

**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.

### **Vendor/Firm Name and Address**

**Raison sociale et adresse du  
fournisseur/de l'entrepreneur**

### **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

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

**Instructions: See Herein**

**Instructions: Voir aux présentes**

<b>Delivery Required - Livraison exigée</b>	<b>Delivery Offered - Livraison proposée</b>
<b>Vendor/Firm Name and Address</b> <b>Raison sociale et adresse du fournisseur/de l'entrepreneur</b>	
<b>Telephone No. - N° de téléphone</b> <b>Facsimile No. - N° de télécopieur</b>	
<b>Name and title of person authorized to sign on behalf of Vendor/Firm (type or print)</b> <b>Nom et titre de la personne autorisée à signer au nom du fournisseur/ de l'entrepreneur (taper ou écrire en caractères d'imprimerie)</b>	
<b>Signature</b>	<b>Date</b>

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**This bid solicitation cancels and supersedes previous bid solicitation number W8483-117051/B dated 2012-08-06 with a closing of 2012-10-01 at 2:00 PM EDT.**

**This amendment is intended to incorporate all the answers provided to the Bidders questions and all modifications to the previous RFP are identified in yellow.**

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Solicitation No. - N° de l'invitation

W8483-117051/C

Client Ref. No. - N° de réf. du client

W8483-117051

Amd. No. - N° de la modif.

002

File No. - N° du dossier

034mlW8483-117051

Buyer ID - Id de l'acheteur

034ml

CCC No./N° CCC - FMS No/ N° VME

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## PART 1 - GENERAL INFORMATION

### 1.1 Introduction

The bid solicitation and resulting Contract document is divided into seven parts plus Annexes as follows:

Part 1 General Information: provides a general description of the requirement;

Part 2 Bidder Instructions: provides the instructions, clauses and conditions applicable to the bid solicitation and states that the Bidder agrees to be bound by the clauses and conditions contained in all parts of the bid solicitation;

Part 3 Bid Preparation Instructions: provides bidders with instructions on how to prepare their bid;

Part 4 Evaluation Procedures and Basis of Selection: indicates how the evaluation will be conducted, the evaluation criteria that must be addressed in the bid, and the basis of selection;

Part 5 Certifications: includes the certifications to be provided;

Part 6 Security Requirements: includes specific requirements that must be addressed by bidders; and

Part 7 Resulting Contract Clauses: includes the clauses and conditions that will apply to any resulting contract.

The Annexes as listed in the Table of Contents.

### 1.2 Summary

**Only the Bidders in RFP W8483-117051/B that have attended both Mandatory site visits in Victoria and Halifax will be able to meet the qualification requirements.**

The Department of National Defence has a requirement for the replacement of the Autopilot Systems (AS) fitted onboard the Department of National Defence (DND) VICTORIA Class submarines. The AS consists of an "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. It is Canada's plan to replace the AS with a fully supportable system that provides the same core functionality as the existing system. All of 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 weights of the legacy system. A new Onboard Trainer (OBT) will be designed and the Submarine Control Trainer (SCT) and Maintenance Trainer (MT) will be upgraded to use the new submarine AS hardware, software and the new user interfaces. The Submarine Control Trainer installation will not be part of this contract.

There are four (4) Victoria Class submarines (Victoria, Windsor, Cornerbrook and Chicoutimi), two (2) are located at Canadian Forces Base (CFB) Halifax and two (2) at Canadian Forces Base (CFB) Victoria. This requirement also details the work on the new Onboard Trainer (OBT) and the upgrade work on the shore based trainers; Submarine Control Trainer (SCT) and the Maintenance Trainer (MT). The shore based trainers are located at the Canadian Forces Base (CFB) Halifax.

This requirement includes all associated Work and services described herein including the Statement of Work (SOW) and Technical Statement of Requirement (TSOR), attached as Annex "A" and Annex "B".

The Delivery Schedule in Annex D is to be based on a two (2) year contract duration, excluding installations, all deliverables shall be delivered during this period.

The current planned VCS installation schedule is:

1. Victoria: January 2015, SWP5
2. Chicoutimi: May 2015, SWP2
3. Windsor: March 2016, SWP6
4. Corner Brook: July 2016, SWP1

The Bidders shall provide a firm price for the installations to be based on a window of five (5) years, starting Jan 2015.

The Contractor is responsible for installing the MT AS related equipment.

The SCT shall not be part of the upgrade. The Contractor is not responsible for installing the SCT AS related equipment. There will be another separate contract to install the SCT AS related equipment. However, the AS hardware and software equipments for the SCT is part of the deliverables.



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**The fundamental objectives of the AS replacement system is to:**

1. Sustain the existing functions of the AS 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. Upgrade the SCT to use 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.

### **1.3 Communications Notifications**

As a courtesy, the Government of Canada requests that successful bidders notify the Contracting Authority in advance of their intention to make public an announcement related to the award of a contract.

### **1.4 Debriefings**

After contract award, bidders may request a debriefing on the results of the bid solicitation process. Bidders should make the request to the Contracting Authority within 15 working days of receipt of the results of the bid solicitation process. The debriefing may be in writing, by telephone or in person.

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## PART 2 - BIDDER INSTRUCTIONS

### 2.1 Standard Instructions, Clauses and Conditions

All instructions, clauses and conditions identified in the bid solicitation by number, date and title are set out in the Standard Acquisition Clauses and Conditions

(<https://buyandsell.gc.ca/policy-and-guidelines/standard-acquisition-clauses-and-conditions-manual>) Manual issued by Public Works and Government Services Canada.

Bidders who submit a bid agree to be bound by the instructions, clauses and conditions of the bid solicitation and accept the clauses and conditions of the resulting contract.

The 2003 (2012-07-11) Standard Instructions - Goods or Services - Competitive Requirements, are incorporated by reference into and form part of the bid solicitation.

Section 07 "Transmission by facsimile" is deleted in its entirety and replaced by the following:

"Due to the nature of the bid solicitation, bids transmitted by facsimile or electronic mail to PWGSC will not be accepted."

Bidders shall include all project management prices in each of the items listed in the Financial Bid and defacto in the Milestones Payments schedule, Canada will not accept any extra costs.

### 2.2 Submission of Bids

Bids must be submitted only to Public Works and Government Services Canada (PWGSC) Bid Receiving Unit by the date, time and place indicated on page 1 of the bid solicitation.

Bids will NOT be opened publicly.

### 2.3 Enquiries - Bid Solicitation

All enquiries must be submitted in writing to the Contracting Authority no later than October 26th, 2012 at 5:00PM Eastern Daylight Saving Time (EDT). Enquiries received after that time will not be answered.

Prior to November 2nd an amended RFP will be issued. The different sections of the amended RFP will be modified to include all the answers to the different questions received.

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

## 2.4 Applicable Laws

Any resulting Contract must be interpreted and governed, and the relations between the parties determined, by the laws in force in Ontario.

Bidders may, at their discretion, substitute the applicable laws of a Canadian province or territory of their choice without affecting the validity of their bid, by deleting the name of the Canadian province or territory specified and inserting the name of the Canadian province or territory of their choice. If no change is made, it acknowledges that the applicable laws specified are acceptable to the bidders.

## 2.5 Mandatory Vessel Site Visit

It is mandatory that the Bidder or a representative of the Bidder visit the work site. Arrangements have been made for the following site visits:

- Concerning the submarine, the site visit will be held on **Septembre 5th 2012 at 9:00AM** at the following address:

Corner Brook  
825 Admirals Road  
Victoria, BC  
V9A 2P1

- Concerning the Shore Base Trainers, the site visit will be held on **Septembre 7th 2012 at 9:00AM** at the following address

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CFNOS  
Building S17  
Stadacona  
2638 Lorne Terrace  
Halifax

**Bidders must communicate with the Contracting Authority as soon as possible** to confirm attendance and provide the names of the person(s) who will attend.

Bidders will be required to sign an attendance form. Bidders should confirm in their bids that they have attended the site visit. Bidders who do not attend or send a representative will not be given an alternative appointment and their bids will be rejected as non-compliant. Any clarifications or changes to the bid solicitation resulting from the site visit and during the bid process will be included as an amendments to the bid solicitation.

## PART 3 - BID PREPARATION INSTRUCTIONS

### 3.1 Bid Preparation Instructions

Canada requests that bidders provide their bid in separately bound sections as follows:

Vol	Title	Hard Copy Quantity	Soft Copy CD Quantity
1	Technical Bid	5	2
2	Financial Bid and Certifications	1	0

**3.1.1 Prices must appear in the Financial bid only. No prices shall be indicated in any other section of the bid.**

3.1.2 If there is a discrepancy between the wording of the soft copy and the hard copy, the wording of the hard copy will have priority over the wording of the soft copy. The hard copy shall be numbered and the copy which bears the serial number "1" will be treated as the master copy and will take precedence over all other copies should there be any discrepancy between copies.

3.1.3 Soft copies of the Bid shall be in MS Word 2003.

3.1.4 Cross-referencing

Each section of the Bidder's Bid should be written to the greatest extent possible on a stand-alone basis so that its content may be evaluated with a minimum of cross-referencing to other sections of the Bid.

Cross-referencing within a proposal Section is permitted where its use would conserve space without impairing clarity.

3.1.5 Except as specifically provided otherwise in this solicitation, Canada will evaluate the Bids on the documentation provided as part of that Bid. References in a proposal to additional information not submitted with the Bid, such as:

(a) web site addresses where additional information can be found;

(b) technical manuals or brochures not submitted with the Bid;

or

- 
- (c) existing standing offers, supply arrangements or contracts with the Government of Canada

will not be considered.

- 3.1.6 Canada requests that bidders follow the format instructions described below in the preparation of their bid:

- (a) use 8.5 x 11 inch (216 mm x 279 mm) paper or 8.3 x 11.7 inch (210mm x 297mm); and
- (b) use a numbering system that corresponds to the bid solicitation.

- 3.1.7 Bidders are not to self-score their proposal, Canada will use the Annex I for Point Rated and Annex H for Mandatory in order to evaluate each proposals.

### 3.2 Technical Bid

In their technical bid, bidders should demonstrate their understanding of the requirements contained in the bid solicitation and explain how they will meet these requirements. Bidders should demonstrate their capability and describe their approach in a thorough, concise and clear manner for carrying out the work.

The technical bid should address clearly and in sufficient depth the points that are subject to the evaluation criteria against which the bid will be evaluated. Simply repeating the statement contained in the bid solicitation is not sufficient. In order to facilitate the evaluation of the bid, Canada requests that bidders address and present topics in the order of the evaluation criteria under the same headings. To avoid duplication, bidders may refer to different sections of their bids by identifying the specific paragraph and page number where the subject topic has already been addressed.

Bids shall follow all instructions, general terms, conditions and clauses identified herein by title, number and date. All references to descriptive material, technical manuals and brochures included as part of this Bid should be referenced accordingly.

The Technical Bid shall also include:

- (a) Statement of compliance to the SOW and TSOR, this in a requirements matrix format;
- (b) Duly completed Annex "H", Mandatory Technical Criteria, and Bidders must demonstrate how they meet each Mandatory Technical Criteria of the RFP, including provision of design drawings and other drawings, calculations and materials specified therein; and
- (c) Duly completed Annex "I", Point Rated Technical Criteria, and Bidders must demonstrate how they meet each Point Rated Technical Criteria of the RFP, including provision of design drawings and other drawings, calculations and materials specified therein.

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### 3.3 Financial Bid

Bidders must submit their financial bid in accordance with the Annex "J" "Financial Bid". The Financial Bid must include a price for every Line item in Annex "J". All prices must be in **Canadian dollars**, Canadian customs duties and excise taxes included. The total amount of Goods and Services Tax or Harmonized Sales Tax must be shown separately, if applicable.

All prices quoted shall include Travel and Living expenses, delivery, installation, testing and acceptance for each Autopilot System onboard the submarines and Trainers located at the Canadian Forces Base (CFB) of Halifax.

The Financial Bid shall include:

- (a) The full legal name of the Bidder;
- (b) Bidders shall provide the name of a company representative, their telephone, facsimile number and email address, to be the contact person in the event that clarification of their proposal is required;
- (c) Duly completed Annex "C", Milestone Payment Schedule;
- (d) Duly completed Annex "D", Delivery Schedule;
- (e) Duly completed Annex "E", Prices and Quantities of Material, Spare Parts, Design, Installation and Cadre Training to be delivered;
- (f) Duly completed and signed Annex "J", Financial Bid; and
- (g) Duly completed and signed Certifications as per Part 5 of the RFP.

### 3.4 Exchange Rate Fluctuation

C 3011T (2010-01-11), Exchange Rate Fluctuation.



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## **PART 4 - EVALUATION PROCEDURES AND BASIS OF SELECTION**

### **4.1 Evaluation Procedures**

4.1.1 Bids will be assessed in accordance with the entire requirement of the bid solicitation including the Technical and Financial evaluation criteria.

4.1.2 An evaluation team composed of representatives of Canada will evaluate the bids.

#### **4.1.3 Mandatory Technical Criteria**

The Technical mandatory requirements to be met by any Bid is attached hereto as Annex "H", Mandatory Technical Criteria.

#### **4.1.4 Point Rated Technical Criteria**

The Point rated requirements to be met by any Bid is attached hereto as Annex "I", Point Rated Technical Criteria.

#### **4.1.5 Financial Evaluation**

The price of the bid will be evaluated in Canadian dollars, the Goods and Services Tax or the Harmonized Sales Tax excluded, FOB destination, Canadian customs duties and excise taxes included.

## 4.2 Basis of Selection

4.2.1 To be declared responsive, a bid must:

- (a) Comply with all the requirements of the bid solicitation;
- (b) Meet all Mandatory Technical Evaluation Criteria; and
- (c) Achieve a minimum of 75% for each of the Point Rated of Table 1 in Annex "I", prior to applying weighting factors and achieve a minimum of 80% for each of the Point Rated of Table 3 in Annex "I", prior to applying weighting factors.
- (d) A Bidder's Individual Technical Score will be the addition of the scores obtained in Table 1 and Table 3.

4.2.2 Bids not meeting 4.2.1 (a) or (b) or (c) will be declared as non-responsive.

4.2.3 The responsive Bid with the **Highest Total Score**, will be recommended for award of a Contract.

**Total Score** will be calculated as:

$$= \frac{\text{Lowest Total Price for the Project} \times 70\%}{\text{Individual Total Price for the Project}} + \frac{\text{Individual Technical Score} \times 30\%}{\text{Highest Technical Score}}$$

4.2.4 In case of a tie, the proposal with the Lowest Total Price for the Project, as per Annex "J", shall be recommended for award of a Contract.

## PART 5 - CERTIFICATIONS

Bidders must provide the required certifications to be awarded a contract. Canada will declare a bid non-responsive if the required certifications are not completed and submitted as requested.

Compliance with the certifications bidders provide to Canada is subject to verification by Canada during the bid evaluation period (before award of a contract) and after award of a contract. The Contracting Authority will have the right to ask for additional information to verify bidders' compliance with the certifications before award of a contract. The bid will be declared non-responsive if any certification made by the Bidder is untrue, whether made knowingly or unknowingly. Failure to comply with the certifications or to comply with the request of the Contracting Authority for additional information will also render the bid non-responsive.

### 5.1 Code of Conduct Certifications - Consent to a Criminal Record Verification

5.1.1 Bidders must submit with their bid, by the bid solicitation closing date:

- (a) a complete list of names of all individuals who are currently directors of the Bidder;
- (b) a properly completed and signed form Consent to a Criminal Record Verification (PWGSC-TPSGC 229), for each individual named in the list.

### 5.2 Certifications Precedent to Contract Award

The certifications listed below should be completed and submitted with the bid but may be submitted afterwards. If any of these required certifications is not completed and submitted as requested, the Contracting Authority will so inform the Bidder and provide the Bidder with a time frame within which to meet the requirement. Failure to comply with the request of the Contracting Authority and meet the requirement within that time period will render the bid non-responsive.

#### 5.2.1 Federal Contractors Program - Certification

A3030T (2010-08-16), Federal Contractors Program - \$200,000 or more

#### 5.2.2 Former Public Servant Certification

A3025T (2010-01-11), Former Public Servant Certification

## PART 6 - SECURITY REQUIREMENTS AND OTHER REQUIREMENTS

### 6.1 Security Requirement

6.1.1 Before award of a contract, the following conditions must be met:

- (a) the Bidder must hold a valid organization security clearance as indicated in Part 7 - Resulting Contract Clauses;
- (b) the Bidder's proposed individuals requiring access to classified or protected information, assets or sensitive work site(s) must meet the security requirement as indicated in Part 7 - Resulting Contract Clauses; and
- (c) the Bidder must provide the name of all individuals who will require access to classified or protected information, assets or sensitive work sites.

6.1.2 Bidders are reminded to obtain the required security clearance promptly. Any delay in the award of a contract to allow the successful bidder to obtain the required clearance will be at the entire discretion of the Contracting Authority.

6.1.3 For additional information on security requirements, bidders should consult the "Security Requirements for PWGSC Bid Solicitations - Instructions for Bidders"  
(<http://www.tpsgc-pwgsc.gc.ca/app-acq/lc-pl/lc-pl-eng.html#a31>) document on the Departmental Standard Procurement Documents Web site.

### 6.2 Insurance Requirements

The Bidder must provide a letter from an insurance broker or an insurance company licensed to operate in Canada stating that the Bidder, if awarded a contract as a result of the bid solicitation, can be insured in accordance with the Insurance Requirements specified in Part 7, clause 17.

If the information is not provided in the bid, the Contracting Authority will so inform the Bidder and provide the Bidder with a time frame within which to meet the requirement. Failure to comply with the request of the Contracting Authority and meet the requirement within that time period will render the bid non-responsive.

## PART 7 - RESULTING CONTRACT CLAUSES

The following clauses and conditions apply to and form part of any contract resulting from the bid solicitation.

### 1.0 REQUIREMENT

The Department of National Defence has a requirement for the replacement of the Autopilot Systems (AS) fitted onboard the Department of National Defence (DND) VICTORIA Class submarines. The AS consists of an "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. It is Canada's plan to replace the AS with a fully supportable system that provides the same core functionality as the existing system. All of 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 weights of the legacy system. A new OnBoard Trainer (OBT) will be designed and the Submarine Control Trainer (SCT) and Maintenance Trainer (MT) will be upgraded to use the new submarine AS hardware, software and the new user interfaces.

There are four (4) Victoria Class submarines (Victoria, Windsor, Cornerbrook and Chicoutimi), two (2) are located at Canadian Forces Base (CFB) Halifax and two (2) at Canadian Forces Base (CFB) Victoria. This requirement also details the work on the new Onboard Trainer (OBT) and the upgrade work on the shore based trainers; Submarine Control Trainer (SCT) and the Maintenance Trainer (MT). The shore based trainers are located at the Canadian Forces Base (CFB) Halifax.

This requirement includes all associated Work and services described herein including the Statement of Work (SOW) and Technical Statement of Requirement (TSOR), attached as Annex "A" and Annex "B".

The Delivery Schedule in Annex D is to be based on a two (2) year contract duration, excluding installations, all deliverables shall be delivered during this period.

