material Safety Data Sheets

The hazardous materials shall be used only when no acceptable effective, less hazardous substitute is available, in accordance with the Treasury Board Hazmat policy & HFX Class G-1 spec, see paragraphs 33, 41 & 42, (section 2, Table 1 and item 13).

7.9.2

The Materiel Requirement Packages delivered with the equipment shall be IAW CDRL item CDRL-LOG-02 and DID-LOG-02 and it shall include the following:

1. Equipment Identification Plate data: This document details the information that the Contractor proposes to incorporate on Equipment Identification Plates and is used to obtain Canada's approval prior to manufacturing Equipment Identification Plates for AS LRUs; and

2. The Material Safety Data Sheet (MSDS) and justification for each hazardous material used. The Material Safety Data Sheets (MSDS) provide information and instructions on the chemical and physical characteristics of a substance, its hazards and risks, the safe handling requirements, and actions to be taken in the event of fire, spill, overexposure, or other risk.

Note: *Dangerous/Hazardous material shall be defined as any substance which is capable of posing a risk to health, safety, property or the environment when stored, handled or transported, and is so classified in regulations governing transportation.*

Hazardous materials include (but are not limited to) dangerous goods identified in the Canadian Transportation of Dangerous Goods Act.

7.10 Packaging, Handling, Storage & Transportability

7.10.1 General

The Contractor shall conduct Packaging, Handling, Storage and Transportability IAW A-LM-505-001/AG-001 (section 2, Table 1 and item 5).

7.10.2 Packaging Methods and Levels

The Contractor shall ensure that packaging of provisioned items will provide adequate protection for a minimum of five (5) years, consistent with good economy, against damage, deterioration and loss of identification during storage, handling and shipment.

7.10.3 Marking of Packages

The Contractor shall mark all packages, shipping containers and consolidation containers IAW D-LM-008-002/SF-001 (section 2, Table 1 and item 11), as applicable.

7.10.4 Marking of Dangerous/Hazardous Items

The Contractor shall mark dangerous/hazardous items as follows:

1. Shipping Container: "In accordance with the Transportation of Dangerous Goods Act"; and
2. Immediate Product Container: "In accordance with the Hazardous Products Act, Controlled Products Regulation".

7.10.5 Shelf Life Items

The Contractor shall mark the individual package for each shelf life item with:

1. The date of manufacture;
2. The shelf life expiry date; and
3. The storage environment restrictions (for example no freezing, no sunlight).

7.10.6 Contract End Items List

The Contractor shall provide a Contract End Items List (CEIL) for materials the Contractor developed or acquired in response to the SOW IAW CDRL item CDRL-EN-08 and DID-EN-08. The CEIL shall include all non-documentation items, e.g. AS Systems, parts list, that the Contractor shall be required to deliver as applicable.

7.11 Obsolescence

7.11.1

The Contractor shall ensure that the AS does not include parts that have become obsolete, or are expected to become obsolete within five (5) years after all the ASs have been delivered.

8 Engineering Change Specifications

8.1 General

The Engineering Changes (ECs) shall be detailed specifications for changes to the Victoria Class Submarines to support the installation of the AS equipment as required by Canada and the trainers, SCT and MT. The EC specifications shall be in Canada's EC format and these shall provide all the necessary detailed electrical and mechanical interfaces and component modifications. The EC Specifications shall be reviewed and approved for implementation by the TA. The EC work packages shall then be implemented on all four Victoria Class Submarines IAW the Submarine Modification Implementation Plan (SMIP) and the trainers, SCT and MT.

Following acceptance of the initial EC specifications by TA, the Contractor shall only particularize the submarine EC for each of the remaining Victoria Class Submarines. Particularization is required because of potential minor configuration variations between submarines caused by the enhancements and improvements over the years of service.

8.2 Engineering Changes Designs

The contractor shall:

1. Design all the EC specifications for the FoC and the trainers SCT and MT IAW the requirements as per reference to 04TF283-1-227-1 EDWP (section 2, Table 1 and item 2);
2. Prepare the EC drawings IAW D-01-400-001/SG-000, section 2.1, Table 1 and item 12 and C-03-007-000/AG-001 (section 2, Table 1 and items 2);
3. Particularize the EC Specification for each of the remaining 3 Submarines after the initial EC Specification has been accepted and subsequently updated upon completion of STW.
4. Conduct a detailed inspection of each of the follow-on submarines to determine the variance of configuration and thus the requirement to particularize the EC specification(s);
5. Prepare the EC packages using metric units for all ship integration deliverables, unless the source of the original documentation is non-metric, and no changes to that original documentation is being made; and
6. Ensure that EC Specifications meets the requirements of the Canadian Environmental Assessment Act (CEAA), as specified in A-EN-007-000/FP-001 (section 2, Table 1 and item 3).

The initial EC Specification, including the preliminary and final versions, as well as all particularized EC specifications and the ECs for the trainers SCT and MT, shall be reviewed by the TA. Following a successful review, the TA will approve the EC specifications for implementation.

9 Acronyms and Abbreviations

AIL	Action Item List
AT	Acceptance Test
ATP	Acceptance Test Procedure
BIT	Built In Test
BITE	Built In Test Equipment
CA	Contract Authority or Contract Award
CCA	Circuit Card Assemblies
CDR	Critical Design Review
CDRL	Contract Deliverable Requirements List
CEAA	Canadian Environmental Assessment Act
CEIL	Contract End Items List
CFB	Canadian Force base
CFITES	Canadian Forces Individual Training and Education System
CMP	Configuration Management Plan
COTS	Commercial Off The Shelf
CPU	Central Processing Unit
CSCI	Computer Software Configuration Items
CSS	Central Surveillance System
CTP	Consolidated Training Package
DID	Data Item Description
DMP	Data Management Plan
DRDC	Defence Research and Development Canada
DSSP	DRDC Submarine Simulation Program
EC	Engineering Change
EDWP	Extended Dock Work Period
FCA	Functional Configuration Audit
FDS	Fire Detection System
FoC	First of Class
FMF	Fleet Maintenance Facility
FPR	Final Project Review
FQT	Final Qualification Plan
HFX	Halifax
IAW	In Accordance With
ID	Identification
I/O	Input Output
ILS	Integrated Logistics Support
IMP	Interface Management Plan
ITR	Initial Technical Review

LCD	Liquid Crystal Display
LRU	Line Replaceable Unit
LSAR	Logistics Support Analysis Record
LW	Legacy Wiring
LSU	Local Scanning Unit
MSDS	Material Safety Data Sheet
MRB	Material Review Board
OEM	Original Equipment Manufacturer
MT	Maintenance Trainer
NaMMS	Naval Maintenance Management System Manual Volume 1 NaMMS Policy and Procedures
OEM	Original Equipment Manufacturer
PCA	Physical Configuration Audit
PDF	Portable Document Format
PDR	Preliminary Design Review
PM	Project Management
PMP	Project Management Plan
POU	Portable Operating Unit
PRM	Progress Review Meeting
PS	Project Schedule
PWGSC	Public Works Government Services Canada
QA	Quality Assurance
QT	Quality Testing
RCRM	Requirements Cross Reference Matrix
RLCTTE	Recommended List of COTS Tools and Test Equipment
RMAT	Reliability, Maintainability, Availability and Testability
RMP	Risk Management Plan
SBT	Shore Based Trainer
SCC	Submarine Control Console
SCT	Submarine Control Trainer
SME	System Matter Expert
SOW	Statement Of Work
SPTATE	Special Purpose Tools And Test Equipment
SRCL	Security Requirements Check List
SRR	System Requirement Review
STW	Set To Work
TA	Technical Authority
TBD	To Be Determined
TDP	Technical Data Package
TSOR	Technical Statement Of Work

WBS	Work Breakdown Structure

10 Attachments

The information in the references called up in section 2 is an integral part of this SOW.

11 Contract Deliverable Requirements List (CDRL) and Data Item Description (DID)

11.1 General

11.1.1 Document Changes/Updates

All the approved documents shall be prepare and updated as required by the CDRL. All changes to updated versions of documents shall be identified as follows:

1. On a change page indicating page numbers, paragraph numbers, date of change and reason for change;
2. Within the hard copy, by use of change bars in the side margins of the printed document; and
3. Within the soft copy, using a method appropriate to the authoring tools that clearly differentiates old content from new or revised content.

Proposed amendments and the list of effective pages shall be forwarded to the TA for approval as described in the CDRL.

11.1.2 Deliverable Format and Number of Copies:

The number of documentation copies required for each CDRL is defined within each CDRL.

NOTE: All soft copies of documentation shall be in the original editable source file format, e.g. Microsoft Word 2003.

11.1.3 Abbreviations:

The following abbreviations are used in the CDRLs and DIDs.

A	Approval	PCA	Physical Configuration Audit
AT	Acceptance Test	PDR	Preliminary Design Review
CA	Contract Award	R	Review
CDR	Critical Design Review	SRR	System Requirements Review
I	Information only	STW	Set To Work
Month	Calendar month	wd	Working day

11.2 CDRLs

11.2.1 Project Management CDRL Summary

Project Management CDRL					
CDRL #	**DID #**	**Deliverable**	**Review Level**	**Due**	**Section in SOW**
CDRL-PM-01	DID–PM-01	Project Management Plan	A	CA +10 wd	4.2
CDRL-PM-02	DID-PM-02	Meeting Agendas	A	Meeting date - 5 wd	4.4.5.1.2
CDRL-PM-03	DID-PM-03	Meeting Minutes	A	Meeting date + 5 wd	4.4.5.3.2
CDRL-PM-04	DID-PM-04	Project Status Reports	R	5th wd of each month	4.5.1
CDRL-PM-05	N/A	Project Kick Off Meeting	R	CA +20 wd	4.4.1

11.2.2 Engineering CDRL Summary

Engineering CDRL					
CDRL #	**DID #**	**Deliverable**	**Review Level**	**Due**	**Section in SOW**
CDRL-EN-01	DID-EN-01	System Requirements Review Data Package	R	SRR-10 wd	5.8.2
CDRL-EN-02	DID-EN-02	Preliminary Design Review Data Package	R	PDR-20 wd	5.8.3
CDRL-EN-03	DID-EN-03	Critical Design Review Data Package	R	CDR-20 wd	5.8.4
CDRL-EN-04	N/A	FMEA Report	R	CDR-20 wd	5.7
CDRL-EN-05	DID-EN-05	Functional Configuration Audit Packages	A	FCA-10 wd	5.8.5
CDRL-EN-06	DID-EN-06	Engineering Changes Specifications Packages	A	CA + 18 months	3.2.2
CDRL-EN-07	DID-EN-07	Design Qualification Report	R	FCA-15 wd	5.6.6
CDRL-EN-08	DID-EN-08	Physical Configuration Audit Package	A	Delivery-10 wd	5.8.5.1, 5.8.6.1, 7.10.6
CDRL-EN-09	DID-EN-09	Version Description Document	R	STW-10 wd	5.8.5.1
CDRL-EN-10	DID-EN-10	Signal Interface List	R	CDR-20 wd	7.7.1
CDRL-EN-11	N/A	Interface Management Plan	R	PDR-10 wd	5.4
CDRL-EN-12	N/A	AS Interface Control Documents	R	CDR-20 wd	5.4
CDRL-EN-13	N/A	Reliability, Maintainability, Availability and Testability Report	R	CDR-20 wd	5.3.2

11.2.3 Acceptance Testing CDRL Summary

Acceptance Testing CDRL					
CDRL #	**DID #**	**Deliverable**	**Review Level**	**Due**	**Section in SOW**
CDRL-AT-01	DID-AT-01	Acceptance Test Plans	A	STW-20 wd	6.3.1
CDRL-AT-02	DID-AT-02	Acceptance Test Procedures	A	STW Test-20 wd	6.3.2
CDRL-AT-03	N/A	Acceptance Test Reports	R	Acceptance Test+10 wd	6.3.2.1

11.2.4 Integrated Logistics Support CDRL Summary

Integrated Logistics Support CDRL					
CDRL #	**DID #**	**Deliverable**	**Review Level**	**Due**	**Section in SOW**
CDRL-LOG-01	N/A	Provisioning Documentation	A	CDR-15 wd	7.6.1
CDRL-LOG-02	DID-LOG-02	Materiel Safety Data Sheet (MSDS)	A	CDR-15 wd	7.9.2
CDRL-LOG-03	DID-LOG-03	Consolidated Training Package	A	STW-15 wd	7.5.3
CDRL-LOG-04	N/A	Recommended COTS Tools and Test Equipment (RTTL)	A	PCA-20 wd	7.3.2
CDRL-LOG-05	N/A	Maintenance Concept	R	PDR-20 wd	7.3.1
CDRL-LOG-06	Section 2.1 and item 9 (C-01-100-100/AG-006)	See section 11.2.8.6 CDRL-LOG-06	A	STW-20 wd	7.7
CDRL-LOG-07	N/A	Logistics Support Analysis Record	A	CDR-20 wd	7.2.1

11.2.5 Project Management CDRL Details

11.2.5.1 CDRL-PM-01

1	**Sequence Number:**	PM-01
2	**Title or Description of Data**	Project Management Plan
3	**Data Item Description Number:**	DID-PM-01
4	**Reference:**	SOW
5	**First Submission:**	CA+ 10 wd
6	**Number of Copies:**	1 soft copy in source format
7	**TA Approval Required:**	Yes
8	**Approval Lead Time:**	10 wd
9	**Subsequent Submission:**	As required, if changes needed. Deliver soft copy of the change pages only
10	**Remarks:**	Deliver via email or FTP

11.2.5.2 CDRL-PM-02

1	**Sequence Number:**	PM-02
2	**Title or Description of Data:**	Meeting Agendas
3	**Data Item Description Number:**	DID-PM-02
4	**Reference:**	SOW
5	**First Submission:**	Meeting Date -5 days
6	**Number of Copies:**	1 soft copy in source format
7	**TA Approval Required:**	Yes
8	**Approval Lead Time:**	N/A
9	**Subsequent Submission:**	N/A
10	**Remarks:**	Deliver via email or FTP

11.2.5.3 CDRL-PM-03

1	**Sequence Number:**	PM-03
2	**Title or Description of Data:**	Meeting Minutes
3	**Data Item Description Number:**	DID-PM-03
4	**Reference:**	SOW
5	**First Submission:**	Meeting date + 5 wd
6	**Number of Copies:**	1 soft copy in source format
7	**TA Approval Required:**	Yes
8	**Approval Lead Time:**	N/A
9	**Subsequent Submission:**	N/A
10	**Remarks:**	Deliver via email or FTP

11.2.5.4 CDRL-PM-04

1	**Sequence Number:**	PM-04
2	**Title or Description of Data:**	Project Status Reports
3	**Data Item Description Number:**	DID-PM-04
4	**Reference:**	SOW
5	**First Submission:**	5th wd of each month
6	**Number of Copies:**	1 soft copy in source format
7	**TA Approval Required:**	No
8	**Approval Lead Time:**	N/A
9	**Subsequent Submission:**	N/A
10	**Remarks:**	Deliver via email or FTP

11.2.5.5 CDRL-PM-05

1	**Sequence Number:**	PM-05
2	**Title or Description of Data:**	Project Kick Off Meeting
3	**Data Item Description Number:**	N/A
4	**Reference:**	SOW
5	**First Submission:**	CA + 20 wd or less
6	**Number of Copies:**	N/A
7	**TA Approval Required:**	No
8	**Approval Lead Time:**	N/A
9	**Subsequent Submission:**	N/A
10	**Remarks:**	Deliver via email or FTP

11.2.6 Engineering CDRL Summary

11.2.6.1 CDRL-EN-01

1	**Sequence Number:**	EN-01
2	**Title or Description of Data:**	System Requirements Review Data Package
3	**Data Item Description Number:**	DID-EN-01
4	**Reference:**	SOW
5	**First Submission:**	SRR-10 wd
6	**Number of Copies:**	1 soft copy in source format
7	**TA Approval Required:**	No
8	**Approval Lead Time:**	N/A
9	**Subsequent Submission:**	N/A
10	**Remarks:**	Deliver via email or FTP

11.2.6.2 CDRL-EN-02

1	**Sequence Number:**	EN-02
2	**Title or Description of Data:**	Preliminary Design Review Data Package
3	**Data Item Description Number:**	DID-EN-02
4	**Reference:**	SOW
5	**First Submission:**	PDR-20 wd
6	**Number of Copies:**	1 soft copy in source format
7	**TA Approval Required:**	No
8	**Approval Lead Time:**	N/A
9	**Remarks:**	Deliver via email or FTP

11.2.6.3 CDRL-EN-03

1	**Sequence Number:**	EN-03
2	**Title or Description of Data:**	Critical Design Review Data Package
3	**Data Item Description Number:**	DID-EN-03
4	**Reference:**	SOW
5	**First Submission:**	CDR-20 wd
6	**Number of Copies:**	1 soft copy in source format
7	**TA Approval Required:**	No
8	**Approval Lead Time:**	N/A
9	**Subsequent Submission:**	N/A
10	**Remarks:**	Deliver via email or FTP

11.2.6.4 CDRL-EN-04

1	**Sequence Number:**	EN-04
2	**Title or Description of Data:**	FMEA Analysis Report
3	**Data Item Description Number:**	N/A
4	**Reference:**	SOW
5	**First Submission**	CDR-20 wd
6	**Number of Copies:**	1 soft copy in source format
7	**TA Approval Required:**	No
8	**Approval Lead Time:**	N/A
9	**Subsequent Submission:**	N/A
10	**Remarks:**	Deliver via email or FTP

11.2.6.5 CDRL-EN-05

1	**Sequence Number:**	EN-05
2	**Title or Description of Data:**	Functional Configuration Audit Packages
3	**Data Item Description Number:**	DID-EN-05
4	**Reference:**	SOW
5	**First Submission:**	FCA-10 wd
6	**Number of Copies:**	1 soft copy in source format
7	**TA Approval Required:**	No
8	**Approval Lead Time:**	N/A
9	**Subsequent Submission:**	N/A
10	**Remarks:**	Deliver via email or FTP

11.2.6.6 CDRL-EN-06

1	**Sequence Number:**	EN-06
2	**Title or Description of Data:**	Engineering Changes Specifications
3	**Data Item Description Number:**	DID-EN-06
4	**Reference:**	SOW
5	**First Submission:**	CA+18 months
6	**Number of Copies:**	1 soft copy in source format
7	**TA Approval Required:**	No
8	**Approval Lead Time:**	N/A
9	**Subsequent Submission:**	N/A
10	**Remarks:**	Deliver via email or FTP

11.2.6.7 CDRL-EN-07

1	**Sequence Number:**	EN-07
2	**Title or Description of Data:**	Design Qualification Reports
3	**Data Item Description Number:**	DID-EN-07
4	**Reference:**	SOW
5	**First Submission:**	FCA-15 wd
6	**Number of Copies:**	1 soft copy in source format
7	**TA Approval Required:**	No
8	**Approval Lead Time:**	N/A
9	**Subsequent Submission:**	N/A
10	**Remarks:**	Deliver via email or FTP

11.2.6.8 CDRL-EN-08

1	**Sequence Number:**	EN-08
2	**Title or Description of Data:**	Physical Configuration Audit Package
3	**Data Item Description Number:**	N/A
4	**Reference:**	SOW
5	**First Submission:**	Delivery - 10 wd
6	**Number of Copies:**	1 soft copy in source format
7	**TA Approval Required:**	No
8	**Approval Lead Time:**	N/A
9	**Subsequent Submission:**	N/A
10	**Remarks:**	Deliver via email or FTP

11.2.6.9 CDRL-EN-09

1	**Sequence Number:**	EN-09
2	**Title or Description of Data:**	Version Description Document
3	**Data Item Description Number:**	DID-EN-09
4	**Reference:**	SOW
5	**First Submission:**	STW-10 wd
6	**Number of Copies:**	1 soft copy in source format
7	**TA Approval Required:**	No
8	**Approval Lead Time:**	N/A
9	**Subsequent Submission:**	N/A
10	**Remarks:**	Deliver via email or FTP

11.2.6.10 CDRL-EN-10

1	**Sequence Number:**	EN-10
2	**Title or Description of Data:**	Signal Interface List
3	**Data Item Description Number:**	DID-EN-10
4	**Reference:**	SOW
5	**First Submission:**	CDR-20 wd
6	**Number of Copies:**	1 soft copy in source format
7	**TA Approval Required:**	No
8	**Approval Lead Time:**	N/A
9	**Subsequent Submission:**	N/A
10	**Remarks:**	Deliver via email or FTP

11.2.6.11 CDRL-EN-11

1	**Sequence Number:**	EN-11
2	**Title or Description of Data:**	Interface Management Plan
3	**Data Item Description Number:**	N/A
4	**Reference:**	SOW
5	**First Submission:**	PDR-10 wd
6	**Number of Copies:**	1 soft copy in source format
7	**TA Approval Required:**	No
8	**Approval Lead Time:**	N/A
9	**Subsequent Submission:**	N/A
10	**Remarks:**	Deliver via email or FTP

11.2.6.12 CDRL-EN-12

1	**Sequence Number:**	EN-12
2	**Title or Description of Data:**	Interface Control Documents
3	**Data Item Description Number:**	N/A
4	**Reference:**	SOW
5	**First Submission:**	CDR-20 wd
6	**Number of Copies:**	1 soft copy in source format
7	**TA Approval Required:**	No
8	**Approval Lead Time:**	N/A
9	**Subsequent Submission:**	N/A
10	**Remarks:**	Deliver via email or FTP

11.2.6.13 CDRL-EN-13

1	**Sequence Number:**	EN-13
2	**Title or Description of Data:**	Reliability, maintainability, Availability and Testability Report
3	**Data Item Description Number:**	N/A
4	**Reference:**	SOW
5	**First Submission:**	CDR-20 wd
6	**Number of Copies:**	1 soft copy in source format
7	**TA Approval Required:**	No
8	**Approval Lead Time:**	N/A
9	**Subsequent Submission:**	N/A
10	**Remarks:**	Deliver via email or FTP

11.2.7 Testing and Acceptance CDRL Summary

11.2.7.1 CDRL-AT-01

1	**Sequence Number:**	AT-01
2	**Title or Description of Data:**	Acceptance Test Plans
3	**Data Item Description Number:**	DID-AT-01
4	**Reference:**	SOW
5	**First Submission:**	STW-20 wd
6	**Number of Copies:**	1 soft copy in source format
7	**TA Approval Required:**	Yes
8	**Approval Lead Time:**	10 wd
9	**Subsequent Submission:**	N/A
10	**Remarks:**	Deliver via email or FTP

11.2.7.2 CDRL-AT-02

1	**Sequence Number:**	AT-02
2	**Title or Description of Data:**	Acceptance Test Procedures
3	**Data Item Description Number:**	DID-AT-02
4	**Reference:**	SOW
5	**First Submission:**	STW Test -20 wd
6	**Number of Copies:**	1 soft copy in source format
7	**TA Approval Required:**	Yes
8	**Approval Lead Time:**	N/A
9	**Subsequent Submission:**	As required, if changes
10	**Remarks:**	Deliver via email or FTP

11.2.7.3 CDRL-AT-03

1	**Sequence Number:**	AT-03
2	**Title or Description of Data:**	Acceptance Test Reports
3	**Data Item Description Number:**	N/A
4	**Reference:**	SOW
5	**First Submission:**	STW Test Completed + 10 wd
6	**Number of Copies:**	1 soft copy in source format
7	**TA Approval Required:**	No
8	**Approval Lead Time:**	N/A

9	**Subsequent Submission:**	N/A
10	**Remarks:**	Deliver via email or FTP

11.2.8 Integrated Logistics Support CDRL Summary

11.2.8.1 CDRL-LOG-01

1	**Sequence Number:**	LOG-01
2	**Title or Description of Data:**	Provisioning Documentation
3	**Data Item Description Number:**	N/A
4	**Reference:**	SOW
5	**First Submission:**	CDR-15 wd
6	**Number of Copies:**	1 soft copy in source format
7	**TA Approval Required:**	Yes
8	**Approval Lead Time:**	N/A
9	**Subsequent Submission:**	N/A
10	**Remarks:**	Deliver via email or FTP

11.2.8.2 CDRL-LOG-02

1	**Sequence Number:**	LOG-02
2	**Title or Description of Data:**	Material Safety Data Sheets (MSDS) requirements package
3	**Data Item Description Number:**	DID-LOG-02
4	**Reference:**	SOW
5	**First Submission:**	CDR - 15 wd
6	**Number of Copies:**	1 soft copy in source format
7	**TA Approval Required:**	No
8	**Approval Lead Time:**	N/A
9	**Subsequent Submission:**	N/A
10	**Remarks:**	Deliver via email or FTP

