Public Works and Government Services Canada | Travaux publics et Services gouvernementaux Canada

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Place du Portage , Phase III
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Québec
K1A 0S5
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LETTER OF INTEREST
LETTRE D'INTÉRÊT

Comments - Commentaires
THIS DOCUMENT CONTAINS A SECURITY REQUIREMENT.

Issuing Office - Bureau de distribution
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K1A 0S5

Title - Sujet LOI - RAM SERVO UNITS	
Solicitation No. - N° de l'invitation W8482-178553/A	**Date** 2016-09-21
Client Reference No. - N° de référence du client W8482-178553	**GETS Ref. No. - N° de réf. de SEAG** PW-$$ML-034-25984
File No. - N° de dossier 034ml.W8482-178553	**CCC No./N° CCC - FMS No./N° VME**
Solicitation Closes - L'invitation prend fin at - à 02:00 PM on - le 2016-11-14	**Time Zone** **Fuseau horaire** Eastern Daylight Saving Time EDT
F.O.B. - F.A.B. **Plant-Usine:** ☐ **Destination:** ☑ **Other-Autre:** ☐	
Address Enquiries to: - Adresser toutes questions à: Clement, Gérard	**Buyer Id - Id de l'acheteur** 034ml
Telephone No. - N° de téléphone (819) 420-2905 ( )	**FAX No. - N° de FAX** (819) 956-0897
Destination - of Goods, Services, and Construction: **Destination - des biens, services et construction:** Specified Herein Précisé dans les présentes	

Instructions: See Herein

Instructions: Voir aux présentes

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

Canada

Please note that this is not a solicitation and no contract will result from this Letter of Interest – Pre-Qualification.

Letter of Interest (LOI) - Pre-Qualification

For the

Replacement of the Ram Servo Units

On the

Victoria Class Submarines

For Department of National Defence (DND)

Purpose

The purpose of this Letter of Interest (LOI) - Pre-Qualification is to determine Industry's interest and to qualify suppliers for the replacement of the Ram Servo Units (RSUs), three (3) per submarine, which are specialized servo valves, fitted onboard the four (4) VICTORIA Class Submarines (VCS); SSK 876 VICTORIA, SSK 878 CORNER BROOK and SSK 879 CHICOUTIMI which are docked in Esquimalt, BC, and SSK 877 WINDSOR which is docked in Halifax, NS. The replacement of the RSUs shall be accomplished by customization of Commercial Off The Shelf (COTS) or by design, integration, design qualification test, installation, set to work (STW), training, integrated logistics support (ILS) and documentation.

The Work described in this Letter of Interest (LOI) - Pre-Qualification 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. First Level systems are safety critical and therefore require high levels of reliability and redundancy, as expanded in this Letter of Interest (LOI) - Pre-Qualification. Manufacture, repair, overhaul, installation, inspection and tests for each such item identified in the requirement must be documented IAW the requirements of the above mentioned CFTO.

The attached Statement of Works (SOWs) at Annex 'A' details the replacement of the RSUs.

Requested Information, Interested Supplier's Capability and Qualification

The interested Supplier must demonstrate to Canada's satisfaction that they meet the following mandatory evaluation criteria in order to qualify for Phase II, Request for Proposal (RFP):

1. **Experience:**

   In a submarine environment, the interested Supplier must have been the prime contractor, have designed and delivered within the last five (5) years, at least one (1) system in similar complexity and function to the existing Victoria Class Submarine Ram Servo Units.

   The interested Supplier must provide a detailed description and function of the project in a document which clearly outlines and demonstrates the functionalities of the system delivered including but not limited to, a full description of the system, components supplied and interaction with other systems.

   The interested Supplier must provide the project name, client name, contract value and date delivered.

2. **Capability:**

   The interested Supplier must demonstrate to Canada's satisfaction that they have the capability in system design, manufacturing, system integration, installation and set-to-work for RSU.

3. **Proposed RSU Replacement:**

   Interested Suppliers are to review the attached SOW in relation to their proposed RSU and the following issues shall be addressed:

   - System design;
   - Proposed components;

- Compatibility and interface requirements with existing field devices and external systems: and
- Deliverables as identified in Section 2 of the SOW.

4. Quality Assurance:

In the performance of the Work described herein, interested Suppliers shall comply with the requirements of:

- ISO 9001-2000 – Quality Management Systems – Requirements, published by the International Organization for Standardization (ISO), current edition at closing date of LOI; and

- It is not the intent to require that the interested Supplier be registered to the applicable standard; however, interested Supplier's quality management system must address each requirement contained in the standard.

5. Rough Order of Magnitude (ROM) Price:

- Provide a Rough Order of Magnitude price estimate in Canadian currency; and

- Provide a breakdown of the price structure per RSU as well as spare parts, special purpose tools and test equipment (SPTATE), Engineering Change (EC) development, FAT, etc.

6. Security Requirements:

The Supplier must meet the following security conditions: and demonstrate their compliance by providing the requested information.

- The Contractor must, at all times during the performance of the Contract, hold a valid Facility Security Clearance (FSC) at the level of **SECRET** with approved Document Safeguarding **and** Production Capabilities at the level of **PROTECTED A** issued by the Canadian Industrial Security Directorate (CISD), Public Works and Government Services Canada (PWGSC).

- 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.

- 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 **PROTECTED A**.

- Subcontracts, which contain security requirements, are **NOT** to be awarded without the prior written permission of CISD/PWGSC.

- The Contractor must comply with the provisions of the:

  a) Security Requirements Check List, attached at Annex B;

  b) Industrial Security Manual (Latest Edition).

7. **Controlled Goods Registration:**

   The Supplier must be registered with the Controlled Goods Program of PWGSC or if a foreign supplier, registered in an approved program recognized by Canada.

   The Supplier must provide proof of registration.

Communications

All communications during this requirement period shall be directed to Gérard Clément Contracting Authority, via email at Gerard.clement@pwgsc.gc.ca to ensure fair and transparent treatment of all Interested Suppliers.

Submission of Responses

Companies must submit their written response to this Letter of Interest (LOI) - Pre-Qualification directly to:

Public Works and Government Services Canada
Marine Systems, ML Division
Place du Portage, Phase III, 6C2
11 Laurier Street
Gatineau, Québec K1A 0S5
Attention: Gérard Clément
Email: Gerard.clement@pwgsc.gc.ca
Phone: (819) 420-2905
Fax: (819) 956-0897

The written response shall be submitted in the quantities specified below:

Volume	Title	Hard Copy Quantity per Item
1	**Technical: - Capability and Qualification:** - Item 1: Experience - Item 2: Capability - Item 3: Proposed RSU Replacement - Item 4: Quality Assurance	**3**
2	**Financial, Security and Controlled Goods Registration:** - Item 5: Rough Order of Magnitude Pricing - Item 6: Security Requirements - Item 7: Controlled Goods Requirements	**1**

Evaluation of Interested Supplier's Deliverables

It is the sole responsibility of interested Supplier to provide sufficient information to adequately assess its Deliverables. Only interested Suppliers who provided information to Canada's satisfaction will receive the Bid Package for Phase II (RFP).

Interested Supplier must comply with the requirements of this Letter of Interest (LOI) - Pre-Qualification and meet all mandatory evaluation criteria to be declared responsive.

Following the response of the interested Supplier, Canada may request clarification and/or demonstration of the proposed system.