The current planned VCS installation schedule is:

1. Victoria: January 2015, SWP5

2. Chicoutimi: May 2015, SWP2
3. Windsor: March 2016, SWP6
4. Corner Brook: July 2016, SWP1

The Contractor is responsible for installing the MT AS related equipment.

The SCT shall not be part of the upgrade. The Contractor is not responsible for installing the SCT AS related equipment. There will be another separate contract to install the SCT AS related equipment. However, the AS hardware and software equipments for the SCT is part of the deliverables.

The Contractor shall be responsible for any additional AS equipment required to conduct design qualifications testing.

The Contractor shall not deliver any environmentally tested AS equipment as part of the submarine deliverables.

#### **The fundamental objectives of the AS replacement system is to:**

1. Sustain the existing functions of the AS 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. Upgrade the SCT to use 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.

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## 1.1 Conduct of the Work

- 1 The Contractor, represents and warrants that it has the experience, qualifications, personnel, equipment, facilities and all other resources to perform the Work.
- 2 In the performance of the Work, the Contractor shall supply, other than Government Supplied Material (GSM), all the resources, facilities, labour, management, services, equipment, materials, drawings, tools technical data, technical assistance, engineering services and planning necessary to complete the Work.
- 3 The Contractor agrees to:
  - (a) commence and carry out the Work promptly and diligently and upon the terms and conditions and in the manner contemplated by this Contract;
  - (b) carry out the Work in accordance with good, modern shipbuilding practices;
  - (c) provide efficient and effective supervision and inspection of the carrying out of the Work; and
  - (d) provide material and workmanship of the highest quality commensurate with the nature of the work and take all such steps as are necessary to ensure that the installation of the AS are completed according to the Contract.
- 4 No material or parts shall be used or processed and no finished Work shall be submitted for acceptance or delivery unless approved by the Technical Authority. The Contractor shall complete the Work to the satisfaction of Technical Authority and fully in accordance with the Contract and deliver all of the Work as required by the Contract.
- 5 The Contractor shall submit for examination by the Technical Authority any designs, drawings, models, completed or under preparation by it or its behalf in connection with the Work at any time.
- 6 The Contractor shall provide the such reports on the performance of the Work as are required by the Contract and such other reports as may be reasonably required by the Contracting Authority and the Technical Authority.

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- 7 The Contractor shall provide the services required under the Contract. In case of failure by the Contractor to provide any of the described services in the Contract, Canada may suspend payment until such failure has been corrected to the satisfaction of Canada.

## 1.2 Design Reviews

- 1 The Design Reviews, Preliminary and Critical, shall be completed and design packages deliverables submitted in accordance with the SOW and TSOR.
- 2 The Contractor shall submit the design packages deliverables for each of the Design Reviews.
- 3 Where Canada alleges and the Contractor agrees that the design is defective or deficient, the Contractor shall correct the design.
- 4 In the event that the Contracting Authority and the Contractor's representative, as per section 5.3 of the contract, are unable to resolve the dispute, it shall be referred to the Contractor's Manufacturing Vice-president and PWGSC Senior Director for the Marine Systems Directorate. They shall have ten (10) Business days to resolve the dispute. The Parties may agree to refer the dispute to the Senior Management of the Parties who shall have twenty (20) Business days to resolve the dispute. Should the Contractor be successful in the dispute, Canada hereby agrees to amend the Contract in accordance with the solution(s) that both Parties will agree on.
- 5 In the event the Senior Management are unable to resolve the dispute, Canada alleges the design is defective or deficient and the Contractor does not agree and no agreement on the correction to the design has occurred, Canada may by written notice to the Contractor terminate the Contract. Upon such termination, Canada shall be liable to the Contractor only for its costs of producing the design deliverables to date. Such costs shall be determined in accordance with PWGSC - TPSGC Contract Cost Principles 1031-2 up to the maximum amount of the associated milestone.
- 6 Where the parties to the Contract can reach agreement on correcting the design, changes to the AS, and to any other contracted item affected, and any cost thereof, the Contractor shall be responsible for completing the Work in accordance with the Contract.



- 7 After reaching agreement as referred to in sub-clause 5 above, the Contractor shall provide a written statement. The Contractor shall be liable for all additional costs which may be required to complete the Work.
- 8 The Contractor shall not incur Material Costs and Labour costs until a written statement has been accepted by the Contracting Authority.
- 9 The Technical Authority will perform the evaluation and acceptance of the design Work. The Technical Authority shall also be responsible for inspecting and accepting all other phases of the Work as described in this Contract.

### **1.3 Production Schedule**

- 1 The Production Schedule shall be in accordance with the Annex D "Delivery Schedule" of the Contract.
- 2 The Contractor is responsible for planning and scheduling the Work required herein. The Production Schedule shall be updated on a continuous basis.

### **1.4 Drawings during Design, Manufacturing and Installation Phase**

- 1 All drawings shall be submitted to the Technical Authority for examination.
- 2 The review of the Contractor's drawings by Canada shall not relieve him of its contractual responsibility and the same applies to the subcontracts issued by the Contractor to the subcontractor.

In particular, examination or approval of drawings shall not:

- (a) Relieve the Contractor of its obligation to ensure that all details are correct;
- (b) Obligate Canada to accept an item that does not meet the Contract requirements;
- (c) Confirm that an item complies with the Contract requirements; and
- (d) Relieve the Contractor of the responsibility for any omissions and the consequences resulting thereof.

- 3 Any drawings which are supplied to the Contractor by or on behalf of Canada are for such purpose as the Contractor may wish to use them but are not evidence of any interpretation to be given to the Contract requirements. Any such use by the Contractor shall not relieve the Contractor of any responsibility under this Contract. The Contractor shall indemnify and save harmless Canada from any claims, actions, suits or proceedings based upon the use by the Contractor of such drawings.

## **1.5 Additional / Unscheduled Work including Design Change**

- 1 The Contractor hereby acknowledges that Canada may require the Contractor to perform Additional / Unscheduled Work at any time and from time to time, during this Contract. The Additional / Unscheduled Work could include but not be limited to:
  - (a) Additions or variations to the Work including Design Changes;
  - and
  - (b) Dispensing with or change to any portion of the Work.
- 2 Any Additional / Unscheduled Work will be process according to the Annex "F", Procedure for Processing Additional / Unscheduled Work. All negotiations must be completed and the Additional / Unscheduled Work authorized on form PWGSC - TPSGC 1686 prior to the commencement of the Work, unless and until the Contracting Authority specifically authorizes commencement of the Additional / Unscheduled Work, in writing, prior to completion of negotiations and completion of form PWGSC - TPSGC 1686.
- 3 The Contractor shall perform the Additional / Unscheduled Work under the same terms and conditions of the Contract. The Additional / Unscheduled Work will be negotiated using the labor rates and mark-ups contained in the Contract.
- 4 The Contractor may request a change to the Work for Canada's consideration by submission of a request for change proposal to the Contracting Authority.
- 5 Extensions in the delivery date as a result of the Additional / Unscheduled Work must be presented at the time of the proposal and to the satisfaction of the Contracting Authority otherwise extensions to the delivery date will not be considered.

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- 6 No cost, Additional / Unscheduled Work; Notwithstanding the foregoing, should Canada deem it advisable to make any reasonable change in the Work during the course of the Work, provided the change is ordered before that particular part of the Work to which Canada refers is commenced and involves no extra cost to the Contractor, such changes shall be made by the Contractor without extra cost to Canada.
  - 7 Incorporation of Additional / Unscheduled Work including Design Change, agreed to by the Contractor, shall be incorporated into the Work and shall not relieve the Contractor of its obligation to ensure that the AS meet all of the performance requirements set out in the SOW and TSOR and shall not affect the delivery date unless otherwise provided for in form PWGSC - TPSGC 1686 relating to such design change.

## 1.6 Inspection and Acceptance

- 1 All reports, deliverables, documents, goods and all services rendered under this Contract shall be subject to inspection by the Technical Authority. Should any report, document, good or service not be in accordance with the requirements of the Contract, the Technical Authority shall have the right to reject it or require its correction at the sole expense of the Contractor before recommending payment. Any communication with a Contractor regarding the quality of Work performed pursuant to this Contract shall be undertaken by official correspondence through the Contracting Authority.
- 2 The Contractor shall be responsible for properly setting up, preparing, providing access to and presenting Work for inspection and for giving adequate notice to the Technical Authority and the Regulatory Body that the Work is complete, and having been pre-tested or inspected, is ready for the inspection.
- 3 Inspection will be done by the Technical Authority at the most appropriate location:
  - (a) During the Autopilot System Design, manufacturing and factory acceptance, at Contractor's facilities;
  - (b) During the Autopilot System Installation, at submarines locations; and
  - (c) For most of the Documentation, at Canada's facilities.

- 4 Inspection requirements shall be in accordance with the provisions of this Contract including 2030 (2012-07-16), General Conditions - Higher Complexity - Goods, and the following procedures:

- (a) Non-conformance Report (NCR): A NCR will be issued for each Non-conformance noted by the Technical Authority. Each report will be uniquely numbered for reference purposes, will be signed and dated by the Technical Authority, and will describe the Non-conformance.

When the Non-conformance has been corrected by the Contractor and has been re-inspected and accepted by the Technical Authority, the Technical Authority will complete the NCR by signing and dating the NCR.

When Delivery Acceptance trials have been completed and the Contractor has corrected/addressed items on the Non-conformance list, an Acceptance Inspection of the AS shall be carried out by the Technical Authority. Three (3) working days prior to the scheduled Completion Date, the content of all Non-conformance Reports which have not been signed-off by the Technical Authority will be transferred to the Delivery Document prior to the Technical Authority certification of such document. A final Deficiencies Database shall be prepared for signature if necessary.

The Contractor shall correct all outstanding deficiencies during the warranty period at a time and place agreed to by the Contractor, the Technical Authority and the Contractual Authority.

- (b) Notwithstanding the above including the Inspection by the Technical Authority, the discrepancy notices, the Non-conformance reports, or absences thereof, or corrections thereto, or acceptance thereof, do not relieve the Contractor of its obligations to satisfy the requirements of this Contract. As such, the Contractor shall correct any and all defects or deficiencies discovered at no additional cost to Canada.

## 1.7 Tests and Demonstrations Acceptance

- 1 To enable the Technical Authority to certify that the Work has been performed satisfactorily, in accordance with the Contract, the Contractor shall schedule, coordinate, perform, and record all specified Tests and Demonstrations required by the Technical Authority.

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- 2 Where the Contract contains a specific performance requirement for any component, equipment, subsystem or system, the Contractor shall test such component, equipment, subsystem or system to the satisfaction of the Technical Authority, to prove that the specified performance has been achieved and that the component, equipment, subsystem or system performs as required by the Contract.
  - 3 Tests and demonstrations shall be conducted in accordance with a logical, systematic schedule which shall ensure that all associated components and equipment are proven prior to subsystems demonstration or testing, and subsystems are proven prior to system demonstration or testing.
  - 4 Where the Contract does not contain specific performance requirements for any component, equipment, subsystem or system, the Contractor shall demonstrate such the performance of such component, equipment, subsystem or system to the satisfaction of the Technical Authority.
  - 5 The Contractor shall keep written records of all tests and demonstrations conducted, including all rejections, comments, or recommendations made at such times. Records shall be in a format, and contain data, such that the Technical Authority can certify compliance of the component, equipment, subsystem, or system with the specified requirements. The Contractor may utilize the PWGSC Standard Tests Record Sheets which can be customized by the Contractor to suit individual test requirements. These Record Sheets are available from the Technical Authority.
  - 6 The Contractor shall in all respects be responsible for the conduct of all tests in accordance with the requirements of this Contract.
  - 7 Canada reserves the right to defer starting or, continuing with any tests for any reasonable cause including but not limited to equipment failure or degradation, lack of qualified personnel and inadequate safety standards.

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## 2.0 STANDARD CLAUSES AND CONDITIONS

All clauses and conditions identified in the Contract by number, date and title are set out in the Standard Acquisition Clauses and Conditions (<https://buyandsell.gc.ca/policy-and-guidelines/standard-acquisition-clauses-and-conditions-manual>) Manual issued by Public Works and Government Services Canada.

### 2.1 General Conditions

- 1 2030 (2012-07-16), General Conditions - Higher Complexity - Goods, apply to and form part of the Contract.
- 2 1031-2 (2008-05-12) Contract Cost Principles, apply to the Unscheduled Work and form part of the Contract.

### 2.2 Supplemental General Conditions

4006 (2010-08-16) Contractor to Own Intellectual Property Rights in Foreground Information, apply to and form part of the Contract.

## 3.0 SECURITY REQUIREMENT

- 1 The Contractor must, at all times during the performance of the Contract, hold a valid Facility Security Clearance at the level of **SECRET**, with approved Document Safeguarding and Production Capabilities at the level of **SECRET**, issued by the Canadian Industrial Security Directorate (CISD), Public Works and Government Services Canada (PWGSC);
- 2 The Contractor personnel requiring access to **CLASSIFIED** information, assets or sensitive work site(s) must EACH hold a valid personnel security screening at the level of **SECRET**, granted or approved by the CISD, PWGSC;
- 3 The Contractor **MUST NOT** utilize its Information Technology systems to electronically process, produce or store any sensitive **CLASSIFIED** information until CISD/PWGSC has issued written approval. After approval has been granted, these tasks may be performed at the level of **SECRET**;
- 4 Subcontracts which contain security requirements are **NOT** to be awarded without the prior written permission of CISD/PWGSC; and

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- 5 The Contractor must comply with the provisions of the:
- (a) Security Requirements Check List and security guide (if applicable), attached at Annex G; and
  - (b) Industrial Security Manual (Latest Edition).

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## **4.0 TERM OF CONTRACT**

### **4.1 Delivery and Acceptance**

- 1 All Delivery must be as per Annex "D" Delivery Schedule.
- 2 The AS to be delivered for acceptance pursuant to the above section 1 shall be based on the original Critical Design Review (CDR) and include all design changes approved by the Technical Authority.
- 3 Prior to the scheduled Acceptance Date for each deliverable, the Technical Authority will prepare a final list of all outstanding Work items (including non-conformance) for review at the Acceptance Conference.
- 4 Each outstanding Work item on the list referred above shall have a price determined in accordance with the following: twice (2) the cost for the outstanding Work to be completed by the Contractor, or twice (2) the cost for the outstanding Work to be completed as quoted by a third party. The CA shall select one of the two costs mention above, the amount shall be deducted from the contract price.
- 5 It is understood and agreed that where the Work has been substantially completed and the parties have agreed upon the terms and conditions for the Contractor to make good any deficiencies, the certificate may be executed with a statement attached concerning the making good of the deficiencies.
- 6 Acceptance of each of the AS by Canada shall occur with a written execution of a certificate in accordance with form CF 1148, with evidence satisfactory to Canada that the AS has successfully completed all Tests. The execution of the Certificate shall in no way relieve the Contractor of its obligations under the Contract.

### **4.2 Shipping Instructions - FOB Destination and DDP**

Goods must be consigned and delivered to the destinations specified in the Contract, FOB Destination including all delivery charges and customs duties and taxes.



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#### **4.3 Delivery of the four (4) Autopilot Systems for the submarines and the Onboard Trainers**

Two (2) complete Autopilot Systems shall be delivered to each of the following addresses:

Department of National Defence  
Main Supply Warehouse BLDG 66  
Colwood  
British Columbia  
V9A 7N2  
Canada

Department of National Defence  
Main Supply BLDG Receipt Off  
D206 HMC Dockyard  
Halifax  
Nova Scotia  
B3K 5X5  
Canada

#### **4.4 Delivery of the Spare Parts for the four (4) submarines and the Onboard Trainers, including the Special Purpose Tools and Test Equipment Set**

Two (2) complete Spare Parts Kit, this as per Annex "E", shall be delivered to each the following addresses:

Department of National Defence  
Main Supply Warehouse BLDG 66  
Colwood  
British Columbia  
V9A 7N2  
Canada

Department of National Defence  
Main Supply BLDG Receipt Off  
D206 HMC Dockyard  
Halifax  
Nova Scotia  
B3K 5X5  
Canada

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#### **4.5 Delivery of the two (2) associated Trainers; Maintenance Trainer and Submarine Control Trainer**

The complete two (2) associated trainers shall be delivered to the following addresses:

Department of National Defence  
Main Supply BLDG Receipt Off  
D206 HMC Dockyard  
Halifax  
Nova Scotia  
B3K 5X5  
Canada

#### **4.6 Delivery of the Spare Parts for the two (2) associated Trainers; Maintenance Trainer and Submarine Control Trainer**

All Spare Parts shall be delivered to DND to the following address:

Department of National Defence  
Main Supply BLDG Receipt Off  
D206 HMC Dockyard  
Halifax  
Nova Scotia  
B3K 5X5  
Canada

#### **4.7 Release Documents - Distribution**

The Contractor must prepare the release documents in a current electronic format and distribute them as follows:

- (a) One (1) copy mailed to consignee marked: "Attention: Receipts Officer";
- (b) Two (2) copies with shipment (in a waterproof envelope) to the consignee;
- (c) One (1) copy to the Contracting Authority;
- (d) One (1) copy to:

National Defence Headquarters  
Mgen George R. Pearkes Building  
101 Colonel By Drive  
Ottawa, ON K1A 0K2  
Attention: \_\_\_\_\_

- (e) One (1) copy to the Quality Assurance Representative;

- 
- (f) One (1) copy to the Contractor; and
  - (g) For all non-Canadian contractors, one (1) copy to:  
DQA/Contract Administration  
National Defence Headquarters  
Mgen George R. Pearkes Building  
101 Colonel By Drive  
Ottawa, ON K1A 0K2  
E-mail: ContractAdmin.DQA@forces.gc.ca

#### **4.8 SACC Manual Clause**

D5604C (2008-12-12) Release Documents (DND) - Foreign-based Contractor  
D5606C (2012-07-16) Release Documents (DND) - Canadian-based Contractor  
D6010C (2007-11-30) Palletization

## 5.0 AUTHORITIES

### 5.1 Contracting Authority

Gérard Clément  
Manager  
Public Works and Government Services Canada  
Acquisitions Branch  
Machinery & Logistics Support Division (ML)  
Place du Portage, Phase III, 6C2  
11 Laurier Street  
Gatineau QC  
K1A 0S5

Telephone: 819-956-6233

Facsimile: 819-956-0897

E-mail address: gerard.clement@tpsgc-pwgsc.gc.ca

The Contracting Authority is responsible for the management of the Contract and any changes to the Contract must be authorized in writing by the Contracting Authority. The Contractor must not perform work in excess of or outside the scope of the Contract based on verbal or written requests or instructions from anybody other than the Contracting Authority.

### 5.2 Technical Authority

Department of National Defence  
Édifice Louis St-Laurent  
555 Boul. De la Carrière  
Gatineau, Quebec K1A 0K2

Attention: \_\_\_\_\_

Tel: \_\_\_\_\_

Fax: \_\_\_\_\_

Email address: \_\_\_\_\_

The Technical Authority may delegate its authority to authorized representatives.

For the purposes of this agreement the Technical Authority will also be the Inspection Authority.

The Technical Authority is the representative of the department or agency for whom the Work is being carried out under the Contract and is responsible for all

matters concerning the technical content of the Work under the Contract.