11.2.8.3 CDRL-LOG-03

1	**Sequence Number:**	LOG-03
2	**Title or Description of Data:**	Consolidated Training Package
3	**Data Item Description Number:**	DID-LOG-03
4	**Reference:**	SOW
5	**First Submission:**	STW - 15 wd
6	**Number of Copies:**	1 soft copy in source format
7	**TA Approval Required:**	Yes
8	**Approval Lead Time:**	N/A
9	**Subsequent Submission:**	N/A
10	**Remarks:**	Deliver via email or FTP

11.2.8.4 CDRL-LOG-04

1	**Sequence Number:**	LOG-04
2	**Title or Description of Data:**	Recommended Tool and Test equipment List (RTTL)
3	**Data Item Description Number:**	N/A
4	**Reference:**	SOW

5	**First Submission:**	PCA-20 wd
6	**Number of Copies:**	1 soft copy in source format
7	**TA Approval Required:**	Yes
8	**Approval Lead Time:**	N/A
9	**Subsequent Submission:**	N/A
10	**Remarks:**	Deliver via email or FTP

11.2.8.5 CDRL-LOG-05

1	**Sequence Number:**	LOG-05
2	**Title or Description of Data:**	Maintenance Concept
3	**Data Item Description Number:**	N/A
4	**Reference:**	SOW
5	**First Submission:**	PDR-20 wd
6	**Number of Copies:**	1 soft copy in source format
7	**TA Approval Required:**	No
8	**Approval Lead Time:**	N/A
9	**Subsequent Submission:**	N/A
10	**Remarks:**	Deliver via email or FTP

11.2.8.6 CDRL-LOG-06

1	**Sequence Number:**	LOG-06
2	**Title or Description of Data:**	1. Hardware requirements Document; 2. Hardware designs document; 3. SPTATE design document; 4. Software requirements document; 5. Software designs document' 6. Circuit cards design descriptions with data path flow; 7. Operations manual; 8. Software user manual; 9. Maintenance manual with trouble shooting and repair details; and Test Form.
3	**Data Item Description Number:**	IAW CFTO standard C-01-100-100/AG-006, see section 2 and item 9,
4	**Reference:**	SOW
5	**First Submission:**	STW-20 wd
6	**Number of Copies:**	1 soft copy in source format
7	**TA Approval Required:**	Yes
8	**Approval Lead Time:**	N/A
9	**Subsequent Submission:**	N/A
10	**Remarks:**	Deliver via email or FTP

11.2.8.7 CDRL-LOG-07

1	**Sequence Number:**	LOG-07
2	**Title or Description of Data:**	Logistics Support Analysis Record
3	**Data Item Description Number:**	N/A
4	**Reference:**	SOW

5	**First Submission:**	CDR-20 wd
6	**Number of Copies:**	1 soft copy in source format
7	**TA Approval Required:**	Yes
8	**Approval Lead Time:**	N/A
9	**Subsequent Submission:**	N/A
10	**Remarks:**	Deliver via email or FTP

Data Item Descriptions

11.2.9 Project Management DIDs

11.2.9.1 DID-PM-01

1. TITLE Project Management Plan		2. IDENTIFICATION NUMBER DID-PM-01
3. DESCRIPTION / PURPOSE To provide a Project Management Plan for the AS development for the Victoria Class Submarines.		
4. APPROVAL DATE	5. OFFICE OF PRIMARY INTEREST (OPI) Technical Authority, DMEPM(SM) 4-3	6. SPARE
7. APPLICATION / INTERRELATIONSHIP CDRL - PM-01 SOW Ref: 4.2, 4.4.1		
8. ORIGINATOR	9. APPLICABLE FORMS	

10. PREPARATION INSTRUCTIONS	
10.1	The Project Management Plan (PMP) shall be prepared in Contractor's format.
10.2	Structure - The PMP shall contain, as a minimum, the following sections: 1. Introduction; 2. Management Organization and Responsibilities; 3. Work Breakdown Structure (WBS); 4. Master Schedule with Milestones; 5. Hardware Development Plan; 6. Software development Plan; 7. Risk Management; 8. Configuration Management; 9. QA Plan; 10. ILS Plan; 11. FAT Plan; and 12. STW Plan.

11.2.9.2 DID-PM-02

1. TITLE Meeting Agendas		2. IDENTIFICATION NUMBER DID-PM-02
3. DESCRIPTION / PURPOSE The purpose of the Meeting / Teleconference / Conference Supporting Documentation and Agenda is to provide the proposed subject items for review and discussion.		
4. APPROVAL DATE	5. OFFICE OF PRIMARY INTEREST (OPI) Technical Authority, DMEPM(SM) 4-3	6. SPARE
7. APPLICATION / INTERRELATIONSHIP CDRL - PM-02		

SOW Ref: 4.4.5.1.2	
8. ORIGINATOR	9. APPLICABLE FORMS

10. PREPARATION INSTRUCTIONS

10.1 Supporting documentation and agenda shall be prepared in the Contractor's format.

10.2 The Agenda shall include the following:

1. Purpose of the meeting;
2. List of expected attendees;
3. Time, date, location and expected duration of the meeting;
4. Facilities and equipment to be provided for attending personnel;
5. List of data items and documents to be reviewed or provided to support the meeting. Adequate copies of all such data and documentation shall be provided; and
6. Adequate copies of the current AIL where appropriate.

10.3 Other pertinent information such as security requirements, if submarine visits are planned or other relevant information that would assist attending personnel.

11.2.9.3 DID-PM-03

1. TITLE Meeting Minutes	2. IDENTIFICATION NUMBER DID-PM-03

3. DESCRIPTION / PURPOSE

The purpose of Meeting / Teleconference / Conference Minutes is to document discussions, agreements and action items identified (with the responsible parties and closure dates) reached during subject meetings.

4. APPROVAL DATE	5. OFFICE OF PRIMARY INTEREST (OPI) Technical Authority, DMEPM(SM) 4-3	6.SPARE

7. APPLICATION / INTERRELATIONSHIP

CDRL-PM-03
SOW Ref: 4.4.5.3.2

8. ORIGINATOR	9. APPLICABLE FORMS

10. PREPARATION INSTRUCTIONS - INSTRUCTIONS SUR LA PRESENTATION DES DONNEES

10.1 Meeting / Teleconference / Conference Minutes shall be prepared in the Contractor's format and shall include the following information:

1. Date and location of meeting;
2. Name, organization, phone number, e-mail address and title of each person that attended the meeting;
3. Statement relating to the purpose and/or objective of the meeting; and
4. The original agenda and any revisions to the agenda - this may be accomplished by reference to attachments or enclosures.

10.2 Minutes should include a record of each item discussed or reviewed during the meeting, including:

1. A brief statement identifying the item or problem and their status;
2. A summary of pertinent information associated with the item;
3. A recommendation;
4. An action item - identifying the person or organization responsible for taking and/or co-ordinating required action with key dates; and
5. An updated Action Item List (AIT).

10.3 Meeting minutes should be distributed, where possible, at the end of the meeting and signed by the responsible parties before leaving. Otherwise the meeting minutes shall be delivered as directed in CDRL.

11.2.9.4 DID-PM-04

1. TITLE Project Status Reports (PSR)		2. IDENTIFICATION NUMBER DID-PM-04
3. DESCRIPTION / PURPOSE Project Status Reports provide the project status of work in progress, management and mitigation of risk, and schedule. The report shall be used to evaluate progress and to identify project management, technical, and schedule issues.		
4. APPROVAL DATE	5. OFFICE OF PRIMARY INTEREST (OPI) Technical Authority, DMEPM(SM) 4-3	6. SPARE
7. APPLICATION / INTERRELATIONSHIP CDRL-PM-05 SOW Ref: 4.5.1		
8. ORIGINATOR	9. APPLICABLE FORMS	
10. PREPARATION INSTRUCTIONS		

10.1 The Project Status Reports shall be prepared in the Contractor's format and contain necessary amendments to the PMP as appropriate.

10.2 The Project Status Reports shall include at least the following information:

1. A narrative report providing sufficient detail to enable the Contracting Authority and the Technical Authority to evaluate the progress of the work to date;
2. Risk management activities. Significant problems or concerns encountered together with recommended course of action;
3. Schedules status, schedule changes and planned activities for the next reporting period;
4. A summary of any issues for meeting requirements / specifications;
5. Running summary of hardware, software and system observations and problems that have been opened, are in progress or have been resolved; and
6. Subset of Action Item List containing all open action items.

11.2.10 Engineering DIDs

11.2.10.1 DID-EN-01

1. TITLE System Requirements Review Data Package		2. IDENTIFICATION NUMBER DID-EN-01
3. DESCRIPTION / PURPOSE The System Requirements Review Data Package shall provide all of the review materials required for the System Requirements Review meeting.		
4. APPROVAL DATE	5. OFFICE OF PRIMARY INTEREST (OPI) Technical Authority, DMEPM(SM) 4-3	6. SPARE
7. APPLICATION / INTERRELATIONSHIP - APPLICATION / INTERDEPENDANCE CDRL-EN-01 SOW Ref: 5.8.2		
8. ORIGINATOR	9. APPLICABLE FORMS	
10. PREPARATION INSTRUCTIONS		
10.1 The following documents must be provided for the System Requirements Review meeting: 1. System Requirements Specification Including Hardware and Software; 2. System Architecture and Requirements Allocation Description; and 3. Interface Management Plan.		

11.2.10.2 DID-EN-02

1. TITLE Preliminary Design Review Data Package		2. IDENTIFICATION NUMBER DID-EN-02
3. DESCRIPTION / PURPOSE The Preliminary Design Review Data Package shall provide all of the review materials required for the Preliminary Design Review meeting.		
4. APPROVAL DATE	5. OFFICE OF PRIMARY INTEREST (OPI) Technical Authority, DMEPM(SM) 4-3	6. SPARE
7. APPLICATION / INTERRELATIONSHIP CDRL-EN-02 SOW Ref: 5.8.3		
8. ORIGINATOR	9. APPLICABLE FORMS	
10. PREPARATION INSTRUCTIONS		
10.1 The following preliminary documents must be provided for the Preliminary Design Review meeting: 1. Hardware design; 2. Special Purpose Test And Test Equipment (SPTATE) design; 3. Signal Interface Point to Point List; 4. Hardware interface control document; 5. Software architecture ; 6. Software design; 7. HMI GUI pages design; 8. Software interface design; 9. Control algorithm design description; and 10. OBT, SCT and MT designs.		

11.2.10.3 DID-EN-03

1. TITLE Critical Design Review Data Package		2. IDENTIFICATION NUMBER DID-EN-03
3. DESCRIPTION / PURPOSE The Critical Design Review Data Package shall provide all of the review materials required for the Critical Design Review meeting.		
4. APPROVAL DATE	5. OFFICE OF PRIMARY INTEREST (OPI) Technical Authority, DMEPM(SM) 4-3	6. SPARE
7. APPLICATION / INTERRELATIONSHIP - APPLICATION / INTERDEPENDANCE CDRL-EN-03 SOW Ref: 5.8.4		
8. ORIGINATOR	9. APPLICABLE FORMS	
10. PREPARATION INSTRUCTIONS		
10.1 The following detailed documents must be provided for the Critical Design Review meeting: 1. Hardware design; 2. Special Purpose Test And Test Equipment (SPTATE) design; 3. Signal Interface point to point list; 4. Hardware interface control document; 5. AS Circuit cards schematics and all the internal wiring schematics of the AS equipment; 6. Software architecture; 7. Software design; 8. Software interface design; 9. HMI GUI pages design; 10. Control Algorithm design description; 11. OBT, SCT and MT (both hardware and software) designs; 12. Preliminary FAT plan; and 13. Preliminary STW Plan.		

11.2.10.4 DID-EN-05

1. TITLE Functional Configuration Audit Package		2. IDENTIFICATION NUMBER- DID-EN-05
3. DESCRIPTION / PURPOSE The Configuration Audit Package shall provide the results of the contractor testing of the AS against its functional specification and test procedures. Evidence of compliance with requirements shall be provided.		
4. APPROVAL DATE	5. OFFICE OF PRIMARY INTEREST (OPI) Technical Authority, DMEPM(SM) 4-3	6. SPARE
7. APPLICATION / INTERRELATIONSHIP CDRL-EN-05; SOW Ref : 5.8.5		
8. ORIGINATOR	9. APPLICABLE FORMS	
10. PREPARATION INSTRUCTIONS - INSTRUCTIONS SUR LA PRESENTATION DES DONNEES		

10.1 The Configuration Audit Package may be prepared in the Contractor's format.

This document shall contain the following specific information items:

1. Objective evidence shall be supplied to ensure the following:
   a. As-coded software product reflects the design documentation;
   b. Hardware reflects the design documentation;
2. Review and testing prescribed by documentation is adequate for the acceptance of the software and hardware;
3. Test data compliance with test plan and test procedures;
4. AS was successfully tested and met its requirements;
5. QT and STW reports are correct and discrepancies between actual and expected results have been resolved;
6. TDP complies with standards specified;

10.2 Activities have been conducted according to applicable requirements, plans, and contract.

11.2.10.5 DID-EN-06

1. TITLE - TITRE	2. IDENTIFICATION NUMBER
Engineering Change Specifications Packages	DID-EN-06

3. DESCRIPTION / PURPOSE

The Engineering Changes specifications (EC) packages shall be detailed specifications for changes to the Victoria Class Submarines and the trainers SCT and MT to support the installation of the AS equipment as required by Canada. The EC specifications shall provide the necessary modifications to the electrical and mechanical interfaces and submarine components.

4. APPROVAL DATE	5. OFFICE OF PRIMARY INTEREST (OPI)	6. SPARE
	Technical Authority, DMEPM(SM) 4-3	

7. APPLICATION / INTERRELATIONSHIP INTERDEPENDANCE

CDRL-EN-06
SOW Ref: 3.2.2

8. ORIGINATOR	9. APPLICABLE FORMS

10. PREPARATION INSTRUCTIONS

10.1 Be IAW the requirements in C-03-007-000/AG-001, “Guide For Development of Engineering Change Installation Package”.

10.2 Prepare drawings IAW:
C-03-005-012/AM-001 Part 16, “Standard Engineering Drawing Practices for Class 1 Drawings and Technical Data List”
D-01-400-001/SG-000, “Engineering Drawing Practices for Class Drawing and Technical Data List”
D-01-400-002/SF-000, “Drawing, Engineering and Associated List”
D-01-003-001/SG-000, “Engineering Control of the Ship Drawing and Associated List”

10.3 Prepare the EC Specifications packages using metric units for all submarine integration deliverables, unless the source of the original documentation is non-metric, and no changes to that original documentation is being made.

10.4 Ensure that EC specifications meet the requirements of the Canadian Environmental Assessment Act (CEAA), as specified in A-EN-007-000/FP-001, “Canadian Environment Assessment Act (CEAA)”.

10.5 The EC Specifications Packages including both the preliminary and final versions shall be reviewed by the TA for issues of SAFETY, compliance to the SOW, and any impact on submarine system and trainers SCT and MT effectiveness.

10.6 Shall include lists of all equipment to be removed for refurbishment.

10.7 Shall include lists of all equipment that will be removed permanently for disposition.

10.8 Shall include installation drawings of all equipment that will be replaced, including cables.

1. TITLE - TITRE Design Qualification Report	2. IDENTIFICATION NUMBER- NUMERO D'IDENTIFICATION DID –EN-07

3. DESCRIPTION / PURPOSE - DESCRIPTION / OBJET

The Design Qualification Report reflects the results of all the Design Qualification activities and details how compliance with the AS specification (ref TBD) was achieved in accordance with the Design Qualification Plan (ref TBD)

4. APPROVAL DATE DATE D' APPROBATION	5. OFFICE OF PRIMARY INTEREST (OPI) BUREAU DE PREMIERE RESPONSABILITE (BPR)	6. SPARE

7. APPLICATION / INTERRELATIONSHIP - APPLICATION / INTERDEPENDANCE

CDRL –EN-07
SOW para: 5.6.5

8. ORIGINATOR - AUTEUR	9. APPLICABLE FORMS - FORMULES PERTINENTES

10. PREPARATION INSTRUCTIONS - INSTRUCTIONS SUR LA PRESENTATION DES DONNEES

10.1 The Design Qualification Report may be prepared in the Contractor's format.

10.2 The Design Qualification Report shall as a minimum contain the following information:

a) Description of all the units tested including:

1. Part number/ version number
2. Serial number, and
3. Photographs, if available for Hardware Items.

b) Test Procedures used for testing
c) Traceability from system specification requirements, and
d) Recommendations for further action – if required.

11.2.10.6 DID-EN-08

1. TITLE Physical Configuration Audit Package	2. IDENTIFICATION NUMBER DID-EN-08

3. DESCRIPTION / PURPOSE

The purpose of the As Built List is to provide a set of drawings that define the configuration of the system.

4. APPROVAL DATE	5. OFFICE OF PRIMARY INTEREST (OPI) Technical Authority, DMEPM(SM) 4-3	6. SPARE

7. APPLICATION / INTERRELATIONSHIP

CDRL-EN-08
SOW Ref: 5.8.5.1, 5.8.6.1, 7.10.6

8. ORIGINATOR	9. APPLICABLE FORMS

10. PREPARATION INSTRUCTIONS

10.1 The As Built List may be prepared in the Contractor's format. Exact version and revision numbers shall be verified for the equipment.

10.2 The as built list shall include as a minimum the following drawings:

1. Parts list;
2. Change notices;
3. Software CSCIs; and
4. Other documents in accordance with the requirements stated in the SOW.

11.2.10.7 DID-EN-09

1. TITLE Version Description Document	2. IDENTIFICATION NUMBER DID-EN-09
3. DESCRIPTION / PURPOSE - DESCRIPTION / OBJET Identify and record the exact version of the software, hardware and documentation to be delivered to a user, support, or other site.	
4. APPROVAL DATE	5. OFFICE OF PRIMARY INTEREST (OPI) Technical Authority, DMEPM(SM) 4-3
6. SPARE	
7. APPLICATION / INTERRELATIONSHIP CDRL-EN-09 SOW Ref: 5.8.5.1	
8. ORIGINATOR	9. APPLICABLE FORMS
10. PREPARATION INSTRUCTIONS	

10.1 May be prepared in the Contractor's format.

10.2 This document shall contain the following generic information items:

1. Date of issue and status;
2. Scope;
3. Issuing organization;
4. Intended recipients;
5. References;
6. Overview of system, software and hardware;
7. Full identification of the system, hardware and software, including identification number(s), title(s), abbreviation(s), part number(s), serial number(s), version number(s) and release number(s) (as applicable);
8. Security and privacy considerations;
9. Body;
10. Glossary;
11. Change history.

Specific software related information items for this document have been extracted from MIL-STD-498, Software Version Description (SVD).

11.2.10.8 DID-EN-10

1. TITLE Signal Interface List (Point To Point)	2. IDENTIFICATION NUMBER DID-EN-10
3. DESCRIPTION / PURPOSE - DESCRIPTION / OBJET To aid in hardware and software diagnostic activities, the Signal Interface List shall provide complete and comprehensive point To Point routing information from the AS to the field devices and other submarine equipment.	
4. APPROVAL DATE	5. OFFICE OF PRIMARY INTEREST (OPI) Technical Authority, DMEPM(SM) 4-3
6. SPARE	

7. APPLICATION / INTERRELATIONSHIP CDRL-EN-10 SOW Ref: 7.7.1	
8. ORIGINATOR	9. APPLICABLE FORMS

10. PREPARATION INSTRUCTIONS

10.1 The Signal Interface List may be prepared in the Contractor's format.

10.2 The Signal Interface List shall include as a minimum:

1. Equipment name to which a signal is connected;
2. Signal name or ID;
3. Connector name or ID and PIN information;
4. Electrical signal characteristics, e.g. voltage, current, frequency, digital input/output, and analog input/output and coefficient;
5. Console device number, field device number (Field device functional part number);
6. Electrical wiring diagram representation in a set of hierarchy, systems, subsystem and unit;
7. Signal count with signal type information;
8. Sensor or field device data;
9. Historical record of changes to the sensor configuration data, including date of change and user identification;
10. Default sensor configuration data; and
11. Point to point information internal and external to AS.

10.3 The signal list shall be prepared in Microsoft Excel software to enable it to be uploaded into an existing Signal Data base for the submarines.

11.2.11 Acceptance Testing DIDs

11.2.11.1 DID-AT-01

1. TITLE Acceptance Test Plans		2. IDENTIFICATION NUMBER DID-AT-01
3. DESCRIPTION / PURPOSE Describe the plans for testing of hardware/software items and system integration for the submarines and the trainers OBTT and the MT. Describe the test environments to be used for the testing, identify the tests to be performed, and provide schedules for test activities.		
4. APPROVAL DATE	5. OFFICE OF PRIMARY INTEREST (OPI) Technical Authority, DMEPM(SM) 4-3	6. SPARE
7. APPLICATION / INTERRELATIONSHIP CDRL-AT-01 SOW Ref: 6.3.1		
8. ORIGINATOR	9. APPLICABLE FORMS	
10. PREPARATION INSTRUCTIONS		

10.1 May be prepared in the Contractor's format.

10.2 This document shall contain the following generic information items:

1. Date of issue and status;
2. Scope;
3. Issuing organization;
4. References;
5. Approval authority;
6. Planned activities and tasks;
7. Schedules;
8. Resources and their allocation;
9. Responsibilities and authority;
10. Risks;
11. Quality control measures;
12. Interfaces among parties involved;
13. Environment/infrastructure, including safety needs;
14. Glossary; and
15. Change procedures and history.

10.3 This document shall contain the following specific information items:

1. Test levels;
2. Test classes;
3. General test conditions;
4. Test progression;
5. Data recording, reduction, and analysis;
6. Test coverage (breadth and depth) or other methods for assuring sufficiency of testing;
7. Planned tests, including items and their identifiers;
8. Test schedules;
9. Requirements traceability;
10. Testing environment, site, personnel, and participating organizations.

10.4 This document shall conform to test standards.

11.2.11.2 DID-AT-02

1. TITLE	2. IDENTIFICATION NUMBER
Acceptance Test Procedures	DID-AT-02
3. DESCRIPTION / PURPOSE - DESCRIPTION / OBJET Supplier developed Set-To-Work acceptance test procedures for the AS equipment and software for the submarines and the OBT and MT.	

4. APPROVAL DATE	5. OFFICE OF PRIMARY INTEREST (OPI)	6. SPARE
	Technical Authority, DMEPM(SM) 4-3	

7. APPLICATION / INTERRELATIONSHIP CDRL-AT-02 SOW Ref: 6.3.2 Equipment drawings and specifications, Equipment manuals, “As Configured” list/audit Required Test record forms, and/or computer test results, format samples, previous test results.	
8. ORIGINATOR	9. APPLICABLE FORMS
10. PREPARATION INSTRUCTIONS	
10.1	May be prepared in the Contractor’s format.
10.2	The STW acceptance test procedure shall contain the following, as a minimum: 1. Brief description of the system under test. 2. Set-to-Work set-up description. 3. Set-up plan and procedures. 4. Issuing organization and 5. Approval authority; 6. A clear and concise detailed description of the steps to be followed in the setting to work of the system. 7. Set up Scenarios. 8. Procedures required to perform a system end-to-end calibration. 9. Instructions in a “command-response” type format, stating the commands required and the response that is expected. 10. Conditions, precautions and adjustments required. 11. Expected test results. 12. List of the tools and test equipment required to verify the correct operation of the entire AS and all AS interfaces to existing equipment, and to all internal and external interfaces to submarine systems. 13. Related Interface Control Documents (ICD). 14. Personnel and Equipment safety precautions. 15. Test equipment calibration certificates, as required

11.2.11.3 DID-AT-03

1. TITLE Acceptance Test Reports	2. IDENTIFICATION NUMBER DID-AT-03	
3. DESCRIPTION / PURPOSE To report on the Set-To-Work results for each submarine and the OBT and MT after completion of the task.		
4. APPROVAL DATE	5. OFFICE OF PRIMARY INTEREST (OPI) Technical Authority, DMEPM(SM) 4-3	6. SPARE
7. APPLICATION / INTERRELATIONSHIP CDRL-AT-03 SOW Ref: 6.3.2.1		
8. ORIGINATOR	9. APPLICABLE FORMS	
10. PREPARATION INSTRUCTIONS		

10.1 May be prepared in the Contractor's format.

10.2 The Set-To-Work Report shall include the following as a minimum:

1. Description of the system and the test set up environment.
2. Copies of the STW test plan, the STW test procedures and the STW acceptance procedure.
3. Copies of all the test reports.
4. A summary of the status of the equipment, any changes / modifications that were made during the set up and details of any failures experienced, and the remedial action that was taken to restore the equipment to its specified operating conditions.
5. A section detailing faulty field devices on equipment "set-to-work", which shall include as a minimum:
    a. Test / measurement plan for the I/O testing.
    b. Test / measurement procedure and instrument listing. If appropriate, calibration data on the instruments.
    c. Tabular report on the I/Os status, showing the following:
        i. Operational (Y/N);
        ii. Within tolerance (Y/N); and
        iii. Comments.
    d. Include summary of any (external) I/Os that are outside the AS operational tolerances.