Should an interested Supplier be of the opinion that some issues are not addressed above, that interested Supplier is encouraged to provide additional information. This information may be used during Phase II (RFP) of the project.

Any and all expenses incurred by a potential supplier in pursuing this opportunity including the provision of information, clarification, presentation to Canada and any visits are at the supplier's sole risk and expense.

Letter Of Interest

Statement of Work

For The

Ram Servo Units

For the

VICTORIA Class Submarines

NOTICE

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

AVIS

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

LIST OF EFFECTIVE PAGES

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

NOTE

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

Dates of issue for original and changed pages are:

Original …0…02 August 2016
Change

A zero in Change No. column indicates an original page. The Total number of pages in this SOW is 46 consisting of the following:

Page No.	Change No.
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1 Scope

1.1 Purpose

This Letter Of Interest (LOI) Statement of Work (SOW) defines some of the work and technical performance requirements for the replacement of the Ram Servo Units (RSUs), which are specialized servo valves, on the four (4) VICTORIA Class Submarines (VCS); SSK 876 VICTORIA, SSK 878 CORNER BROOK and SSK 879 CHICOUTIMI which are docked in Esquimalt, BC, and SSK 877 WINDSOR which is docked in Halifax, NS. The replacement of the RSUs shall be accomplished by customization of Commercial Off The Shelf (COTS) or by design, as well as integration, design qualification test, installation, set to work (STW), training, integrated logistics support (ILS) and documentation.

The Work described in this LOI 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*. First Level systems are safety critical and therefore require high levels of reliability and redundancy, as expanded in this LOI. Manufacture, repair, overhaul, installation, inspection and tests for each such item identified in the requirement must be documented IAW the requirements of the above mentioned CFTO.

1.2 RSU Functionality

The VCS are each fitted with three (3) different RSUs, originally designed and manufactured by Ferranti Instrumentation Limited, to operate the Forward Hydroplane, After Hydroplane and Rudder control surfaces. The RSUs have common functionality, as described in the following paragraph, but each RSU also has its own unique capabilities to meet the requirements of its respective control surface.

Each RSU is fed with control signals from the autopilot or manual stickwheel via its own Electronic Enclosure (EE), as shown in Figures 4 and 5. The EEs and all Port and Starboard Hydroplane interfaces aren't part of the requirement, only the RSUs. Each EE in turn drives a torque motor/tacho generator unit within the RSUs which controls a hydraulic spool valve. The valve controls the flow of hydraulic oil to and from a ram cylinder which provides the correct degree of movement to the control surfaces. A tachometer sensor is built into the torque motor to provide feedback for servo damping, and a mechanical linkage interfaces with the RSUs and the operating ram to provide an additional feedback mechanism. This applies to all RSUs but they each have their own capabilities as follows.

1.2.1 Forward Hydroplane RSU

The forward hydroplane RSU is connected to the forward hydroplane tilting cylinder and has regular RSU functionality with the addition of a centring capability. The centring capability automatically drives the hydroplanes to midship

(0°) when selected. The forward hydroplane tilting cylinder is supplied with hydraulic oil from the Main Hydraulic System (MH).

1.2.2 After Hydroplane RSU

The after hydroplane RSU is connected to the after hydroplane hydraulic and air cylinders, allowing for regular operation using hydraulic oil and emergency operations using High Pressure (HP) air. Both hydraulic and air cylinders are connected to the same rod that controls the after hydroplanes, but only one (1) cylinder can be powered at a time. The after hydroplane hydraulic cylinder is supplied with oil by the dedicated Hydroplane & Steering Hydraulic System (H&S). The after hydroplane air cylinder is supplied by the HP Air system.

1.2.3 Rudder RSU

The rudder RSU is connected to the rudder hydraulic cylinder allowing regular RSU functionality in addition of an emergency rate control. In case of emergency or loss of regular controls, the rudder RSU can be switched to rate control which allows manual control without feedback of the rudder hydraulic cylinder. The Rudder Hydraulic Cylinder is supplied by oil from the H&S for regular controls and by the MH for rate control.

1.3 Objectives of the RSUs Replacements

The fundamental objectives of the RSUs replacement systems are to:

1. Sustain the existing functions of the RSUs by replacing the existing RSUs and all components contained therein with modern, fully supportable technology within the same space envelopes currently occupied by the existing RSUs;

2. Design the new RSUs so as to retain the existing mounting arrangements, and retain the existing hydraulic, air, electric connectors, and mechanical feedback linkage; and

3. Meet First Level Material requirements as defined in *Canadian Forces Technical Order (CFTO) C-23-VIC-000/AM-001, Quality Assurance for Safety in Submarines VICTORIA Class*.

1.4 Acronyms and Abbreviations

For acronyms and abbreviations refer to section 8.