**Technical matters may be discussed with the Technical Authority, however the Technical Authority has no authority to authorize changes to the scope of the Work. Changes to the scope of the Work can only be made through a contract amendment issued by the Contracting Authority.**

### 5.3 Supplier Contacts

Name and telephone number of the person responsible for :

General enquiries :

Name: \_\_\_\_\_

Tel: \_\_\_\_\_

Fax: \_\_\_\_\_

E-mail address: \_\_\_\_\_

Delivery follow-up :

Name: \_\_\_\_\_

Tel: \_\_\_\_\_

Fax: \_\_\_\_\_

E-mail address: \_\_\_\_\_

## 6.0 PAYMENT

### 6.1 Basis of Payment - Firm Unit Prices

- 1 In consideration of the Contractor satisfactorily completing all of its obligations under the Contract, the Contractor will be paid firm unit prices as identified in Annex "C", Milestone Payment Schedule. Customs duties are included and Goods and Services Tax or Harmonized Sales Tax is extra, if applicable.

All project management prices shall be included in each of the items listed in the Milestones Payments schedule. Canada will not accept any modifications.

The Contractor shall provide a firm price for the installations to be based on a window of five (5) years, starting Jan 2015.

When applicable, all prices quoted shall include the delivery, installation, testing and acceptance for each Autopilot System onboard the submarines and Trainers located at the Canadian Forces Base (CFB) of Halifax.

Canada will not pay the Contractor for any design changes, modifications or interpretations of the Work, unless they have been approved, in writing, by the Contracting Authority before their incorporation into the Work.

No travel and living expenses in the performance of the Work shall be reimbursed to the Contractor.

- 2 Labor Rate for Additional / Unscheduled Work including Design Change, or Engineering Change or change in the scope of Work

For the performance of the Work as a result of approved Additional / Unscheduled Work including Design, or Engineering Change or change in the scope of Work, the Contractor shall be paid the firm hourly charge-out rate of \$\_\_\_\_\_/hr. This rate shall be a blend rate for all classes of labour, engineering, supervision and all overheads and profit.

- 3 Overtime for Additional / Unscheduled Work including Design Change, or Engineering Change or change in the scope of Work

Overtime shall not be paid unless authorized in writing by the Contracting Authority and for authorized additional Work only. The Overtime Rate shall be calculated and paid as follows:

- (a) Time and One-Half (1 ½) - The Contractor shall be paid the firm hourly charge-out rate, plus half the average of the hourly direct labor rates detailed in the union agreement, plus applicable fringe benefits plus profit of 7½% on labour and fringe benefits. The firm overtime hourly rate is \$\_\_\_\_\_ /hr.
- (b) Double Time (2) - The Contractor shall be paid the firm hourly charge-out rate, plus the average of the hourly direct labour rates detailed in the union agreement, plus applicable fringe benefits, plus profit of 7½% on labour and fringe benefits. The firm overtime hourly rate is \$\_\_\_\_\_ / hr.

4 Material for Additional / Unscheduled Work including Design Change, or Engineering Change or change in the scope of Work

For the performance of the Work to procure additional Material as a result of approved Additional / Unscheduled Work including Design Change, or Engineering Change or change in the scope of Work, the Contractor shall be paid the Direct Material Cost as defined in Contract Cost Principles 1031-2 plus a firm mark-up of 10%, Goods and Services Tax or Harmonized Sales Tax extra. Other than the 10% mark-up, no additional charges relating to material procurement, insurance, handling, store keeping and activities of this nature, or any other charge whatsoever, will be accepted as part of the Additional / Unscheduled Work prices. For the purposes of pricing Additional / Unscheduled Work, material shall be deemed to include subcontracts.

## 6.2 Payment for Additional / Unscheduled Work, including Design Change

The Contractor will be paid its costs reasonably and properly incurred in the performance of the Work, in accordance with Annex "F" and in accordance with Contract Cost Principles 1031-2, as determined by a government audit, plus a profit computed in accordance with Chapter 10, Cost and Profit, of the Supply Manual, Public Works and Government Services Canada. The results and findings of the government's audit will be conclusive.

## 6.3 Limitation of Price

SACC Manual clause C6000C (2011-05-16) Limitation of Price

## 6.4 Milestone Payments

- 1 Canada will make milestone payments in accordance with the Schedule of Milestones detailed in the Contract and the payment provisions of the Contract, up to 90 percent of the amount claimed and approved by Canada if:
  - (a) an accurate and complete claim for payment using form PWGSC-TPSGC 1111, Claim for Progress Payment, and any other document required by the Contract have been submitted in accordance with the invoicing instructions provided in the Contract;
  - (b) the total amount for all milestone payments paid by Canada does not exceed 90 percent of the total amount to be paid under the Contract;
  - (c) all the certificates appearing on form PWGSC-TPSGC 1111 have been signed by the respective authorized representatives; and
  - (d) all work associated with the milestone and as applicable any deliverable required have been completed and accepted by the Technical Authority and the Contracting Authority.
- 2 Ninety (90) days after the written acceptance by DND TA of all Milestones, the Contracting Authority (CA) shall give its final acceptance to the project before he releases the Holdback. If during that ninety (90) days period DND is encountering defect(s), problem(s) or failure(s) with one (1) or any of the deliverables, the Holdback will not be released and the Contractor will be informed in writing by the CA of the problem(s). Canada will not release the Holdback until all defect(s), problem(s) or issue(s) are repaired by the Contractor. Following the completion of the repair(s), the Contractor shall grant Canada a Ninety (90) days period to test the repair(s) that were done. Following that, if no defect(s), problem(s) or issue(s) are found, the DND TA and PWGSC CA shall provide the Contractor with a written acceptance of all Milestones. The contractor may submit an application for final payment, in accordance with the contract.
- 3 The Milestones payments are detailed in Annex "C" of the Contract.

## 6.5 SACC Manual Clauses

C2611C (2007-11-30) Customs Duties - Contractor Importer  
 H4500C (2010-01-11) Lien - Section 427 of the Bank Act



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## **6.6 Discretionary Audit for Additional / Unscheduled Work including Design Change, or Engineering Change or change in the Scope of Work**

- 1 The following are subject to government audit before or after payment is made:
  - (a) The amount claimed under the Contract, as computed in accordance with the Basis of Payment, including time charged;
  - (b) The accuracy of the Contractor's time recording system;
  - (c) The estimated amount of profit in any firm-priced element, firm time rate, firm overhead rate, or firm salary multiplier, for which the Contractor has provided the appropriate certification. The purpose of the audit is to determine whether the actual profit earned on a single contract if only one exists, or the aggregate of actual profit earned by the Contractor on a series of negotiated contracts containing one or more of the prices, time rates or multipliers mentioned above, during a particular period selected, is reasonable and justifiable based on the estimated amount of profit included in earlier price or rate certification(s); and
  - (d) Any firm-priced element, firm time rate, firm overhead rate, or firm salary multiplier for which the Contractor has provided a "most favoured customer" certification. The purpose of such audit is to determine whether the Contractor has charged anyone else, including the Contractor's most favoured customer, lower prices, rates or multipliers, for like quality and quantity of goods or services.
- 2 Any payments made pending completion of the audit must be regarded as interim payments only and must be adjusted to the extent necessary to reflect the results of the said audit. If there has been any overpayment, the Contractor must repay Canada the amount found to be in excess.

## 7.0 INVOICING INSTRUCTIONS

- 1 The Contractor must submit a claim for payment using form PWGSC-TPSGC 1111, Claim for Progress Payment.

Each claim must show:

- (a) all information required on form PWGSC-TPSGC 1111;
- (b) all applicable information detailed under the section entitled "Invoice Submission" of the general conditions; and
- (c) the description and value of the milestone claimed as detailed in the Contract.

Each claim must be supported by:

- (a) a copy of time sheets to support the time claimed;
  - (b) a copy of the invoices, receipts, vouchers for all direct expenses, travel and living expenses; and
  - (c) a copy of the monthly progress report.
- 2 The Goods and Services Tax or Harmonized Sales Tax (GST/HST), as applicable, must be calculated on the total amount of the claim before the holdback is applied. At the time the holdback is claimed, there will be no GST/HST payable as it was claimed and payable under the previous claims for progress payments.
  - 3 The Contractor must prepare and certify one original and two (2) copies of the claim on form PWGSC-TPSGC 1111, and forward it to the Technical Authority identified under the section entitled "Authorities" of the Contract for appropriate certification after inspection and acceptance of the Work takes place.

The Technical Authority will then forward the original and two (2) copies of the claim to the Contracting Authority for certification and onward submission to the Payment Office for the remaining certification and payment action.

4. The Contractor must not submit claims until all work identified in the claim is completed.

## 8.0 CERTIFICATIONS

Compliance with the certifications provided by the Contractor in its bid is a condition of the Contract and subject to verification by Canada during the term of the Contract. If the Contractor does not comply with any certification or it is determined that any certification made by the Contractor in its bid is untrue, whether made knowingly or unknowingly, Canada has the right, pursuant to the default provision of the Contract, to terminate the Contract for default.

## 9.0 APPLICABLE LAWS

The Contract must be interpreted and governed, and the relations between the parties determined, by the laws in force in \_\_\_\_\_. (Insert the name of the province or territory as specified by the bidder in its bid, if applicable).

## 10.0 PRIORITY OF DOCUMENTS

If there is a discrepancy between the wording of any documents that appear on the list, the wording of the document that first appears on the list has priority over the wording of any document that subsequently appears on the list.

- (a) the Articles of Agreement;
- (b) 2030 (2012-07-16), General Conditions - Higher Complexity - Goods;
- (c) 1031-2 (2008-07-16) Contract Cost Principles;
- (d) 4006 (2010-08-16), Supplemental General Conditions - Contractor to Own Intellectual Property Rights in Foreground Information
- (e) Annex "A", Statement of Work (SOW);
- (f) Annex "B", Technical Statement of Requirement (TSOR);
- (g) Annex "C", Milestone Payment Schedule;
- (h) Annex "D", Delivery Schedule;
- (i) Annex "E", Prices and Quantities of Material, Spare Parts, Design, Installation and Cadre Training to be delivered
- (j) Annex "F", Procedure for Processing Additional / Unscheduled Work;
- (k) Annex "G", Security Requirements Check List (SRCL); and
- (l) Contractor's Proposal dated \_\_\_\_\_ TBD.

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## 11.0 DEFENCE CONTRACT

The Contract is a defence contract within the meaning of the Defence Production Act, R.S.C. 1985, c. D-1, and must be governed accordingly.

Title to the Work or to any materials, parts, work-in-process or finished work must belong to Canada free and clear of all claims, liens, attachments, charges or encumbrances. Canada is entitled, at any time, to remove, sell or dispose of the Work or any part of the Work in accordance with section 20 of the Defence Production Act.

## 12.0 FOREIGN NATIONALS (CANADIAN CONTRACTOR)

SACC Manual clause A2000C (2006-06-16) Foreign Nationals (Canadian Contractor)

**OR (Will be decided at Contract award)**

## 12.0 FOREIGN NATIONALS (FOREIGN CONTRACTOR)

SACC Manual clause A2001C (2006-06-16) Foreign Nationals (Foreign Contractor)

## 13.0 COMMERCIAL GENERAL LIABILITY INSURANCE

- 1 The Contractor must obtain Commercial General Liability Insurance, and maintain it in force throughout the duration of the Contract, in an amount usual for a contract of this nature, but for not less than \$2,000,000 per accident or occurrence and in the annual aggregate.
- 2 The Commercial General Liability policy must include the following:
  - (a) Additional Insured: Canada is added as an additional insured, but only with respect to liability arising out of the Contractor's performance of the Contract. The interest of Canada should read as follows: Canada, as represented by Public Works and Government Services Canada.
  - (b) Bodily Injury and Property Damage to third parties arising out of the operations of the Contractor.
  - (c) Products and Completed Operations: Coverage for bodily injury or property damage arising out of goods or products manufactured,

sold, handled, or distributed by the Contractor and/or arising out of operations that have been completed by the Contractor.

- (d) **Personal Injury:** While not limited to, the coverage must include Violation of Privacy, Libel and Slander, False Arrest, Detention or Imprisonment and Defamation of Character.
- (e) **Cross Liability/Separation of Insureds:** Without increasing the limit of liability, the policy must protect all insured parties to the full extent of coverage provided. Further, the policy must apply to each Insured in the same manner and to the same extent as if a separate policy had been issued to each.
- (f) **Blanket Contractual Liability:** The policy must, on a blanket basis or by specific reference to the Contract, extend to assumed liabilities with respect to contractual provisions.
- (g) **Employees and, if applicable, Volunteers** must be included as Additional Insured.
- (h) **Employers' Liability** (or confirmation that all employees are covered by Worker's compensation (WSIB) or similar program)
- (i) **Broad Form Property Damage including Completed Operations:** Expands the Property Damage coverage to include certain losses that would otherwise be excluded by the standard care, custody or control exclusion found in a standard policy.
- (j) **Notice of Cancellation:** The Insurer will endeavour to provide the Contracting Authority thirty (30) days written notice of policy cancellation.
- (k) If the policy is written on a claims-made basis, coverage must be in place for a period of at least 12 months after the completion or termination of the Contract.

## 14.0 CONTROLLED GOODS PROGRAM

There is Controlled Goods requirement associated with the requirement

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## 15.0 LIMITATION OF LIABILITY

- 1 This section applies despite any other provision of the Contract and replaces the section of the general conditions entitled "Liability". Any reference in this section to damages caused by the Contractor also includes damages caused by its employees, as well as its subcontractors, agents, and representatives, and any of their employees.
- 2 Whether the claim is based in contract, tort, or another cause of action, the Contractor's liability for all damages suffered by Canada caused by the Contractor's performance of or failure to perform the Contract is limited to the **Contract value**. This limitation of the Contractor's liability does not apply to:
  - (a) any infringement of intellectual property rights;
  - (b) any breach of warranty obligations.
- 3 The Contractor agrees to pay to Canada the amounts of all of Canada's losses, liabilities, damages, costs, and expenses resulting from any claim made by a third party relating to the Contract, including the complete costs of defending any legal action by a third party. The Contractor agrees that Canada is not required to have satisfied its liability to the third party before the Contractor is obliged to pay Canada in respect of that liability. The Contractor also agrees, if requested by Canada, to defend Canada against any third party claims.

## 16.0 PROGRESS MEETINGS

1. Progress Review Meetings shall be held as required at the Contractor's facility and chaired by the Contracting Authority. Attendees will be the Contractor Representatives, the Contracting Authority and Technical Authority.

An agenda shall be drafted by the Contractor prior to each meeting for the Contracting Authority and the Technical Authority review and request for changes. The final agenda will be provided prior to the meeting by the Contractor.

The Contractor shall record the minutes of all meetings, and include as a minimum discussion items, records of decisions, all action items, risk items, and a record of conclusions reached at the meetings. The Contractor will distribute a draft of all minutes to the Contracting Authority,

Technical Authority for review/comments, this prior issuing the final version. The Minutes shall be signed as accepted by the Contractor and Contracting Authority once comments are incorporated to the satisfaction of Contracting Authority.

2. Technical Meetings shall be held as required at the Contractor's facility in accordance with the SOW and chaired by the Technical Authority. Attendees will be the Contractor Representatives, the Contracting Authority and Technical Authority.

An agenda shall be drafted by the Contractor prior to each meeting for the Contracting Authority and the Technical Authority review and request for additions. The final agenda will be provided prior to the meeting by the Contractor.

The Contractor shall record the minutes of all meetings, and include as a minimum discussion items, records of decisions, all action items, risk items, and a record of conclusions reached at the Technical Meetings. The Contractor will distribute a draft of all minutes to the Technical Authority and Contracting Authority for review/comments of Canada prior to issuing the final version. The Minutes shall be signed as accepted by the Contractor and Technical Authority once comments are incorporated to the satisfaction of Technical Authority.

## **17.0 QUALITY ASSURANCE REQUIREMENTS - SUBMARINE SAFETY**

The Work described in the Contract involves submarine systems or equipment classified as First Level or otherwise critical to submarine safety, as defined in Canadian Forces Technical Order (CFTO) C-23-VIC-000/AM-001, Quality Assurance for Safety in Submarines VICTORIA Class. Manufacture, repair, overhaul, installation, inspection and tests for each such item identified in the requirement must be documented in accordance with the requirements of the above mentioned CFTO.

For each such item, the Contractor must provide a Certificate of Conformity [form DND 2513 or locally produced equivalent approved by the Quality Assurance Authority (QAA)] in accordance with this CFTO. For subcontracted work, the Contractor must obtain that Certificate of Conformity from the subcontractor. Obtaining the said certificate from a subcontractor does not relieve the Contractor from its obligation to ensure compliance with the technical requirements of the Contract, nor must it be construed as authorizing any liability on the part of Canada to the subcontractor.

For each such item, the Certificate of Conformity, along with certified true copies of any deviation, waiver and all required records identified in the Statement of Quality Requirements (form DND 2328 or equivalent) attached to the Statement of Work in Annex A or the Technical Statement of Requirements in Annex B to the Contract, must be completed and made available for review by the designated QAA before release of such item and associated documents to the Department of National Defence. Unless otherwise directed by the QAA, those documents must be attached to, or enclosed with, the shipment they are associated to, in a waterproof envelope.

## **18.0 NOTICE OF LABOUR DISPUTES**

Whenever the Contractor has knowledge that any actual or potential labour dispute is delaying or threatens to delay the timely performance of this Contract, the Contractor shall immediately give notice thereof, including all relevant information with respect thereto, to the Contracting Authority.

## **19.0 STORAGE**

All four (4) Autopilot Systems have to be ready for delivery within 24 months, but Contractor is required to ship the equipment only when the submarines are made available for installations. Following the FAT of each AS, the Contractor shall be responsible for storing the AS equipment at Contractors own cost and risk. The Contractor shall be responsible for the safe keeping of the equipment while awaiting installations.