10.3 Summary of any recommendations.

11.2.12 Integrated Logistics Support DIDs

11.2.13 DID-LOG-02

1. TITLE - TITRE Material Safety Data Sheets		2. IDENTIFICATION NUMBER- NUMERO D'IDENTIFICATION DID –LOG-02
3. DESCRIPTION / PURPOSE - DESCRIPTION / OBJET Material Safety Data sheets provide information and instructions on the chemical and physical characteristics of a substance, its hazards and risks, the safe handling requirements and actions to be taken in the event of fire, spill, overexposure or other risk		
4. APPROVAL DATE DATE D' APPROBATION	5. OFFICE OF PRIMARY INTEREST (OPI) BUREAU DE PREMIERE RESPONSABILITE (BPR)	6. SPARE
7. APPLICATION / INTERRELATIONSHIP - APPLICATION / INTERDEPENDANCE CDRL 032 SOW para: 7.9.2		
8. ORIGINATOR - AUTEUR		9. APPLICABLE FORMS - FORMULES PERTINENTES
10. PREPARATION INSTRUCTIONS - INSTRUCTIONS SUR LA PRESENTATION DES DONNEES		
10.1 Material safety data sheets may be prepared in the original product vendor format provided the requirements of sections 10.2 and 10.3 of this DID are met. 10.2 MSDS shall be provided in both English and French		

Contents: - The MSDS shall conform to the requirements specified under the Canada ‘s Hazards Product Act and the Canadian Hazardous Material Information System (WHMIS) and will contain as a minimum information under the following nine headings:

1. Hazardous Ingredients;
2. Preparation Information;
3. Product Information;
4. Physical Data;
5. Fire or Explosion Hazard;
6. Reactivity data;
7. Toxicological Properties;
8. preventive measures and
9. First Aid measures.

11.2.13.1 DID-LOG-03

1. TITLE Consolidated Training Package		2. IDENTIFICATION NUMBER DID-LOG-03
3. DESCRIPTION / PURPOSE A Consolidated Training Package shall be prepared for the Cadre Training course. It shall include deliverables required up on completion of Cadre Training (CT) serial including instruction material, as well as: 1. Course Certificate: The purpose of the Course Certificate is to provide students with objective proof of successful completion of the course. 2. Course Completion Report: The purpose of the Course Completion Report is to report the completion and a basic assessment of each student and a summary of the conduct of the course. 3. Notification of Student Attendance: The purpose of the Notification of Student Attendance is to inform the Technical Authority of personnel who actually reported to the course. 4. Notification of Student Performance Deficiency: The purpose of the Notification of Student Performance Deficiency is to inform the Technical Authority of training problems in a timely manner.		
4. APPROVAL DATE	5. OFFICE OF PRIMARY INTEREST (OPI) Technical Authority, DMEPM(SM) 4-3	6. SPARE
7. APPLICATION / INTERRELATIONSHIP CDRL –LOG-03 SOW Ref: 7.5.3		
8. ORIGINATOR		9. APPLICABLE FORMS
10. PREPARATION INSTRUCTIONS		

10.1 Format of Course Certificate: The Course Certificate shall be prepared in a format similar to that of Form CF289. The certificate shall be printed on high quality paper, with a minimum size of 8 1/2 x 11 inches.

10.1.1 Content: The Course Certificate will contain the following as a minimum:

1. Student name;
2. Course identification and serial;
3. Dates of course; and
4. Signature of course officer.

10.1.2 The Course Certificate shall include any general information that aids in understanding and define any terms and acronyms used.

10.2 Format of Consolidated Training Package: May be prepared in the Contractor's format acceptable to the TA. The Contractor shall implement any Canada recommended format changes to ensure that a clear understanding of this DID has been reached between the Contractor and Canada.

10.2.1 Content of Consolidated Training Package: The Contractor shall utilize the guidance specified in "A-P9-050-000/PT-003 Canadian Forces Manual of Individual Training and Education (CFITES) - Analysis of Instructional Requirements" and CMP Instruction 01/06 to aid in QSP documentation development.

10.3.1 This document shall contain the following generic information items:

1. Date of issue and status;
2. Scope;
3. Issuing organization;
4. References;
5. Summary;
6. Introduction;
7. Context;
8. Message;
9. Contributors;
10. Body;
11. Conclusions and recommendations;
12. Bibliography;
13. Glossary; and
14. Change history.

10.3.2 A Consolidated Training Package shall be delivered for the Cadre Training course serial. The package shall, as a minimum, include the following:

1. Qualification Standard and Plan (QSP) documentation;
2. Lesson plans;
3. Computer aided instruction modules, including learning objects;
4. Reference materials;
5. Student handouts;
6. Student study materials;
7. Scenarios and mission plans;
8. Instructors' notes;
9. Instructors' assessment sheets;
10. Enabling checks;
11. Performance checks;
12. Student Course evaluation (critique) forms;
13. A list and description of all training aids, component cross-sections, simulators or equipment necessary for the conduct and evaluation of the course; and
14. A list and description of any other documentation or software necessary for the conduct of training and learner assessment, in the particular course.

Format of Course Completion Report: The Course Completion Report shall be prepared in the Contractor's format. The format of the first Course Completion Report submitted shall be subject to approval by the Technical Authority, and once approved, shall become the standard for future Course Completion Reports.

10.4.1 Content: The Course Completion Report shall provide, as a minimum, the following information:

1. Course Details:
   a) The Course Name,
   b) Course Dates,
   c) Course Qualification,
   d) Location(s) of Training, and
   e) A general summary of the conduct of the course by the course instructor(s) and of the results and comments from the students' course critiques.

2. Class List and Completion Status Summary including a listing of all students and their results as either pass, fail, or incomplete; and

3. A CF377 Course Report for each student completed IAW the directions contained in DAOD 5031-9.

10.4.2 The Course Completion Report shall include any general information that aids in understanding and define any terms and acronyms used.

10.5 Format: for Notification of Student Attendance: The Notification of Student Attendance shall be prepared in the Contractor's format.

10.5.1 Content: The Notification of Student Attendance will contain the following sections as a minimum:

1. Dates of the reporting period;
2. Training days during the reporting period; and
3. For each student missing any training time:
   a) The dates and duration of the absence(s), and
   b) Reason for absence (if known).

10.5.2 The Notification of Student Attendance shall include any general information that aids in understanding and define any terms and acronyms used.

10.6 Format: The Notification of Student Performance Deficiency shall be prepared in the Contractor's format.

10.6.1 Content: The Notification of Student Performance Deficiency shall contain the following sections as a minimum:

1. Student name and rank;
2. Student Service Number;
3. Course name and serial;
4. Course dates;
5. A description of the problem;
6. A description of any remedial action taken and/or planned; and
7. Recommendations.

10.6.2 The Notification of Student Performance Deficiency shall include any general information that aids in understanding and define any terms and acronyms used.

ANNEX B

TECHNICAL STATEMENT OF REQUIREMENTS (TSOR) FOR THE AUTOPILOT SYSTEM (AS) FOR THE VICTORIA CLASS SUBMARINES (VCS)

NOTICE

This documentation has been reviewed by the technical authority and does not contain controlled goods. Disclosure notices and handling instructions originally received with the document shall continue to apply.

AVIS

Cette documentation a été révisée par l'autorité technique et ne contient pas de marchandises contrôlées. Les avis de divulgation et les instructions de manutention reçues originalement doivent continuer de s'appliquer.

LIST OF EFFECTIVE PAGES

Insert latest changed pages, dispose of superseded pages in accordance with applicable orders.

NOTE

On a changed page, the portion of the text affected by the latest change is indicated by a vertical line in the margin of the page.

Dates of issue for original and changed pages are:

Change	…1.0…	03 August 2012
Change	1.1	26 October 2012

A zero in Change No. column indicates an original page. The Total number of pages in this TSOR is 66, consisting of the following:

Page No.	**Change No.**
1 to 66	1.0
6, 7, 10, 12, 13, 14, 25, 26, 30, 31, 33, 34, 35, 36, 37, 40 41, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 54, 55, 56, 59, 62, 63, 64, 65, 66, 67, 68 and 69	1.1

Table of Contents

LIST OF FIGURES

List of Tables

1 Scope

1.1 Purpose

This Technical Statement Of Requirements (TSOR) defines the technical and performance requirements for the replacement of the Autopilot System (AS) on the VICTORIA Class Submarines (VCS), four (4) in total; SSK 876 VICTORIA, SSK 877 WINDSOR, SSK 878 CORNER BROOK and SSK 879 CHICOUTIMI. There are two submarines located in Halifax and two in Esquimalt. This TSOR also details the upgrade work for the associated shore based trainers, Submarine Control Trainer (SCT) and Maintenance Trainer (MT); and the new an Onboard Trainer (OBT). The Shore Based Trainers are located at the Canadian Forces Base (CFB) Halifax.

The AS consists of a One Man Console (OMC), Computers and three (3) Electronic Enclosures distributed throughout the submarine. The AS replacement shall be accomplished by customization of Commercial Off The Shelf (COTS) components and or by design, integration, system test, installation, set to work, training, integrated logistics support, and documentation.

1.2 Background

The Victoria Class Submarine (VCS) is fitted with the Ferranti design based AS that implements the automatic control, the manual control and numerous combinations of these controls. Due to obsolescence the AS is no longer supportable.

It is a Canada's plan to replace the AS with a fully supportable system that provides the same core functionality as the existing system. Block diagram of the existing system and a conceptual block diagram of the replacement system are provided in **Figure 1** and **Figure 3**. All the existing AS components including, Operator Panel keyboard and display, Computers, Electronics Enclosures, Monitoring and Mode Selection Unit and Maintenance Panel shall be replaced with new components that fit into the existing space envelopes and weights of the legacy system. A new OBT shall be designed and the SCT and the MT shall be upgraded to use the new submarine AS hardware, software and the new user interfaces. Due to the design information not being available of the SCT simulation software, the Contractor shall not be responsible for the upgrade (integrate) of SCT using the new AS hardware and software. The interface software development for the new AS hardware and software and the upgrade of the SCT shall be carried out in a separate contract

1.3 Objectives of the AS Replacement

The fundamental objectives of the AS replacement system is to:

1. Sustain the existing AS functions, their functionality and the performances as per section 4.5.7 by replacing the AS equipment enclosures and all components contained therein with modern, fully supportable technology within the same space envelopes currently occupied by the existing AS equipment enclosures;

2. Implement the AS to interoperate with the existing Electrical Ethernet Local Area Network (LAN) installed as part of the Fire Detection System (FDS) and the Central Surveillance System (CSS) projects;

3. Retain to the maximum extent possible the existing field cabling between the AS components, the field devices and the external systems/panels with which the AS interfaces;

4. Provide the SCT upgrade kit using the submarine AS hardware and software to represent the same man machine interface as on board the submarine;

5. Enhance the existing shore-based MT to include the complete functionality of the AS. The MT shall be used to facilitate training on the conduct of preventive maintenance, trouble-shooting and defect rectification of the AS; and

6. Document the technical details of the control algorithm and provide the AS software as both source code and a linkable executable for research, computer simulation, and free-swimming scale model simulation purposes.

1.4 Acronyms and Abbreviations

For acronyms and abbreviations, refer to section 7.

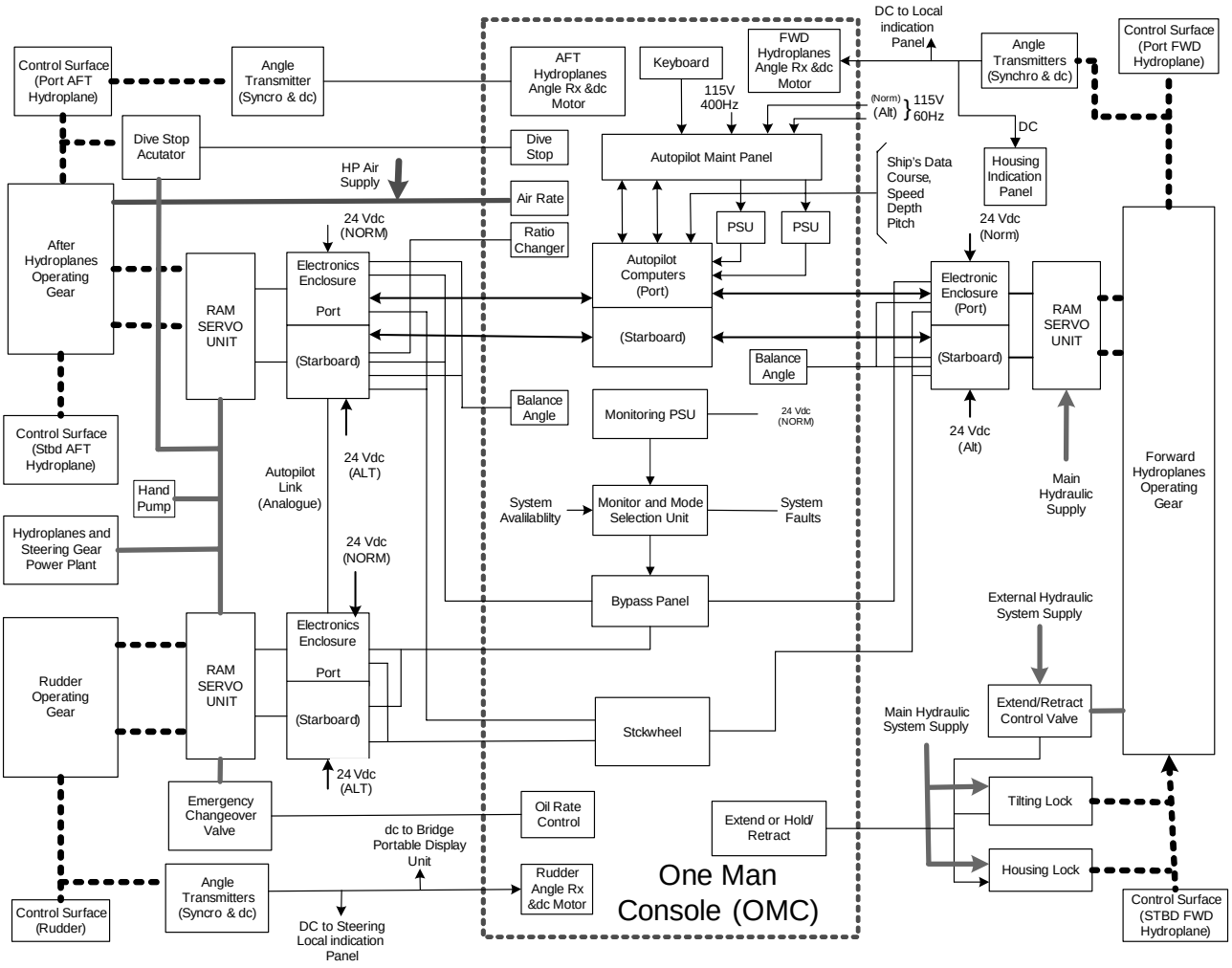

Figure 1: Block Diagram of the Existing AS

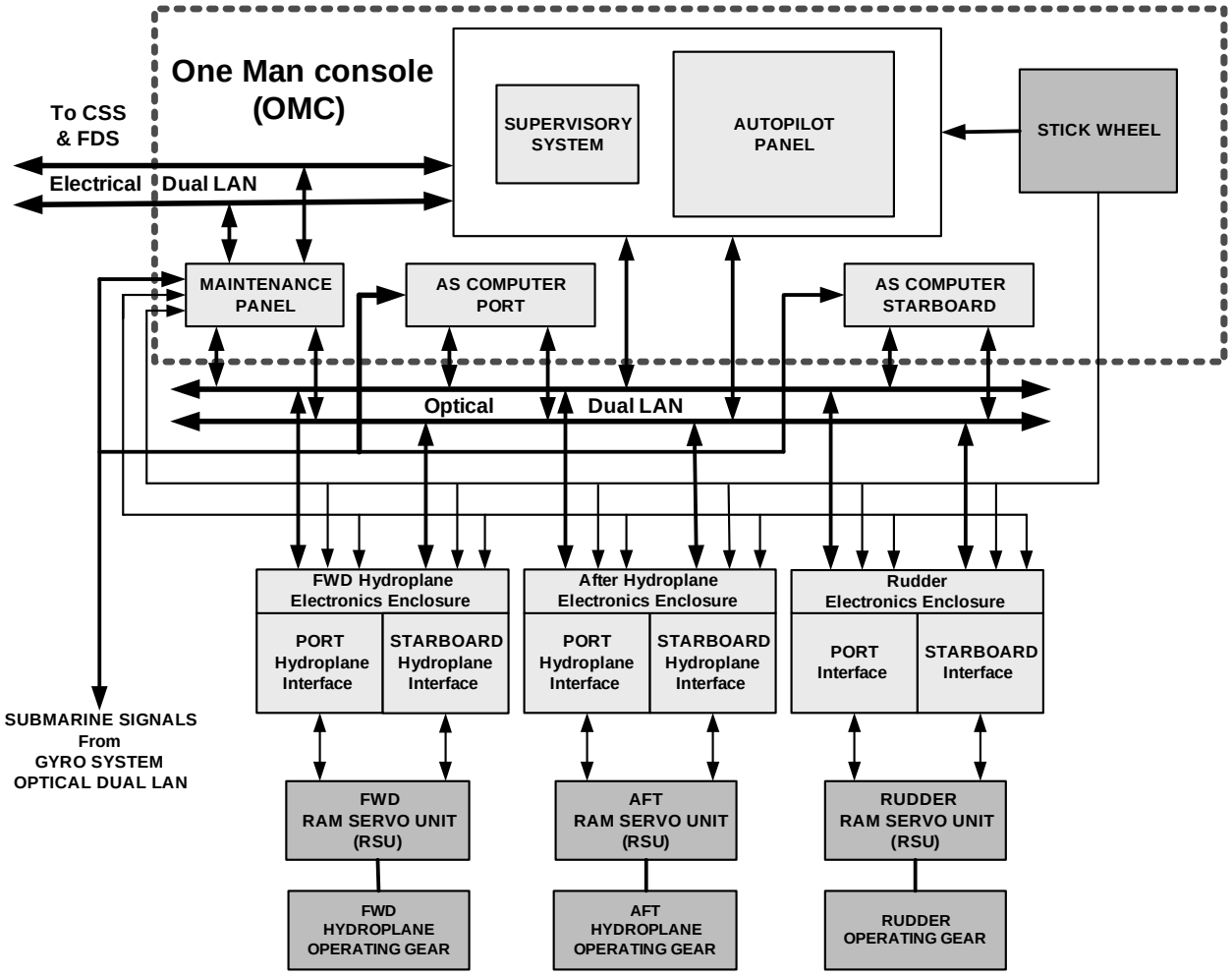

Figure 2: Conceptual Block Diagram of the Replacement AS

2 Applicable Documents

The prescribed versions of the following documents are to form a part of this specification to the extent specified herein.

2.1 Government Documents

Table 1: List of Government Documents

Item	Document Number	Title
1.	Annex A Version 1.0	AS SOW
2.	BRF1966(21)02	One Man Control Console
3.	BRF 1966(22)12 Part 1	Autopilot and Rudder and Hydroplanes Electronics Enclosures
4.	BRF 1966(22)12 Part 2	Autopilot and Rudder and Hydroplanes Electronics Enclosures
5.	BRF1966(22)03	Rudder and Hydroplanes Control Systems
6.	S/EL/DES/2400/27 Feb 1991	Hydroplane and Steering Control System (As Built System Design Description)
7.	Ref: NE149	Design Report for Autopilot System for Type 2400 Submarines, July 1980
8.	Autopilot Maintainer's Notes	Autopilot Maintainer's Notes
9.	SSK/P/423/60/5079	OMC Facia Panel (Mechanical drawing)
10.	BRF 1966(21) 06	Grade A and B Alarms
11.	C-03-007-000/AG-001	Guide to development of Engineering Change Installation package
12.	C-03-005-012/AM-001	Naval Maintenance Management System Parts 1 & 2
13.	A-EN-007-000/FP-001	Canadian Environment Assessment Act (CEAA)
14.	D-03-003-007/SG-000	Light & Medium Weight Environment
15.	Excel Spread File, Version 1.0	AS I/O Signal List Summary
16.	BRf 1966(220 10	Rudder and Hydroplane Control Gear

2.2 Non-Government Documents

Where Standards are referenced in this document, the whole standard shall not apply unless specifically directed. The reference will indicate what tailoring is required by the Technical Authority. If no tailoring is specified, then the Bidder shall specify the extent of his compliance to the referenced standard in his proposal.

If any referenced standard has been superseded by a new revision or it has become obsolete and it has been replaced by a new standard or it has not been replaced, then the Contractor shall use the latest revision or replaced standard or an equivalent standard respectively.

Table 2: List of Non-Government Documents

Item	Standard	Title
1.	MIL-STD-167-1A 02 Nov 2005	Vibration of Shipboard Equipment
2.	MIL-STD-461E Rev E: Aug 1999	Requirements for the control of electromagnetic interference characteristics of subsystems and equipment shall comply with CE 101, CE 102, CS 109, CS 114, CS 116, RE 101, RE 102, RS 101 and RS 103
3.	MIL-STD-1310G Rev G: June 1996	Shipboard bonding grounding and other, techniques for Electromagnetic Compatibility and Safety
4.	MIL-S-901D (Navy) Rev D: March 1989	Shock Tests. H.I. (High-Impact) Shipboard Machinery, Equipment, And Systems
5.	MIL-STD 810F Rev D: 1 January 2000 Revision Change Notice 3 May 2003	Environmental Engineering Considerations And Laboratory Tests
6.	MIL STD 464A (Active) Base: March 1997 Revision A: Dec. 2002	Electromagnetic Environmental Effects Requirements For Systems
7.	MIL STD 1399C –300 (Active) Rev C: Feb.1988	Interface Standard for Shipboard Systems, Electric Power, Alternating Current
8.	MIL HDBK 2036 Base: November 1999	Preparation of Electronic Equipment Specifications
9.	MIL-HDBK-454A Base: April 1995 Rev A: Nov 2000	General Guide Lines (1 to 78) for electronic equipment excluding guidelines 6, 21, 27, 29, 31, 41, 42, 43, 46, 48, 49, 53 and 56.
10.	ISO/IEC 12207, 1995	IEEE Standard for Software Life Cycle Processes
11.	Mil STD 973 CM	Configuration Management
12.	NMEA 0183, Version 4.0 January 1, 2002	National Marine Electronics Association Standard for Interfacing marine Electronics Devices

2.3 Order of Precedence

In the event of a conflict between the contents of this document and the applicable portions of the referenced documents, the contractor shall inform the Technical Authority (TA) of the differences and request for a resolution.

3 Existing Autopilot System (AS)

This section provides a general overview of the existing Autopilot System (AS) functionality and its performance capabilities. For more details, refer to references in section 2.1, Table 1 and items 2 to 10.

3.1 System Description

3.1.1 General

The AS provides the control of the submarine's course, pitch and depth. The AS design is based on dual completely independent redundant computers and these computers are designated as Port and Starboard. A block diagram of the existing AS is shown in Figure 1. Each computer has a total capability for providing automatic depth and course control. A single autopilot keyboard inputs set point data to both computers simultaneously, i.e. if the Port computer is 'on line' the starboard computer is in the 'follow up or back up' mode, and vice versa.

Commands from the computers are transported over the serial signalling systems; also known as 'S^3 or 'S-Cubed' to the Electronic Enclosures which then drive the Torque motors fitted as part of the Ram Servo Units (RSU). The RSU controls the flow of oil to hydraulic cylinder and hence the position of the control surfaces of the forward and aft hydroplanes and the rudder. All components with the exception of the Electronic Enclosures (EEs) and Ram Servo Units (RSUs) are contained within the OMC which is part of the Submarine Control Console (SCC). Each EE and RSU is located local to each control surface which it serves.

Comprehensive fault monitoring facilities are built into the legacy AS and associated data links and failure is communicated directly to the monitoring and mode selection system. Both Port and Starboard computers are continuously supervised by the Monitor and Mode Selection Unit which detects operational faults and based on types of failures performs the necessary transference from one computer system to the other. In the event of the automatic control failure, audible and visual alarms are generated and the system immediately reverts to manual control. The indication provided by the monitoring system in conjunction with the legacy AS keyboard indications constitutes the primary 'man-machine interface' for automatic control of the submarine.

3.1.2 AS Computers

The legacy AS Computer rack contains the circuit cards called the STEP modules containing the port and starboard computers, computer interfaces and their associated cooling fans. The computers are installed in the base of the One Man Console (OMC). For details, refer to OMC and the Autopilot Computers in Figure 3 and Figure 4.