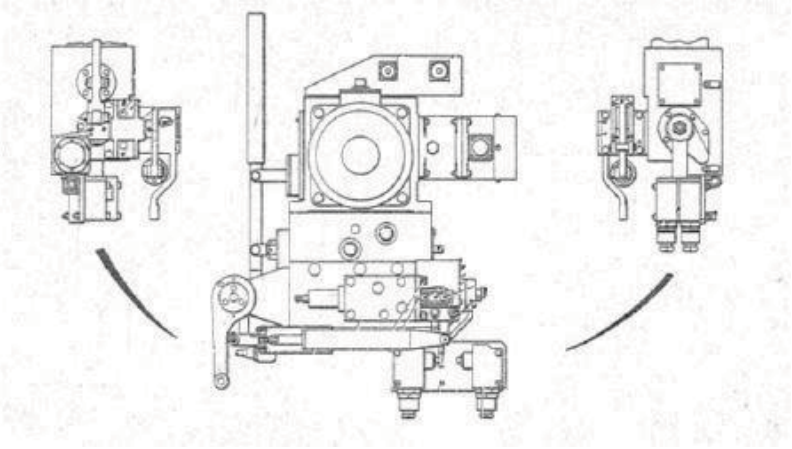

Figure 1: Forward Hydroplane RSU General Arrangement

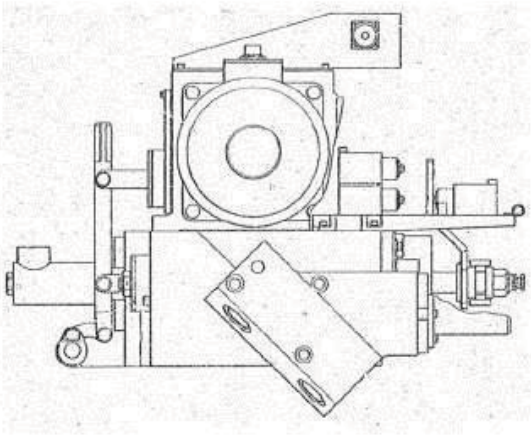

Figure 2: After Hydroplane RSU General Arrangement Front View

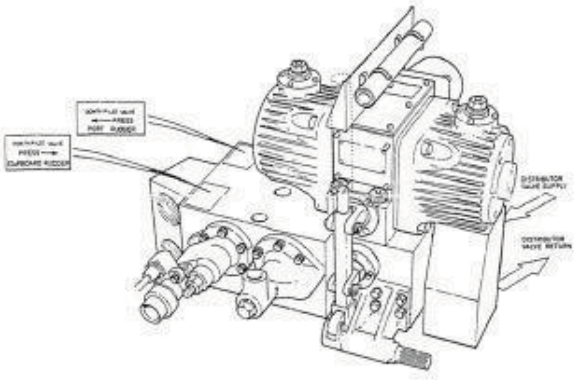

Figure 3: Rudder RSU General Arrangement

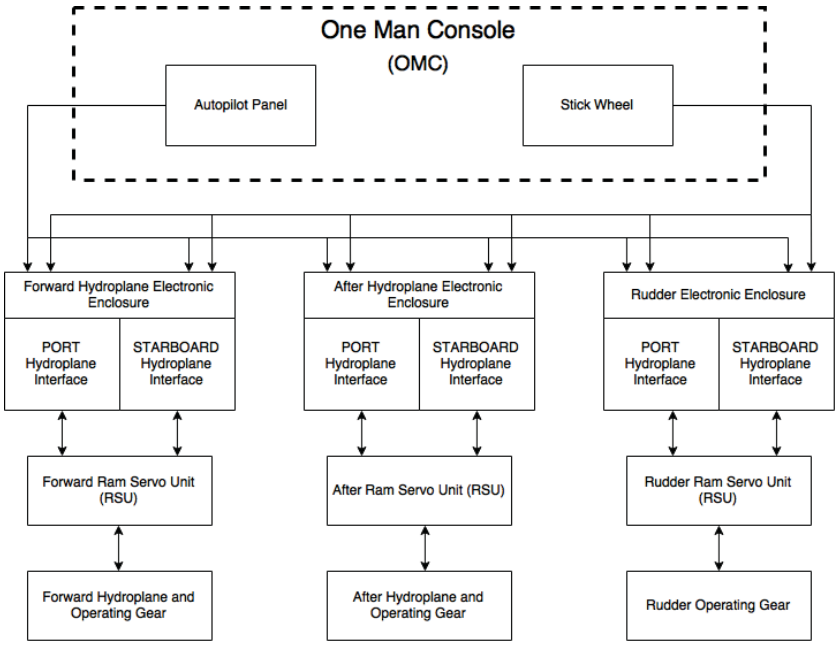

Figure 4: Block Diagram of Hydroplane Control System

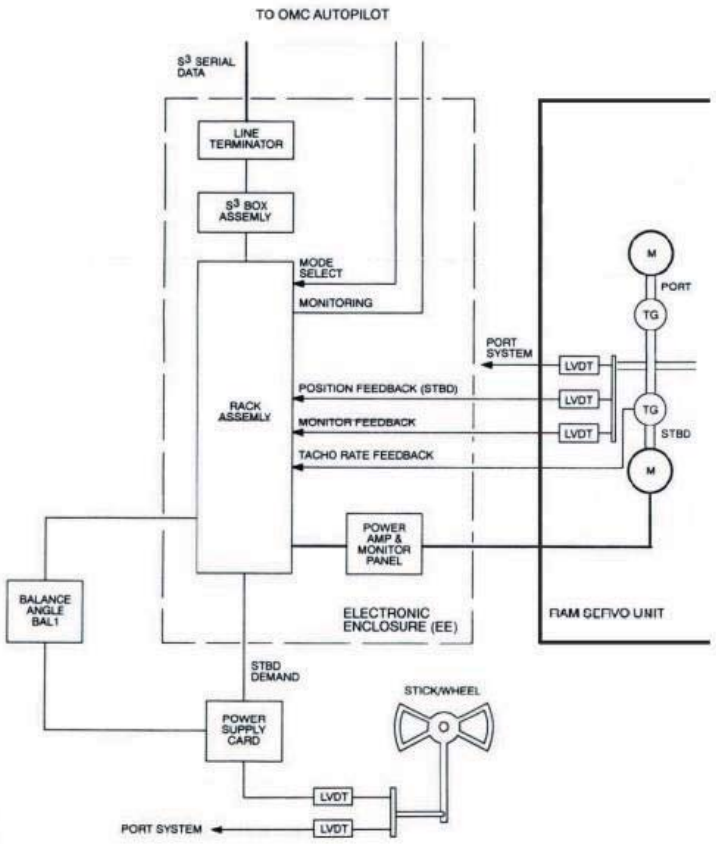

Figure 5: Electronic Enclosure System Diagram

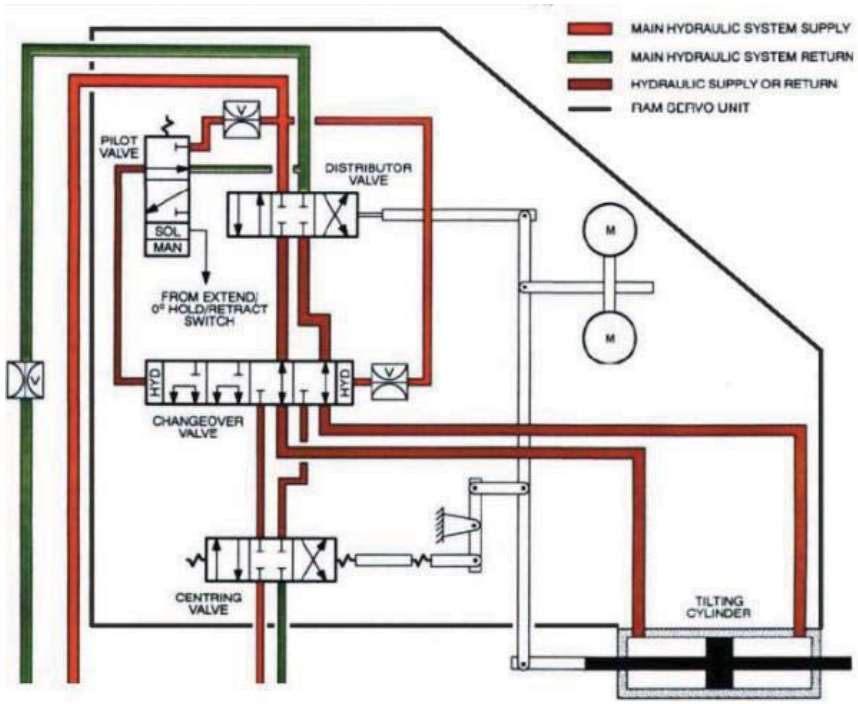

Figure 6: Forward RSU System Diagram

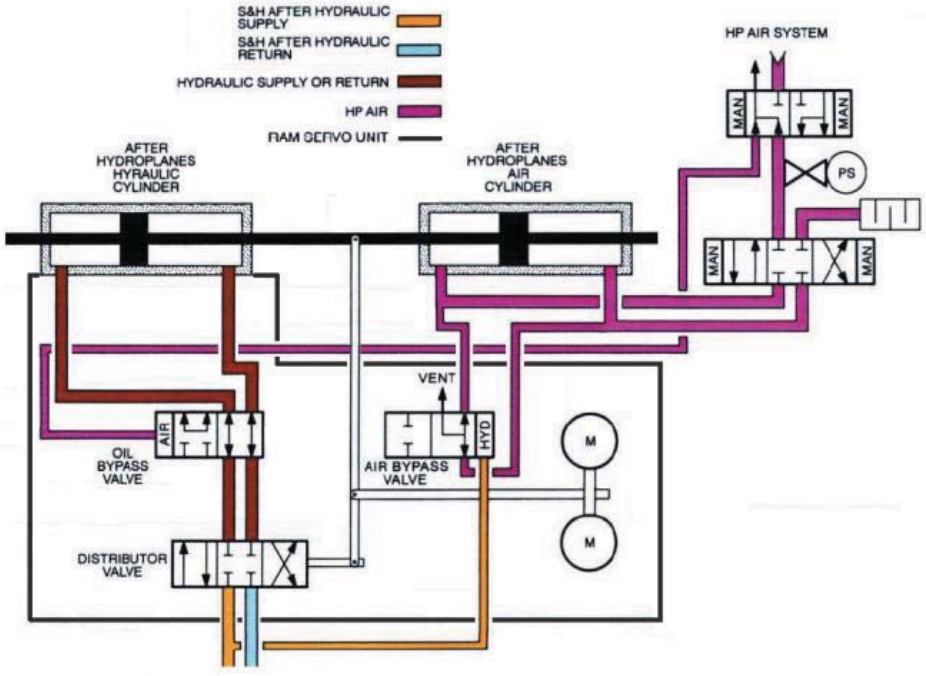

Figure 7: After RSU System Diagram

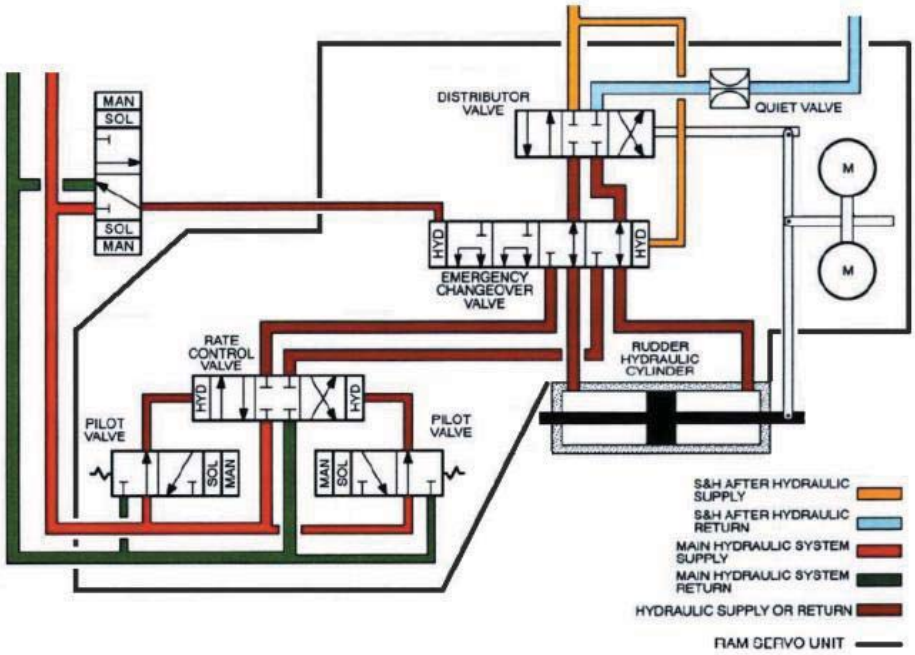

Figure 8: Rudder RSU System Diagram

2 Deliverables

The Contractor shall produce and deliver four (4) sets of RSUs for the VCS IAW Table 1, one (1) set of Special Purpose Tools and Test equipment IAW Table 2, one (1) set of documentation IAW Table 3 and one (1) set of spares line replaceable components IAW Table 4 one (1) set of environmentally tested RSUs for the Fleet Training School IAW Table 5.

Table 1: List of RSUs per Submarine Set

Equipment Name	Qty
After Hydroplane RSU	1
Forward Hydroplane RSU	1
Rudder RSU	1

Table 2: List of RSU Special Purpose Tools and Test Equipment Set

Equipment Name	Qty	Comments
Complete Special Purpose Tools And Test Equipment (SPTATE) Set	3	One (1) complete set required for 1st and 2nd line maintenance for Fleet Training Schools Two (2) complete sets required for 1st and 2nd line maintenance for Fleet Maintenance Facilities (FMFs) (Equipment to be defined, designed, developed and tested by the Contractor). 1st line maintenance is defined as maintenance normally performed under the authority and sponsorship of the ship's Engineering department and performed by shipboard naval technicians. 2nd line maintenance is defined as maintenance normally performed under the authority and sponsorship of the FMF and achieved through FMF.

1st Line Maintenance SPTATE Set	4	Four sets, one set per ship, required for 1st level maintenance (Equipment to be defined, designed, developed and tested by the Contractor).

Table 3: List of RSU Documentation Set

Installation Support	Qty	Comments
Design documents	1 1 1 1 1 1	A complete set of documents required for the: System Requirements review; Preliminary Design Review; Critical Design review; Design Qualification testing; Factory acceptance Testing; and Set To Work Testing. **NOTE:** All of the above documentation shall be in MS Word 2003 and PDF.
Design Qualification Report	1	In MS Word 2003 and PDF