## **20.0 SACC MANUAL CLAUSE**

A1009C (2008-05-12) Work Site Access  
 A9019C (2011-05-16) Hazardous Waste Disposal  
 B7010C (2008-05-12) Marking and Labelling  
 B8041C (2008-05-12) Catalogue of Material on CD-ROM  
 D5510C (2011-05-16) Quality Assurance Authority (DND)- Canadian-based Contractor  
 D5515C (2010-01-11) Quality Assurance Authority (DND) - Foreign-based and United States Contractor  
 D5540C (2010-08-16) - ISO 9001:2008 - Quality Management Systems - Requirements (QAC C)



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## **ANNEX "A"**

### **Statement of Work (SOW)**

**As per attachment**

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## **ANNEX "B"**

### **Technical Statement of Requirement (TSOR)**

**As per attachment**

**ANNEX "C"****Milestone Payment Schedule**

#	Milestone	Firm Amount (\$)	Holdback (\$)	Payment (\$)
1	Acceptance of Preliminary Design Review, as per Annex "E", Section 5			
2	Acceptance of Critical Design Review, as per Annex "E", Section 5			
3	Factory Acceptance Testing of each of the four (4) Submarine Autopilot Systems, as per Annex "E", Section 1 and 6			
4	Factory Acceptance Testing of the Onboard Trainer (OBT) at Factory, as per Annex "E", Section 2 and 6			
5	Factory Acceptance Testing of the Maintenance Trainer (MT) at Factory, as per Annex "E", Section 3 and 6			
6	Factory Acceptance Testing of the Submarine Control Trainer (SCT) at Factory, as per Annex "E", Section 4 and 6			
7	Installation, Testing and Acceptance of 1st AS Installation onboard the submarine, as per Annex "E", Section 7 and 8			
8	Installation, Testing and Acceptance of 2nd AS Installation onboard the submarine, as per Annex "E", Section 7 and 8			

9	Installation, Testing and Acceptance of 3rd AS Installation onboard the submarine, as per Annex "E", Section 7 and 8			
10	Installation, Testing and Acceptance of 4th AS Installation onboard the submarine, as per Annex "E", Section 7 and 8			
11	Acceptance of the AS Spare parts and the Special Purpose Tools and Test Equipment Set for the 4 Submarines, as per Annex "E", Section 10			
12	Installation, Testing and Acceptance of the Onboard Trainer (OBT), as per Annex "E", Section 7 and 8			
13	Acceptance of the Spare parts for the Onboard Trainer (OBT), as per Annex "E", Section 11 (if applicable)			
14	Installation, Testing and Acceptance of the Maintenance Trainer (MT), as per Annex "E", Section 7 and 8			
15	Acceptance of the Spare parts for the Maintenance Trainer (MT), as per Annex "E", Section 12			
16	Acceptance of the Spare parts for the Submarine Control Trainer (SCT), as per Annex "E", Section 13			
17	Acceptance of the Documentation, as per Annex "E", Section 9			
18	Cadre Training #1, as per Annex E", Section 14			

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19	Cadre Training #2, as per Annex E", Section 14			
<b>TOTAL PRICE FOR THE PROJECT</b>				<b>\$</b>

**Note: The Holdback shall be of 10 % for each Milestone.**

**ANNEX "D"****Delivery Schedule**

#	Description	Weeks after Contract Award (CA)
1	Preliminary Design Review	
2	Critical Design Review	
3	Design Qualification, as per SOW, Section 5.6	
4	EC Specifications, as per SOW, Section 8	
5	FAT for the Four (4) AS	
6	FAT for the Onboard Trainer (OBT)	
7	FAT for the Maintenance Trainer (MT)	
8	FAT for the Submarine Control Trainer (SCT)	
9	SPTATE, as per TSOR, Section 4.9.6.1	
10	1st AS and Onboard Trainer (OBT) Installations onboard submarine	
11	2nd AS and Onboard Trainer (OBT) Installations onboard submarine	
12	3rd AS and Onboard Trainer (OBT) Installations onboard submarine	
13	4th AS and Onboard Trainer (OBT) Installations onboard submarine	
14	AS Spare Parts for the Four (4) Submarines, for Five (5) years	

15	Onboard Trainers (OBT) Spare parts for Five (5) years	
16	Maintenance Trainer (MT) Installation	
17	Maintenance Trainer (MT) Spare Parts for Five (5) years	
18	Documentation, as per SOW, Section 7.7	
19	Cadre Training #1	
20	Cadre Training #2	

The above delivery schedule is based on the forecasted availability of the submarines.

- (a) The Contractor shall not be in default if the submarines and/or trainer are not made available for the installation of the ASs and for the upgrade on the shore based trainer.
- (b) If at the Contractor's proposed dates, the submarines and/or trainer are not made available for the installation of the ASs and for the upgrade on the shore based trainer, Canada shall not be held liable for any delays and costs incurred by the Contractor.





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**- Section #2 Material Breakdown for the Onboard Trainer (OBT), including software (if applicable)**

Part Number	Description	Unit price	QTY	Total Price
	Licensing fee (if applicable)			
<b>Total Price</b>				

**- Section #3 Material Breakdown for the Maintenance Trainer (MT), including software**

Part Number	Description	Unit price	QTY	Total Price
	Licensing fee (if applicable)			
<b>Total Price</b>				

**- Section #4 Material Breakdown for the Submarine Control Trainer (SCT) including software**

Part Number	Description	Unit price	QTY	Total Price
	Licensing fee (if applicable)			
<b>Total Price</b>				

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<b>- Section #5 Design of the AS</b>	<b>Total Price</b>
Preliminary Design Review	
Critical Design Review	
<b>Total Price</b>	

<b>- Section #6 Factory Acceptance Test of the ASs and Trainers</b>	<b>Unit price</b>	<b>QTY</b>	<b>Total Price</b>
Cost of the AS		4	
Cost of the Onboard Trainer (OBT)		1	
Cost of the Maintenance Trainer (MT)		1	
Cost of the Submarine Control Trainer (SCT)		1	
<b>Total Price</b>			

<b>- Section #7 Installation of the ASs and Trainers</b>	<b>Unit price</b>	<b>QTY</b>	<b>Total Price</b>
Cost of the AS		4	
Cost of the Onboard Trainer (OBT)		1	
Cost of the Maintenance Trainer (MT)		1	
<b>Total Price</b>			

<b>- Section #8 Testing and Acceptance of the ASs and Trainers following installation</b>	<b>Unit price</b>	<b>QTY</b>	<b>Total Price</b>
Cost of the AS		4	
Cost of the Onboard Trainer (OBT)		1	
Cost of the Maintenance Trainer (MT)		1	
<b>Total Price</b>			

<b>- Section #9 Documentation, as per SOW, Section 7.7</b>	<b>Unit price</b>	<b>QTY (as per SOW)</b>	<b>Total Price</b>
Cost of the AS			
Cost of the Special Purpose Tools and Test Equipment (SPTATE)			
Cost of the Onboard Trainer (OBT)			
Cost of the Maintenance Trainer (MT)			
Cost of the Submarine Control Trainer (SCT)			
<b>Total Price</b>			

<b>-Section #10 Breakdown of the AS Spare Parts for the Four (4) submarines, for Five (5) years, and Special Purpose Tools and Test Equipment</b>				
<b>Part Number</b>	<b>Description</b>	<b>Unit price</b>	<b>QTY</b>	<b>Total Price</b>
<b>Total Price</b>				
<b>Price per submarine</b>				

<b>- Section #11 Breakdown of the Spare Parts for the Onboard Trainer (OBT) for the Four (4) submarines, for Five (5) years (if applicable)</b>				
<b>Part Number</b>	<b>Description</b>	<b>Unit price</b>	<b>QTY</b>	<b>Total Price</b>
<b>Total Price</b>				

**- Section #12 Breakdown of the Spare Parts for the Maintenance Trainer (MT), for Five (5) years**

Part Number	Description	Unit price	QTY	Total Price
<b>Total Price</b>				

**- Section #13 Breakdown of the Spare Parts for the Submarine Control Trainer (SCT), for Five (5) years**

Part Number	Description	Unit price	QTY	Total Price
<b>Total Price</b>				

**- Section #14 Cadre Trainings, including all necessary Training Documentation**

Unit price	QTY	Total Price
	2	
<b>Total Price</b>		

**TOTAL PRICE OF THE PROJECT**
**\$**

Note: - All provided prices shall be before GST or HST as applicable.

- No changes shall be made to this list unless specifically requested by Canada, in which case the Design Change procedure will apply.

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## **ANNEX "F"**

### **Procedure for Processing Additional / Unscheduled Work**

#### **1 Purpose**

The Unscheduled Work Procedure has been instituted for the following purposes:

- (a) To establish a uniform method of dealing with requests for Unscheduled Work;
- (b) To obtain the necessary Technical Authority approval and Contracting Authority authorization before Unscheduled Work commences; and
- (c) To provide a means of maintaining a record of Unscheduled Work requirements including Serial Numbers, dates, and accumulated cost. The Contractor shall have a cost accounting system that is capable of assigning job numbers for each Unscheduled Work requirement so that each requirement can be audited individually.

#### **2 Definitions**

- (a) An Unscheduled Work Procedure is a contractual procedure whereby changes to the scope of Work under the Contract may be defined, priced and contractually agreed to. Such changes may arise from;
  - (i) "Work Arising" from opening up of machinery and/or surveys of equipment and material;
  - or
  - (ii) "New Work" not initially specified but required on the Vessel.
- (b) The procedure does not allow for the correction of deficiencies in the Contractor's Bid;
- (c) No unscheduled work may be undertaken by the Contractor without written authorization of the Contracting Authority except under emergency circumstances described in Sub. Paragraph 3(b). Unscheduled Work;
- (d) Work undertaken without written Contracting Authority authorization will be considered the Contractor's responsibility and cost; and

- (e) The appropriate PWGSC form is the final summary of the definition of the Unscheduled Work requirement, and the costs negotiated and agreed to.

### 3 Procedures

- (a) The procedure involves the electronic form PWGSC 1379 for refit and repair and will be the only form for authorizing all Unscheduled Work;
- (b) Emergency measures required to prevent loss or damage to the Vessel which would occur if this procedure were followed, shall be taken by the Contractor on its own authority. The responsibility for the cost of such measures shall be determined in accordance with the terms and conditions of the Contract;
- (c) The Technical Authority will initiate a work estimate request by defining the Unscheduled Work requirement. It will attach drawings, sketches, additional specifications, other clarifying details as appropriate, and allocate their Serial Number for the request;
- (d) Notwithstanding the foregoing, the Contractor may propose to the Technical Authority in writing, either by letter or some type of Defect Advice Form (this is the Contractor's own form) that certain Unscheduled Work should be carried out;
- (e) The Technical Authority will either reject or accept such Proposal, and advise the Contractor and Contracting Authority. Acceptance of the Proposal is not to be construed as authorization for the work to proceed. If required, the Technical Authority will then define the Unscheduled Work requirement in accordance with Sub. Paragraph 3(c);
- (f) The Contractor will electronically submit its Proposal to the Contracting Authority together with all price support, any qualifications, remarks or other information requested.

The price support shall demonstrate the relationship between the scope of work, the Contractor's estimated costs and its selling price. It is a breakdown of the Contractor's unit rates, estimates of person hours by trade, estimate of material cost per item for both the contractor and all of its subcontractors including quotations, estimates of any related schedule impact and an evaluation of the contractor's time required to perform the Unscheduled Work;

- 
- (g) The Contractor shall provide copies of purchase orders and paid invoices for Subcontracts and/or materials, including stocked items, in either case. The Contractor shall provide a minimum of two quotations for Subcontracts or materials. If other than the lowest, or sole source is being recommended for quality and/or delivery considerations, this shall be noted. On request to the Contractor, the Contracting Authority shall be permitted, to meet with any proposed Subcontractor or material supplier for discussion of the price and always with the Contractor's representative present.
  - (h) After discussion between the Contracting Authority and the Contractor and if no negotiation is required, the Contracting Authority will seek Technical Authority confirmation to proceed by signing the form. The Contracting Authority will then sign and authorize the Unscheduled Work to proceed;
  - (i) In the event the Technical Authority does not wish to proceed with the work, it will cancel the proposed Unscheduled Work through the Contracting Authority in writing;
  - (j) In the event the negotiation involves a Credit, the appropriate PWGSC form will be noted as "credit" accordingly; and
  - (k) In the event that the Technical Authority requires Unscheduled Work of an urgent nature or an impasse has occurred in negotiations, the commencement of the Unscheduled Work should not be unduly delayed and should be processed as follows, in either case. The Contractor will complete the appropriate PWGSC 1379 form indicating the offered cost and pass it to the Contracting Authority. If the Technical Authority wishes to proceed, the Technical Authority and the Contracting Authority will sign the completed PWGSC form with the notation, "CEILING PRICE SUBJECT TO DOWNWARD ADJUSTMENT", and allocate a Serial Number having the suffix "A". The work will proceed with the understanding that following an audit of the Contractor's actual costs for completing the described work, the cost will be finalized at the ceiling price or lower, if justified by the audit. A new PWGSC form will then be completed with the finalized costs, signed and issued with the same Serial Number without the suffix "A", and bearing a notation that this form is replacing and canceling the form having the same Serial Number with the suffix "A".

NOTE: PWGSC forms bearing Serial Numbers with a suffix "A" shall not to be included in any contract amendments, and therefore no payment shall be made until final resolution of the price and incorporation into the contract.

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#### 4 Amendment to Contract or Formal Agreement

The Contract will be amended from time to time in accordance with the Contract terms to incorporate the costs authorized on the appropriate PWGSC forms.



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## **ANNEX "G"**

### **Security Requirements Check List (SRCL)**

As per attachment

**ANNEX "H"****Mandatory Technical Criteria**

<b>Mandatory Technical Criteria</b>				
<b>Item #</b>	<b>Criteria</b>	<b>Compliant</b>		<b>Reference to applicable page and paragraph of Proposal</b>
		<b>Yes</b>	<b>No</b>	
1	Bidder has delivered at least one Control System in similar complexity to Autopilot System (AS) for submarine application within the last five (5) years.			
2	Bidder shall provide a preliminary Project Management Plan with a work break down structure (WBS) to level 3, which will clearly articulate how the bidder proposes to achieve a scheduled timeline of the Engineering Change Package no later than eighteen (18) months after contract award with all the four (4) Autopilot Systems ready for installation as well as the trainers, no later than twenty four (24) months after contract award.			
3	Bidder's proposed AS shall fully meet the environmental requirements IAW Annex B of the AS TSOR, section 4.2.			
4	The Bidder's proposed AS shall meet the AS mechanical requirements and fit into the existing mechanical envelope IAW Annex A of the AS SOW and Annex B AS TSOR, section 4.3.1.			
5	Bidder's proposed AS shall use a 17 inch LCD panel to replace the existing Autopilot Panel (AP) and be flush fit with the OMC panel.			TSOR section 4.4.4.2

6	Bidder's proposed AS shall at a minimum use a 13.3 inch LCD panel for the Supervisory System (SS) and be flush fit with the SS panel.			TSOR section 4.4.4.3
7	Bidder's proposed AS shall have a dual redundant Optical Ethernet LAN			
8	Bidder's proposed AS shall have an external POU plug in port for each of the AP, SS, AS Computers, Maintenance Panel and EES			
9	Contractor shall be responsible for the complete reconnection of the new AS equipment, including wire termination repairs or additional wire patches.			
10	Contractor shall be responsible for the installation of the Optical Ethernet LAN and the connections to the existing Electrical Ethernet LAN.			
11	Contractor shall provide the AS control algorithm software simulation for testing and verification to Canada.			
12	Contractor shall provide Canada the AS control system for design verification and testing prior to installation on the submarines.			
13	Contractor shall use the new AS software and hardware for the SCT upgrade.			
14	Bidder shall describe the history and attributes of their proposed dynamic model and control algorithm and demonstrate how they have been used in the past in successful submarine autopilot installations.			
15	Contractor shall document the developed AS control algorithm in detail and the final control algorithm shall be provided in source and executable codes to Canada.			

**ANNEX "I"****Point Rated Technical Criteria****Table 1: Point Rated Technical Bid Evaluation Scoring Scale Spread Sheet**

<b>Section #</b>	<b>SOW REQUIREMENTS</b>	<b>Maximum Score Points</b>	<b>Weighting Factors (1 to 5)</b>	<b>Maximum Weighted Score Points Total = 940</b>	<b>Actual Score</b>	<b>Rational</b>
4.2.2	Work Breakdow Structure	10	2	20		
4.2.3	Risk Management Plan	10	2	20		
4.2.5	Configuration Management Plan	10	2	20		
4.2.6	ILS Plan	10	3	30		
4.2.7	Hardware development plan	10	3	30		
4.2.8	Software development plan	10	3	30		
4.2.9	STW Plan	10	3	30		
4.2.12	Quality Assurance Plan	10	3	30		
5.3	Reliability, Maintainability, Availability and Testability Report	10	3	30		
5.4	Interface Management Plan	10	5	50		
5.5	VCS Dynamic Simulation Software Model and AS Control Algorithm Development	10	5	50		
5.6	Design Qualification	10	5	50		
5.7	Failure Mode and Effects Analysis Report	10	3	30		
7.5	Cadre Training	10	2	20		

Section #	TSOR REQUIREMENTS	Maximum Score Points	Weighting Factors (1 to 5)	Maximum Weighted Score Points	Actual Score	Rationale
4.4.3	Hardware Architecture Design	10	4	40		
4.4.4.4	Spare CPU and Memory Capacity	10	3	30		
4.4.5	Supply Voltages and Power Consumption	10	3	30		
4.5.5	Human Machine Interface	10	3	30		
4.5.7	Performance	10	3	30		
4.6.6	Software Functions	10	3	30		
4.7	Diagnostics	10	4	40		
4.8.1.1	System Design Approach	10	5	50		
4.9.5	Mean Time To Repair	10	3	30		
4.9.6.1	Special Purpose Test and Test Equipment (SPTATE)	10	4	40		
4.10.2	Redundancy	10	4	40		
4.11.1	On Board Trainer (OBT)	10	3	30		
4.11.2.2	SCT Software and Hardware Upgrade and Integration	10	4	40		
4.11.2.3	MT Enhancement and Integration	10	4	40		

**NOTE: The Scoring Scale Criteria in Table 2 below will apply to Table 1.**

**Table 2: Point Rated Technical Bid Evaluation Scoring Scale Criteria**

<b>Score</b>	<b>Description</b>
10 Superior	The proposal unequivocally demonstrates that the Bidder would meet this requirement in a comprehensive manner. The proposal includes more than one element that goes beyond the basic requirement in a way that will significantly enhance the service delivery or project performance. The requirement is fully understood and clearly demonstrates an understanding of the work. It appears that the requirement is fully understood and there are no apparent weaknesses that would affect the achievement of the work associated with this requirement.
9 Excellent	The proposal unequivocally demonstrates that the Bidder would meet this requirement in a comprehensive manner. The proposal includes one element that goes beyond the basic requirement in a way that will enhance the service delivery or project performance. The requirement is fully understood and clearly demonstrates an understanding of the work. It appears that the requirement is fully understood and there are no apparent weaknesses that would affect the achievement of the work associated with this requirement.
8 Enhanced	The proposal fully demonstrates that the Bidder would meet this requirement. The requirement is fully understood and clearly demonstrates an understanding of the work, however, there are weaknesses which should not impact the accomplishment of the requirement.
7 Good	The proposal reasonably demonstrates that the Bidder would meet this requirement. It appears that the requirement is understood; however, there are weaknesses for which a risk must be raised, which should not impact the accomplishment of the requirement, however, these weaknesses may adversely affect project schedule, cost, or scope.
6 Acceptable	The proposal meets the minimum requirement for demonstrating that the Bidder would meet this requirement. It appears that the requirement is understood. The response has substance but there are minor shortcomings which are correctable, for which at least one risk must be raised, and which may impact the accomplishment of the requirement. These shortcomings will adversely affect project schedule, cost, or scope.