3.1.3 Keyboard Module (Autopilot Panel)

A single keyboard provides facility to input simultaneously set point data to both the system computers. The keyboard also provides the facility to conduct a number of special test manoeuvres. Incorporated into the keyboard is a system test facility for onboard determination of AS performance. In normal operation this facility is disenabled. The keyboard module is designed for quick removal and replacement by a spare unit in the event of a failure. The spare unit is housed in the console. For details, refer to Keyboard Module in Figure 5.

3.1.4 Monitor and Mode Selection Unit

The Monitor and Mode Selection Unit (MMSU) is central to the design philosophy of the legacy AS. For details, refer to the MMSU in Figure 6. The MMSU is housed in the OMC and contains selector pushbuttons and indicators to allow the operator to identify and control modes available and those that are currently in use. It also provides facility for changing the modes when required; that is engaging either of the two channels available for both auto and manual control.

The MMSU comprises of a number of distributed local monitoring units each communicating with the central unit. The local monitoring units are designed to detect abnormalities with the hydroplanes and steering system and are able to relay the fault and fault location back to the central control unit, i.e. MMSU

The MMSU is capable of automatically changing the control and system modes, i.e. automatic to manual and port to starboard, in the event of abnormalities in the system and depending on the current conditions and fault location.

3.1.5 Bypass Panel

The bypass panel allows operator selection of manual control and selection of the port or starboard control channel. For details, refer to the Bypass panel in Figure 10.

3.1.6 Ratio Changer

The Ratio Assembly allows the adjustment of the angle ratio between the aft and fwd hydroplanes over the range -25% to 100%. This is achieved using a manually settable ratio control mounted adjacent to the stickwheel on the OMC incorporating two Linear Variable Differential Transformers (LVDTs) driven by a lead screw mechanism; one LVDT for each control channel. For details, refer to the Ratio Changer in Figure 8.

3.1.7 Balance Angle Assembly

The Balance Angle Assembly adjustment allows up to +/- 4^{o} deflection from the zero datum for both aft and fwd hydroplane control surfaces. The angular adjustment is accomplished by two LVDTs operated by control knobs mounted on

the OMC adjacent to the stickwheel; one LVDT is designated for each channel. For details, refer to the Balance Angle in Figure 9.

3.1.8 Remote Rate Control

In the event of failure of manual position control, the rudder can be operated by an electrical remote rate control. The rudder is operated using hydraulic oil from either the Steering and Hydroplanes hydraulic system (normal) or Main hydraulic system (rate main control) using a remotely operated change-over valve.

3.1.9 After Planes Air Emergency Control

In the event of failure of manual position control the after hydroplanes can be operated by a remote air emergency system using high pressure (HP) air on a pneumatic cylinder connected in tandem with the hydraulic cylinder. Air emergency is selected via a pneumatic change-over valve in the control room.

3.1.10 Local Rate Control

In the event of total failure of the electronic and the electrical control, facilities are provided for manually controlling all the control surfaces locally. Facilities are incorporated into the RSUs of all three surfaces to allow control of the hydraulic cylinders through the Local Rate Control Valves.

3.1.11 Manual Position Control

Manual position control is affected by a small stickwheel mechanism mounted directly to the submarine control console. Ordered angles are generated as D.C. voltages which are applied to the RSU Torque Servo amplifier as a reference signal. The LVDTs signal generators are driven by the stickwheel mechanism. The balance angle facilities are provided on the forward hydroplane. The balance angle and ratio change facilities are provided on the after hydroplane.

For each control surface dual signal generators are fitted, designated Port and Starboard. On failure of automatic control the monitoring system reverts to and requires manual position control. Both monitoring and control system are configured such that when this occurs the control surface comes to the position demanded by the stickwheel and thereafter follows it.

3.1.12 Maintenance Panel

The Maintenance Panel (MP) allows the checking, verification and maintenance of the operations of the MMSU, keyboard, computers and power supplies. In addition, the MP allows a spare keyboard to be plugged in to carry out system diagnostics. For details, refer to Maintenance Panel in Figure 7.

3.1.13 S^3 or S-Cubed Data Link

The S^3 data link is a high rate digital data link with high noise immunity. For integrity purposes, there are two independent Fwd and Aft S^3 data links. The commands from the AS computers are transmitted to each forward and after Electronic Enclosures over the S^3 data link. For details, refer to S^3 in Figure 11.

3.1.14 Electronic Enclosures

The forward and after hydroplanes Electronic Enclosures (EEs) contain the S^3 data link interfaces, Digital to Analogue (D/A) converters, monitoring circuits and power amplifiers. The Rudder EE does not have a direct S^3 data link interface to the AS Computers, instead the AS commands to the rudder EE are transmitted via an analogue link from the aft hydroplane EE. For details, refer to Electronic Enclosure in Figure 12.

3.1.15 Ram Servo Unit (RSU)

The complete independent direct drive torque motors provide commands to the tilting ram servo valve (distributor valve). Each servo motor is packaged with position and velocity feedback transducers to form a composite unit. These units together with their servo amplifiers form type 1 position servos. The servo amplifiers, digital to analog converters and monitoring circuits are housed in a separate environmental proof enclosure.

3.1.16 Power Supplies

3.1.16.1 AS Computers

The legacy AS computers use two (2) independent 115V 60 Hz single phase supplies. In the case that both 115V 60 Hz supplies fail, then the 24 VDC Grade 1 supply is used to generate two (2) independent 115VAC 60Hz sources.

3.1.16.2 Manual Control and Monitoring Panel

The 24 V DC Grade 1 supply provides power to the central MMSU, to both the port and starboard manual systems. The central monitoring systems have two (2) redundant converters configured in parallel, each capable of supplying the maximum power requirements for the central MMSU, hence failure of one (1) converter does not make the central monitoring system unavailable. The port and starboard systems each have their own independent DC/DC converters so that upon failures of one DC/DC converter, full manual control is still available by the other DC/DC converter.

3.1.16.3 Electronic Enclosures

Each EE uses the submarine's 24VDC Grade 1 (normal) and Grade 2 (Alternate/Backup) supplies. The EE re-distributes the 24VDC to the stickwheel and MMSU at the OMC. Each control channel has an independent Power Supply Unit deriving power from submarine's 24 VDC supplies.

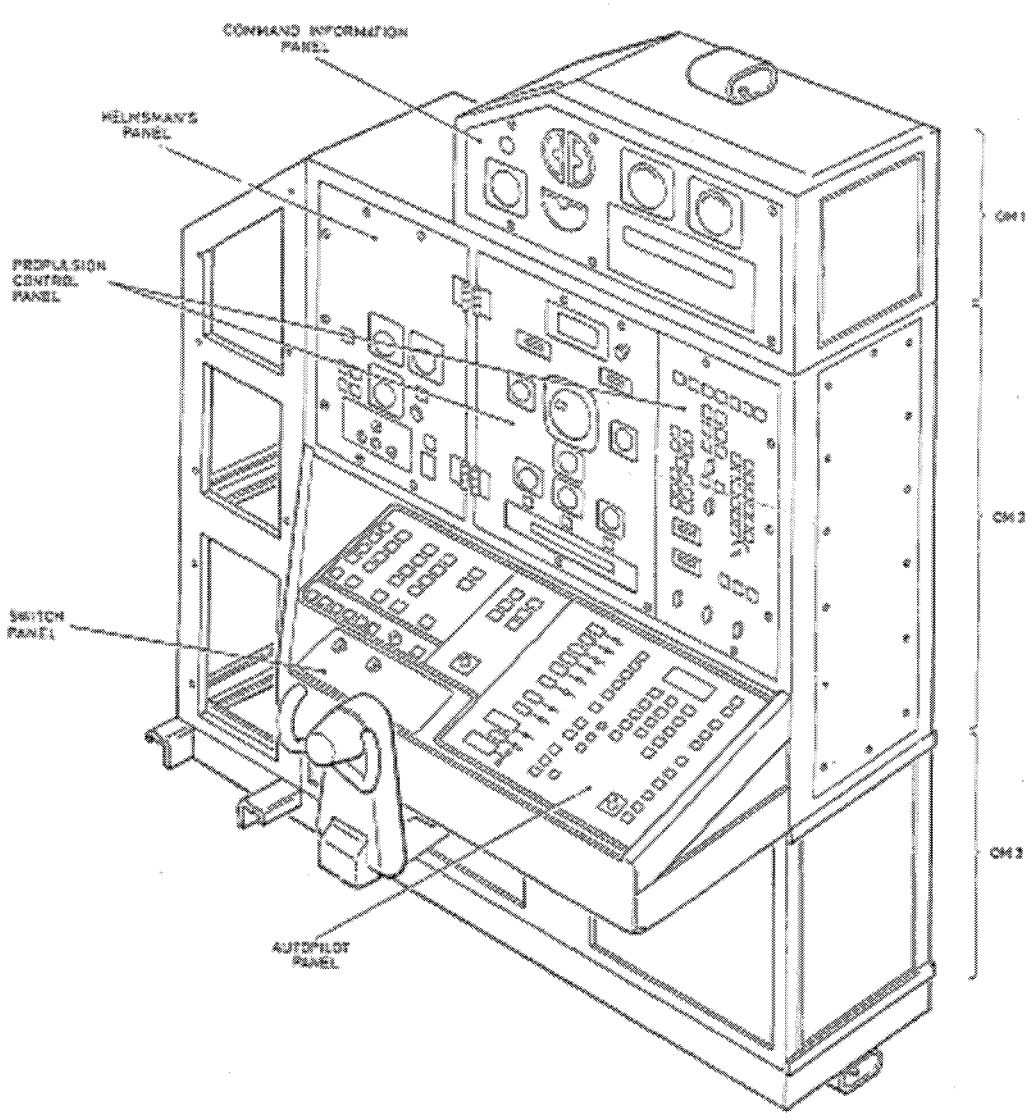

Figure 3: One Man Console (OMC)

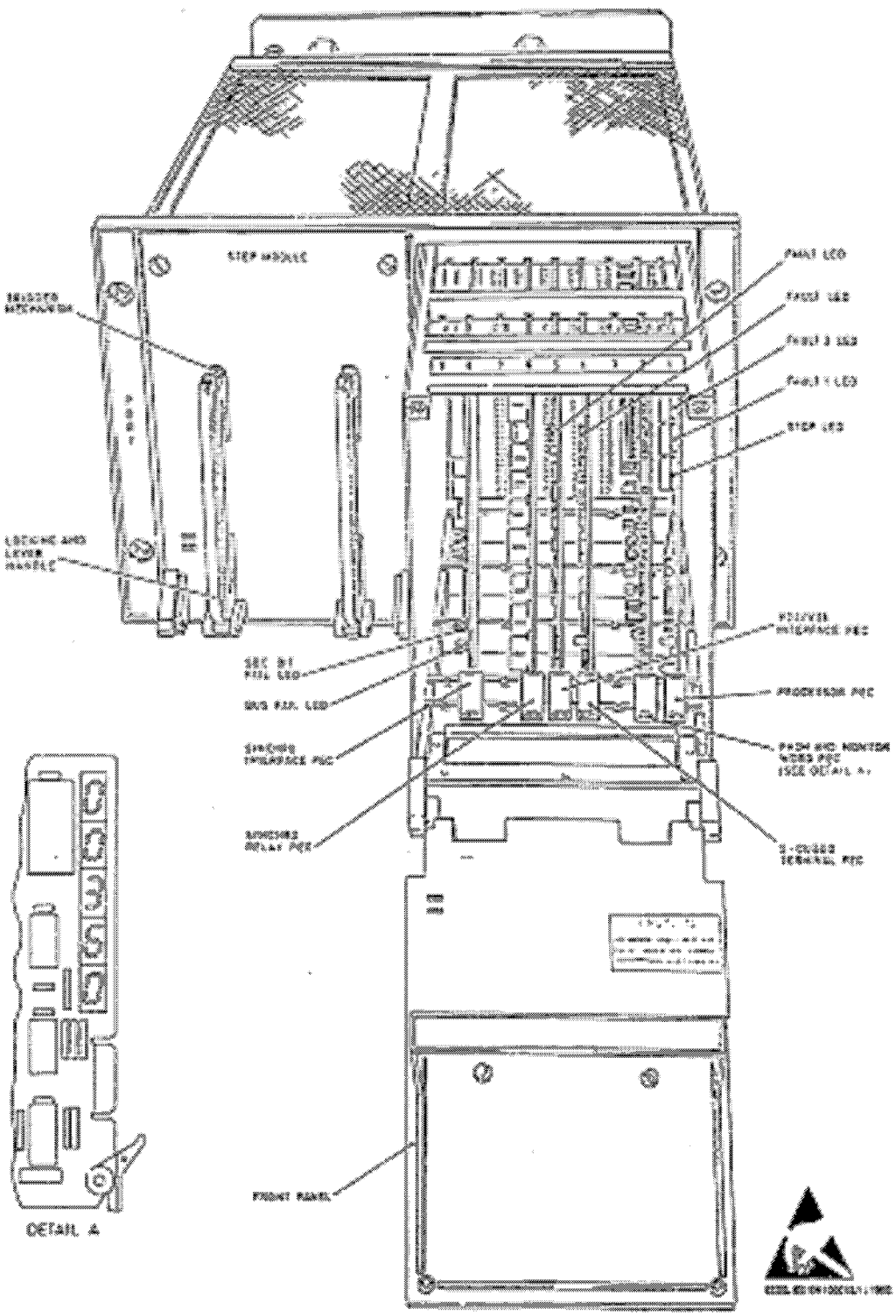

Figure 4: AS Computers (Step Modules)