Mechanical Design Drawings	1	In PDF
Hardware Design Document, Software Design Document, Operator manual and Maintenance Manual	1	These documents shall be in DND CFTO format and in MS Word 2003 and PDF
Electrical schematics of Contractor's and the COTS' designs	1	Electrical schematics of all COTS' designs
Signal Interface Database	1	In MS Excel 2003 spreadsheet
Engineering Change (EC) Package	1	A baseline EC for the submarine
Particularized ECs	4	Four (4) particularized ECs (one (1) for each submarine)

Table 4: List of RSU Spares Line Replaceable Units (LRUs)

Maintenance Support	Qty	Comments
FWD Hydroplane RSU	2	Complete units
AFT Hydroplane RSU	2	Complete units
Rudder RSU	2	Complete units

Spares for 1st and 2nd level maintenance support	2	Spares Component types and quantities set for each coast (two (2) coasts) shall be proposed by the Contractor and approved by Technical Authority (TA) based on the Mean Time Between Failures (MBTF) report for each of the Line Replaceable Units (LRUs) to support the 1st and 2nd line maintenance in the FMFs for five (5) years. **NOTE:** The calculations for determining the quantity of spares of each type per submarine shall be: = (Number of components of each type used) * 1.0 (duty Cycle) * ((24*365*5) (number of hours for five years))/MTBF.
On board submarine spares for 1st level maintenance support	4	Spares Component types and quantities set for each submarine (four (4) submarines total) shall be proposed by the Contractor and approved by TA based on the MBTF report for each of the LRUs to support the 1st line maintenance on board the submarine for five (5) years.

Table 5: List of Environmentally Tested RSUs for Training Aids

Equipment Name	Qty	Comments
After Hydroplane RSU	1	One (1) complete environmentally tested unit, refurbished if required
Forward Hydroplane RSU	1	One (1) complete environmentally tested unit, refurbished if required
Rudder RSU	1	One (1) complete environmentally tested unit, refurbished if required

3 Project Management

The Contractor shall implement a Project Management Plan to identifying how to fulfill the project management requirements of this LOI SOW.

3.1 Project Management Plans

The Contractor shall prepare and deliver Project Management Plans IAW industry standards, including the 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, Software Development Plan, a Factory Acceptance Test (FAT) Plan, Set To Work (STW) Plan, Harbour Acceptance Trial (HAT) Plan, Sea Acceptance Trials (SAT) Plan, Cadre Training and a Quality Assurance (QA) Plan.