Score	Description
5 Fair	The proposal fails to meet the minimum requirement for demonstrating that the Bidder would meet this requirement. It appears that the requirement is understood. The response has shortcomings which are moderate and would take some oversight to resolve, for which risks must be raised, and which will impact the accomplishment of the requirement. These shortcomings will adversely affect project schedule, cost, or scope.
4 Marginal	The proposal fails to meet the minimum requirement for demonstrating that the Bidder would meet this requirement. It appears that the requirement is not fully understood. The response has shortcomings which are moderate and tending towards being a challenge to overcome, for which risks must be raised, and which will significantly impact the accomplishment of the requirement. These shortcomings will adversely affect project schedule, cost, or scope.
3 Poor	The proposal fails to meet the minimum requirement for demonstrating that the Bidder would meet this requirement. It appears that the requirement is not understood. The response has shortcomings, which are significant and are unlikely to be resolved, for which risks must be raised, and which will significantly impact the accomplishment of the requirement. These shortcomings will adversely affect project schedule, cost, or scope.
2 Weak	The proposal fails to meet the minimum requirement for demonstrating that the Bidder would meet this requirement. The requirement is not understood. The response has shortcomings which are significant and can not be resolved, for which several risks must be raised, and which will significantly impact the accomplishment of the requirement. These shortcomings will adversely affect project schedule, cost, or scope.
1 Inadequate / Non-responsive	<p>The proposal falls significantly below the minimum requirement for demonstrating that the Bidder would meet this requirement. The requirement is not understood. The response has no merit and fails to demonstrate that the requirement will be met in an acceptable manner. Appropriate risks to the project must be raised.</p> <p>or</p> <p>There is no response to the applicable requirement, or the response provided is not applicable to the requirement. Appropriate risks to the project must be raised.</p>

---

**Definitions:**

1.      **Weakness:**      Failing, a flaw or weak point, referred to as an Area for Improvement
2.      **Shortcoming:**      Deficiency where the quality is being observed as being inadequate or unsuitable
3.      **Substance:**      The idea that is intended, a meaning that is not expressly stated but can be inferred
4.      **Risk:**      Exposure to the probability of loss or damage that affects project success, the potential impact (positive or negative) to an asset or some characteristic of value that may arise from some present process or from some future event.



**Table 3: Point Rated Criteria for the AS Performance**

Item #	TSOR Performance Requirements As per Section 4.5.8.3	Maximum Score Points	Weighting Factors (1 to 5)	Maximum Weighted Score Points Total = 560	Actual Score	Rationale
1	Depth keeping at periscope depth (Measured at Keel) Sea state: 0	10	2	20		
2	Depth keeping at periscope depth (Measured at Keel) Direction: Head seas Sea state: 3	10	3	30		
3	Depth keeping at periscope depth (Measured at Keel) Direction: Following seas Sea state: 3	10	3	30		
4	Depth keeping at periscope depth (Measured at Keel) Direction: Head seas Sea state: 6	10	5	50		
5	Depth keeping at periscope depth (Measured at Keel) Direction: Following seas Sea state: 6	10	5	50		
6	Depth Keeping	10	3	30		
7	Course keeping Near Surface (Snort & Periscope) Sea State: 3 Depth: 15 m (Measured at Keel)	10	3	30		

8	Course keeping Near Surface (Snort & Periscope) Sea State: 6 Depth: 15 m (Measured at Keel)	10	5	50		
9	Course keeping at Depth Depth : 100 m	10	2	20		
10	Depth Change DC: 100 m to 200 m Pitch angle: 20 deg and +2 deg and - 0.5 deg	10	5	50		
11	Depth Change DC: 100 m to 200 m Pitch angle: 10 deg and +2 deg and - 0.5 deg	10	5	50		
12	Depth Change (DC) DC: 100 m to 200 m Pitch angle: 6 deg and +2 deg and - 0.5 deg	10	5	50		
13	Turn manoeuvres Depth: 100 m Turn angle: 90 deg Speed: 5 knots	10	5	50		
14	Spiral Down Manoeuvre Depth: 100 m to 200 m Pitch angle: Contractor to recommend	10	5	50		

**NOTE:** The Scoring Scale Criteria in Table 4 below will apply to Table 3.

**Table 4: Point Rated for the AS Performance Scoring Scale Criteria**

Item #	Requirements Description	Performance Parameters	Score	Requirement Evaluation Description
1	Depth keeping at periscope depth (Measured at Keel) Sea state: 0	0.1m < DKT = or < 0.25 m	8	Depth keeping Tolerance (DKT)
		0.1 m > or = DKT > 0.05 m	9	
		DKT = or < 0.05 m	10	
2	Depth keeping at periscope depth (Measured at Keel) Direction: Head seas Sea state: 3	0.1m < DKT = or < 0.25 m	8	Depth keeping Tolerance (DKT)
		0.1 m > or = DKT > 0.05 m	9	
		DKT = or < 0.05 m	10	
3	Depth keeping at periscope depth (Measured at Keel) Direction: Following seas Sea state: 3	0.1m < DKT = or < 0.25 m	8	Depth keeping Tolerance (DKT)
		0.1 m > or = DKT > 0.05 m	9	
		DKT = or < 0.05 m	10	
4	Depth keeping at periscope depth (Measured at Keel) Direction: Head seas Sea state: 6	0.1m < DKT = or < 0.25 m	8	Depth keeping Tolerance (DKT)
		0.1 m > or = DKT > 0.05 m	9	
		DKT = or < 0.05 m	10	

5	Depth keeping at periscope depth (Measured at Keel) Direction: Following seas Sea state: 6	$0.1\text{ m} < \text{DKT} = \text{or} < 0.25\text{ m}$	8	Depth keeping Tolerance (DKT)
		$0.1\text{ m} > \text{or} = \text{DKT} > 0.05\text{ m}$	9	
		$\text{DKT} = \text{or} < 0.05\text{ m}$	10	
6	Depth Keeping	$0.2\text{ m} > \text{or} = \text{DKT} > 0.05\text{ m}$	8	Depth keeping Tolerance (DKT)
		$\text{DKT} = \text{or} < 0.05\text{ m}$	10	
7	Course keeping Near Surface (Snort & Periscope) Sea State: 3 Depth: 15 m (Measured at Keel)	$2\text{deg} > \text{or} = \text{CKT} > 1\text{ deg}$	8	Course keeping Tolerance (CKT)
		$1\text{deg} > \text{or} = \text{CKT} > 0.5\text{ deg}$	9	
		$\text{CKT} = \text{or} < 0.5\text{ deg}$	10	
8	Course Keeping Near Surface (Snort & Periscope) Sea State: 6 Depth: 15 m (Measured at Keel)	$5\text{deg} > \text{or} = \text{CKT} > 2\text{ deg}$	8	Course keeping Tolerance (CKT)
		$2\text{deg} > \text{or} = \text{CKT} > 1\text{ deg}$	9	
		$\text{CKT} = \text{or} < 1\text{ deg}$	10	
9	Course keeping at Depth Depth: 100 m	$2\text{deg} > \text{or} = \text{CKT} > 1\text{ deg}$	8	Course keeping Tolerance (CKT)
		$1\text{deg} > \text{or} = \text{CKT} > 0.5\text{ deg}$	9	
		$\text{CKT} = \text{or} < 0.5\text{ deg}$	10	

10	Depth Change DC: 100 m to 200 m Pitch angle: 20 deg and +2 deg and - 0.5 deg	50 sec > DC T > 15 sec	8	Depth Change Tolerance (DCT)
		15 sec > or = DCT > 10 sec	9	
		DCT < 10 sec	10	
11	Depth Change DC: 100 m to 200 m Pitch angle: 10 deg and +2 deg and - 0.5 deg	50 sec > DC T > 15 sec	8	Depth Change Tolerance (DCT)
		15 sec > or = DCT > 10 sec	9	
		DCT < 10 sec	10	
12	Depth Change DC: 100m to 200m Pitch angle: 6 deg and +2 deg and - 0.5 deg	50 sec > DCT > 15 sec	8	Depth Change Tolerance (DCT)
		15 sec > or = DCT > 10 sec	9	
		10 sec > DCT	10	
13	Turn Manoeuvres Depth: 100 m Turn angle: 90 deg Speed: 5 knots	5% > TMT > 3%	8	Turn Manometer Tolerance (TMT)
		3% > or = TMT > 1%	9	
		TMT < 1%	10	
14	Spiral Down Manoeuvre Depth: 100 m to 200m Pitch angle: Contractor to Recommend	2 > SDT = or < 1	8	Spiral Down Turns (SDT)
		3 > or = SDT = or > 2	9	
		SDT = or > 3	10	

**ANNEX "J"****Financial Bid****SUBMITTED BY:** \_\_\_\_\_

<b>Item #</b>	<b>Price Breakdown</b>	<b>Total Price</b>
1	ASs Onboard the submarines, as per Annex "E", Section 1	
2	Onboard Trainer (OBT), as per Annex "E", Section 2	
3	Maintenance Trainer (MT), as per Annex "E", Section 3	
4	Submarine Control Trainer (SCT), as per Annex "E", Section 4	
5	Design of the AS, as per Annex "E", Section 5	
6	Factory Acceptance Test of the ASs and the Trainers, as per Annex "E", Section 6	
7	Installation of the ASs and the Trainer, as per Annex "E", Section 7	
8	Testing and Acceptance of the ASs and the Trainer following the installation, as per Annex "E", Section 8	
9	Documentation, as per Annex "E", Section 9	
10	Spare Parts for the ASs and the SPTATE, as per Annex "E", Section 10	
11	Spare Parts for the Onboard Trainer (OBT), if applicable, as per Annex "E", Section 11	
12	Spare Parts for the Maintenance Trainer (MT), as per Annex "E", Section 12	

Solicitation No. - N° de l'invitation

W8483-117051/C

Amd. No. - N° de la modif.

002

Buyer ID - Id de l'acheteur

034ml

Client Ref. No. - N° de réf. du client

W8483-117051

File No. - N° du dossier

034mlW8483-117051

CCC No./N° CCC - FMS No/ N° VME

13	Spare parts for the Submarine Control Trainer (SCT), as per Annex "E", Section 13	
14	Cadre Trainings, as per Annex "E", Section 14	
<b>Total Price for the Project</b>		

**Canada has no obligation to procure from the contractor all the Spare Parts and / or Trainings.**

**Bidder must provide the following Hourly rates as requested in Part 7, Clause 6.1 "Basis of Payment" of the RFP:**


<b>Clause</b>	<b>Descriptions</b>	<b>Rates</b>
6.1.2	Labor Rate for Additional / Unscheduled Work including Design Change	
6.1.3	Overtime for Additional / Unscheduled Work: Time and One-Half	
6.1.3	Overtime for Additional / Unscheduled Work: Double Time	

Note: All provided prices / rates shall be before GST or HST as applicable.

**Signed:** \_\_\_\_\_ **Date:** \_\_\_\_\_

## ANNEX A

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

	<b>NOTICE</b> 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.
	<b>AVIS</b> 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
<u>Change ...1.1...</u>	<u>26 Oct 2012</u>

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	<u>1.0</u>
7, 8, 11, 12, 14, 15, 16, 17, 19, 24, 25, 26 27, 30	1.1

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## 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,

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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.

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			1.0	26 Oct 2012

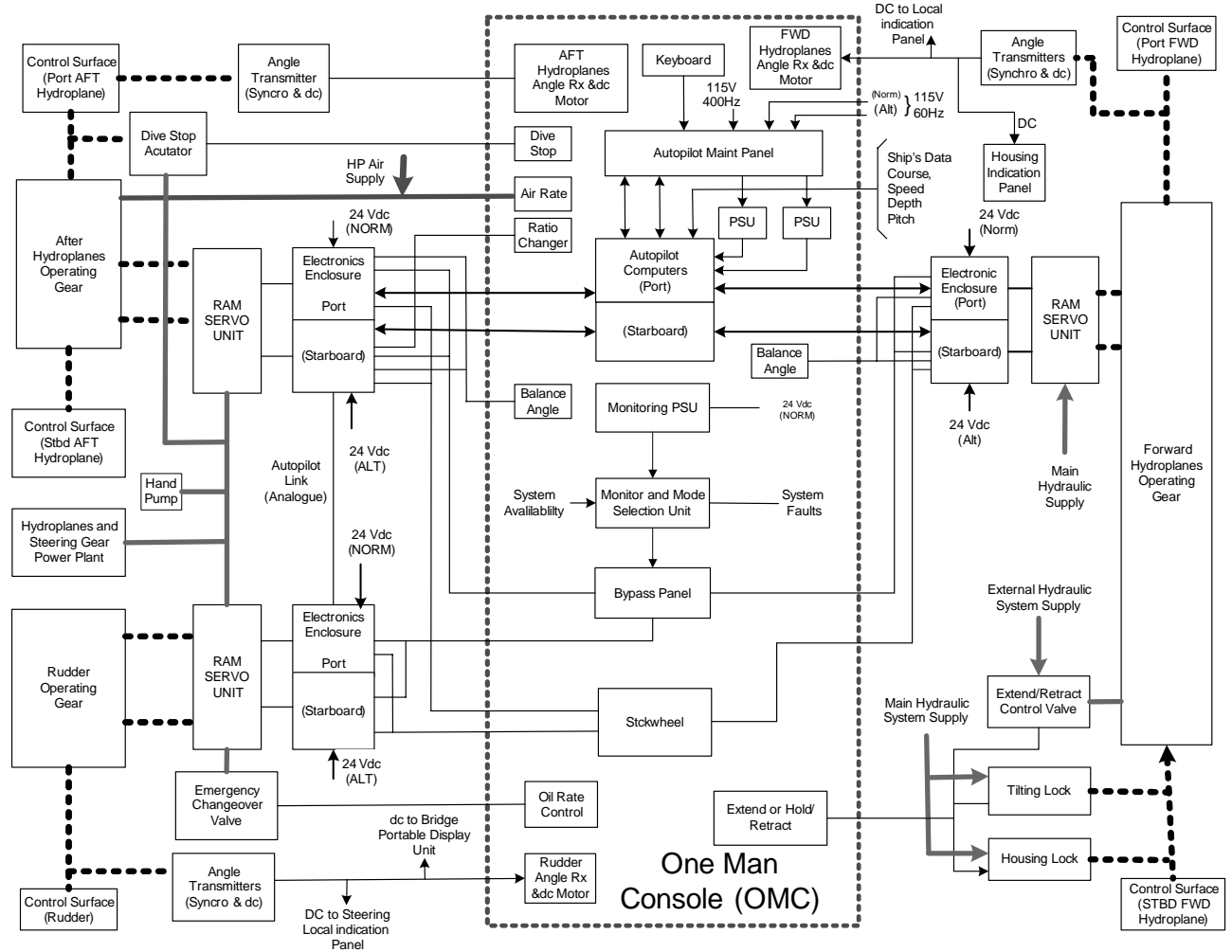
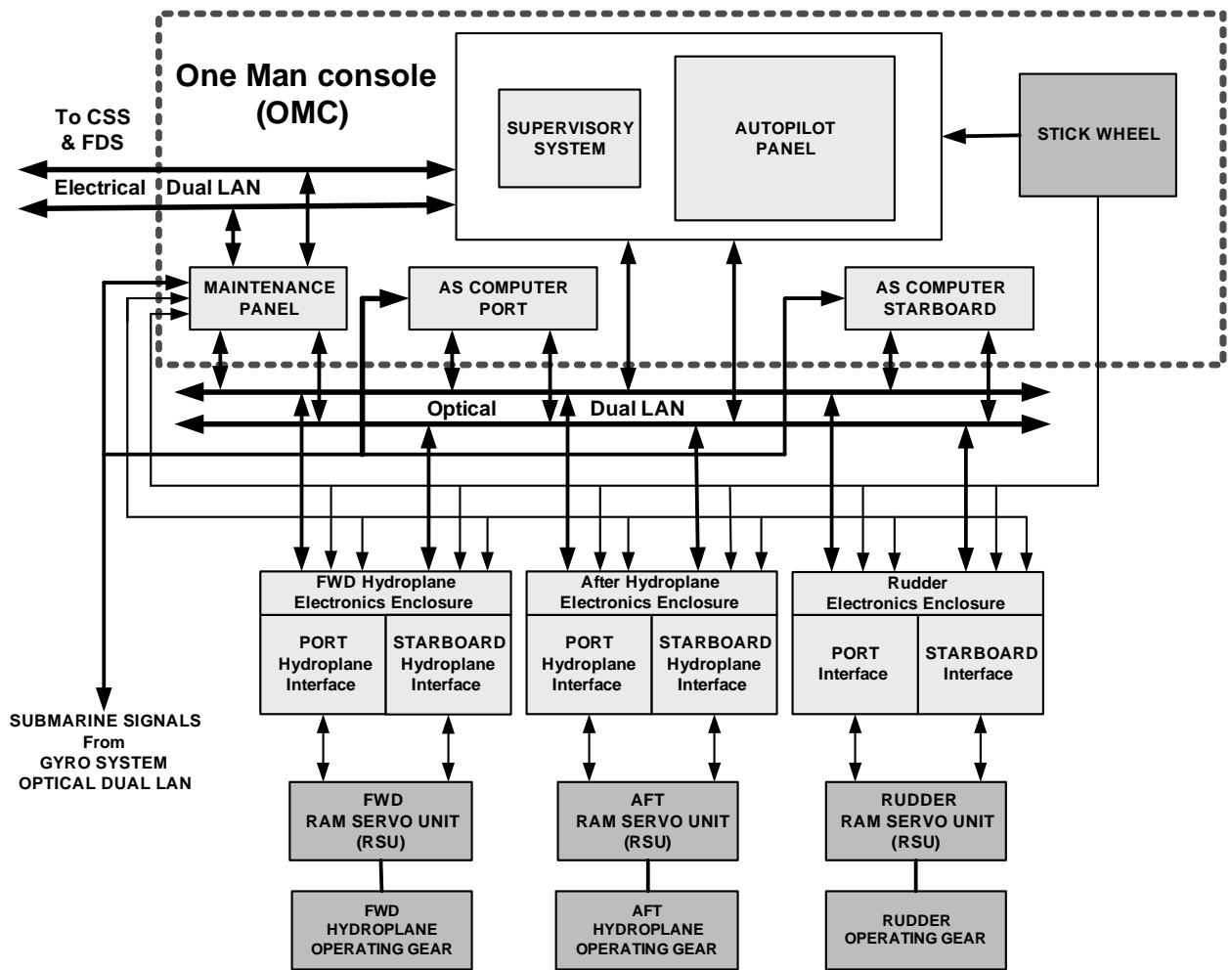


Figure 1: Block Diagram of the Existing AS





**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	<a href="http://cradpdf.drdc-rddc.gc.ca/PDFS/unc101/p533617_A1b.pdf">http://cradpdf.drdc-rddc.gc.ca/PDFS/unc101/p533617_A1b.pdf</a>
15.	DSSP50 Build 090910 Documentation: Part 2: Input Reference	<a href="http://cradpdf.drdc-rddc.gc.ca/PDFS/unc101/p533618_A1b.pdf">http://cradpdf.drdc-rddc.gc.ca/PDFS/unc101/p533618_A1b.pdf</a>
16.	DSSP50 Build 090910 Documentation: Part 3: Algorithm Description	<a href="http://cradpdf.drdc-rddc.gc.ca/PDFS/unc101/p533619_A1b.pdf">http://cradpdf.drdc-rddc.gc.ca/PDFS/unc101/p533619_A1b.pdf</a>

## 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.	<u>MIL HDBK 502</u>	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.	<u>ANSI-649-A, 2004</u>	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
<b>AP with 17" LCD and keyboard with protective cover</b>	1	Control Room
<b>SS with 13.3" LCD and keyboard protective cover</b>	1	Control Room
<b>AS computers</b>	2	Control Room
<b>Maintenance Panel</b>	1	Control Room
<b>Electronic Enclosures</b>	3	Forward and After Hydroplanes and Rudder
<b>OBT</b>	1	Software
	1	PC

Unit	Qty	Locations and or Comments
<b>Cables and all the necessary hardware</b>	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**

<b>SHORE BASED TRAINING SYSTEMS (SBTs)</b>		Qty	Locations and or Comments
<b>Submarine Control Trainer (SCT)</b>	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
<b>Maintenance Trainer (MT) Upgrade</b>	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
<b>On board submarine Spares for 1<sup>st</sup> and 2<sup>nd</sup> level maintenance support on board submarine</b>	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 1 <sup>st</sup> and 2 <sup>nd</sup> level maintenance on board the submarine for five (5) years
<b>SCT and MT trainers spares for 1<sup>st</sup> and 2<sup>nd</sup> level maintenance support at the fleet training schools</b>	1	Components types and quantities set for each trainer shall be proposed by the Contractor and approved by TA to support the 1 <sup>st</sup> and 2 <sup>nd</sup> level maintenance for five (5) years

**Table 6:AS Installation Support EC Specifications**

Installation Support	Qty	Comments
Submarine EC Specifications	1	One (1) baseline EC specification
	4	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)	<u>2</u>	To be designed/developed/tested and provided by the Contractor and approved by the TA. <u>One kit for each coast.</u>
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 1<sup>st</sup> and 2<sup>nd</sup> level maintenance activities. The MT shall be enhanced to include the AS operator training and the 1<sup>st</sup> and 2<sup>nd</sup> 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.