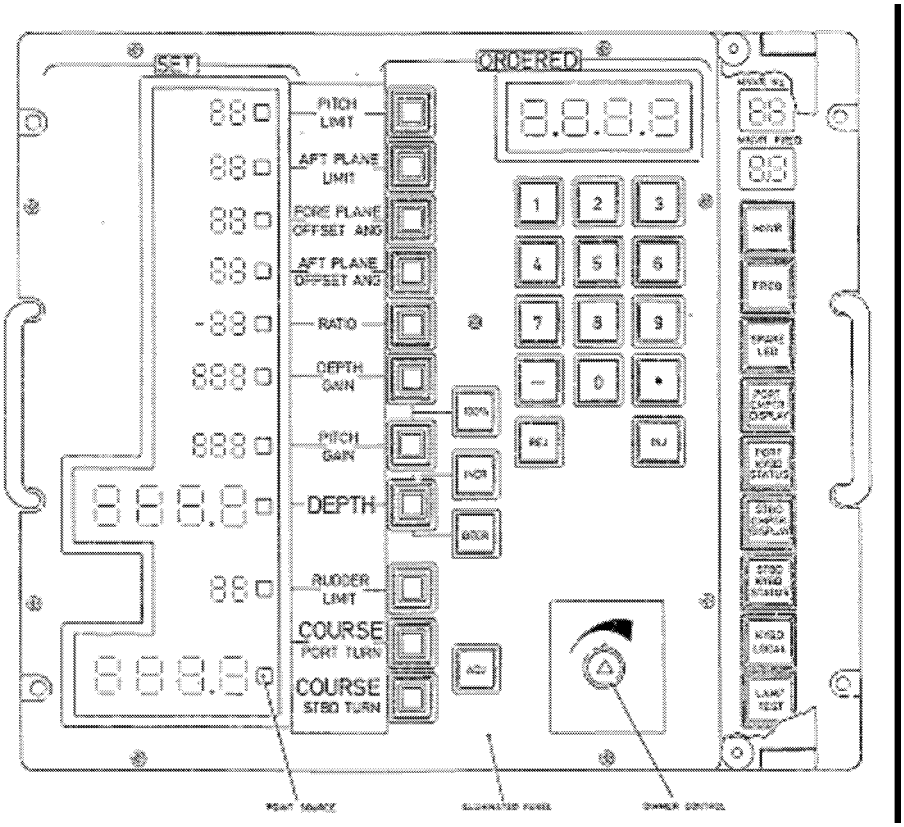

Figure 5: Keyboard Module

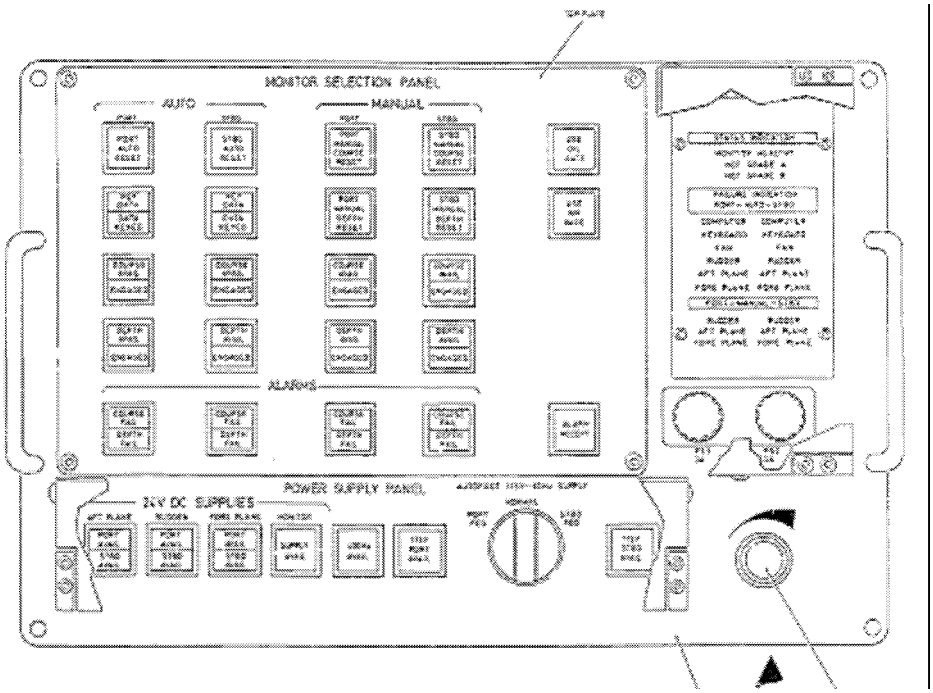

Figure 6: Monitor and Mode Selection Unit

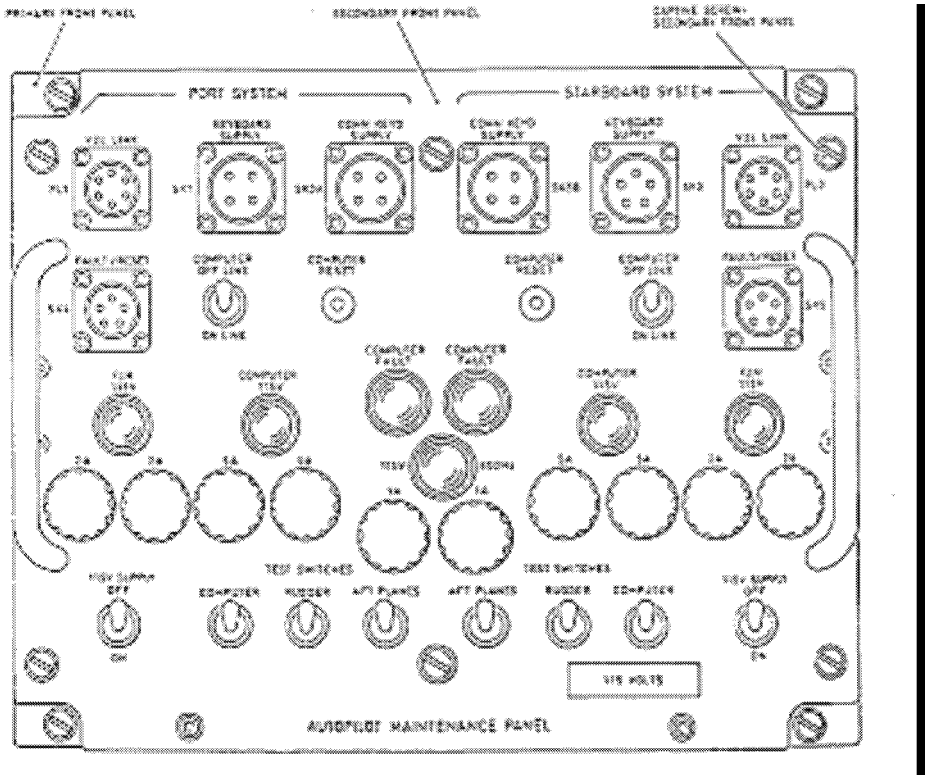

Figure 7: Maintenance Panel

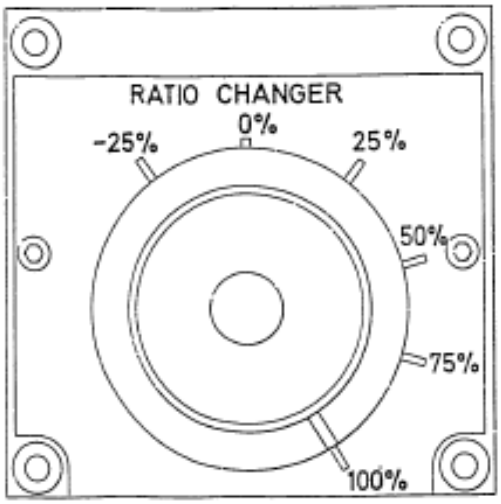

Figure 8: Ratio Changer

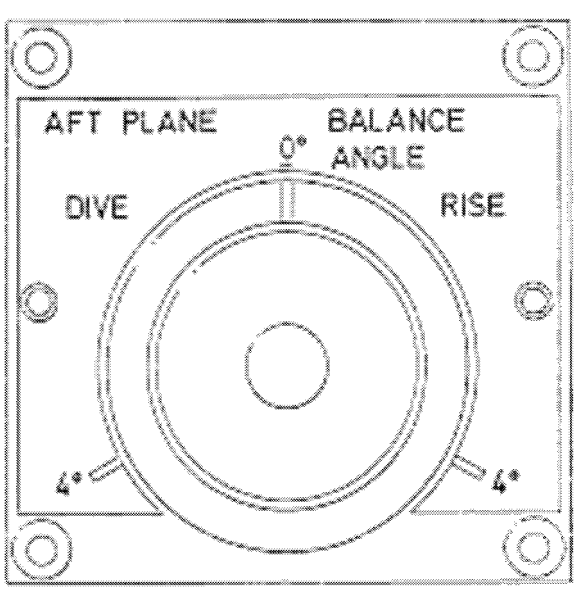

Figure 9: Balance Angle

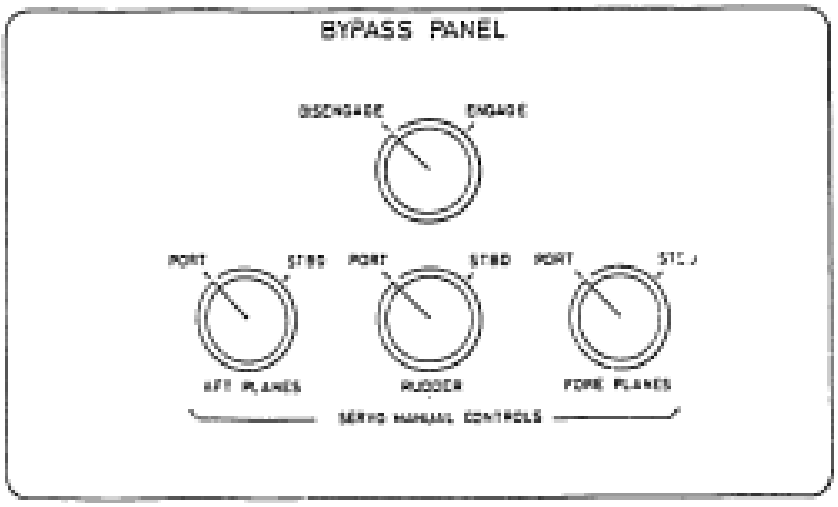

Figure 10: Bypass Panel

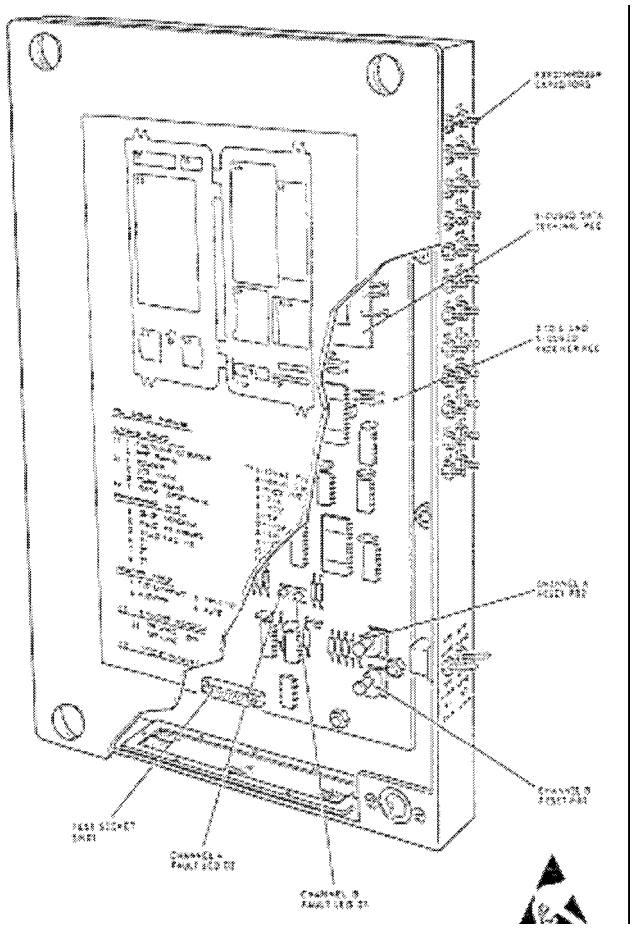

Figure 11: S^3 Assembly

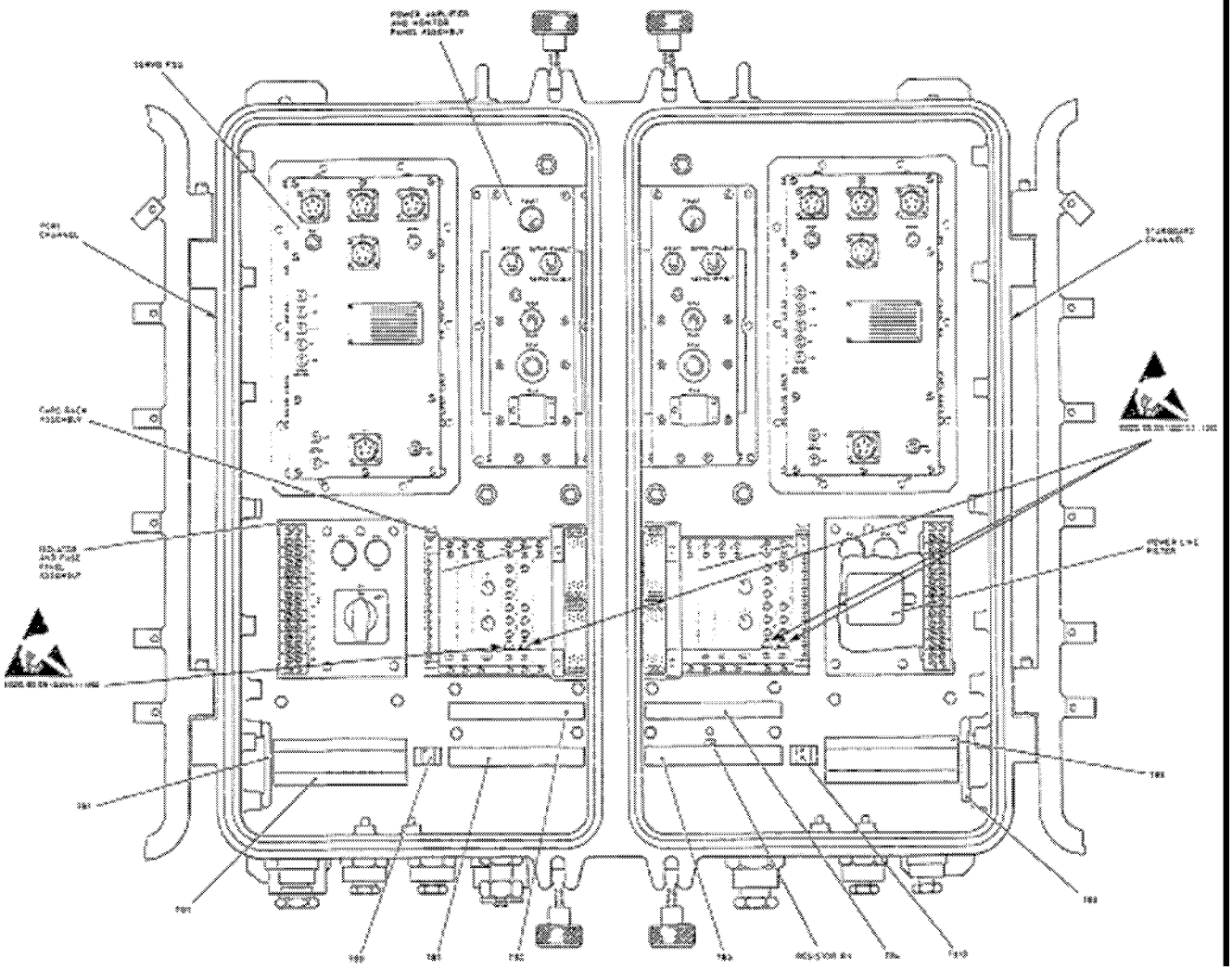

Figure 12: Electronic Enclosure

3.2 System Operation

3.2.1 General

In automatic control, digital signals from the AS computers are communicated on the S^3 serial data link highway to the EEs, which are then converted within the EEs to analogue signals by the D/A converters. In manual control, analogue signals are received from the LVDTs operated by the stickwheel. The selection between signals is made within the EEs by operator action at the OMC using the MMSU.

At the EE the analogue demand signal drives a servo amplifier. The output from the servo amplifier is applied to the torque motor which moves the input end of the differential beam. The differential beam, pivoting about its mechanical feedback connection to the ram, moves the distributor valve spool from the neutral position. Hydraulic oil is admitted to the ram and moves it in the required direction until differential beam, now pivoting about the input point, returns the distributor valve spool to the neutral position.

In case of an emergency with no remote control available, it is possible by disconnecting a mechanical link, to override the torque motor and operate the distributor valve by hand using a locally housed extender bar on the differential beam. During local hand operation, control surface angles are read off the local mechanical indicators or DC meters.

3.2.2 Automatic Control

The automatic control of depth and course is achieved by the AS and it consists of:

1. Port Computer System;
2. Starboard Computer System;
3. Keyboard;
4. Monitoring and Mode Selection Panel;
5. Bypass Panel;
6. Forward Electronic Enclosure and RSU;
7. After Electronic Enclosure and RSU;
8. Rudder Electronic Enclosure and RSU; and
9. AS Maintenance Panel.

All units with the exception of the EEs and the RSUs are contained within the OMC.

3.2.3 AS Operation

The port and starboard computers are separately controlled and monitored. Each system is designed to accept data from depth, course, speed, pitch, roll and heading transducers via their respective synchro distribution systems and to calculate and output ordered angle values to the control surfaces.

All set point data to both computers is entered simultaneously through the common keyboard. The keyboard display identifies set course and depth values while actual values of controlled surface angles are shown via meters on the OMC.

Fault monitoring is performed within each computer system to ensure that each system is operating within the defined limits.

3.2.4 S^3 Data Link

The S^3 data link uses a four (4) wire bidirectional data transmission system. The data is transmitted in digital form in frames; each frame consists of a header, an envelope consisting of data groups and check sum group. The envelope holds between one (1) and fifteen (15) groups of data. The digital data is then converted to analogue by D/A converters mounted locally to the servo amplifiers in the EEs.

3.2.5 Keyboard Module (Autopilot Panel)

The keyboard provides the Man/Machine interface to the AS. The keyboard layout is organized such that the normal operator input to the computer is by a keypad made of individual pushbuttons. The operator first selects a function key, i.e. depth, Course etc. followed by the numeral set data point value. The data value is then displayed on the 'ordered' display on the panel.

If the data is within allowable system parameters, monitored by hardware and verified by software, the value entered as the 'ordered' display is transferred to the 'set' display by pushing the 'INJECT' (INJ) button. If the data is outside the allowable system parameters the 'ordered' display value is not entered into the 'set' display, four (4) decimal points are shown in the 'ordered' display indicating data is outside limits. New values must then be entered into the 'ordered' display after first rejecting the unacceptable order by pressing the 'REJECT' (REJ) button.

The balance and ratio controls described earlier operate only in Manual control. In the Automatic mode, the corresponding offset figures must be keyed in using the appropriate buttons on the keyboard. Offsets can only set the rise direction for each depth control interface.

The Maintainer controls are located beneath a hinged cover and these provide the following to:

1. Take one (1) channel off-line for test and maintenance purposes and also blank one or both channels on the operator displays; and
2. Select and operate pre-programmed manoeuvres held in the computer software to check their correct functioning.
3. Tests for correct functioning of operator controls (pushbutton switches and displays) independent of the AS computers and without interfering with control.

3.2.6 Electronic Enclosures

Each enclosure is configured into dual port and starboard systems, each comprising power supply conditioning and distribution, test panel, position control servo electronics and electronic circuit monitoring.

The control demand and feedback signals are fed to the EE as inputs to the power amplifier, the output of which drives the torque motor on the RSU. Each of the three (3) EEs contains Port and Starboard system control channels, either channel can be selected to control the relevant RSU, refer to section 2.1, Table 1 and Item # 16. The distributor valve of the RSU controls the flow of oil to the ram which ultimately positions the control surface.

Only one (1) power amplifier is selected at any one time and consequently only one (1) motor on the distributor valve drive unit of the RSU is energized at a time.

The electronic monitoring circuits provide a fault signal to the MMSU when pre-determined parameters within the electric servo loop are exceeded. This causes the selected control channel to trip out.

Each EE has built in diagnostics for both port and starboard channels to aid fault diagnosis and identify status of the equipment at any time.

3.2.7 Monitor and Mode Selection Unit (MMSU)

The computers, keyboard and electronic equipment within each EEs continually monitor their status and transmit the results to the MMSU. The MMSU contains selector pushbuttons and indicators to allow the operator to identify the control modes that are available for use as well as those that are currently in use and to be able to change these modes when required.

The MMSU continuously monitors the AS electronics and immediately recognizes fault conditions arising in all possible combinations of automatic and manual position control. The systems are designed on a fail-safe basis and it cascades the system from the highest level of control downward as follows:

1. Port autopilot using port servo to;
2. Starboard autopilot using starboard servo to;
3. Starboard manual position control using starboard servo to;
4. Port manual position control using port servo to; and
5. Emergency alarms (use rate control).

Apart from the change of mode that takes place when the fault occurs the system element that is at fault is identified by a display. In the event of failure of one (1) AS Computer, a low level flashing light warning is provided on the panel and a Grade B alarm is asserted. If both AS computers should fail, the system automatically reverts to manual position control, a high level alarm is provided and

a Grade A alarm is asserted. If one (1) manual channel should fail a Grade B alarm is asserted and if both channels fail a Grade A alarm is asserted.

3.2.8 Bypass Panel

If MMSU develops a fault, the operation at the Control Surfaces can be automatically switched at the bypass panel to manual control, i.e. stickwheel, etc. The bypass panel is housed close to the MMSU. The servo through which control is carried out (i.e. port or starboard) is then selected by switches on the Bypass Panel.

3.2.9 Maintenance Panel

The AS Maintenance Pane (MP) provides the following features:

1. 115V 60Hz fuse, indication and isolation to each computer system;
2. 115V 60Hz fuse, indication and isolation to the synchro links used within the autopilot;
3. 115V 60Hz fuse, indication for each cooling fan;
4. Fault indication and reset to each computer system;
5. Facility to switch off each computer off line, i.e. advises MMSU that a computer is not available;
6. Facility to connect spare/test keyboard to each computer via V24 link, keyboard supply, computer keyboard supply and fault/reset connectors; and
7. Facility to check the MMSU cascade sequences by use of the test switches.

The MP is mounted inside the OMC and the switches and lamps are not normally visible externally.

3.2.10 Power Supplies

Remote manual position control equipment derives all its power requirements from the 24V DC Grade 1 and Grade 2 supplies through the three EEs. The power input to the LVDTs devices is supplied from their respective EEs, port LVDTs on the port supply and starboard LVDTs on the starboard supply.

The port and starboard Servo Power Supply Units in the forward hydroplane and after hydroplane EES drive the remote links of the AS namely the D/A and S^3 receiver electronics as well as providing power to the servo and monitoring electronics and power amplifier. The rudder has similar servo power supply unit to power its analogue electronic circuitry and servo amplifier.

3.2.11 Manual Position Control

Manual position control of rudder, forward and after hydroplanes is affected by a stickwheel mounted on the OMC. The stickwheel has self-centring column and self-centring wheel and damping is provided on each to improve the “feel” of the controls. For all three (3) control surfaces the movement of stickwheel is sensed by

the two (2) LVDTs transducers for each control surface, designated port and starboard. The LVDTs DC voltage outputs from the stickwheel are applied to all RSUs torque motor servo amplifiers in the EEs to effect the Ram movements.

3.2.12 Ratio Control

A control knob mounted adjacent to the stickwheel on the OMC provides the ratio control of -25% to 100% of the after hydroplane movement relative to the forward hydroplane provides. The control knob is mechanically linked to the two LVDTs and the output voltages from both LVDTs control the output voltage signal to modify the stick command signal to the servo amplifier by introducing a ratio effect via a multiplying device.

3.2.13 Balance Control

Two control knobs mounted on the OMC adjacent to the stickwheel provides the adjustment of each control surface deflection balance angle for up to +/-4deg from zero datum for both forward and aft hydroplanes. Each control knob is mechanically linked to two LVDTs and the rotation of the knobs varies the LVDT DC output voltage signals. The output signals are transmitted to the servo amplifiers in EEs to modify the stick commands to the hydroplanes servo motors by introducing an offset.

3.2.14 Distributor Valve Drive Unit

The power amplifiers in the EEs receive the processed demand and feedback signals and output the power drive signal to the torque motors of the Distributor Valve Drive Unit. The torque motors operate the linkage which positions the distributor valve in the RSU to change the angle of the control surface. The torque motors also operate the position and monitoring feedback LVDTs. The LVDTs transducers are used to close the electronic servo loop and provide signals to the electronic monitoring circuits. Each torque motor assembly incorporates a tachogenerator to provide rate feedback to EE to improve the control loop stability.

3.2.15 Aft Hydroplane Ram Servo Unit

The aft hydroplane Ram Servo Unit (RSU) incorporates air and oil bypass valves connected across the air and hydraulic cylinders respectively. In normal position control, oil from the distributor valves flows to the hydraulic via the oil bypass valve whilst the air bypass valve is selected to bypass mode, allowing the air cylinder to idle.

In the selected emergency operation, control air from a manually operated air valve local to the OMC panel moves the oil bypass valve against its standing pressure servo into its bypass position. Simultaneously, a lever driven by the oil bypass valve pushes the air bypass valve into its closed position; the ram is thus controlled by the

air system. A micro-switch on the valve and an air operated pressure switch energize a lamp indication at the SCC.

On return to hydraulic position control, the standing pressure oil servo moves the bypass valve to their normal position and the air bypass valve vents any residual by air to atmosphere.

A dive stop unit is fitted to the aft hydroplane which when selected, limits the travel of the control surface in the DIVE direction to 10^0 down. A dive stop selector switch at the OMC operates a hydraulic selector valve in the motor room which directs oil to a semi-rotary activator which rotates a scotch plate via pinion. The actuator may also be operated manually. In the event of electrical supply failure the selector will fail 'as is'. An interlock is provided to inhibit the selection of the dive stop unless the hydroplanes are set to 0^0 or to rise.

Hydraulic oil for the aft planes and dive stop is supplied from the Hydroplane and steering Hydraulic Power Plant.

3.2.16 Rudder Ram Servo Unit

The rudder RSU operates in a similar manner to the aft hydroplane RSU whilst in position control. A manual emergency changeover valve is included in the system to supply oil to the hydraulic cylinder from either the distributor valve or the manual emergency rate main valve. The position of the emergency changeover valve is governed by a solenoid operated pilot selector valve.

The pilot selector valve is solenoid operated with manual override end, on failure of the 24VDC, remains in the last selected position until it is altered manually. Normally, the pilot selector vents pressure from one side of the spool of the emergency changeover valve; a standing pressure oil servo holds the valve such that oil is supplied to the cylinder from the distributor valve. When the pilot valve is energized it supplies oil to the larger area spool of the changeover valve and moves it to allow the oil to be supplied from the emergency rate main valve.

The emergency rate main valve is operated by two (2) solenoid pilot valves with manual override controlled from the OMC. When de-energized, the pilot valves connect both ends of the rate control spool to the hydraulic return line, thus it is centred (by spring action) in the blind neutral position. Operation of a pilot valve connects the respective side of the emergency rate main valve spool to the hydraulic supply causing it to move and supply oil to the hydraulic cylinder hence operating the Ram and the Rudder. Hydraulic oil for the rudder is supplied by the Hydroplane and Steering Hydraulic Power Plant.

3.2.17 Forward Hydroplane Ram Servo Unit

The Forward Hydroplane RSU is similar in operation to the Aft Hydroplane RSU, but there is no pneumatic control. The Forward Hydroplane tilting cylinder and locks are supplied with Hydraulic oil from the Main Hydraulic system. The extend

and retract cylinders are supplied by the External Hydraulic System Control of the Forward Hydroplanes extend/retract facility is provided by means of a leaver switch annotated "EXTEND/0^0 HOLD/RETRACT" located at the OMC. The hydroplane status is provided by indicating lamps at the OMC and the Hydroplane Housing Indications Panel (located in the ATP space).

Housing lock and Tilting lock facilities are provided by means of solenoid actuated valves controlled from a switch at the OMC. The Hydroplanes cannot be withdrawn until the Housing lock is withdrawn and cannot be tilted until fully extended and the Housing lock is engaged. The Tilting Lock cannot be withdrawn until the planes are fully extended and locked. The planes cannot be retracted until they have been set to 0^0 and the Tilting lock is engaged.

3.2.18 Hydro and Pneumatic System

A high pressure hydraulic feed and return system is required for hydroplanes and rudder operation. For maintenance purposes a hand pump facility can be connected to all surface cylinders. If no hydraulic system is available, only the aft hydroplanes can be operated from a pneumatic system. The air supply is provided by the high pressure system.

The angle of each control surface is indicated both locally and remotely at the OMC. Each RSU is connected by linkages to the ram follower assembly driven by the hydraulic cylinder piston rod. Each ram follower is fitted with:

1. Mechanical indication of Control Surface angle;
2. A 60 HZ synchro transmitter; and
3. A DC potentiometer transmitter.

Each forward and aft hydroplane synchro transmitter drives a receiver at the OMC. The rudder has DC indication at the Emergency Steering Position.

Local indication of the fore planes angle is provided on two (2) local analogue indicators, one (1) in the Forward Hydroplane Housing Indication Panel adjacent to the RSU and the other adjacent at the EE in the Officers wash place for set to work.

4 Autopilot System Requirements

In addition to requirements listed in this section, the AS shall meet all the control functional requirements listed in section 3.

4.1 General

The AS components requiring replacement to meet the terms of this TSOR are listed in the AS SOW, section 2.1, Table 1, item 1.

4.2 Environmental

The AS shall meet the following environmental requirements. If any of the proposed COTS equipment does not fully comply with any of the following specifications, then the Contractor shall customize the equipment to meet the requirements.

All references to Government requirements and standards in the following MIL STD specifications shall be understood as Canadian Government / Organisations, in place of US Government.

Table 3: Environmental Requirements

Item	Environmental Condition	Requirements	Standard (reference) and Comments
1	Storage Temperature	All AS components -40°C to +80°C	MIL STD 810F Table 501.4-III: induced high, storage and transit Table 502-4-I Severe cold probability >1%
2	Operating Temperature	OMC mounted equipment: 1°C to + 55°C Continuous Electronic Enclosures: 0°C to +75°C Continuous	MIL HBBK 2036 Sec. 5.4.2 Table XII verify Duration of this temperature test can be minimum of 2 hours
3	Humidity	30 to 80% condensing (wet bulb) at 38°C	MIL STD 810F: 507.4 To meet prescribed tests, steady temperature.
4	Salt Fog	a) Relative Humidity 95% b) Temperature 35 deg C c) Salt concentration 5% d) PH level 6.2 to 7.2	MIL-STD-810F, Method 509.4
5	Rain	Spray	MIL-STD-810F Method 506.4, customize for spray
6	Nitrogen	1.5 bar (pressure build up	To quench a sealed

Item	Environmental Condition	Requirements	Standard (reference) and Comments
	drench	time 30 sec)	compartment fire
7	Shock Protection	Light & Medium Weight	MIL STD 901D Shock grade A, Class A and Type B, (type II with shock mounts) **For all OMC mounted equipment:** 30g Half Sine wave 12.5ms loading on X, Y and Z axis **Electronic Enclosures:** 200g Half sine wave, 12.5 ms loading on X, Y and Z axis. (Testing tailored as per CFTO D-03-003-007/SG-000)
8	Vibration	Type I equipment	MIL-STD-167-1A - 1-13.2 Hz, 1mm Peak to Peak - 5-33 Hz, +/- 0.125mm Peak to Peak - 14-70 Hz, at 0.7g For only the OMC mounted equipment, the above requirement are reduced to 50% of the above requirement
9	Compartment Pressure	Operational: 750-1310 mbar Abnormal: 713 mbar for 5 min with no detrimental effects Non Operational; 500 - 2300 mbar	

Item	Environmental Condition	Requirements	Standard (reference) and Comments
10	Submarine Motion	The equipment shall be capable of operation in the following conditions: **Submerged:** **Heel:** 45 deg for 5 Sec 20 deg for 45 Sec 10 deg continuously **Trim:** 30 deg for 30 Sec 20 deg for 3 minutes 15 deg continuously **Combined Heel and Trim:** 30 deg trim, 10 heel for 30 sec duration, 15 Deg trim, 40 deg for 5 seconds duration **Roll:** +30 deg for 17 seconds Pitch: 2.5 deg for 95 sec **Surfaced:** **Heel:** 10 deg Continuously, **Trim:** 5 deg Continuously **Roll:** +30 deg for 14 seconds Pitch: 2.5 deg for 7 sec **Emergency Condition:** 30 deg continuously from the vertical in any direction	
11	EMI General		MIL STD 461E (DGS 250B) CE 101, CE 102, CS 101, CS 114, CS 116, RE 101, RE 102, RS 101 and RS 103.

Item	Environmental Condition	Requirements	Standard (reference) and Comments
12	Water ingress (Watertight)	All Electronic Enclosures shall be watertight @ 1 bar (15 PSI)	Due to the fact that bottom of the OMC is open, all AS fitted equipment in the OMC shall have water splash guard protection at the bottom of each unit.

4.2.1 Cooling

If any of the AS components require cooling, then cooling shall be forced air cooling with dual redundant fans. Or, solid state cooling may be used, but the power consumption shall remain within specification for that AS component.

4.3 Mechanical

The existing AS equipment resides in the OMC, Motor Room and by the Officers Washrooms.

The mechanical design of the AS components enclosures shall:

1. Be Form-fit-function of the existing AS Electronic Enclosures (EEs) ;
2. Be within the same total weight;
3. Have no water ingress into the AS fitted equipment in the OMC;
4. The EEs shall be completely sealed enclosures;
5. Be accessible from the front to facilitate maintenance; and
6. Meet the mechanical shock and vibration requirements as per Table 3. Items 7 and 8.

4.3.1 Weight and Dimensions

The AS components weights shall be equal or less than as per the Table 4: Equipment, Function, Location, Weight, Width, Height and Depth. Minor increases in weight of these components if any must be submitted to TA for approval.

Table 4: Equipment, Function, Location, Weight, Width, Height and Depth

Item #	Equipment	Function	Location	Weight (Kg)	Dimensions (mm)
1	Computer Rack	Houses two Step Modules (Computers)	OMC	17	222 X 336 X 600
2	Computer Power Supply	Regulated power supply for each computer	OMC	8.8	280 X 95 X 347
3	Keyboard	Man/Machine	OMC	15	350 X 413 X 210

	Module	Interface to Computers	Autopilot Panel		
4	Keyboard Power Supply	Regulated power supply	OMC	2	160 X 200 X 260
5	AS Maintenance Panel	Junction terminal and maintenance panel for AS equipment	OMC	6	217 X 278 X 260
6	Fan tray	Forced air cooling for each computer	OMC	9	98 X336 X 424
7	Electronics Enclosures Rudder	Servo control of Ram Servo	Motor Room	76	714 X 744 X 418
8	Electronics Enclosures Forward Hydroplanes	Servo control of Ram Servo	Officer's washroom	76	714 X 744 X 418
9	Electronics Enclosures After Hydroplane	Servo control of Ram Servo	Motor Room	76	714 X 744 X 418
10	Monitor and Mode selection Unit	Availability and selection of modes and faults and alarm indications	OMC Autopilot Panel	15	255 X 380 X 240
11	Monitoring Power Supply	Regulated power supply	OMC		130 X 200 X 243
12	Bypass Panel	Alternative manual selection for manual mode	OMC Helmsman's Panel	1.5	85 X 220 X 127
13	Aft hydroplane angle balance	Compensation for out of trim conditions in manual mode	OMC Helmsman's Panel	2.45	100 X 100 X 217
14	Fwd hydroplane angle balance		OMC		
15	Ratio changer	Speed compensation for after hydroplanes in manual mode	OMC Helmsman's Panel		
16	RSUs	Hydroplanes and Rudder drive units			

4.3.2 AS Components and Enclosures

4.3.2.1 AS Computers

The replacement AS computers, power supplies and cooling fans shall fit within the same mechanical space envelope as per the requirements in Table 4 and items 1, 2 and 6. If AS computers require forced air cooling, refer to section 4.2.1.