3.2 Project Meetings

The Contractor shall conduct the project meetings including project kick off, systems requirements review, project design reviews, test and trials and final project closure meetings. The Contractor shall be responsible for preparing the meeting agendas and writing the meeting minutes.

4 Engineering

4.1 General

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

4.2 Engineering Reviews and Audits

The Contractor shall conduct engineering reviews and these shall include System Requirements Review, Preliminary Design Review, Critical Design Review, Functional Configuration Review, Physical Configuration Audit, FAT, STW, HAT, and SAT plans review.

4.3 Design Qualification

4.3.1 General

The Contractor shall provide documentary evidence that the RSUs meet all the requirements of the LOI SOW. The Design Qualification may be done by analysis or testing, to be approved by TA.

4.3.2 RSUs Acceptance Testing

The Contractor shall conduct the RSUs design verification and validation tests as per section 7.5.

4.3.3 Software

The existing RSUs design doesn't use software and it is not required for the replacement RSUs. However, software may be used for the design of the new RSUs but if so, thorough explanation of value added must presented for review and approved by TA.

5 Integrated Logistics and Support

5.1 General

The Contractor shall establish, implement and control an ILS Program for the RSUs. The Contractor ILS activities shall form an integral part of all RSUs planning, development, design, production, design qualification test, installation, and STW efforts associated with this LOI SOW.

5.2 Maintenance of the RSUs

The Contractor shall provide a maintenance concept describing how the RSUs 1st and 2nd line maintenance (see Table 2) can be supported in service and provide all the special purpose tools and test equipment required to conduct first and second level maintenance.

The RSUs equipment maintenance philosophy consists of the following:

1. In-service maintenance (1st and 2nd line maintenance): to be provided on board the submarine or at the Fleet Maintenance Facilities (FMFs) using built in diagnostics, with all repairs done locally and individual components easily accessible through modular design, limited to minor defects (unit functional with reduced efficiency e.g. leaks);

2. Major equipment failure: the repair and overhaul will be done by replacing the RSU and the replaced RSU will be sent to the Original Equipment Supplier (OEM); and

3. Extended Docking Work Period (EDWP) Maintenance: during scheduled submarine EDWP, the RSU will be sent to the OEM for scheduled repair and overhaul.

5.3 Initial Cadre Training

The Initial Cadre Training shall include two (2) sets of training sessions with all the necessary training documentation for twelve (12) students in each training sessions. The training shall include but will not be limited to the assembly/disassembly of the RSUs. The training shall be conducted in English at the CFNOS submarine division in Halifax.

5.4 Documentation

The Contractor shall provide a complete set of design and training documentation including maintenance and user manuals IAW DND format and Contract Deliverable Requirements List (CDRLs) and Data Item Descriptions (DIDs) (to be supplied in the Request For Proposal (RFP) phase) and in source format. The documentation shall include Engineering Changes (EC) for the submarines.

6 Current RSUs Design

6.1 General

Each RSU is fed with control signals from the autopilot or manual stickwheel, located on the One Man Console (OMC), via the Electronic Enclosure (EE), as shown in Figure 4. The EE in turn drives a torque motor/tacho generator unit within the RSU which controls a hydraulic spool valve. The spool valve controls the hydraulic flow to and from the ram cylinders, and the force developed in the ram cylinders in turn operates the linkages that actuate the control surfaces. A tachometer sensor is built into the torque motor to provide feedback for servo damping, and a mechanical linkage interfaces with the RSU and the operating ram to provide an additional feedback mechanism.

For each RSU, a positional feedback loop from the RSU is provided to the EE. The RSUs are controlled by one (1) of two (2) independent supplies from the EE, Port channel Grade 1 (battery backup), 24V DC and Starboard (Stbd) channel Grade 2 (no battery backup), 24V DC. Only one (1) supply is selected, from the OMC, at a time while the other is in standby mode. Each RSU has a method for manual (local) override in the event of electrical failure. The manual override is capable of actuating the control surfaces via the hydraulic circuit.

Both the Main Hydraulic System (MH) and the Hydroplanes and Steering Hydraulic System (H&S) are powered by dedicated three (3) stage internal gear pump with a rated output of 70 litres per minute at 207 bar and an oil temperature of 38°C.

Figure 9: One Man Console and Stickwheel

6.1.1 Forward Hydroplane RSU

The current forward hydroplane RSU is procured under NATO Stock Number (NSN) #2030-99-723-2060; assemblies and sub-assemblies are identified in the Hydroplanes and rudder Controls Illustrated Parts Catalogue (IPC) FER-2. The general arrangement is shown in Figure 1, a section view is show in Figure 10, and the system diagram is show in Figure 11.

The forward hydroplanes RSU incorporates the ability to center the hydroplanes. The centring capability automatically drives the hydroplanes to midship (0°) when selected. This is achieved with the use of a changeover valve that switches the RSU output flow from the distributor valve to the centring valve, which in turn functions through a mechanical feedback mechanism. This centering control is operated at the One Man Console (OMC) and can also be operated locally at the RSU. In the event of loss of electrical supply a manual override facility is provided to enable centering of the hydroplanes.

6.1.2 After Hydroplane RSU

The current after hydroplane RSU is procured under NSN #2030-99-723-2071; assemblies and sub-assemblies are identified in the Hydroplane and Rudder Controls IPC FER-2. The general arrangement is shown in Figure 2, a section view is show in Figure 12, and the system diagram is show in Figure 13.

The after hydroplane RSU incorporates the facility to allow air operation of the after hydroplanes by High Pressure (HP) Air in the event of emergency or loss of hydraulics. Air Emergency operation is achieved by the use of an air ram cylinder connected to the hydraulic ram. Both ram cylinders function independently, but only one (1) can function at a time. This is achieved through two (2) bypass valves where only one (1) can be opened at a time.

6.1.3 Rudder RSU

The current rudder RSU is procured under NSN #2030-99-723-2082; assemblies and sub-assemblies are identified in the Hydroplanes and rudder IPC FER-2. The general arrangement is shown in Figure 3, a section view is show in Figure 14 and the system diagram is show in Figure 15.

In the event of electrical control failure or loss of regular controls, the rudder RSU incorporates the facility to operate the RSU in hydraulic rate control. Rate control means the rudder angular position can be controlled without feedback, which can be controlled at the OMC or locally. This is accomplished by a changeover valve which switches the control to a rate control valve, in turn operated by two (2) pilot valves.