<b>Annex A</b>	<b>RDIMS #</b>
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### **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  $\lambda=15$ . 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 CDRL-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 CDRL-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.

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## **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.

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			1.0	<u>26</u> Oct 2014

## **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

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WBS	Work Breakdown Structure
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**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	5 <sup>th</sup> wd of each month	4.5.1
CDRL-PM-05	N/A	Project Kick Off Meeting	R	CA + <u>20</u> 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

<b>Integrated Logistics Support CDRL</b>					
<b>CDRL #</b>	<b>DID #</b>	<b>Deliverable</b>	<b>Review Level</b>	<b>Due</b>	<b>Section in SOW</b>
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

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## 11.2.5 Project Management CDRL Details

### 11.2.5.1 CDRL-PM-01

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

### 11.2.5.2 CDRL-PM-02

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

### 11.2.5.3 CDRL-PM-03

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

### 11.2.5.4 CDRL-PM-04

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

### 11.2.5.5 CDRL-PM-05

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

## 11.2.6 Engineering CDRL Summary

### 11.2.6.1 CDRL-EN-01

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

### 11.2.6.2 CDRL-EN-02

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

### 11.2.6.3 CDRL-EN-03

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

### 11.2.6.4 CDRL-EN-04

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



<b>Annex A</b>	<b>RDIMS #</b>
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#### 11.2.6.9 CDRL-EN-09

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

#### 11.2.6.10 CDRL-EN-10

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

#### 11.2.6.11 CDRL-EN-11

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

#### 11.2.6.12 CDRL-EN-12

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

### 11.2.6.13 CDRL-EN-13

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

### 11.2.7 Testing and Acceptance CDRL Summary

#### 11.2.7.1 CDRL-AT-01

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

#### 11.2.7.2 CDRL-AT-02

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

#### 11.2.7.3 CDRL-AT-03

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

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<b>9</b>	<b>Subsequent Submission:</b>	N/A
<b>10</b>	<b>Remarks:</b>	Deliver via email or FTP

### 11.2.8 Integrated Logistics Support CDRL Summary

#### 11.2.8.1 CDRL-LOG-01

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

#### 11.2.8.2 CDRL-LOG-02

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

#### 11.2.8.3 CDRL-LOG-03

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

#### 11.2.8.4 CDRL-LOG-04

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

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

#### 11.2.8.5 CDRL-LOG-05

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

#### 11.2.8.6 CDRL-LOG-06

<b>1</b>	<b>Sequence Number:</b>	LOG-06
<b>2</b>	<b>Title or Description of Data:</b>	<ol style="list-style-type: none"> <li>1. Hardware requirements Document;</li> <li>2. Hardware designs document;</li> <li>3. SPTATE design document;</li> <li>4. Software requirements document;</li> <li>5. Software designs document'</li> <li>6. Circuit cards design descriptions with data path flow;</li> <li>7. Operations manual;</li> <li>8. Software user manual;</li> <li>9. Maintenance manual with trouble shooting and repair details; and Test Form.</li> </ol>
<b>3</b>	<b>Data Item Description Number:</b>	IAW CFTO standard C-01-100-100/AG-006, see section 2 and item 9,
<b>4</b>	<b>Reference:</b>	SOW
<b>5</b>	<b>First Submission:</b>	STW-20 wd
<b>6</b>	<b>Number of Copies:</b>	1 soft copy in source format
<b>7</b>	<b>TA Approval Required:</b>	Yes
<b>8</b>	<b>Approval Lead Time:</b>	N/A
<b>9</b>	<b>Subsequent Submission:</b>	N/A
<b>10</b>	<b>Remarks:</b>	Deliver via email or FTP

#### 11.2.8.7 CDRL-LOG-07

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

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

## Data Item Descriptions

### 11.2.9 Project Management DIDs

#### 11.2.9.1 DID-PM-01

1. TITLE		2. IDENTIFICATION NUMBER	
Project Management Plan		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)		6. SPARE
	Technical Authority, DMEPM(SM) 4-3		
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:		
	<ol style="list-style-type: none"> <li>1. Introduction;</li> <li>2. Management Organization and Responsibilities;</li> <li>3. Work Breakdown Structure (WBS);</li> <li>4. Master Schedule with Milestones;</li> <li>5. Hardware Development Plan;</li> <li>6. Software development Plan;</li> <li>7. Risk Management;</li> <li>8. Configuration Management;</li> <li>9. QA Plan;</li> <li>10. ILS Plan;</li> <li>11. FAT Plan; and</li> <li>12. STW Plan.</li> </ol>		

#### 11.2.9.2 DID-PM-02

1. TITLE		2. IDENTIFICATION NUMBER	
Meeting Agendas		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)		6. SPARE
	Technical Authority, DMEPM(SM) 4-3		
7. APPLICATION / INTERRELATIONSHIP			
CDRL - PM-02			

SOW Ref: 4.4.5.1.2	
8. ORIGINATOR	9. APPLICABLE FORMS
10. PREPARATION INSTRUCTIONS	
<p>10.1 Supporting documentation and agenda shall be prepared in the Contractor's format.</p> <p>10.2 The Agenda shall include the following:</p> <ol style="list-style-type: none"> <li>1. Purpose of the meeting;</li> <li>2. List of expected attendees;</li> <li>3. Time, date, location and expected duration of the meeting;</li> <li>4. Facilities and equipment to be provided for attending personnel;</li> <li>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</li> <li>6. Adequate copies of the current AIL where appropriate.</li> </ol> <p>10.3 Other pertinent information such as security requirements, if submarine visits are planned or other relevant information that would assist attending personnel.</p>	

### 11.2.9.3 DID-PM-03

1. TITLE		2. IDENTIFICATION NUMBER	
Meeting Minutes		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)		6.SPARE
	Technical Authority, DMEPM(SM) 4-3		
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			
<p>10.1 Meeting / Teleconference / Conference Minutes shall be prepared in the Contractor's format and shall include the following information:</p> <ol style="list-style-type: none"> <li>1. Date and location of meeting;</li> <li>2. Name, organization, phone number, e-mail address and title of each person that attended the meeting;</li> <li>3. Statement relating to the purpose and/or objective of the meeting; and</li> <li>4. The original agenda and any revisions to the agenda - this may be accomplished by reference to attachments or enclosures.</li> </ol> <p>10.2 Minutes should include a record of each item discussed or reviewed during the meeting, including:</p> <ol style="list-style-type: none"> <li>1. A brief statement identifying the item or problem and their status;</li> <li>2. A summary of pertinent information associated with the item;</li> <li>3. A recommendation;</li> <li>4. An action item - identifying the person or organization responsible for taking and/or co-ordinating required action with key dates; and</li> <li>5. An updated Action Item List (AIT).</li> </ol> <p>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.</p>			



#### 11.2.9.4 DID-PM-04

1. TITLE		2. IDENTIFICATION NUMBER	
Project Status Reports (PSR)		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)		6. SPARE
	Technical Authority, DMEPM(SM) 4-3		
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:			
<ol style="list-style-type: none"> <li>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;</li> <li>2. Risk management activities. Significant problems or concerns encountered together with recommended course of action;</li> <li>3. Schedules status, schedule changes and planned activities for the next reporting period;</li> <li>4. A summary of any issues for meeting requirements / specifications;</li> <li>5. Running summary of hardware, software and system observations and problems that have been opened, are in progress or have been resolved; and</li> <li>6. Subset of Action Item List containing all open action items.</li> </ol>			

### 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: <ul style="list-style-type: none"> <li>1. System Requirements Specification Including Hardware and Software;</li> <li>2. System Architecture and Requirements Allocation Description; and</li> <li>3. Interface Management Plan.</li> </ul>			

### 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: <ul style="list-style-type: none"> <li>1. Hardware design;</li> <li>2. Special Purpose Test And Test Equipment (SPTATE) design;</li> <li>3. Signal Interface Point to Point List;</li> <li>4. Hardware interface control document;</li> <li>5. Software architecture ;</li> <li>6. Software design;</li> <li>7. HMI GUI pages design;</li> <li>8. Software interface design;</li> <li>9. Control algorithm design description; and</li> <li>10. OBT, SCT and MT designs.</li> </ul>			

### 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: <ol style="list-style-type: none"> <li>1. Hardware design;</li> <li>2. Special Purpose Test And Test Equipment (SPTATE) design;</li> <li>3. Signal Interface point to point list;</li> <li>4. Hardware interface control document;</li> <li>5. AS Circuit cards schematics and all the internal wiring schematics of the AS equipment;</li> <li>6. Software architecture;</li> <li>7. Software design;</li> <li>8. Software interface design;</li> <li>9. HMI GUI pages design;</li> <li>10. Control Algorithm design description;</li> <li>11. OBT, SCT and MT (both hardware and software) designs;</li> <li>12. Preliminary FAT plan; and</li> <li>13. Preliminary STW Plan.</li> </ol>			

#### 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: <ol style="list-style-type: none"> <li>1. Objective evidence shall be supplied to ensure the following: <ol style="list-style-type: none"> <li>a. As-coded software product reflects the design documentation;</li> <li>b. Hardware reflects the design documentation;</li> </ol> </li> <li>2. Review and testing prescribed by documentation is adequate for the acceptance of the software and hardware;</li> <li>3. Test data compliance with test plan and test procedures;</li> <li>4. AS was successfully tested and met its requirements;</li> <li>5. QT and STW reports are correct and discrepancies between actual and expected results have been resolved;</li> <li>6. TDP complies with standards specified;</li> </ol>			
10.2 Activities have been conducted according to applicable requirements, plans, and contract.			

### 11.2.10.5 DID-EN-06

1. TITLE - TITRE Engineering Change Specifications Packages		2. IDENTIFICATION NUMBER 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) Technical Authority, DMEPM(SM) 4-3		6. SPARE
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: <ol style="list-style-type: none"> <li>1. Date of issue and status;</li> <li>2. Scope;</li> <li>3. Issuing organization;</li> <li>4. Intended recipients;</li> <li>5. References;</li> <li>6. Overview of system, software and hardware;</li> <li>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);</li> <li>8. Security and privacy considerations;</li> <li>9. Body;</li> <li>10. Glossary;</li> <li>11. Change history.</li> </ol> <p>Specific software related information items for this document have been extracted from MIL-STD-498, Software Version Description (SVD).</p>			

### 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.

<b>Annex A</b>	<b>RDIMS #</b>
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### 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 (BTT 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		2. IDENTIFICATION NUMBER	
Acceptance Test Reports		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)	6. SPARE	
	Technical Authority, DMEPM(SM) 4-3		
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		2. IDENTIFICATION NUMBER	
Consolidated Training Package		DID-LOG-03	
3. DESCRIPTION / PURPOSE			
<p>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:</p> <ol style="list-style-type: none"> <li>1. Course Certificate: The purpose of the Course Certificate is to provide students with objective proof of successful completion of the course.</li> <li>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.</li> <li>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.</li> <li>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.</li> </ol>			
4. APPROVAL DATE	5. OFFICE OF PRIMARY INTEREST (OPI)		6. SPARE
	Technical Authority, DMEPM(SM) 4-3		
7. APPLICATION / INTERRELATIONSHIP			
CDRL –LOG-03 SOW Ref: <b>7.5.3</b>			
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)**

	<p style="text-align: center;"><b>NOTICE</b></p> <p>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.</p>
	<p style="text-align: center;"><b>AVIS</b></p> <p>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.</p>

## 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	<u>26 October 2012</u>

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

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## 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:

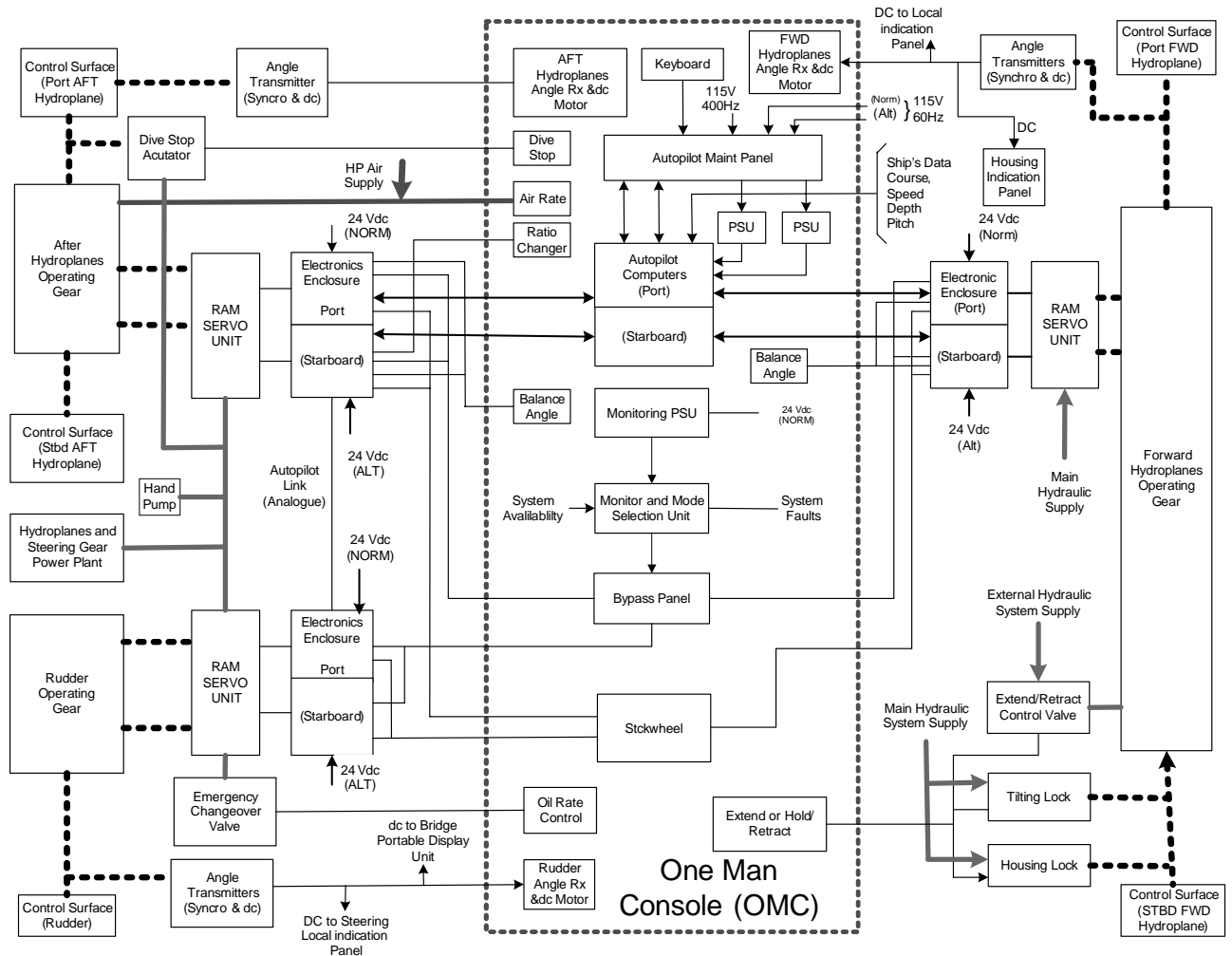
1. Sustain the existing AS functions, their functionality and the performances as per section 4.5.7 by replacing the AS equipment enclosures and all components contained therein with modern, fully supportable technology within the same space envelopes currently occupied by the existing AS equipment enclosures;

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.