4.3.2.2 Autopilot Panel (AP)

The existing Autopilot Panel (keyboard module), power supplies and pushbuttons shall be replaced by a new AP using a computer, LCD, keyboard and power supplies to fit within the same space mechanical envelopes as per the requirements in Table 4, Items 3 and 4. For more details of the AP, refer to section 4.4.4.2. The LCD display may or may not be flush mounted with the OMC panel. If not flush mounted, then, the max protrusion shall be less or equal to 10 mm.

4.3.2.3 Supervisory System Console (Equivalent to Monitor and Mode Selection Panel)

The existing single computer based Monitoring and Mode Select Panel and its power supplies shall be replaced with a new Supervisory System (SS) to fit within the same mechanical space envelop as per the requirements in Table 4 and items 10 and 11. For more components details of SS, refer to section 4.4.4.3. The LCD display may or may not be flush mounted with the OMC panel. If not flush mounted, then, the maximum protrusion shall be less or equal to 10 mm.

4.3.2.4 Maintenance Panel

The replacement maintenance panel and its power supplies shall fit within the same mechanical space envelop as per the requirements in Table 4 and item 5.

4.3.2.5 Bypass Panel, Balance Angle and Ratio Changer

The Bypass Panel, Balance Angle and the Ratio Changer are not required to be replaced.

4.3.2.6 Rate Main and After Planes Air Emergency

The existing Rate Main and After Planes Air Emergency hardware are not required to be replaced.

4.3.2.7 Electronic Enclosures

The replacement Rudder, Forward and After Hydroplanes Electronic Enclosures shall fit within the same mechanical space envelop as per the requirements in Table 4 and items 7, 8 and 9.

4.4 Electrical

4.4.1 General

The AS components designs shall:

1. Be modular to enable maximum maintainability, supportability and operational flexibility. In addition, the modularity should minimize future component obsolescence.

2. Use a minimum number of different standard Line replaceable Units (LRU), which can be software adapted to perform the various functions required to satisfy the functional requirements of AS.

3. Be expandable, reconfigurable and upgradeable to provide Canada with significant advantages in the life cycle support costs normally associated with spares, maintenance, training, and changing operational requirements, as well as future machinery plant upgrades.

4. Have dual redundant network interfaces for all of its major components;

5. Interface to the existing field sensors and other systems with which the existing AS currently interfaces;

6. Provide 16 bit resolution for any analogue to digital converted signals;

7. Retain as much as possible the existing field cables/wires between the new AS enclosures and the external systems/panels with which the AS interfaces.

8. Have the hardware physical connections be standardised to permit maximum component interchangeability and minimum life cycle cost.

9. Be such that malfunction of any one LRU shall not affect the proper functioning of the rest of the modules in the AS.

10. Have built in self-diagnostics to isolate down to a single LRU.

11. Have bonding and grounding IAW section 2.2, Table 2 and item 3.

4.4.2 Electrical Component Selection

When selecting components for the AS design preference shall be given to COTS industrial grade components. In the absence of suitable COTS industrial grade components, COTS commercial components shall be selected and customized if required.

4.4.3 Hardware Architecture Design

The AP and SS shall interface to dual electrical Ethernet LAN to enable it to share information with other systems on the submarine, Fire Detection System (FDS), Central Surveillance System (CSS) and a separate dual optical architecture to control its own network components. The AS computers, the AP, the SS and the EEs shall interface to dual optical Ethernet LAN to share information with its own internal components and to keep it separate from the electrical dual LAN. For details, refer to Figure 3.

4.4.4 AS Components

4.4.4.1 AS Computers

The AS computers shall use port and starboard designated dual redundant standalone computers with their own separate power supplies derived from primary 115V @ 60Hz and a backup 24VDC grade 1 supply.

4.4.4.2 Autopilot Panel

The Autopilot Panel (AP) shall be a computer based, with a Liquid Crystal Display (LCD) and a keyboard to enable an operator to interact with the AS from the AP as a primary position or from the SS as a back-up position if in case the AP fails.

In a stressful environment i.e. smoke filled compartment the buttons on the AP to put the computer from Auto to Manual are hard to find. Recommend "triggers" be installed on the Helm yolk to enable the helm to be put in Manual.

The rudder rate main controls need to stay on the left side of the operator as his right side will be busy operating the after planes in air emergency in an "EOP" for steering and afterplanes failure.

The AP shall consist of the following hardware components:

1. CPU;
2. 17 inch LCD; (Contractor to verify if a larger LCD can be fitted) with protective cover and with handles;
3. Keyboard with protective cover and with handles;
4. Trackball or Touchscreen;
5. DVD drive (For software upgrades and downloading the logged data);
6. Power supply with primary input power 115V @ 60Hz and a backup 24VDC grade 1;
7. Dual Electrical Ethernet LAN; and
8. Dual Optical Ethernet LAN.

4.4.4.3 Supervisory System

The Supervisory System (SS) shall be computer based, with a Liquid Crystal Display (LCD) and a keyboard to enable an operator to interact with the AS. In

addition to its normal functionality, the SS shall provide a back-up secondary position if in case the primary position, the AP fails.
The SS shall consist of the following hardware components:

1. CPU;
2. 13.3 inch LCD; (Contractor to verify if a larger LCD can be fitted) with protective cover and with handles;
3. Keyboard with protective cover and with handles;
4. Trackball or Touchscreen;
5. DVD drive (For software upgrades and downloading the logged data);
6. Power supply with primary input power 115V @ 60Hz and a backup 24VDC grade 1;
7. Dual Electrical Ethernet LAN; and
8. Dual Optical Ethernet LAN.

4.4.4.4 Spare CPU and Memory Capacity

Each CPU in AP, SS, AS computers shall have 100% spare processing capacity based on the software execution time and 100% spare memory based on memory utilization to enable them meet the future potential computing growth.

4.4.4.5 Maintenance Panel

The AS Maintenance Pane (MP) shall provide the following features:

1. 115V 60Hz and 24VDC Grade 1 fuses, indications and isolations to each AS computer;
2. 115V 60Hz and 24VDC Grade 1 fuses, indications for each cooling fan in each AS computer, if cooling fans are used;
3. 115V 60Hz and 24VDC Grade 1 fuses, indications and isolations for AP and SS;
4. 115V 60Hz and 24VDC Grade 1 fuses, indications for each cooling fan in each AP and SS, if cooling fans are used;
5. Fault indication and reset to each AS computer, AP and SS;
6. Facility to switch off each AS computer off line, i.e. advise the AP and the SS that AS computer is not available;
7. Facility to connect a POU to each AS computer, AP and SS;
8. Facility to test/check each EE cascade sequences by use of the test switches;
9. Facility to test/verify the stickwheel LVDTs outputs and power supplies.
10. Submarine signals either from Gyro System (Optical LAN interface signals) or synchro signals, but not both, based on the AS design ;
11. Electrical LAN (between the CSS and AS);
12. Optical LAN amongst the AS' components; and
13. All the monitoring signals from the EEs.

4.4.4.6 Electronic Enclosures

The Electronic Enclosures (EE) shall use port and starboard designated dual redundant hardware with their own separate power supplies derived from 24VDC grade 1 and 2 power supplies respectively.

Each EE at a minimum shall consist of the following hardware components:

1. CPU;
2. Dedicated Circuit breaker to interrupt input power to the EE;
3. Dual Optical LAN ports;
4. One USB port for downloading logged data;
5. POU interface port;
6. Power output for the POU; and
7. Built in light source for maintenance.

4.4.5 Supply Voltages and Power Consumption

The supply voltages to all AS components shall be floating and the supplies returns must not be referenced to HULL of the submarine. The replacement AS shall consume less or equal electrical power than the legacy AS. The existing AS input supply voltages and power consumption requirements are as per the Table 5.

Table 5: The existing Components Supply Voltages and Power Consumptions

Enclosure Name	Input Supply Voltages	Power Consumption
Computer System (Port) only	109-121V 60 Hz	242W (2A)
Computer System (Starboard) only	109-121V 60 Hz	242W (2A)
Keyboard Maintenance Panel	115V 400Hz	Reference voltage for synchro devices
Monitor and Mode Selection Panel	115V 60Hz Normal 24V Grade 1 115V 400Hz Or 115V 60Hz Alternative 24V Grade 1 115V 400Hz	80W 5.1VDC@ 5A +12VDC @2.5A Reference voltage for synchro devices 80W 5.1VDC@ 5A +12VDC @2.5A Reference voltage for synchro devices

Electronic Enclosures	Forward hydroplane (Port and Starboard)	24V DC grade 1 (Port) 24VDC Grade 2 (Stbd)	5.1@ 5A +12.0 @1.5A -12.0 @ 1.5A 24V DC @ 4.5A
	After Hydroplane (Port and Starboard)	24V DD grade 1 (Port) 24VDC Grade 2 (Stbd)	5.1@ 5A +12.0 @1.5A -12.0 @ 1.5A 24V DC @ 4.5A
	Rudder Hydroplane (Port and Starboard)	24V DC grade 1 (Port) 24VDC Grade 2 (Stbd)	5.1@ 5A +12.0 @1.5A -12.0 @ 1.5A 24V DC @ 4.5A

4.4.6 Power Up Time

The AS including all its components shall power up in an operational mode within one minute.

4.4.7 Electrical Interfaces

The existing AS uses the synchro inputs for the submarine signals including, Heading (Course and Fine), Depth, Speed, Pitch and Roll to implement the control. The Contractor shall use the digital submarine signals those are available from the recently replaced Gyro System, on its separate dual optical Ethernet LAN. Refer to section 2.2, item 12, the Standard for Interfacing Marine Electronics Devices, NMEA 0183. These signals are updated on the network at 10 Hz rate. After in-depth analysis, if the Contractor (Bidder) proposes not to use these digital signals because of their update rate is too slow to implement control, then, the Contractor (Bidder) must provide details of the analysis in his proposal. In Table 6, both digital and synchro signals are provided.

4.4.7.1 Field Sensor Input and Output Signals

All AS external field interfaces and input power supplies shall be common and differential modes protected against voltage transients to meet the submarines operational requirements.

The list of field sensor input and output signals between the AS and the other subsystems are identified in per Table 6.

NOTE: The signal list is incomplete. The Contractor is responsible for any additional I/Os that may be required based on the new design of the AS.
If the information for the existing AS provided by Canada is not adequate for the new AS design, then, the Contractor is responsible for acquiring the necessary information by conducting submarine surveys.

Table 6: AS Input and Output Field Signals and between Subsystems

Input and Output Type	Qty	Signal Characteristic		Comments
		Voltage	Type	
AS Computer Systems				
Optical LAN inputs	2	Industry standard	Industry standard	Optical LAN for AS components
Optical LAN inputs	2	Industry standard	Industry standard @10Hz @ 1Hz	Optical LAN from the Gyro System Submarine signals: Heading (Course and Fine), Depth, Speed, Pitch and Roll. Time Signal Refer to section 4.4.7
Analog Inputs	6	90VPP @400Hz	Synchro inputs	Submarine signals, Heading (Course and Fine), Depth, Speed, Pitch and Roll **Provided as an alternative if submarine signals from the Gyro system are not sufficiently fast to implement control**
	1	115V 400Hz	Synchro reference	Reference Input via Maintenance Panel
Analog Outputs	1	115V 400Hz	Synchro reference	
Supervisory System				
Optical LAN inputs	2	Industry standard	Industry standard	Optical LAN for AS components
Electrical LAN inputs	2	Industry standard	Industry standard	Electrical for AS components
Digital Inputs	3	24V		Indicators to show PORT/STBD availability It is an option for the Contractor to use these input on the replacement

				AS
Digital Outputs	5	Miscellaneous voltages		Inputs to the Bypass Panel and Grade A/B alarms at the SCC
Analogue Inputs	1	115V 400Hz		Reference supply voltage
Maintenance Panel				
Optical LAN inputs	2	Industry standard	Industry standard	Optical LAN for AS components
POU	4	Industry standard	Industry standard	
Optical LAN inputs	2	Industry standard	Industry standard @10Hz @ 1Hz	Optical LAN from the Gyro System Submarine signals: Heading (Course and Fine), Depth, Speed, Pitch and Roll. Time Signal Refer to section 4.4.7
AS Computers 115V 60Hz; 24VDC Grade 1; Fuses; Indications; and Power switches. **AP and SS** 115V 60Hz; 24VDC Grade 1; Fuses; Indications; Power switches; Fault indication; and Reset switch to each AS & SS computer. **EEs** All signals test/check each EE cascade sequences **Stickwheel** LVDTs outputs;				All power supplies

and Power supplies.				
Analog Inputs	6	90VPP @400Hz	Synchro inputs	Submarine signals parameters, Heading (Course and Fine), Depth, Speed, Pitch and Roll **Not required if the control is implemented with submarine information from the Gyro system**
	1	115V 400Hz	Synchro reference	
	6	+/-5V	LVDT signals	From the Stickwheel
Analog Output	1	115V 400Hz		Reference output for Synchro devices
Stickwheel				
Analog Outputs	6	+/-5V	LVDT signals	From the Stickwheel
Reference Voltage input	1	±10V (+/- 0.01V)		
Forward Electronic Enclosure				
Optical Ethernet Interfaces	2			Industry standard

POU	1			POU interface
Digital Inputs	4	12 V Relay output		Port/STBD Auto & Servo Selects. Signal from the existing MMSU. It is an option for the Contractor to use these inputs on the replacement AS
Analog Inputs	5	+/- 5V	LVDT signals	Feedback from Ram Servo Unit, and Demand
	2	+/- 4.2V		Balance Angle
	1			Forward Hydroplane Angle
Analog outputs	4	-/+5V		RSU Torque Motor Drive
	3	±10V (+/- 0.01V)		Voltages for LVDT devices in the stickwheel
	2	24 VDC		Stickwheel Supply voltage
After Electronic Enclosure				
Optical Ethernet Interfaces	2			Industry standard
POU	1			POU interface
Digital inputs	4	12 V Relay output		Port/STBD Auto & Servo Selects. Signal from the existing MMSU. It is an option for the Contractor to use these input on the replacement AS
	1			Dive Stop (an option)
Analog Inputs	5	+/- 5V	LVDT signals	Feedback from Ram Servo Unit and demand
	2	+/- 4.2V		Balance Angle
	2	-5.0 -/ + 1.25V		Ratio Changer
	1			After Hydroplane angle
Analog Outputs	4	-/+ 5V		RSU Torque Motor Drive
	3	±10V (+/- 0.01V)		Voltages for LVDT devices in the stickwheel
	2	24 VDC		Stickwheel Supply voltage
Rudder Electronic Enclosure				
Optical Ethernet Interfaces	2			Industry standard
POU	1			POU interface

Digital Inputs	4	12 V Relay output		Port/STBD Auto & Servo Selects. Signal from the existing MMSU. It is an option for the Contractor to use these input on the replacement AS
Analog Inputs	5	+/- 5V	LVDT signals	Feedback from Ram Servo Unit, Demand
	1			Rudder angle
Analog Outputs	4	+/- 5V		RSU Torque Motor Drive
	3	±10V (+/- 0.01V)		Voltages for LVDT devices in the stickwheel
	2	24 VDC		Stickwheel Supply voltage
RSU Electrical Characteristics	If available, Canada will provide this information during the early part of the contract. Regarding any additional signals required, e.g., signal from dive stop selector switch input to the AS, the Contractor is responsible to make any wiring connections.			

4.4.7.1.1 I.O Spare Capacity

The AS shall provide 10% spare capacity of the I/O listed in per Table 6.

4.4.7.2 Field Connectors

The existing AS uses some two parts connectors and some direct hard wiring to connect to the field sensors and to the input/output signals between subsystems and power supplies. The Contractor shall use only two part connectors to all the AS equipment.

4.4.7.2.1 Electronic Enclosures (EEs) Electrical Connections

The replacement EE's shall interface with the electrical connectors currently fitted to the existing field and power supply wiring. Details on the currently fitted electrical connectors are detailed in Table 6, items 3 and 4.

4.4.7.3 Electrical Dual Redundant LAN

The AP and the SS shall interface to the existing electrical Dual Redundant LAN to communicate and share information with the other submarine subsystems, the CSS and the FDS.

4.4.7.3.1 Electrical LAN Functions

The AS shall provide the following functions:

1. The AS shall provide its operational status when requested by the CSS; and

2. The AS shall obtain and display the system status of the CSS and or the Battering Monitoring System status when requested by an operator from the AP or from a POU.

4.4.7.4 Optical Dual Redundant LAN

In each of the insert of the electrical dual redundant LAN in the port and starboard bulkhead penetrators, there is also an optical LAN interface which is currently not implemented. The Contractor shall use these optical LAN interfaces to implement a dual optical LAN for monitoring and control for the AS components only. The manufacturer for the penetrator insert is:

Company name:
Glenair Inc
1211 Air way, Glendale, CA 91201, Phone: 818 247 6000

The NSN for the parts are as follows:
1. 6060 01 5920107, (Gelnair part # FA00028)TRANSITION BOX, FIBER OPTIC CABLE ASY
2. 6020-01-590-3398, FIBER OPTIC CABLE ASSEMBLY (Penetrator insert)

To implement the optical LAN, optical fibre cables and conduits are required between the existing transition boxes. Since the existing penetrator insert design is already pressure tested by the manufacturer, the Contractor is not required to conduct any bulkhead pressure testing. However, the Contractor is responsible for selecting and designing the adequate optical fiber cables and conduits to connect to the transition boxes assemblies. Since the AS shall only be installed during the Extended Docking Work Period (EDWP), Canada will conduct the compartment pressure testing and if any issues are discovered related to the new fibre cables and conduits, the Contractor shall be responsible to correct the issues.

4.4.7.4.1 Optical Dual Redundant LAN Components

All the AS components including the AP, the SS, the AS computer and the EEs shall use the optical dual redundant LAN.

4.4.7.4.2 Electrical and Optical LANs Access Security

Both the electrical and optical LANs shall provide secure access for all the LAN access points by Secure Authentication procedure to consoles and Portable Operator Units (POUs) either connected directly to LAN ports at the consoles or via the Electronic Enclosures. Each user shall have its own set of system access privileges.

The Contractor shall propose a suitable Secure Authentication approach for an approval by TA.

4.4.7.5 AS Users

There shall be total of two user types for the AS, an Operator and a Maintainer. The user names shall be Operator and Maintainer; with their own passwords. On power

up, the system shall default to Operator mode and shall start to operate automatically without any user entry data.

4.4.7.6 Portable Operating Unit (POU) Interface

The POU interface shall be a standard LAN interface that shall provide connectivity to the AS network to monitor the status and conduct built in diagnostics of AS components and monitor the status of the FDS, CSS, the BMS and conduct sensor calibrations. The following POU interfaces shall be provided as shown in Table 7: POU Interface Ports and Types.

Table 7: POU Interface Ports and Types

POU To CSS LAN Connection Locations	POU I/F Quantity	Comments
Maintenance Panel	6	AP (1 optical LAN and 1 Electrical LAN), SS (1 optical LAN and 1 Electrical LAN), ASs (2 Optical LAN)
EEs	3	Electronic Enclosures
TOTAL	**9**	

4.4.8 AS Components Internal Temperatures Monitoring

The AS shall continuously monitor internal ambient temperatures of its components and display them on the AP as part of the component status. The internal temperature monitoring sensor of each component enclosure shall be located such that it monitors the worst case temperature. The AS shall provide temperature monitoring for the following:

1. AS computers;
2. AP;
3. SS; and
4. EEs.

4.4.9 Audio Alarms

Each EE, AP and SS shall have a built in two tone audio alarm for warnings and alarms, but the frequency shall be different from the Grade A and B alarms on the submarine. The location of the audio alarm devices shall proposed by the Contractor for review and approval by the TA. Each audio alarm device shall be volume controlled and shall be able to turn off if required and it shall be indicated on the AP display.

4.5 Operational Requirements

4.5.1 General

The AS at a minimum shall provide a complete set of existing control functions as per section 4.5.3.

4.5.2 Operator Panel

The existing Operator Panel (AP) shall be upgraded by replacing the pushbutton based keyboard and seven segment displays with a computer based LCD and a keyboard. Any switches and indicators used on the new AP shall be illuminated by LEDs and fully dimmable with a lamp test feature.

4.5.2.1 Backup Autopilot Panel

In case of the Autopilot Panel (AP) failure, either its microprocessor or its LCD, the SS shall provide the full backup functionality of the AP.

4.5.2.2 System Reset

The AP shall provide a system reset pushbutton with a spring loaded protection cover to switch the AS from an automatic to a manual mode in a case of an emergency. The reset pushbutton activation time shall be software configurable and the default time shall be 5 Sec.

4.5.3 Control Functions

4.5.3.1 Manual Control

The manual control shall be implemented using the existing stickwheel and the associated control devices, the Balance Angle, the Bypass Panel and the Ratio changer.

4.5.3.2 Automatic Control

The AS shall provide the following automatic control features:

1. Course and depth with minimum overshoot even with trim or weight deviation of the submarine and with look ahead prediction processing:
    a. At periscope depth in Sea State 6, both on a steady course and in a right turn, with the ability to use the autopilot to make small precise depth changes, particularly at periscope depth;
    b. In deep water;
    c. At high speeds in shallow water; and
    d. Automatic emergency depth change from Periscope Depth to Safe Depth.

2. While operating in automatic mode, if the stickwheel is moved to FULL RISE/FULL DIVE or HARD STARBOARD/HARD PORT, or in the case of the hydroplanes and/or rudders failures, the automatic mode shall switch to manual mode within 5 sec or less
3. In an automatic mode, the AS shall provide both trim and ballast information on AP, for communications to the operator at the Submarine

Control Console (SCC) so that the operator at the SCC can take the necessary actions to keep the submarine in trim;

4. While operating in automatic mode, if failures occur within both AS computers, the AS shall revert to manual mode within 5 sec or less, the forward and after hydroplanes and rudder positions shall be set to zero (0) angles; and
5. Warnings and alarms indications shall be generated if any deviation occurs in automatic course and or in depth parameters.

4.5.3.3 Automatic and Manual Combination Control Modes

At a minimum, the AS shall provide all the following combination of control modes:

1. Port automatic depth and course control;
2. Starboard automatic depth and course control;
3. Port automatic depth and port manual course control;
4. Port automatic depth and starboard manual course control;
5. Port automatic course and port manual depth control;
6. Port automatic course and starboard manual depth control;
7. Starboard automatic depth and starboard manual course control;
8. Starboard automatic depth and port manual course control;
9. Starboard automatic course and starboard manual depth control;
10. Starboard automatic course and port manual depth control;
11. Port manual course and port manual depth control;
12. Port manual course and starboard manual depth control;
13. Starboard manual course and starboard manual depth control;
14. Starboard manual course and port manual depth control;
15. Port automatic course and air emergency depth control;
16. Starboard automatic course and air emergency depth control;
17. Port automatic depth and emergency course control;
18. Starboard automatic depth and emergency course control;
19. Port manual course and emergency depth control;
20. Starboard manual course and emergency depth control;
21. Port manual depth and emergency course control;
22. Starboard manual depth and emergency course control; and
23. Emergency depth and emergency course control.

4.5.3.4 Maintenance Mode

In the maintenance mode, when the AS in an off-line mode, the AP or the SS shall enable the maintainer to execute built in on-line and off-line diagnostics and implement changes to the system configurations parameters. This mode of operation is normally only carried out when the submarine is in harbour during a maintenance period or after a refit.

4.5.4 AS Parameters Inputs

The AP shall allow either by the soft keyboard or the hard keyboard the following operator inputs:

1. Set depth with fixed increments and decrements of depth, i.e. 0.1 metre;
2. Pitch limit;
3. After hydroplane limit;
4. Rudder limit;
5. Set course with fixed adjustment of course, i.e. 1 deg;
6. Manual speed input;
7. Ratio-defined as Aft Plane Angle/Forward Plane Angle;
8. Forward plane offset angle; and
9. Aft Plane offset angle.

4.5.5 Human Machine Interface (HMI)

In general, the HMI shall provide:

1 Data entry primarily by use of point and click technology, supplemented with the use of a soft and or hard keyboard for text entries where required;
2 Selection of specific graphic user interface (GUI) pages for display, manipulation and or printing. Any required printing shall be done at the existing electrical LAN printer residing at the Machinery Control Console (MCC); and
3 Both day and night modes of operations.