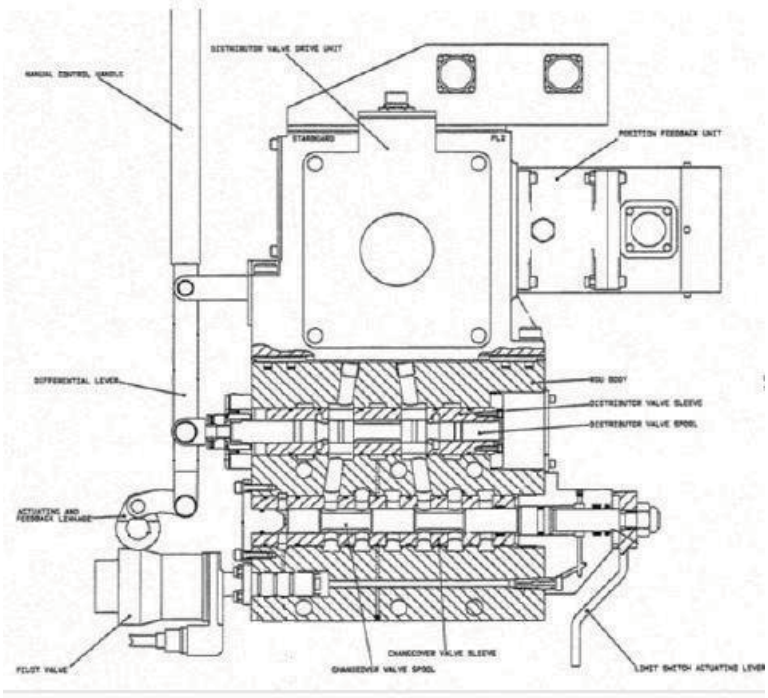

Figure 10: Forward Hydroplane RSU Section View

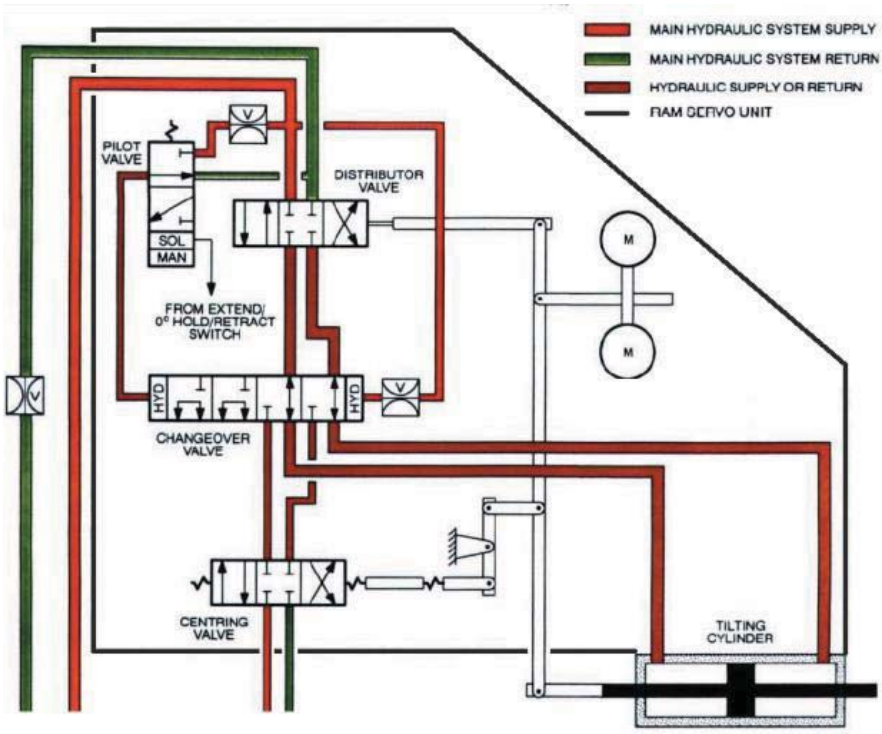

Figure 11: Forward Hydroplane RSU Schematic

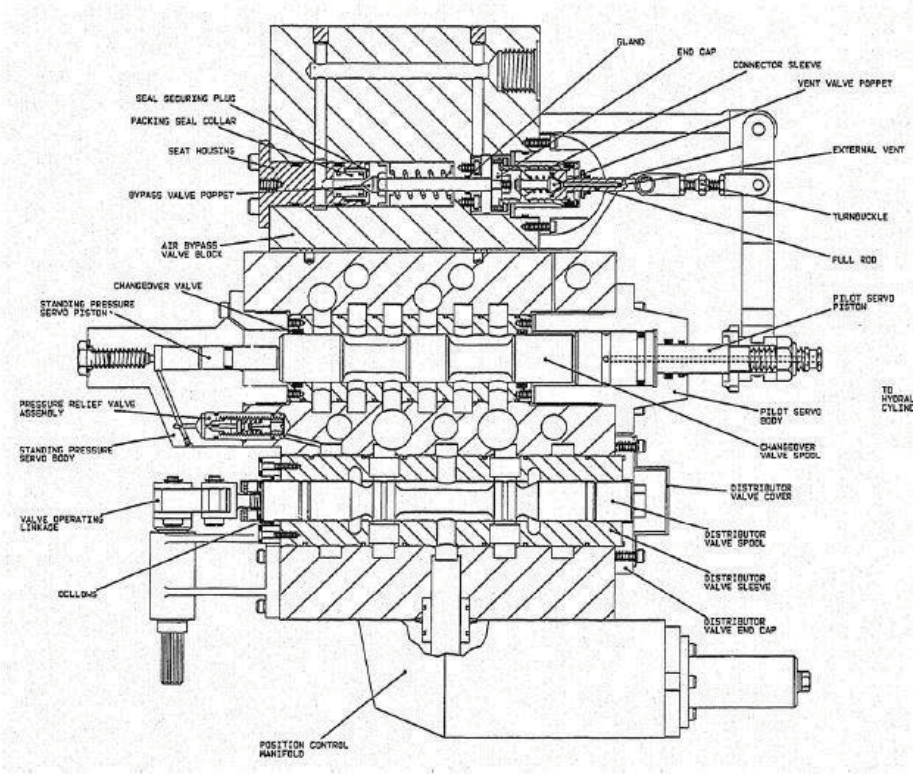

Figure 12: After Hydroplane RSU Section View

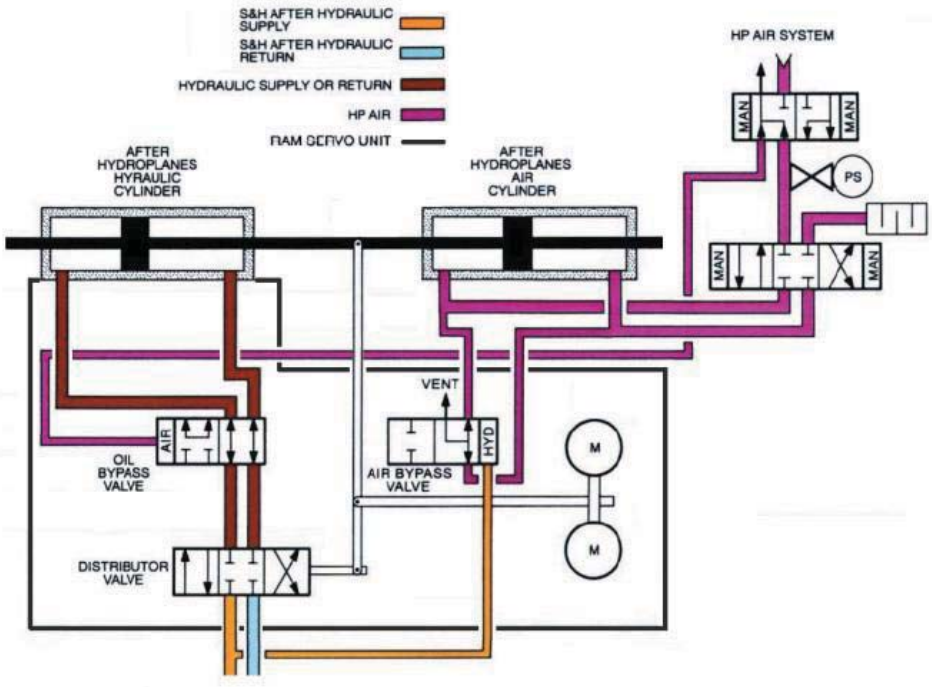

Figure 13: After Hydroplane RSU Schematic

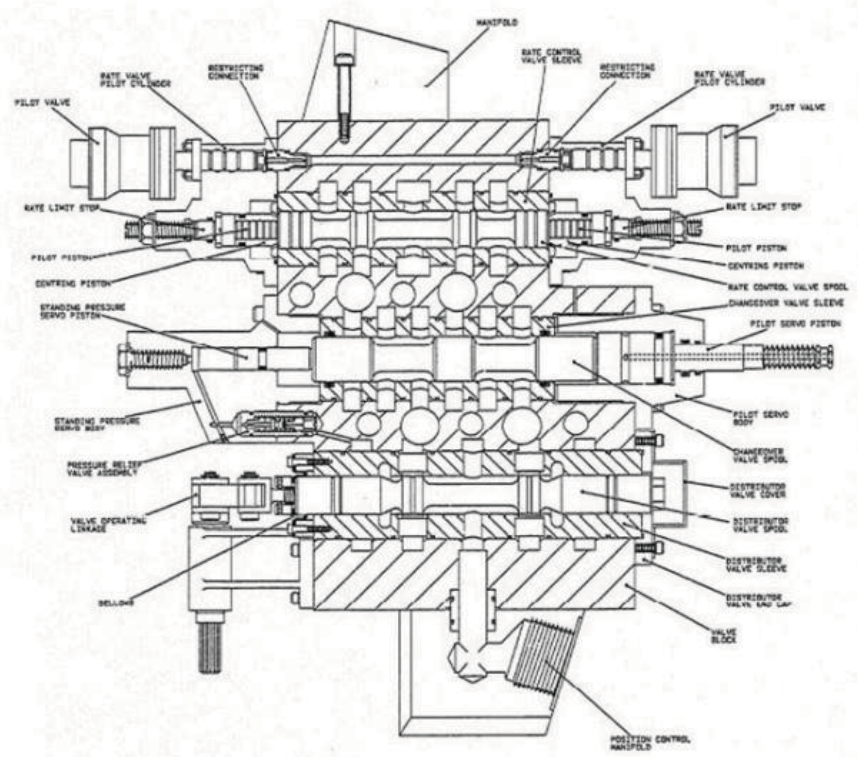

Figure 14: Rudder RSU Section View

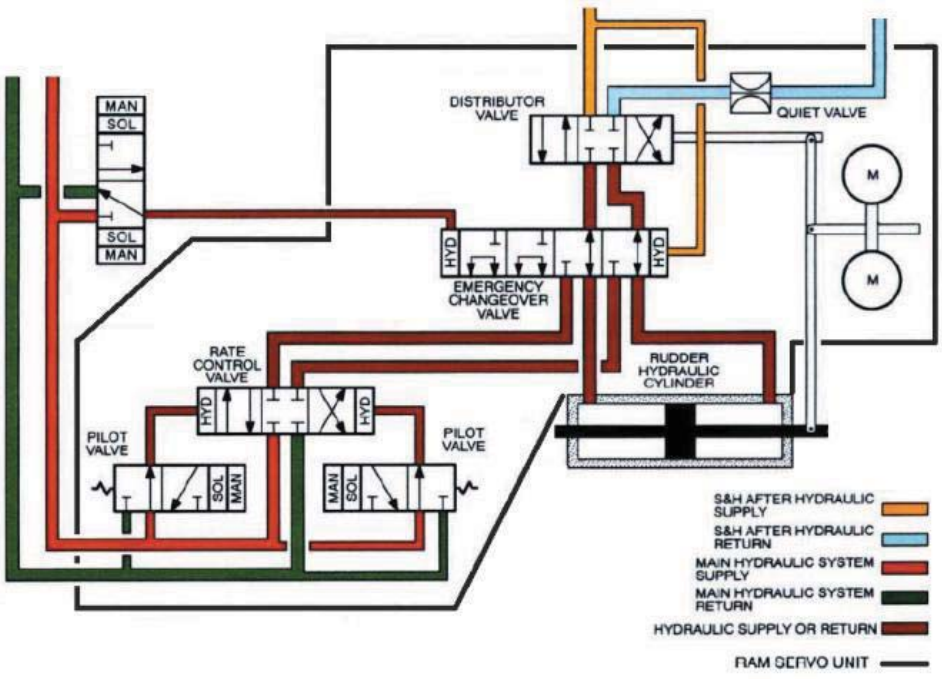

Figure 15: Rudder RSU Schematic

6.2 Operational Characteristics of Control Surfaces

6.2.1 Forward Hydroplane

The forward hydroplanes are capable of tilting and being held at any angle up to ±20 deg from neutral angle, within a range of hydraulic working pressure of 176-207 bar at speeds up to 15 knots submerged or surfaced.

The forward hydroplanes are capable of going hard over (i.e. through 40 deg) in, but not more than, 10 seconds with the submarine at rest, with the hydraulic working pressure in the range of 176-207 bar.

6.2.2 After Hydroplane

The after hydroplanes are capable of tilting and being held at any angle up to ±25 deg, within a range of hydraulic working pressure of 176-207 bar at speeds up to 15 knots submerged or surfaced. The emergency air cylinder is equally capable of moving, stopping and holding the hydroplanes at any angle within the range of motion (±25 deg), and within a working pressure range of 207-280 bar, at speeds up to 15 knots submerged or surfaced.

The after hydroplanes are capable of going hard over (i.e. through 50 deg) in, but not more than, 5 seconds for all submarine speeds, attitudes and through various manoeuvers with the hydraulic working pressure in the range of 176-207 bar, and with the air pressure in the range of 207-280 bar.

6.2.3 Rudder

The Rudder is capable of tilting and being held at any angle up to ±35 deg from neutral angle, within a range of hydraulic working pressure of 176-207 bar at speeds up to 15 knots submerged or surfaced.