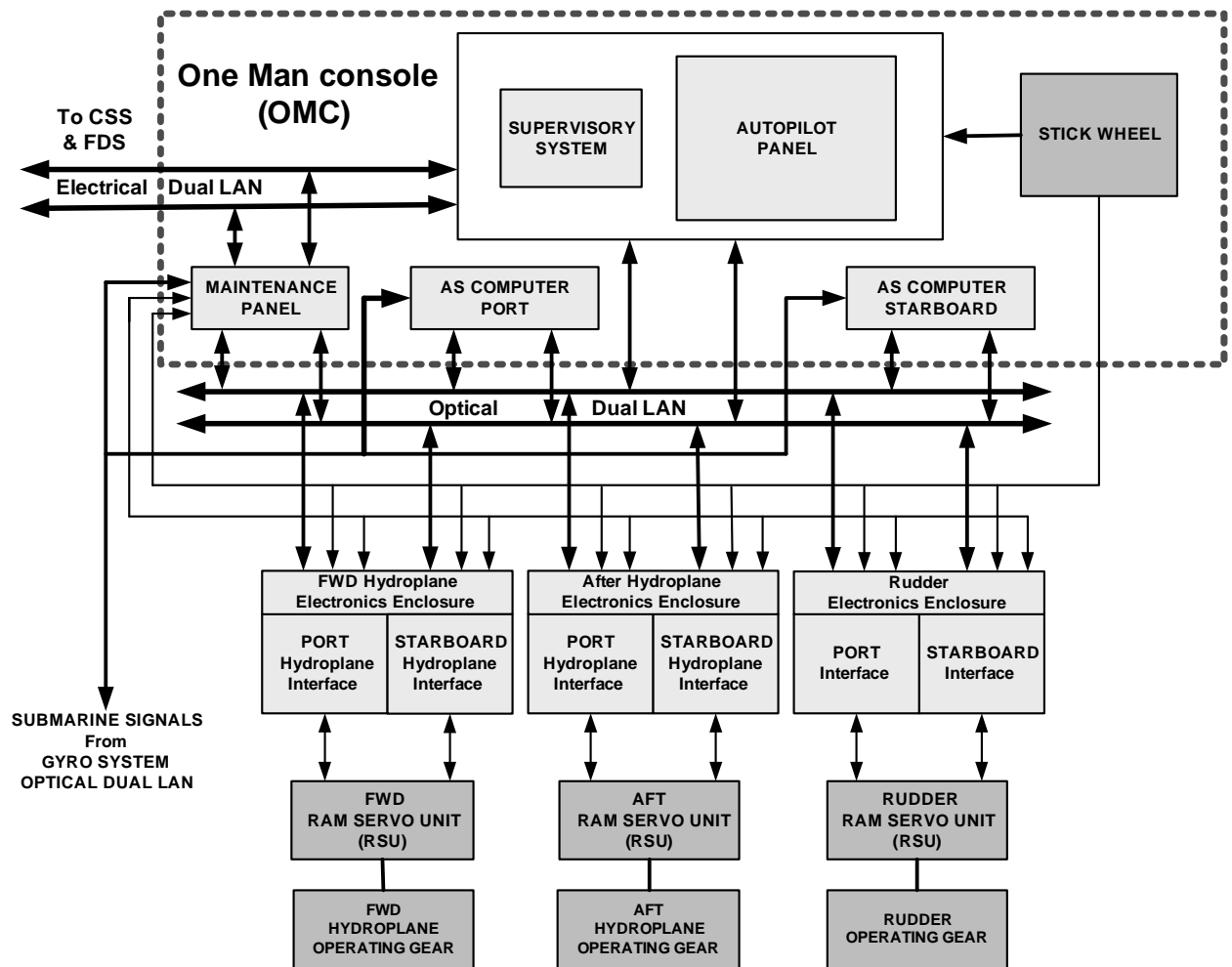
#### 1.4 Acronyms and Abbreviations

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<sup>3</sup>' 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 disabled. 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° 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<sup>3</sup> or S-Cubed Data Link

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

### 3.1.14 Electronic Enclosures

The forward and after hydroplanes Electronic Enclosures (EEs) contain the S<sup>3</sup> data link interfaces, Digital to Analogue (D/A) converters, monitoring circuits and power amplifiers. The Rudder EE does not have a direct S<sup>3</sup> 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.



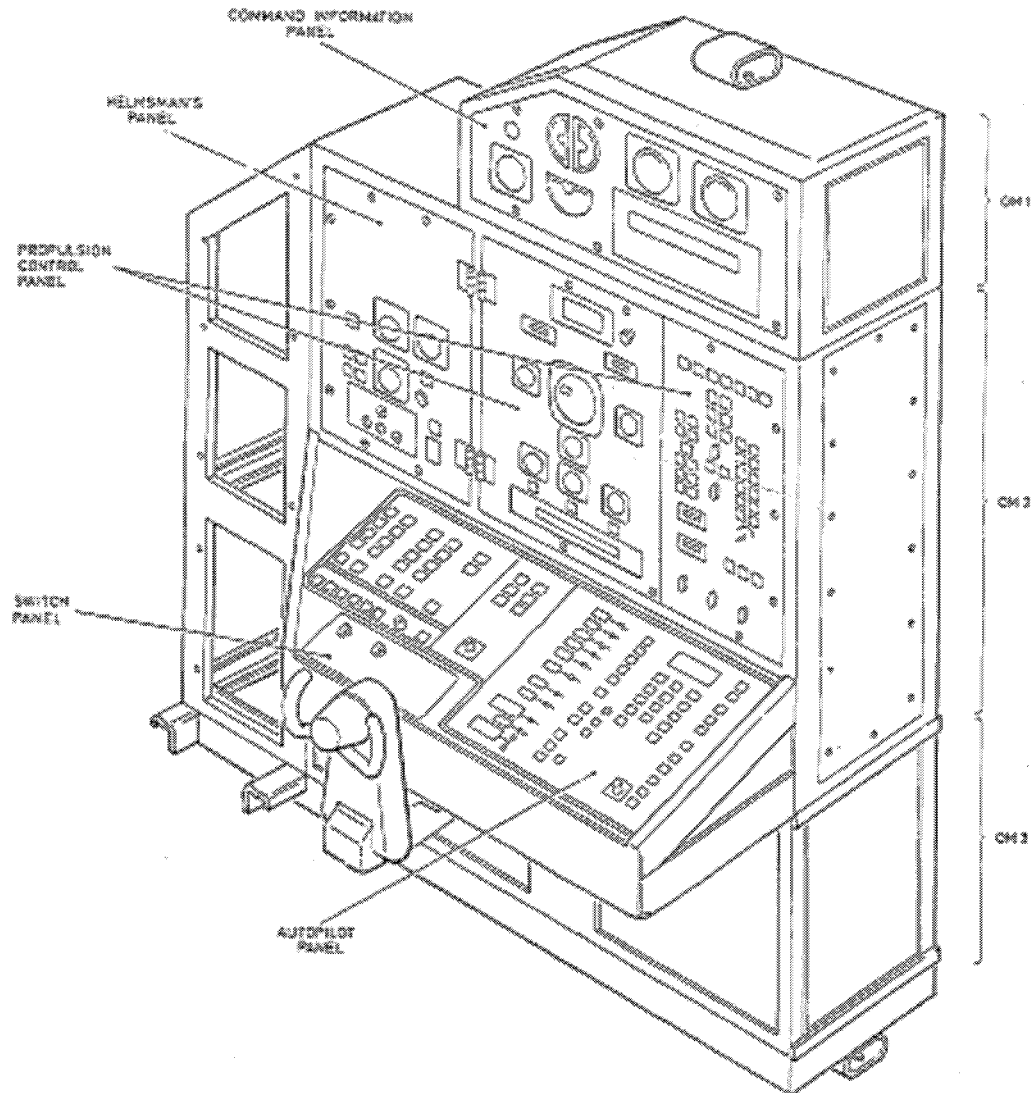


Figure 3: One Man Console (OMC)

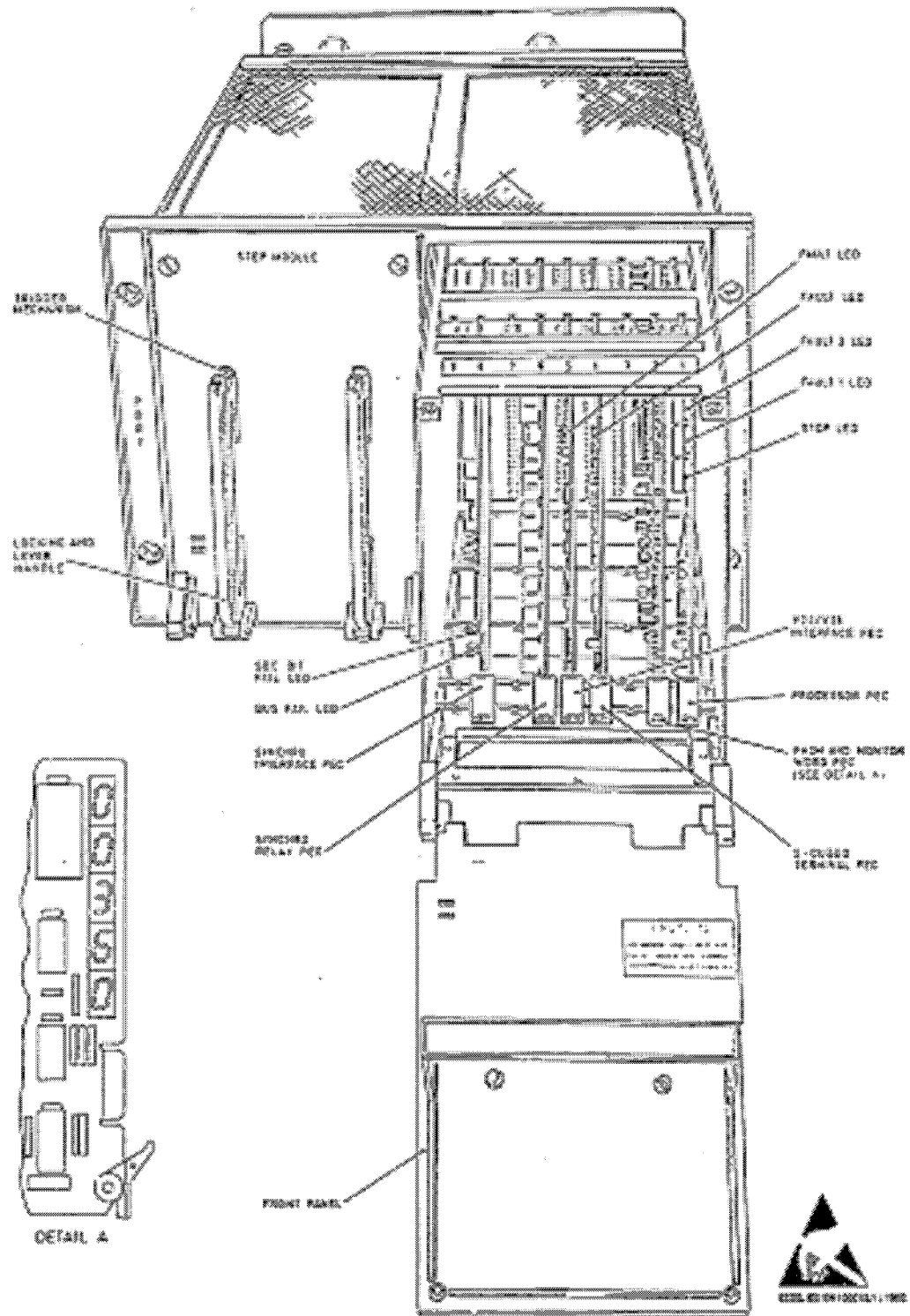


Figure 4: AS Computers (Step Modules)

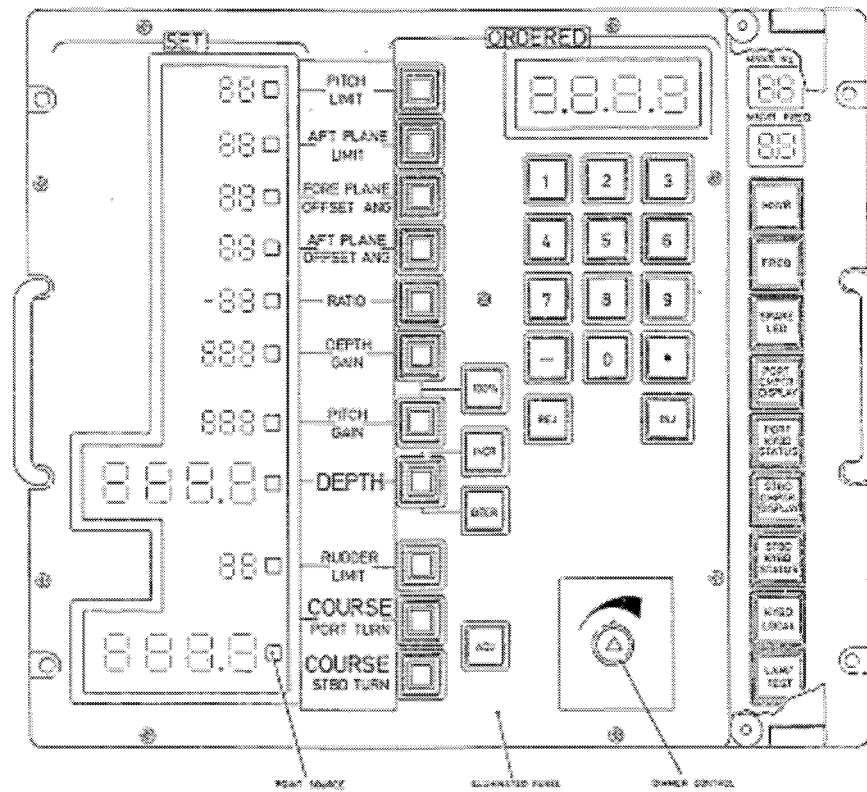


Figure 5: Keyboard Module

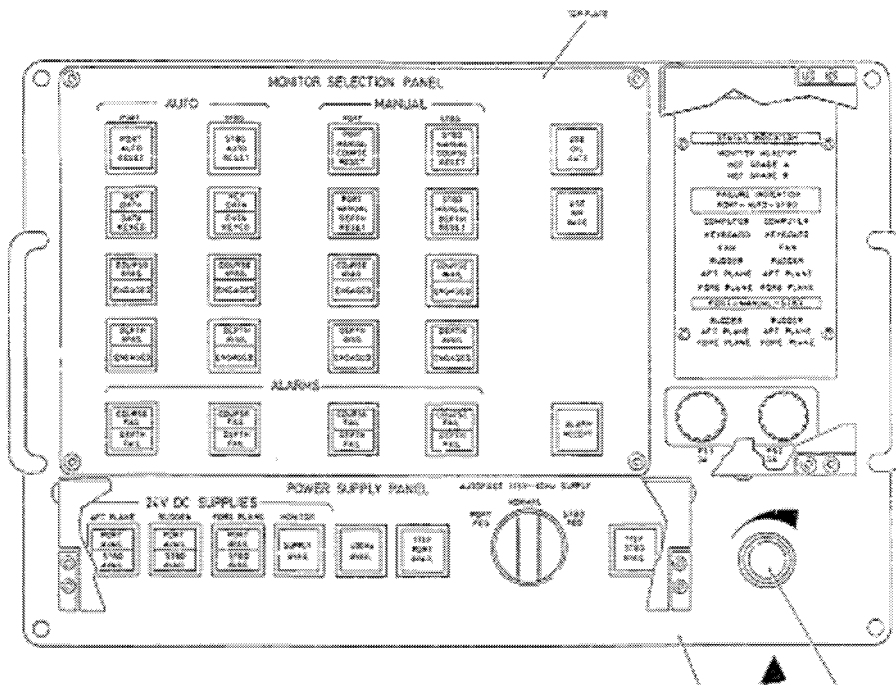


Figure 6: Monitor and Mode Selection Unit

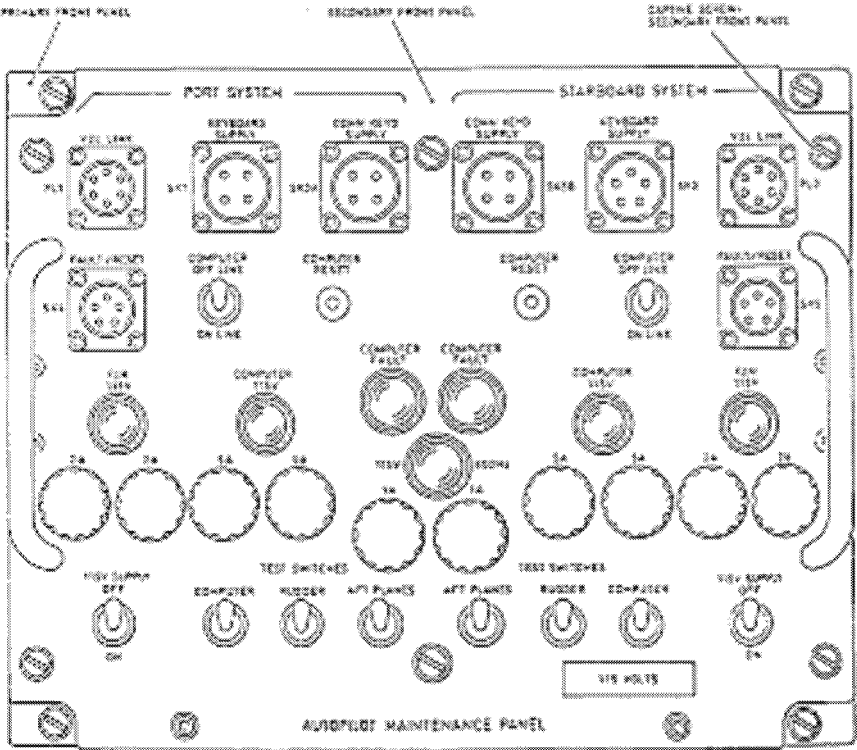


Figure 7: Maintenance Panel

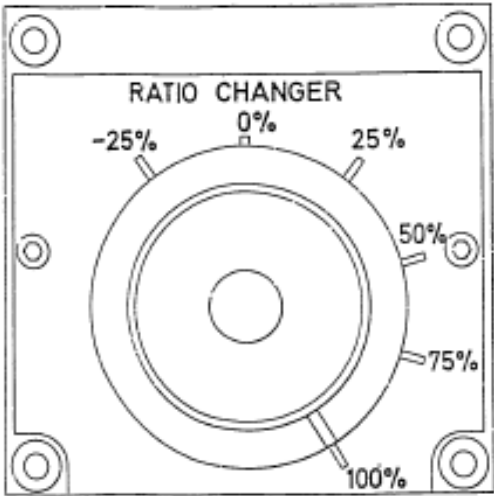


Figure 8: Ratio Changer

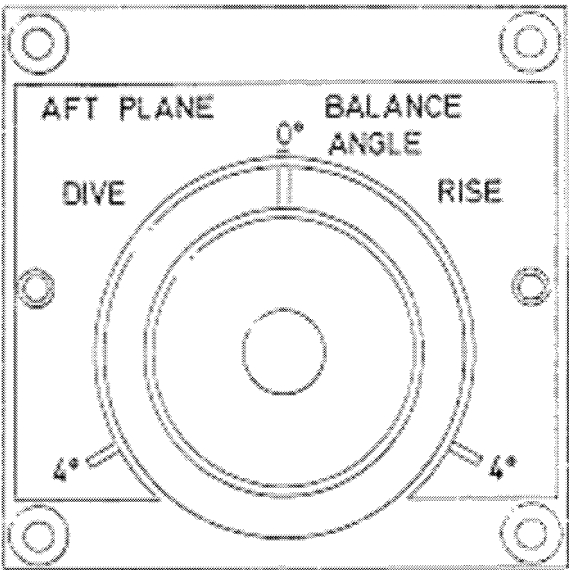


Figure 9: Balance Angle

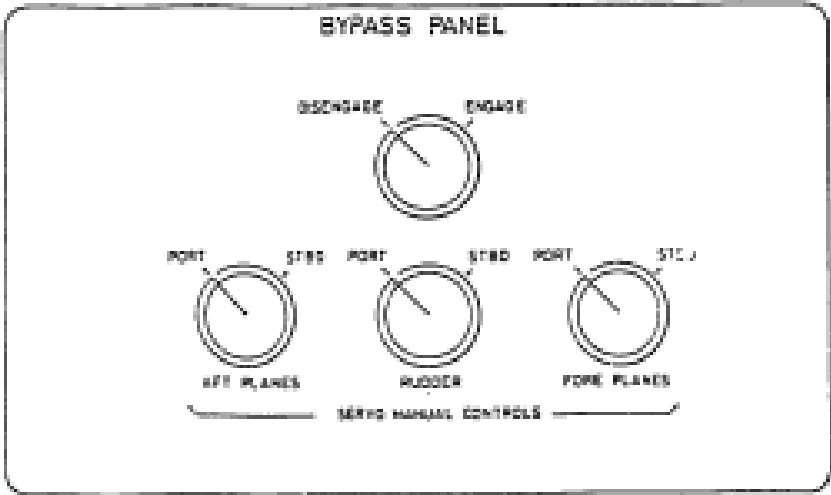
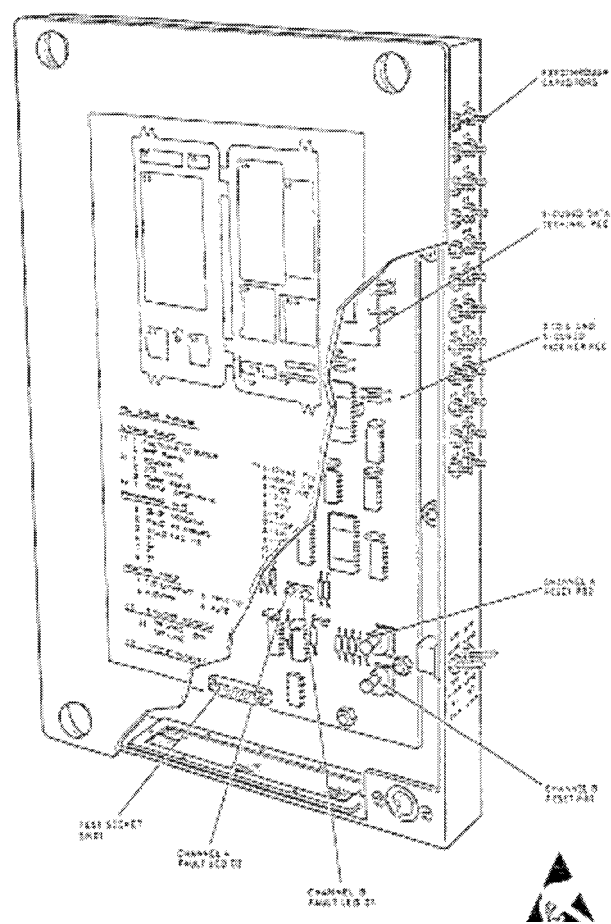