4.5.5.1 Display Information

The GUI pages display information shall include:

1. Course heading ordered and actual;
2. Depth ordered and actual with trend indication;
3. Trim and ballast recommendations based on the submarine information, e.g. depth, speed, pitch and roll. ;
4. Roll actual;
5. Rudder angle ordered and actual;
6. After Hydroplane angle ordered and actual;
7. Forward Hydroplane angle ordered and actual;
8. Speed actual;
9. Pitch;
10. Trim and Ballast recommendations;
11. Date and time (Time shall be synchronized with the time information received from the Gyro system);
12. AS status (including warnings, alarms and hardware and software health status);
13. Hardware and Software Configuration Information;
14. Online system documentation;
15. On-line help functions for all operator/maintainer functions; and

16. CSS status.

4.5.5.2 Graphical User Interface (GUI) Pages

The Contractor shall propose and provide numerous GUI pages for review and approval by TA. At a minimum but not limited to, the following GUI pages shall be provided:

1. AS summary status (Submarine data, warnings, alarms and hardware/software health status);
2. Hardware and software Configuration information
3. Maintenance/Diagnostic;
4. Online system and maintenance documentation;
5. Operator assist;
6. Online help for Operator and Maintainer;
7. CSS Status; and
8. User log ins (The AS shall support two users, an operator and a maintainer).

4.5.5.3 In Process GUI Pages Review

The Contractor shall convene, as required, joint Contractor/Canada In-Process Reviews of GUI pages development activities. These reviews will provide an opportunity for on-going reviews and comments on the format and content of the GUI pages being developed. During the AS design phase, the TA shall approve the GUI pages proposals; any proposed changes during the review by the TA shall be implemented by the Contractor. The Reviews shall be scheduled no less than a month in the period during which GUI pages are being developed.

4.5.6 Data Logging/Storage

The AS shall provide a data logging system at the AP and as a backup at the SS, with a capacity to meet the data storage requirement stated below:

1. Shall have the capacity to record continuously for the duration of minimum, three (3) months'. The AS data logging shall include but not limited to: all AS related traffic on the electrical LAN, AS Optical LAN traffic, Gyro Optical LAN AS traffic, all input/output signals of the AS equipment, Operator/Maintainer interactions, OBT related information, online diagnostics information and the trainer/student interactions for the MT and the SCT;.
2. Long-term data storage, provided by removable non-volatile solid state memory devices that shall be easily exchangeable with replacement units, without the requirement for re-installing any software;
3. Storage data transfer process shall be fully automated and configurable; and
4. The stored data shall only be allowed to be downloaded to USB device or storage device shall only be removed by an operator with appropriate user privileges.

4.5.6.1 Displaying Logged data

The AS shall provide a capability to allow the operator to view graphically the time stamped historical data by selecting up to a maximum of twenty data channels over a selected time period.

4.5.7 Performance

4.5.7.1 System Response to an Operator Actions

The system shall respond to an operator's keyboard or pushbuttons actions within one second, i.e. if a new display page is called up it shall be updated within one second.

4.5.7.2 RSU, Hydroplanes and Rudder Performances

The AS shall have response times for the Hydroplanes and the Rudder IAW Table 8.

Table 8: RSU, Hydroplanes and Rudder Performance

System Names	Performance		
RSU			
Forward Hydroplanes	5 to 10 sec, From Full Rise to Full Dive On current system, it is adjustable and set to 6.2 sec		
After Hydroplanes	5 to 10 sec, From Full Rise to Full Dive On current system, it is adjustable and set 6.2 sec		
Rudder	Speed (Knots)	Rudder Angle (Deg)	Rate of change Deg/sec
	4	5	+ 0.33
		10	+0.52
		20	+0.76
	6	2	+0.46
		10	+0.74
		20	+ 1.06

4.5.7.3 Stickwheel Voltage Outputs for Hydroplanes and Rudder

The AS shall provide the movements of hydroplanes and the rudder, based on the stickwwheel performance IAW Table 9.

Table 9: Stickwheel Voltage Outputs for Hydroplanes and Rudder

Stickwheel Voltage Outputs	Forward Hydroplanes	After Hydroplanes	Rudder
+/- 5VDC	22^0 Full Rise to	25^0 Full Rise to	35^0 Full Port to

	22^0 Full Dive	27^0 Full Dive	37^0 Full Starboard

4.5.8 Sea Conditions, Manoeuvres and Performances

4.5.8.1 Sea Conditions

The sea conditions that may influence the manoeuvres are as follows and some of these sea conditions are included in the performance definitions in section 4.5.8.3:

1. Thermo-clines;
2. Halo-clines;
3. Internal Waves;
4. Surface Waves;
5. Tidal actions;
6. Outfall currents;
7. General Current Fields; and
8. Other conditions that may need to be included to define the AS performance to be determined by Canada.

4.5.8.2 Manoeuvres

The AS shall perform the following manoeuvres:

1. Straight Line Sailing: Maintain **set course and set depth**; Under wave conditions from sea state 0 to sea state 6;

    a. Snorkelling / Snorting depth and operation;
    b. Periscope depth and operation;
    c. Between periscope depth, and 55 meters; and
    d. At depth greater than 55m.

2. Straight Line Dive;
    a. From depth A to depth B; where A and B are any operational depths; and
    b. Emergency dive to depth.

3. Straight Line Rise;
    a. From rise A to depth B; where A and B are any operational depth; and
    b. Emergency Rise.

4. Spiral Dive;
    a. Standard, from depth A to depth B; where A and B are any operational depth; and
    b. Tightest, from depth A to depth B; where A and B are any operational depth.

5. Spiral Rise;

a. Standard, from depth A to depth B; where A and B are any operational depth; and
b. Tightest, from depth A to Depth B; where A and B are any operational depth.

6. Sinusoidal depth and / or course combination, depth and course programmable within boat limits.

7. Tightest Circle;
   a. At Surface;
   b. At Periscope depth; and
   c. At Depth greater than 55 meters, set depth.

8. Evasive Course; and
   a. Zigzag, set angle limits within boat capabilities; and
   b. Other programmable evasive manoeuvres.
9. Other Manoeuvres to be determined.

4.5.8.3 Manoeuvres Performances

At a minimum, the AS shall meet the manoeuvres performances IAW Table Table 10.

Table 10: **AS Performance Requirements and Test/Verification Methods**

Item	Requirements Description	Performance Parameters		Test/Verification Method		
				Software Simulation Test Period = 15 min (SS)	Physical Scaled Model Test Period = 15 min (PSM)	Sea Test = 15 (S
1	**Depth keeping at periscope depth (Measured at Keel) Sea state: 0 Pitch: +/- 3 deg**	**Depth (meters)**	**Depth keeping Tolerance RMS**	**SS**	**PSM**	**S**
	Speed : 5 knots	17 m	+/- 0.25 m	√	√	
	Speed: 8 knots	17 m	+/- 0.25 m	√	√	
	Speed: 12 knots	17 m	+/- 0.25 m	√	√	
2	**Depth keeping at**	**Depth**	**Depth keeping Tolerance**	**SS**	**PSM**	**S**

	periscope depth (Measured at Keel) Direction: Head seas Sea state: 3 Pitch +/- 3 deg	**(meters)**	**RMS**			
	Speed: 5 knots	17 m	+/- 0.25 m + +/- 0.5 H1/3 significant wave height	√	√	
	Speed; 8 knots	17 m	+/- 0.25 m + +/- 0.5 H1/3 significant wave height	√	√	
	Speed 12 knots	17 m	+/- 0.25 m + +/- 0.5 H1/3 significant wave height	√	√	
3	**Depth keeping at periscope depth (Measured at Keel) Direction: Following seas Sea state: 3 Pitch +/- 3 deg**	**Depth (meters)**	**Depth Keeping Tolerance RMS**	**SS**	**PSM**	**S**
	Speed: 5 knots	17 m	+/- 0.25 m + +/- 0.5 H1/3 significant wave height	√	√	
	Speed 8 knots	17 m	+/- 0.25 m + +/- 0.5 H1/3 significant wave height	√	√	
	Speed 12 knots	17 m	+/- 0.25 m + +/- 0.5 H1/3 significant wave height	√	√	
4	**Depth keeping at periscope depth (Measured at Keel) Direction: Head seas Sea state: 6 Pitch Tolerance: Contractor to Recommend**	**Depth (meters)**	**Depth Keeping Tolerance RMS**	**SS**	**PSM**	**S**
	Speed 5 knots	17 m	+/- 0.25 m + +/- 0.5 H1/3 significant wave height	√	√	During trials, t maxim state av
	Speed 8 knots	17 m	+/- 0.25 m + +/- 0.5 H1/3 significant wave height	√	√	During trials, t maxim state av
	Speed 12 knots	17 m	+/- 0.25 m + +/- 0.5 H1/3 significant	√	√	During trials, t maxim

			wave height			state av
5	**Depth keeping at periscope depth (Measured at Keel) Direction: Following seas Sea state: 6 Pitch Tolerance: Contractor to Recommend**	**Depth (meters)**	**Depth Tolerance RMS**	**SS**	**PSM**	**S**
	Speed 5 knots	17 m	+/- 0.25 m + +/- 0.5 H1/3 significant wave height	√	√	During trials, t maxim state av
	Speed 8 knots	17 m	+/- 0.25 m + +/- 0.5 H1/3 significant wave height	√	√	During trials, t maxim state av
	Speed 12 knots	17 m	+/- 0.25 m + +/- 0.5 H1/3 significant wave height	√	√	During trials, t maxim state av
6	**Depth Keeping (DK) Pitch +/- 3 deg**	**Depth (meters)**	**Depth Keeping Tolerance RMS**	**SS**	**PSM**	**S**
	Speed: 5 knots	100 m	+/- 0.2 m	√	√	
	Speed: 10 knots	100 m	+/- 0.2 m	√	√	
	Speed: 15 knots	100 m	+/- 0.2 m	√	√	
	Speed: Max (<20) Knots	100 m	+/- 0.1 m	√	√	
7	**Course keeping Near Surface (Snort & Periscope) Sea State: 3 Depth: 15 m (Measured at Keel)**	**Heading**	**Heading Tolerance RMS**	**SS**	**PSM**	**S**
	Speed 5 knots	0 deg	+/- 2 deg	√	√	
	Speed 8 knots	0 deg	+/- 2 deg	√	√	
	Speed 12 knots	0 deg	+/- 2 deg	√	√	
	Speed 5 knots	45 deg	+/- 2 deg	√	√	
	Speed 8 knots	45 deg	+/- 2 deg	√	√	
	Speed 12 knots	45 deg	+/- 2 deg	√	√	
	Speed 5 knots	90 deg	+/- 2 deg	√	√	
	Speed 8 knots	90 deg	+/- 2 deg	√	√	
	Speed 12 knots	90 deg	+/- 2 deg	√	√	
	Speed 5 knots	135 deg	+/- 2 deg	√	√	
	Speed 8 knots	135 deg	+/- 2 deg	√	√	

	Speed 12 knots	135 deg	+/- 2 deg	√	√	
	Speed 5 knots	180 deg	+/- 2 deg	√	√	
	Speed 8 knots	180 deg	+/- 2 deg	√	√	
	Speed 12 knots	180 deg	+/- 2 deg	√	√	
8	**Course keeping Near Surface (Snort & Periscope) Sea State: 6 Depth: 15 m (Measured at Keel)**	**Heading**	**Heading Tolerance RMS**	**SS**	**PSM**	**S**
	Speed 5 knots	0 deg	+/- 5 deg	√	√	Duri trials, maxim state av
	Speed 8 knots	0 deg	+/- 5 deg	√	√	Duri trials, maxim state av
	Speed 12 knots	0 deg	+/- 5 deg	√	√	Duri trials, maxim state av
	Speed 5 knots	45 deg	+/- 5 deg	√	√	Duri trials, maxim state av
	Speed 8 knots	45 deg	+/- 5 deg	√	√	Duri trials, maxim state av
	Speed 12 knots	45 deg	+/- 5 deg	√	√	Duri trials, maxim state av
	Speed 5 knots	90 deg	+/- 5 deg	√	√	Duri trials, maxim state av
	Speed 8 knots	90 deg	+/- 5 deg	√	√	Duri trials, maxim state av
	Speed 12 knots	90 deg	+/- 5 deg	√	√	Duri trials, maxim state av
	Speed 5 knots	135 deg	+/- 5 deg	√	√	Duri trials, maxim state av
	Speed 8 knots	135 deg	+/- 5 deg	√	√	Duri

						trials, maxim state av
	Speed 12 knots	135 deg	+/- 5 deg	√	√	Duri trials, maxim state av
	Speed 5 knots	180 deg	+/- 5 deg	√	√	Duri trials, maxim state av
	Speed 8 knots	180 deg	+/- 5 deg	√	√	Duri trials, maxim state av
	Speed 12 knots	180 deg	+/- 5 deg	√	√	Duri trials, maxim state av
9	**Course keeping at Depth Depth : 100 m**	**Course**	**Course Tolerance RMS**	**SS**	**PSM**	**S**
	Speed 5 knots		+/- 2 deg	√	√	
	Speed 8 knots		+/- 2 deg	√	√	
	Speed 12 knots		+/- 2 deg	√	√	

10	**Depth Change (DC) DC: 100 m to 200 m Pitch angle: 20 deg and +2 deg and - 0.5 deg After settling time, DKT = +/- 0.25m**	**Time to achieve Depth +/- 20%**	**Settling Time**	**Overshoot Depth Tolerance**	**SS**	**PSM**	**S**
	Speed: 5 knots	114 sec	50 sec	+ 5 m	√	√	
	Speed: 8 knots	71 sec	50 sec	+5 m	√	√	
	Speed: Max (<20) knots	28 sec	50 sec	+5 m	√	√	
11	**Depth Change (DC) DC: 100 m to 200 m Pitch angle: 10 deg and +2 deg and - 0.5 deg After settling time, DKT = +/- 0.25m**	**Time to achieve Depth +/- 20%**	**Settling Time**	**Overshoot Depth Tolerance**	**SS**	**PSM**	**S**
	Speed: 5 knots	224 sec	50 sec	+ 3 m	√	√	
	Speed: 8 knots	140 sec	50 sec	+ 3 m	√	√	
	Speed: Max (<20) knots	56 sec	50 sec	+ 3 m	√	√	
12	**Depth Change (DC) DC: 100m to 200m Pitch angle: 6 deg and +2 deg and - 0.5 deg After settling time,**	**Time to achieve Depth +/- 20%**	**Settling Time**	**Overshoot Depth Tolerance**	**SS**	**PSM**	**S**

	DKT = +/- 0.25m						
	Speed: 5 knots	372 sec	50 sec	+ 2 m	√	√	
	Speed: 8 knots	232 sec	50 sec	+ 2 m	√	√	
	Speed: Max (<20) knots	93 sec	50 sec	+ 2 m	√	√	
13	**Turn manoeuvres Depth: 100 m Turn angle: 90 deg Speed: 5 knots**	**Time To achieve manoeuvres**	**Manoeuvre Time Tolerance RMS**		**SS**	**PSM**	**S**
	Overshoot + 2 deg & -1 deg Rudder angle 5 deg	270 sec	+/- 5%		√	√	
	Overshoot + 2 deg & -1 deg Rudder angle 10 deg	170 sec	+/- 5%		√	√	
	Overshoot + 2 deg & -1 deg Rudder angle 20 deg	120 sec	+/- 5%		√	√	
14	**Spiral Down Manoeuvre Depth: 100 m to 200 m Pitch angle: Contractor to recommend**	**Minimum number of spirals**	**Depth Tolerance RMS**		**SS**	**PSM**	**S**
	Speed 5 knots	1	+/ 5 m		√	√	
	Speed 8 knots	1	+/ 5 m		√	√	
	Speed Max (<20) knots	1	+/ 5m		√	√	

4.6 Software

4.6.1 Operating System

The AS shall use an open industry standard software operating system.

4.6.2 Programming Language

The AS software shall use industry standard programming language and approved by TA.

4.6.3 Software Design

The AS software design shall be modular and each module shall have its own Application Program Interfaces (APIs). All developed source code shall be commented to assist maintenance support activities over the life span of the AS.
The AS software development and documentation including Software development Plan (SDP) shall be in accordance with ISO/IEC 12207, section 2.2, Table 2 and item 10 or equivalent. The SDP shall be reviewed and approved by the TA.

4.6.4 Code Storage and Execution

All application software code for any AS equipment shall only be executed from its local solid-state memory of that equipment.

In case of the AS network host failure, all AS software located in distributed locales shall be stored and executed in the non-volatile memory of that equipment.

4.6.5 Network Interface Communications Protocol

The AS LAN shall use an open industry standard network protocol, e.g. IP protocol.

4.6.5.1 Communications between the Autopilot Computers and the Electronic Enclosures

The communications between the Autopilot Computers and the Electronic Enclosures shall use a secure protocol to ensure that the data on the optical LAN is not corrupted. The Contractor may propose its own secure protocol for TA review and approval or implement a three phase protocol called the **Select-Check-Execute.** It is as follows:

1. **Select:** A demand from the Autopilot computers is sent to an enclosure;
2. **Check:** An enclosure receives the demand and reflects (sends) the demand back to the Autopilot computers for checking; and
3. **Execute:** The Autopilot computers shall check the reflected demand from the enclosure and if the demand is correct, the Autopilot then sends an execute command to the enclosure. The selected enclosure then executes the demand.

4.6.6 Software Functions

The AS shall provide the following software system functions:

1. Submarine depth and course monitoring and control;
2. LANs communications;
3. Control of peripheral devices, e.g. Printer and POU;
4. Maintenance;
5. Data Logging;
6. Onboard trainer; and
7. CSS status monitoring.

4.6.6.1 Software Utilities

The AS shall provide at a minimum the following software utilities:

1. Software Upgrade;
2. Maintenance and online and offline diagnostics;
3. Electrical LAN Communications;
4. Data Logging;
5. Software Failure Logging; and
6. CSS status monitoring.

4.6.6.1.1 Software Upgrade Utility

The AS shall provide a software upgrade utility to implement complete or partial system software upgrade throughout the AS service life. The use of this upgrade utility shall be restricted to authorized personnel, e.g. Maintainer.

4.6.6.1.2 Maintenance Utility

The maintenance utility shall provide capabilities to:

1. View and modify configurations of Hardware Line Replaceable Units (LRUs) and software System resources;
2. Enable or disable or reset warnings and or alarms;
3. Execute off line or online diagnostics; and
4. Set memory contents to simulate warnings and alarms in maintenance or training modes.

4.6.6.1.3 Electrical LAN communications Utility

The Electrical LAN communications utility shall provide capabilities to communicate with other submarine system network devices. The utility shall provide but not be limited to the following capabilities:

1. CSS status;
2. Transfer logged data when requested by the network host device; and
3. Execute off line diagnostics when requested by the network host, e.g. POU.

4.6.6.1.4 Data Logging Utility

The data logging utility shall include logging, processing, transferring and graphical representation of real time data, archived data and event data. The data logging shall be time stamped.

4.6.6.1.4.1 Data Display/Viewing

The real-time data being collected, archived data and events data shall be available for viewing, querying, retrieving, reporting and extraction for further analysis.

The utility shall provide means to:

1. The operator to be able to select signals and events for online real-time/historical data viewing. The procedure for viewing data shall be the same for signals and events that are being viewed in real-time or from captured data;
2. Display current value, set value in tabular and/or graphical format of any signal requested;
3. Display current/historical value of multiple signal data in a graphical format, with recent values extending back 3 months for side-by-side analysis;
4. Graphically display of all captured events. Inclusion of display selection of all signals recorded with the specified event shall be available; and
5. Personalize screen view and reports for monitoring and analysis of real-time/historical equipment health data in response to events.

4.6.6.1.4.2 Logged Data Transfer

The logged data utility shall allow a user to transfer the logged data to a local USB device or to a network device, e.g. POU for an offline processing/analysis.

4.6.6.1.5 Software Failure Logging Utility

The software failure logging utility shall automatically log and capture all pertinent data associated with program interruptions due to software failures. This utility shall also provide the means for users to enter contextual information associated with any software failure.

4.6.6.1.6 CSS Status Monitoring

The CSS status monitoring utility shall allow the user to monitor and display any system status information that is available at the CSS, e.g. submarine machinery status, weapon system status, etc.

4.7 Diagnostics

4.7.1 Hardware Diagnostics

The AS hardware design shall have Built-In-Test (BIT) diagnostics supported by software to detect, identify, locate and indicate to the operator/maintainer any fault that has occurred in the system to isolate faulty LRUs during all operational modes. The BIT shall detect 100% of all fatal faults related to the AS. Further, the BIT shall detect and isolate 95% of all faults down to one LRU within the AS and detect and isolate remaining 5% of all faults down to two LRUs.

The BIT messages/indications shall be graphically presented on the AP in clear language with suitable colour coding for rapid identification of faulty LRUs. The BIT results shall be logged in a non-volatile memory as part of the data logging.

~~1.1.1~~4.7.2 EEs Hardware Diagnostics

Each EE's built in test diagnostics shall also include a dummy RSU load to fully test it with the SPTATE, without connecting the EE to the actual RSU.

4.7.3 Software Diagnostics

The application software shall have built online software diagnostics to isolate failed hardware LRUs and software modules.

4.7.4 Signal Interface List

To aid in hardware and software diagnostic activities, the AS Contractor shall provide a complete Signal Interface List for all the AS external interfaces, field devices, inputs and outputs signals.

The signal database shall include the following:

1. Equipment name to which a signal is connected;
2. Signal name or ID;
3. Connector name or ID and PIN information;
4. Electrical signal characteristics, e.g. voltage, current, frequency, digital input/output and analog input/output;
5. Field device number; and
6. Sensor or field device data.

4.8 VCS Dynamic Simulation Software Model and AS Control Algorithm Development

The Contractor shall develop the VCS dynamic simulation software model and the AS control algorithm based on his own 6- Degree of freedom (DOF) numerical model from deeply submerged to snorkelling depths and while on the surface, in variable sea state conditions IAW Section 4.5.8.

4.8.1 AS Control Algorithm Implementation Steps

The AS control algorithm implementation steps shall be as follows:

4.8.1.1 Phase 0: System Design Approach

The system design approach phase 0 shall be carried out during the **RFP** period. Each bidder shall provide a detailed description with a block diagram clearly detailing the overall design methodology planned to be used, including the general approach, for each manoeuvre, the class of algorithm(s), and the flow of data and commands.

4.8.1.2 Phase 1: VCS Simulation Software Model Design and Verification

The Contractor shall design and develop the VCS AS during the preliminary design phase. The Contractor shall then compare the results of the prototype control algorithms using his own simulator to results obtained when using DSSP and provide to Canada the comparison report for verification and acceptance by Canada prior to proceeding to the next phase.

4.8.1.3 Phase 2: AS Control Algorithm Design and VCS Model Testing

Upon successful implementation of phase 1, the Contractor shall design, develop the AS control algorithm and customize it for the VCS scaled Model for testing. Canada shall test the customized AS control algorithm on a free running model for a sub set of the overall set of manoeuvres that shall be carried out at Government of Canada Test Facilities. Canada will provide full details of scaled Model capabilities and functionality to the Contractor to aid in creating the AS control algorithm.

4.8.1.4 Phase 3: AS Control Algorithm Final Design

Upon successful completion of the phase 2, the Contractor shall then fine tune the AS control algorithm for the STW and full sea trials.

4.9 Maintenance

The AS shall provide two (2) levels of maintenance support for the AS equipment located:

1. On board the submarine;
2. At the Fleet Training Schools; and
3. At the Fleet maintenance Facility.

Refer to section 2.1, Table 1 and item 12.

4.9.1 Maintenance Philosophy

The repair philosophy shall be to Repair by Replacement (R by R) down to a Line Replaceable Unit (LRU) level, i.e. Circuit Card Assembly (CCA), Power Supply Unit (PSU), etc.

4.9.2 Levels of Maintenance

The submarine control system equipment maintenance philosophy consists of the following:

1. 1st level maintenance: to be provided on board the submarine using AS built in test diagnostics, its own personnel and materiel resources; and
2. 2nd level maintenance: to be provided by the Fleet Maintenance Facilities (FMF) personnel at each East and West coasts, by using the Contractor provided SPTATE and COTS test equipment procured by Canada.

4.9.3 First Level Maintenance Support Functions

The first level maintenance support functions include conducting all identified first level preventive maintenance as follows:

1. Isolate AS faults using built in test diagnostics, drawings, documentation, troubleshooting/fault finding guides (in any supplied format);
2. Remove and install replacement LRU;
3. Identify and document AS problems beyond first level capabilities for resolution by 2nd or 3rd level support organizations. E.g. Software issues.