The Rudder is capable of going hard over (i.e. through 70 deg) in, but not more than, 10 seconds with the submarine at rest, with the hydraulic working pressure in the range of 176-207 bar.

6.3 RSUs Design

6.3.1 Distributor Valve Drive Unit (DVDU)

The DVDU converts the electrical signal position ordered by the autopilot or stickwheel into a proportional mechanical displacement of the distributor valve. The DVDU comprises the following components:

1. Two (2) identical torque motor/tachometer generator units which provide the dual drive for the port and stbd channels. Only one (1) channel/torque motor is energized at any one (1) time. Each motor is controlled by its associated servo amplifier which is located in the EE and provides the drive, via the pedestal unit, to a distributor valve operating linkage. The tachometer provides a feedback for servo damping of the torque motor. Electrical interconnection to each motor is provided through a 10 pin plug (PL1 & PL2). The plug is located on a sealed circular mounting plate at the top of the assembly;

2. A position feedback/monitor unit, comprising three (3) transducers, two (2) of which provide position feedback, the other provides monitoring position feedback. The transducers are Linear Variable Differential Transformers (LVDT's) which convert linear motion to an equivalent DC signal. Two (2) LVDT's produce position indication feedback signals for port and stbd servo control channels respectively. The third produces a position indication feedback monitoring signal used to detect a failure in either channel; and

3. A torque motor and position feedback unit, which converts motor rotary motion into linear motion to drive the distributor valve operating linkage and the position feedback/monitor unit. Limit stops are fitted to restrict torque motor rotation to ±30 deg. Note that the torque motor angle is not directly related to the hydroplane angle.