Figure 10: Bypass Panel

**Figure 11: S<sup>3</sup> Assembly**

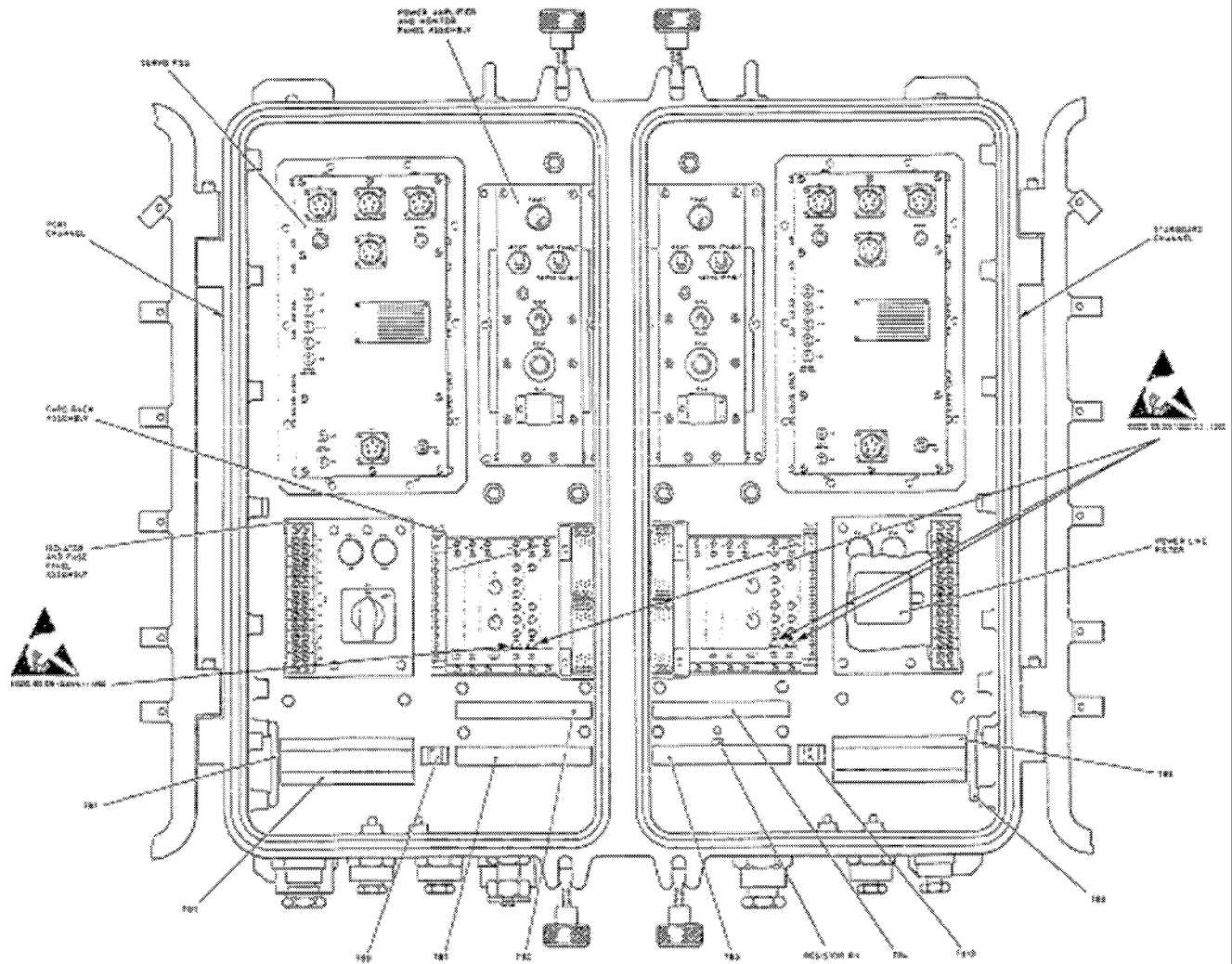


Figure 12: Electronic Enclosure

## 3.2 System Operation

### 3.2.1 General

In automatic control, digital signals from the AS computers are communicated on the S<sup>3</sup> 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<sup>3</sup> Data Link**

The S<sup>3</sup> 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

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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<sup>3</sup> 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

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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

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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 lever switch annotated “EXTEND/0<sup>0</sup> 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<sup>0</sup> 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  <u>Duration of this temperature test can be minimum of 2 hours</u>
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

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Item	Environmental Condition	Requirements	Standard (reference) and Comments
	drench	time 30 sec)	compartment fire
7	Shock Protection	Light & Medium Weight	<p>MIL STD 901D Shock grade A, Class A and Type B, (type II with shock mounts)</p> <p><b>For all OMC mounted equipment:</b> 30g Half Sine wave 12.5ms loading on X, Y and Z axis</p> <p><b>Electronic Enclosures:</b> 200g Half sine wave, 12.5 ms loading on X, Y and Z axis.</p> <p>(Testing tailored as per CFTO D-03-003-007/SG-000)</p>
8	Vibration	Type I equipment	<p>MIL-STD-167-1A</p> <ul style="list-style-type: none"> <li>- 1-13.2 Hz, 1mm Peak to Peak</li> <li>- 5-33 Hz, +/- 0.125mm Peak to Peak</li> <li>- 14-70 Hz, at 0.7g</li> </ul> <p>For only the OMC mounted equipment, the above requirement are reduced to 50% of the above requirement</p>
9	Compartment Pressure	<p>Operational: 750-1310 mbar</p> <p>Abnormal: 713 mbar for 5 min with no detrimental effects</p> <p>Non Operational; 500 - 2300 mbar</p>	



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Item	Environmental Condition	Requirements	Standard (reference) and Comments
10	Submarine Motion	<p>The equipment shall be capable of operation in the following conditions:</p> <p><b>Submerged:</b>  <b>Heel:</b>  45 deg for 5 Sec  20 deg for 45 Sec  10 deg continuously  <b>Trim:</b>  30 deg for 30 Sec  20 deg for 3 minutes  15 deg continuously  <b>Combined Heel and Trim:</b>  30 deg trim, 10 heel for 30 sec duration,  15 Deg trim, 40 deg for 5 seconds duration  <b>Roll:</b>  +30 deg for 17 seconds  Pitch:  2.5 deg for 95 sec</p> <p><b>Surfaced:</b>  <b>Heel:</b>  10 deg Continuously,  <b>Trim:</b>  5 deg Continuously  <b>Roll:</b>  +30 deg for 14 seconds  Pitch:  2.5 deg for 7 sec</p> <p><b>Emergency Condition:</b>  30 deg continuously from the vertical in any direction</p>	
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.

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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

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	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 X 336 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		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

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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) <u>only</u>	109-121V 60 Hz	242W (2A)
Computer System (Starboard) <u>only</u>	109-121V 60 Hz	242W (2A)
-	115V 400Hz	Reference voltage for synchro devices
Keyboard		
Maintenance Panel		
Monitor and Mode Selection Panel	115V 60Hz Normal 24V Grade 1	80W 5.1VDC@ 5A +12VDC @2.5A
	115V 400Hz	Reference voltage for synchro devices
	Or	
	115V 60Hz Alternative 24V Grade 1	80W 5.1VDC@ 5A +12VDC @2.5A
	115V 400Hz	Reference voltage for synchro devices



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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 <b>Provided as <u>an</u>   alternative if submarine signals from the Gyro system are not sufficiently fast to implement control</b>
	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

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				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
<b>Maintenance Panel</b>				
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
<p><b>AS Computers</b> 115V 60Hz; 24VDC Grade 1; Fuses; Indications; and Power switches.</p> <p><b>AP and SS</b> 115V 60Hz; 24VDC Grade 1; Fuses; Indications; Power switches; Fault indication; and Reset switch to each AS &amp; SS computer.</p> <p><b>EEs</b> All signals test/check each EE cascade sequences</p> <p><b>Stickwheel</b> LVDTs outputs;</p>				
				All power supplies

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

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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

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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	<p>If available, Canada will provide this information during the early part of the contract.</p> <p>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.</p>			

#### 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

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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
<b>TOTAL</b>	<b>9</b>	

#### 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**

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

##### 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 stickwheel performance IAW Table 9.

**Table 9: Stickwheel Voltage Outputs for Hydroplanes and Rudder**

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

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	22 <sup>0</sup> Full Dive	27 <sup>0</sup> Full Dive	37 <sup>0</sup> Full Starboard
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#### **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 min (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

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	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



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			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	√	√	

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	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	√	√	Dur trials, maxim state av
	Speed 8 knots	0 deg	+/- 5 deg	√	√	Dur trials, maxim state av
	Speed 12 knots	0 deg	+/- 5 deg	√	√	Dur trials, maxim state av
	Speed 5 knots	45 deg	+/- 5 deg	√	√	Dur trials, maxim state av
	Speed 8 knots	45 deg	+/- 5 deg	√	√	Dur trials, maxim state av
	Speed 12 knots	45 deg	+/- 5 deg	√	√	Dur trials, maxim state av
	Speed 5 knots	90 deg	+/- 5 deg	√	√	Dur trials, maxim state av
	Speed 8 knots	90 deg	+/- 5 deg	√	√	Dur trials, maxim state av
	Speed 12 knots	90 deg	+/- 5 deg	√	√	Dur trials, maxim state av
	Speed 5 knots	135 deg	+/- 5 deg	√	√	Dur trials, maxim state av
	Speed 8 knots	135 deg	+/- 5 deg	√	√	Dur

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							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

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	<b>DKT = +/- 0.25m</b>						
	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	√	√	
<b>13</b>	<b>Turn manoeuvres</b> <b>Depth: 100 m</b> <b>Turn angle: 90 deg</b> <b>Speed: 5 knots</b>	<b>Time</b> <b>To achieve</b> <b>manoeuvres</b>	<b>Manoeuvre Time</b> <b>Tolerance</b> <b>RMS</b>		<b>SS</b>	<b>PSM</b>	<b>S</b>
	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%		√	√	
<b>14</b>	<b>Spiral Down</b> <b>Manoeuvre</b> <b>Depth: 100 m to 200 m</b> <b>Pitch angle:</b> <b>Contractor to</b> <b>recommend</b>	<b>Minimum</b> <b>number of</b> <b>spirals</b>	<b>Depth</b> <b>Tolerance</b> <b>RMS</b>		<b>SS</b>	<b>PSM</b>	<b>S</b>
	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.

#### 4.1.14.7.2 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. 1<sup>st</sup> level maintenance: to be provided on board the submarine using AS built in test diagnostics, its own personnel and materiel resources; and
2. 2<sup>nd</sup> 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 2<sup>nd</sup> or 3<sup>rd</sup> 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 2<sup>nd</sup> level capabilities for resolution by 3<sup>rd</sup> 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 1<sup>st</sup> level maintenance, The AS Contractor shall design, develop, test and deliver the Special Purpose Tools and Test Equipment (SPTATE) for the 2<sup>nd</sup> level maintenance and shall clearly identify any COTS Test Equipment (CTE) that shall be required to support the 2<sup>nd</sup> level maintenance for both on board the submarine and alongside in harbour.

##### 4.9.6.1 Built In Diagnostics for the 1<sup>st</sup> 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 2<sup>nd</sup> 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 2<sup>nd</sup> 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 1<sup>st</sup> and 2<sup>nd</sup> 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 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?		
<input checked="" type="checkbox"/> No / Non <input type="checkbox"/> 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?		
<input type="checkbox"/> No / Non <input checked="" type="checkbox"/> 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? (Specify the level of access using the chart in Question 7. c) (Le fournisseur ainsi que les employés auront-ils accès à des renseignements ou à des biens PROTÉGÉS et/ou CLASSIFIÉS?)		
<input type="checkbox"/> No / Non <input checked="" type="checkbox"/> 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.)		
<input checked="" type="checkbox"/> No / Non <input type="checkbox"/> 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?		
<input checked="" type="checkbox"/> No / Non <input type="checkbox"/> 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 <input checked="" type="checkbox"/>	NATO / OTAN <input type="checkbox"/>	Foreign / Étranger <input type="checkbox"/>
7. b) Release restrictions / Restrictions relatives à la diffusion		
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
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Not releasable À ne pas diffuser		
<input type="checkbox"/>		
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:
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. c) Level of information / Niveau d'information		
PROTECTED A PROTÉGÉ A	NATO UNCLASSIFIED NATO NON CLASSIFIÉ	PROTECTED A PROTÉGÉ A
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PROTECTED B PROTÉGÉ B	NATO RESTRICTED NATO DIFFUSION RESTREINTE	PROTECTED B PROTÉGÉ B
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PROTECTED C PROTÉGÉ C	NATO CONFIDENTIAL NATO CONFIDENTIEL	PROTECTED C PROTÉGÉ C
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CONFIDENTIAL CONFIDENTIEL	NATO SECRET NATO SECRET	CONFIDENTIAL CONFIDENTIEL
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SECRET SECRET	COSMIC TOP SECRET COSMIC TRÈS SECRET	SECRET SECRET
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
TOP SECRET TRÈS SECRET		TOP SECRET TRÈS SECRET
<input type="checkbox"/>		<input type="checkbox"/>
TOP SECRET (SIGINT) TRÈS SECRET (SIGINT)		TOP SECRET (SIGINT) TRÈS SECRET (SIGINT)
<input type="checkbox"/>		<input type="checkbox"/>

TBS/SCT 350-103(2004/12)

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**PART 2 (continued) / PARTIE 2 (suite)**

8. Will the supplier require access to PROTECTED and/or CLASSIFIED COMSEC information or assets?

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 :

☒ No  
Non

☐ Yes  
Oui

9. Will the supplier require access to extremely sensitive INFOSEC information or assets?

Le fournisseur aura-t-il accès à des renseignements ou à des biens INFOSEC de nature extrêmement délicate?

☒ No  
Non

☐ Yes  
Oui

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 3 - PERSONNEL (SUPPLIER) / PARTIE 3 - 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?

Du personnel sans autorisation sécuritaire peut-il se voir confier des parties du travail?

☒ No  
Non

☐ Yes  
Oui

If Yes, will unscreened personnel be escorted?

Dans l'affirmative, le personnel en question sera-t-il escorté?

☒ No  
Non

☐ Yes  
Oui

**PART 4 - SAFEGUARDS (SUPPLIER) / PARTIE 4 - 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?

Le fournisseur sera-t-il tenu de recevoir et d'entreposer sur place des renseignements ou des biens PROTÉGÉS et/ou CLASSIFIÉS?

☐ No  
Non

☒ Yes  
Oui

11. b) Will the supplier be required to safeguard COMSEC information or assets?

Le fournisseur sera-t-il tenu de protéger des renseignements ou des biens COMSEC?

☒ No  
Non

☐ Yes  
Oui

**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?

Les installations du fournisseur serviront-elles à la production (fabrication et/ou réparation et/ou modification) de matériel PROTÉGÉ et/ou CLASSIFIÉ?

☐ No  
Non

☒ Yes  
Oui

**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?

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?

☐ No  
Non

☒ Yes  
Oui

11. e) Will there be an electronic link between the supplier's IT systems and the government department or agency?

Disposera-t-on d'un lien électronique entre le système informatique du fournisseur et celui du ministère ou de l'agence gouvernementale?

☒ No  
Non

☐ Yes  
Oui



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**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	COMSEC TOP SECRET COMSEC TRÈS SECRET	PROTECTED PROTÉGÉ	CONFIDENTIAL CONFIDENTIEL	SECRET	TOP SECRET TRÈS SECRET		
											A	B	C			
Information / Attributs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Production	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
IT Media / Support TI	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
IT Link / Lien électronique	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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, classifiez 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, classifiez le présent formulaire en indiquant le niveau de sécurité dans la case intitulée  
« Classification de sécurité » au haut et au bas du formulaire et indiquez qu'il y a des pièces jointes (p. ex. SECRET avec des pièces jointes).





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**PART D - AUTHORIZATION / PARTIE D - AUTORISATION**

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

Name (print) - Nom (en lettres moulées)  
Hans Pall

Title - Titre  
DMEPM(SM) 4-3-5

Signature  
*Hans R. Pall*

Telephone No. - N° de téléphone  
819 994 3727

Facsimile No. - N° de télécopieur  
819-994-9127

E-mail address - Adresse courriel  
pall.hr@forces.gc.ca

Date  
21 January 2011 21 Jan-11

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

Name (print) - Nom (en lettres moulées)

Title - Titre  
Sasha Medovic - DPM Secur 3  
Senior Security Analyst

Signature  
*Sasha Medovic*

Telephone No. - N° de téléphone

Facsimile No. - N° de télécopieur

E-mail address - Adresse courriel  
E-Mail: sasha.medovic@forces.gc.ca

Date  
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)

*GERARD CLEMENT*  
*Gerard Clement*

Title - Titre  
MANAGER

Signature  
*Gerard Clement*

Telephone No. - N° de téléphone  
819-966-6233

Facsimile No. - N° de télécopieur  
819-966-0877

E-mail address - Adresse courriel  
GERARD.CLEMENT@

Date  
July 23, 2012

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

Name (print) - Nom (en lettres moulées)

Sherry Campbell  
Contract Security Officer, Contract Security Division

Signature  
*Sherry Campbell*

Telephone No. - N° de téléphone

Facsimile No. - N° de télécopieur

E-mail address - Adresse courriel  
Sherry.Campbell@psc-pwsc.gc.ca

Date  
July 31, 2012