4.9.4 Second Level Maintenance Support Functions

The second level maintenance support functions include conducting all identified second level preventive maintenance as follows:

1. Analyse and troubleshoot any automated or manual sequence within the AS using supplied built in diagnostics drawings, documentation, troubleshooting/fault finding guides (in any supplied format) and SPTATE and COTS test equipment;
2. Analyse and troubleshoot AS hardware and software interfaces using supplied drawings, documentation, troubleshooting and fault finding guides (in any supplied format and test equipment);
3. Repair AS components including wiring connectors, any AS wiring including associated interfaces;
4. Repair/replace field sensors if required; and
5. Identify and document AS problems beyond 2nd level capabilities for resolution by 3rd level support organizations, hardware or software issues.

4.9.5 Mean Time To Repair

Any component, which is subject to Repair-by-Replacement, shall have a maximum Mean Time To Repair (MTTR) of 30 minutes using specified procedures and resources. The MTTR shall include time to isolate, remove the faulty component/module and bring the failed equipment of the AS back on-line; it shall not include time taken to obtain the replacement component/module.

4.9.6 Hardware Diagnostics Test Tools and Test Equipment

In addition to the built in hardware diagnostics (refer to section 4.7.1) and software utilities (refer to section 4.6.6.1) for the 1st level maintenance, The AS Contractor shall design, develop, test and deliver the Special Purpose Tools and Test Equipment (SPTATE) for the 2nd level maintenance and shall clearly identify any COTS Test Equipment (CTE) that shall be required to support the 2nd level maintenance for both on board the submarine and alongside in harbour.

4.9.6.1 Built In Diagnostics for the 1st Level Maintenance

The built in diagnostics shall include but not limited to as follows:

1. Built In Test (BIT) hardware for each of the AP, SS, AS computer and EEs;
2. The EEs shall have built in dummy loads to exercise the servo amplifier outputs of the EEs during the 2nd level maintenance; and
3. Software utilities to exercise automatically on a periodic basis the built in hardware and software diagnostics.

4.9.6.2 Special Purpose Tools and Test Equipment (SPTATE)

The FMF personnel is responsible for conducting the 2nd level maintenance on the AS by using SPTATE and COTS test equipment to identify, isolate a failed LRU and repair it by replacing it with a functional spare LRU within each of the AS components, e.g. SS, AP, EE, AS Computers, etc. If for some reason, this exercise fails to correctly identify the problem and the fault remains within the AS components, the external connectors and cables/wires, external systems and the field sensors, then, SPTATE shall fully isolate the AS component under test from the field connections and prove that the AS component is fully functional. It will then be Canada's responsibility to correct the problem in the external connectors, cables/wires, external systems and the field sensors.

The SPTATE deliverable components may include but not limited to the following:

1. Circuit card extender boards;
2. Test Sets/Jigs, Breakout boxes, Special cables and or Plugs to isolate faults between the field sensors/wiring and the AP, the SS, the AS and the EEs. Further to completely verify the functionalities of the AP, the SS, the AS and the EEs as standalone black boxes
3. Special connector pin insertion, extraction and crimping tools for repairing connectors and plugs;
4. Hardware procedures defining any special pins, fuses and/or visual indications that are required to be monitored during first and second level maintenance; and
5. Diagnostics software utilities to be executed in a maintenance mode to isolate down to a failed LRU.

4.9.6.3 COTS Test Equipment (CTE)

The Contractor shall provide a list of COTS Test Equipment (CTE) required to support the second level maintenance.

4.10 System Expansion, Reliability and Survivability

4.10.1 System Integrity

The system shall have built in diagnostics as outlined in section 4.7. However, the system shall be designed to enable failures to be rapidly detected and corrected and maintain as many functions as possible following a failure.

4.10.2 Redundancy

4.10.2.1 Autopilot Panel and the Supervisory System (SS)

The AP and SS shall provide backup functional support to each other in case either one of them fail at a time.

4.10.2.2 AS Computers and EEs

The AS shall provide dual redundant AS computers and dual redundant hardware in the EEs.

4.10.2.3 LANs

The AS shall provide interfaces to dual electrical Ethernet LAN and implement dual optical Ethernet LANs for each of its subcomponents, AP, SS, AS computers and EEs.

4.10.3 System Availability

The mean system availability shall be equal or greater than 99.999% over a 10,000 hours mission time.

4.10.4 Power Failure

Following a power failure the system shall automatically restart when power is re-asserted. Changes to any submarine parameters limits, inhibitions or periodic logs set by the operator shall be remembered. The operator shall be required only to re-enter the time and re-acknowledge any outstanding warnings. Upon power restoration, the AS shall take equal or less than a minute to restart in a fully functional state.

4.11 Trainers

4.11.1 On Board Trainer

The software based On Board Trainer (OBT) shall reside on a standalone PC onboard the submarine. The trainer is intended to be used by the operators on board the submarine to maintain their steady state training skills in addition to periodic

comprehensive training on the SCT at the fleet training school. The trainer shall provide a complete set of training scenarios for the AS automatic and manual control. The trainer shall be connected to the network and the student training interactions and results shall be logged as part of the data logging functionality. The location of the On Board Trainer PC shall be decided by Canada at a later date. However, it will not have a fixed location.

4.11.2 Shore Based Trainers

4.11.2.1 Shore Based Trainers Functional Requirements Overview

The Shore Based Trainers (SBTs), the Submarine Control Trainer (SCT) and the Maintenance Trainer (MT) are deployed at the East coast training facility to provide training to the submarine operators and the FMF maintainers. The training requirements vary considerably and are targeted to persons with varying technical backgrounds that require different levels of system knowledge.

The SCT provides the AS operational training functionalities. The existing SCT shall not be upgraded with the new AS hardware. The existing MT currently provides the Fire Detection System (FDS) and the Central Surveillance System (CSS) maintenance training. The MT shall be enhanced to include the AS training functionality. The following sections provide detailed requirements for the SBTs.

4.11.2.2 Submarine Control Trainer (SCT)

The existing SCT uses software model and simulated hardware to drive the six degree motion system to reproduce the submarine motion. The SCT hardware upgrade kit shall include the new submarine hardware.

4.11.2.2.1 SCT Hardware

The SCT trainer shall provide:

1. 1 AP with protective cover and with handles;
2. 1 SS with protective cover and with handles;
3. 1 Maintenance Panel;
4. 2 AS Computers
5. 3 EEs (FWD, AFT and Rudder);
6. LAN Components; and
7. Any additional hardware required to implement the upgrade.

4.11.2.2.2 SCT Software

The Contractor is not responsible for the design, the development, the test and the integration of the software interfaces required to interface the new AS to the existing simulation software residing on the SCT host computer. This SCT software design, development, test and integration shall be part of another separate contract to be determined at a future date by Canada.

4.11.2.3 Maintenance Trainer (MT)

The existing Maintenance Trainer (MT) is used to train maintenance staff to conduct 1st and 2nd level maintenance activities of one system at a time, namely the Fire Detection System (FDS) and the Central Surveillance System (CSS). The MT has one common trainer console. The existing MT system shall be enhanced to include the AS maintenance training requirements. The AS MT trainer shall be used to train one student at a time.

In addition to the maintenance training, the MT shall also be used to provide operational Cadre Training and steady state training while the SCT is being upgraded.

The AS MT hardware enhancements shall include all types of new AS hardware to provide hands on training to the maintainers, e.g. AP, SS, AS computers, EEs and any other new hardware.

4.11.2.3.1 MT Hardware

At a minimum, the MT equipment shall include the following:

1. 1 AP with protective cover and with handles;
2. 1 SS with protective cover and with handles;
3. 2 AS Computers;
4. 1 EE (If all three EEs are identical, else all EE types are required);
5. 1 Fault insertion and monitoring hardware;
~~5.~~6. LANs Components;
~~6.~~7.1 POU;
~~7.~~8.1 SPTATE; and
~~8.~~9. Any other hardware to implement the AS MT enhancements.

Note: **The upgraded MT shall use the existing MT trainer console.**

4.11.2.3.2 MT Software

The MT shall provide:

1. Software utility to allow the instructor to create on line faults scenarios for training on the following AS components;

    a. AP;
    b. SS;
    c. AS Computers;
    d. EEs;
    e. LANs components
    f. Input and output field signals, e.g. submarine parameters and RSU signals;
    g. Hardware connectors and field cables; and
    h. System hardware and software.

2. A full set of preconfigured hardware and software fault scenarios; and
3. A full set of operational training scenarios with the fault scenarios, but without the motion system.

5 Engineering Change Specifications

5.1 General

The Engineering Change (EC) specifications shall be detailed specifications for changes to the Victoria Class Submarines to support the installation of the AS equipment and for the changes to the SBTs to support the upgrades of the SCT and the MT. The ECs specifications shall provide the necessary electrical and mechanical interfaces, detailed submarine, SCT and MT design modifications to meet the CANADA-format Engineering Change (EC) Specifications. Refer to section 2.1, Table 1 and item 11 .

5.1.1 Engineering Change Specifications for the Submarine

The five (5) Submarine ECs specifications, a baseline EC specification and four (4) customized EC specifications for each of the submarines shall:

1. Be in accordance with the requirements as per reference to section 2.1, Table 1 and item 11;
2. Include any particularization related to each of the four Submarines;
3. Use metric units for all EC specifications, unless the source of the original documentation is non-metric, and no changes to that original documentation is being made; and
4. Meets the requirements of the Canadian Environmental Assessment Act (CEAA), as specified in section 2.1, Table 1 and item 13.

5.1.2 Engineering Changes Specifications for the SCT and MT

The SCT and MT ECs specifications shall:

1. Be in accordance with the requirements as per reference to section 2.1, Table 1 and item 11.
2. Use metric units for specifications , unless the source of the original documentation is non-metric, and no changes to that original documentation is being made; and
3. Meets the requirements of the Canadian Environmental Assessment Act (CEAA), as specified in section 2.1, Table 1 and item 13.

6 Health and Safety

The health and safety requirements are included in the terms and conditions of the RFP.

7 Acronyms and Abbreviations

API	Application Program Interface
BIT	Built In Test
CCA	Circuit Card Assemblies
CEAA	Canadian Environmental Assessment Act
COTS	Commercial Off The Shelf
CPU	Central Processor Unit
CSS	Central Surveillance System
CTE	COTS Test Equipment
DRDC	Defence Research and Development Canada
DSSP	DRDC Submarine Simulation Program
EC	Engineering Change
EDWP	Extended Docking Work Period
FDS	Fire Detection System
GUI	Graphical User Interface
HMI	Human Machine Interface
ID	Identification
I/O	Input Output
IP	Internet Protocol
IPB	Illuminated Push Button
LAN	Local Area Network
LCD	Liquid Crystal Display
LRU	Line Replaceable Unit
MT	Maintenance Trainer
MTTR	Mean Time To Repair
OMC	One Man Console
POU	Portable Operating unit
PSU	Power Supply Unit
R By R	Repair By Replacement
RFP	Request For Proposals
SBT	Shore Based Trainer
SCC	Submarine Control Console
SCT	Submarine Control Trainer
SDP	Software Development Plan
SPTATE	Special Purpose Tools And Test Equipment
TA	Technical Authority

8 Attachments

The information in the references called up in section 2.1 is part of the attached documentation data package which forms an integral part of this TSOR.

Government of Canada / Gouvernement du Canada

Contract Number / Numéro du contrat
W8483-117051
Security Classification / Classification de sécurité
UNCLASS

SECURITY REQUIREMENTS CHECK LIST (SRCL)
LISTE DE VÉRIFICATION DES EXIGENCES RELATIVES À LA SÉCURITÉ (LVERS)

PART A - CONTRACT INFORMATION / PARTIE A - INFORMATION CONTRACTUELLE

1. Originating Government Department or Organization / Ministère ou organisme gouvernemental d'origine	2. Branch or Directorate / Direction générale ou Direction
DGMEPM	DMEPM(SM)

3. a) Subcontract Number / Numéro du contrat de sous-traitance	3. b) Name and Address of Subcontractor / Nom et adresse du sous-traitant

4. Brief Description of Work / Brève description du travail
Autopilot System for the Victoria Class Submarines

5. a) Will the supplier require access to Controlled Goods? Le fournisseur aura-t-il accès à des marchandises contrôlées?	☒ No Non	☐ Yes Oui
5. b) Will the supplier require access to unclassified military technical data subject to the provisions of the Technical Data Control Regulations? Le fournisseur aura-t-il accès à des données techniques militaires non classifiées qui sont assujetties aux dispositions du Règlement sur le contrôle des données techniques?	☐ No Non	☒ Yes Oui
6. Indicate the type of access required / Indiquer le type d'accès requis		
6. a) Will the supplier and its employees require access to PROTECTED and/or CLASSIFIED information or assets? Le fournisseur ainsi que les employés auront-ils accès à des renseignements ou à des biens PROTÉGÉS et/ou CLASSIFIÉS? (Specify the level of access using the chart in Question 7. c) (Préciser le niveau d'accès en utilisant le tableau qui se trouve à la question 7. c)	☐ No Non	☒ Yes Oui
6. b) Will the supplier and its employees (e.g. cleaners, maintenance personnel) require access to restricted access areas? No access to PROTECTED and/or CLASSIFIED information or assets is permitted. Le fournisseur et ses employés (p. ex. nettoyeurs, personnel d'entretien) auront-ils accès à des zones d'accès restreintes? L'accès à des renseignements ou à des biens PROTÉGÉS et/ou CLASSIFIÉS n'est pas autorisé.	☒ No Non	☐ Yes Oui
6. c) Is this a commercial courier or delivery requirement with no overnight storage? S'agit-il d'un contrat de messagerie ou de livraison commerciale sans entreposage de nuit?	☒ No Non	☐ Yes Oui

7. a) Indicate the type of information that the supplier will be required to access / Indiquer le type d'information auquel le fournisseur devra avoir accès

Canada ☒	NATO / OTAN ☐	Foreign / Étranger ☐

7. b) Release restrictions / Restrictions relatives à la diffusion

Canada	NATO / OTAN	Foreign / Étranger
No release restrictions / Aucune restriction relative à la diffusion ☒	All NATO countries / Tous les pays de l'OTAN ☐	No release restrictions / Aucune restriction relative à la diffusion ☐
Not releasable / À ne pas diffuser ☐		
Restricted to: / Limité à : Specify country(ies): / Préciser le(s) pays : Canada ☐	Restricted to: / Limité à : Specify country(ies): / Préciser le(s) pays : ☐	Restricted to: / Limité à : Specify country(ies): / Préciser le(s) pays : ☐

7. c) Level of information / Niveau d'information

Canada	NATO	Foreign / Étranger
PROTECTED A / PROTÉGÉ A ☐	NATO UNCLASSIFIED / NATO NON CLASSIFIÉ ☐	PROTECTED A / PROTÉGÉ A ☐
PROTECTED B / PROTÉGÉ B ☐	NATO RESTRICTED / NATO DIFFUSION RESTREINTE ☐	PROTECTED B / PROTÉGÉ B ☐
PROTECTED C / PROTÉGÉ C ☐	NATO CONFIDENTIAL / NATO CONFIDENTIEL ☐	PROTECTED C / PROTÉGÉ C ☐
CONFIDENTIAL / CONFIDENTIEL ☐	NATO SECRET / NATO SECRET ☐	CONFIDENTIAL / CONFIDENTIEL ☐
SECRET / SECRET ☒	COSMIC TOP SECRET / COSMIC TRÈS SECRET ☐	SECRET / SECRET ☐
TOP SECRET / TRÈS SECRET ☐		TOP SECRET / TRÈS SECRET ☐
TOP SECRET (SIGINT) / TRÈS SECRET (SIGINT) ☐		TOP SECRET (SIGINT) / TRÈS SECRET (SIGINT) ☐

Government of Canada / Gouvernement du Canada

Contract Number / Numéro du contrat
W8483-117051
Security Classification / Classification de sécurité
UNCLASS

PART A (continued) / PARTIE A (suite)

8. Will the supplier require access to PROTECTED and/or CLASSIFIED COMSEC information or assets? — No ☒ / Yes ☐
Le fournisseur aura-t-il accès à des renseignements ou à des biens COMSEC désignés PROTÉGÉS et/ou CLASSIFIÉS?
If Yes, indicate the level of sensitivity:
Dans l'affirmative, indiquer le niveau de sensibilité :

9. Will the supplier require access to extremely sensitive INFOSEC information or assets? — No ☒ / Yes ☐
Le fournisseur aura-t-il accès à des renseignements ou à des biens INFOSEC de nature extrêmement délicate?

Short Title(s) of material / Titre(s) abrégé(s) du matériel : Victoria Class Submarine documents
Document Number / Numéro du document : Documents referenced in RFP, Annex A and B

PART B - PERSONNEL (SUPPLIER) / PARTIE B - PERSONNEL (FOURNISSEUR)

10. a) Personnel security screening level required / Niveau de contrôle de la sécurité du personnel requis

☐ RELIABILITY STATUS / COTE DE FIABILITÉ	☐ CONFIDENTIAL / CONFIDENTIEL	☒ SECRET / SECRET	☐ TOP SECRET / TRÈS SECRET
☐ TOP SECRET – SIGINT / TRÈS SECRET – SIGINT	☐ NATO CONFIDENTIAL / NATO CONFIDENTIEL	☐ NATO SECRET / NATO SECRET	☐ COSMIC TOP SECRET / COSMIC TRÈS SECRET
☐ SITE ACCESS / ACCÈS AUX EMPLACEMENTS			

Special comments:
Commentaires spéciaux : _____

NOTE: If multiple levels of screening are identified, a Security Classification Guide must be provided.
REMARQUE : Si plusieurs niveaux de contrôle de sécurité sont requis, un guide de classification de la sécurité doit être fourni.

10. b) May unscreened personnel be used for portions of the work? — No ☒ / Yes ☐
Du personnel sans autorisation sécuritaire peut-il se voir confier des parties du travail?
If Yes, will unscreened personnel be escorted? — No ☒ / Yes ☐
Dans l'affirmative, le personnel en question sera-t-il escorté?

PART C - SAFEGUARDS (SUPPLIER) / PARTIE C - MESURES DE PROTECTION (FOURNISSEUR)

INFORMATION / ASSETS / RENSEIGNEMENTS / BIENS

11. a) Will the supplier be required to receive and store PROTECTED and/or CLASSIFIED information or assets on its site or premises? — No ☐ / Yes ☒
Le fournisseur sera-t-il tenu de recevoir et d'entreposer sur place des renseignements ou des biens PROTÉGÉS et/ou CLASSIFIÉS?

11. b) Will the supplier be required to safeguard COMSEC information or assets? — No ☒ / Yes ☐
Le fournisseur sera-t-il tenu de protéger des renseignements ou des biens COMSEC?

PRODUCTION

11. c) Will the production (manufacture, and/or repair and/or modification) of PROTECTED and/or CLASSIFIED material or equipment occur at the supplier's site or premises? — No ☐ / Yes ☒
Les installations du fournisseur serviront-elles à la production (fabrication et/ou réparation et/ou modification) de matériel PROTÉGÉ et/ou CLASSIFIÉ?

INFORMATION TECHNOLOGY (IT) MEDIA / SUPPORT RELATIF À LA TECHNOLOGIE DE L'INFORMATION (TI)

11. d) Will the supplier be required to use its IT systems to electronically process, produce or store PROTECTED and/or CLASSIFIED information or data? — No ☐ / Yes ☒
Le fournisseur sera-t-il tenu d'utiliser ses propres systèmes informatiques pour traiter, produire ou stocker électroniquement des renseignements ou des données PROTÉGÉS et/ou CLASSIFIÉS?

11. e) Will there be an electronic link between the supplier's IT systems and the government department or agency? — No ☒ / Yes ☐
Disposera-t-on d'un lien électronique entre le système informatique du fournisseur et celui du ministère ou de l'agence gouvernementale?

Government of Canada / Gouvernement du Canada

Contract Number / Numéro du contrat
W8483-117051
Security Classification / Classification de sécurité
UNCLASS

PART C - (continued) / PARTIE C - (suite)

For users completing the form manually use the summary chart below to indicate the category(ies) and level(s) of safeguarding required at the supplier's site(s) or premises.
Les utilisateurs qui remplissent le formulaire manuellement doivent utiliser le tableau récapitulatif ci-dessous pour indiquer, pour chaque catégorie, les niveaux de sauvegarde requis aux installations du fournisseur.

For users completing the form online (via the Internet), the summary chart is automatically populated by your responses to previous questions.
Dans le cas des utilisateurs qui remplissent le formulaire en ligne (par Internet), les réponses aux questions précédentes sont automatiquement saisies dans le tableau récapitulatif.

SUMMARY CHART / TABLEAU RÉCAPITULATIF

Category / Catégorie	PROTECTED / PROTÉGÉ			CLASSIFIED / CLASSIFIÉ			NATO				COMSEC					
	A	B	C	CONFIDENTIAL / CONFIDENTIEL	SECRET	TOP SECRET / TRÈS SECRET	NATO RESTRICTED / NATO DIFFUSION RESTREINTE	NATO CONFIDENTIAL / NATO CONFIDENTIEL	NATO SECRET	COSMIC TOP SECRET / COSMIC TRÈS SECRET	PROTECTED / PROTÉGÉ A	PROTECTED / PROTÉGÉ B	PROTECTED / PROTÉGÉ C	CONFIDENTIAL / CONFIDENTIEL	SECRET	TOP SECRET / TRÈS SECRET
Information / Assets / Renseignements / Biens					X											
Production					X											
IT Media / Support TI					X											
IT Link / Lien électronique																

12. a) Is the description of the work contained within this SRCL PROTECTED and/or CLASSIFIED?
La description du travail visé par la présente LVERS est-elle de nature PROTÉGÉE et/ou CLASSIFIÉE?

☒ No / Non ☐ Yes / Oui

If Yes, classify this form by annotating the top and bottom in the area entitled "Security Classification".
Dans l'affirmative, classifier le présent formulaire en indiquant le niveau de sécurité dans la case intitulée « Classification de sécurité » au haut et au bas du formulaire.

12. b) Will the documentation attached to this SRCL be PROTECTED and/or CLASSIFIED?
La documentation associée à la présente LVERS sera-t-elle PROTÉGÉE et/ou CLASSIFIÉE?

☒ No / Non ☐ Yes / Oui

If Yes, classify this form by annotating the top and bottom in the area entitled "Security Classification" and indicate with attachments (e.g. SECRET with Attachments).
Dans l'affirmative, classifier le présent formulaire en indiquant le niveau de sécurité dans la case intitulée « Classification de sécurité » au haut et au bas du formulaire et indiquer qu'il y a des pièces jointes (p. ex. SECRET avec des pièces jointes).

Government of Canada / Gouvernement du Canada

Contract Number / Numéro du contrat	
W8483-117051	
Security Classification / Classification de sécurité	
UNCLASS	

PART D - AUTHORIZATION / PARTIE D - AUTORISATION

13. Organization Project Authority / Chargé de projet de l'organisme

Name (print) - Nom (en lettres moulées)	Title – Titre	Signature
Hans Pall	DMEPM(SM) 4-3-5	Hans R. Pall

Telephone No. - N° de téléphone	Facsimile No. - N° de télécopieur	E-mail address - Adresse courriel	Date
819 994 3727	819-994-9127	pall.hr@forces.gc.ca	21 January 2011

14. Organization Security Authority / Responsable de la sécurité de l'organisme

Name (print) - Nom (en lettres moulées)	Title – Titre	Signature
Sasha Medjovic	Sasha Medjovic - DPM Secur 3 Senior Security Analyst	

Telephone No. - N° de téléphone	Facsimile No. - N° de télécopieur	E-mail address - Adresse courriel	Date
	E-Mail: sasha.medjovic@forces.gc.ca		2011-06-21

15. Are there additional instructions (e.g. Security Guide, Security Classification Guide) attached?
Des instructions supplémentaires (p. ex. Guide de sécurité, Guide de classification de la sécurité) sont-elles jointes? ☐ No / Non ☑ Yes / Oui

16. Procurement Officer / Agent d'approvisionnement

Name (print) - Nom (en lettres moulées)	Title – Titre	Signature
GERARD CLEMENT	MANAGER	

Telephone No. - N° de téléphone	Facsimile No. - N° de télécopieur	E-mail address - Adresse courriel	Date
819-956-4233	819-956-0897	GERARD.CLEMENT@PWGSC.GC.CA	July 23, 2012

17. Contracting Security Authority / Autorité contractante en matière de sécurité

Name (print) - Nom (en lettres moulées)	Title – Titre	Signature
Sherry Campbell Contract Security Officer, Contract Security Division Sherry.Campbell@tpsgc-pwgsc.gc.ca Tel/Tél - 613-948-1646 / Fax/Télec - 613-954-4171		Sherry Campbell

Telephone No. - N° de téléphone	Facsimile No. - N° de télécopieur	E-mail address - Adresse courriel	Date
			July 31, 2012