The torque motor/tachometer generator units and position feedback unit are mounted on the torque motor and position feedback unit mounting. The torque motor is driven by a splined shaft; the position feedback/monitor unit is driven by a linkage fitted with a removable pin.

6.3.2 Distributor Valve Operating Linkage

The distributor valve operating linkage comprises a differential beam connected at different points along its length to the DVDU output lever, the distributor valve shaft and the ram follower linkage. The forward hydroplanes RSU has a fourth connection to a centering valve. In the event of failure of the DVDU and during setting up procedure, provision is made for operating the differential beam manually by means of an operating handle. During local hand operation, control surface angles can be read off the mechanical indicators located on each ram cylinder.

6.3.3 Distributor Valve

The distributor valve accurately controls the flow of oil to the hydraulic operating cylinder and provides accurate positional control of its associated control surfaces.

6.3.4 Forward Hydroplane RSU Valves

6.3.4.1 Changeover Valve

The purpose of the changeover valve is to connect the oil flow between either the distribution valve or the centering valve. In position control, i.e. auto or manual mode, the oil flow is via the distributor valve, and when centering the oil flow is via the centering valve. The changeover valve is controlled by a solenoid operated pilot valve actuated from the OMC when centering or retraction is selected. Limit switches (LMS) actuated by the changeover valve provide the following functions:

1. RSU1 LMS1 lights position control indicating lamp at the OMC (LP7) and at the forward hydroplanes Housing Indication Panel (HIP) when in position control;

2. RSU1 LMS2 lights a centering control indicating lamp on the HIP when in centering control; and

3. RSU1 LMS3 interlocks the operation of tilting lock pilot valve HV3, to ensure the changeover valve is in centering control before the tilting locks are engaged.

6.3.4.2 Centering Valve

The centering valve automatically drives the hydroplanes to midship when centering is selected at the OMC. The valve spool is connected by a linkage to the differential beam, which controls spool movement and hence oil flow through the valve. The same action takes place when the hydroplanes are retracted.

6.3.5 After Hydroplane RSU Bypass Valves

The after hydroplanes RSU is fitted with oil and air bypass valves which are mechanically interlinked and connected across the hydraulic and air tilting cylinders oil and air supply lines respectively. In position control the oil bypass valve is set to direct oil from the distributor valve to the hydraulic tilting cylinder and the air bypass valve will be in the bypass position allowing the air tilting cylinder to “idle”. In air emergency control the air bypass valve is set to direct air to the air tilting cylinder and the oil bypass valve will be set to the bypass position. Limit switches actuated by the oil bypass valve provide the following functions:

1. RSU2 LMS2 lights position control indicating lamp (LP9) at the OMC;

2. RSU2 LMS2 operates in conjunction with pressure switch PS1 to light the air emergency indicating lamp (LP1) at the OMC when the after planes are in air emergency control; and

3. RSU2 LMS3 is interlocked with the Monitor and Mode Selection Unit (MMSU) to ensure that when air emergency control is in operation automatic depth control of the forward hydroplanes is cancelled and control is transferred to the manual stickwheel. When this occurs the forward hydroplanes are automatically centered or moved to a position set on the balance angle unit.

6.3.6 Rudder RSU Emergency Changeover Valve

The rudder RSU incorporates an emergency changeover valve which supplies oil to the rudder operating cylinder from the distributor valve in position control, and from the rate control valve in emergency (rate) control. The position of the emergency changeover valve is determined by a solenoid operated pilot selector valve which is fitted with a manual override facility. The selection of normal or emergency control is made at switch S1 on the rudder Emergency Control Panel on the OMC which energises solenoid SV3 or SV4 on the pilot selector valve RV1.

Two (2) limit switches are fitted to, and actuated by, the Emergency Changeover Valve. The two (2) limit switches operate in conjunction with two (2) hydraulic pressure switches (PS2 and PS5). The switches provide the following facilities:

1. RSU3 LMS1 lights position control lamp (LP8) on the OMC when the emergency changeover valve is set to position control; and

2. RSU3 LMS2 lights the 'rate emergency' control indicating lamp (LP2) on the OMC if either pressure switches PS2 or PS5 contacts are closed, thus indicating rudder emergency control using switch S2 is available to the operator.

6.3.7 Emergency Local Control

In the event of failure of all methods of remote control or of the DVDU, the control surfaces can be controlled locally. This is achieved by removing the link pin which connects the DVDU output lever with the differential beam at the RSUs. A manual operating handle, stowed in clips on the DVDU, is fitted to the differential beam of the distributor valve operating linkage. Movement of the handle, forward or backward, operates the distributor valve and subsequently control surface movement. Control surface angles may be read off the engraved mechanical indicators adjacent to their associated hydraulic cylinders. This facility is also used during setting up procedures.

6.3.8 Mounting Arrangements

The forward planes RSU is hard mounted directly on to the Tilting Cylinder by six (6) M10 socket head screws. The after planes RSU and the rudder RSU are each hard mounted directly on to their respective Operating Cylinder by six (6) M16 socket head screws. Each hydraulic cylinder has its own baseplate and bolting pattern, with reference dimensions of the hydraulic cylinder baseplates shown in Figures 16, 17, and 18.

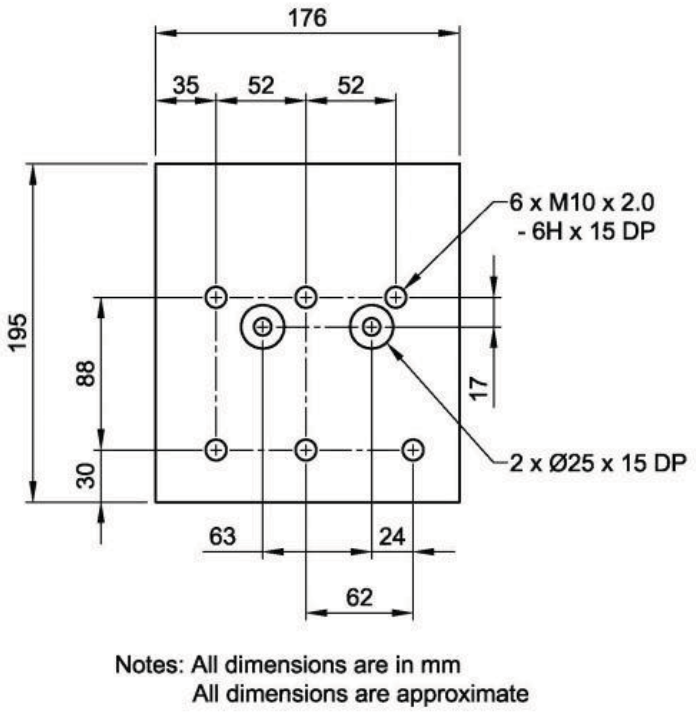

Figure 16: Forward Hydroplane RSU Baseplate Mounting Hole Dimensions

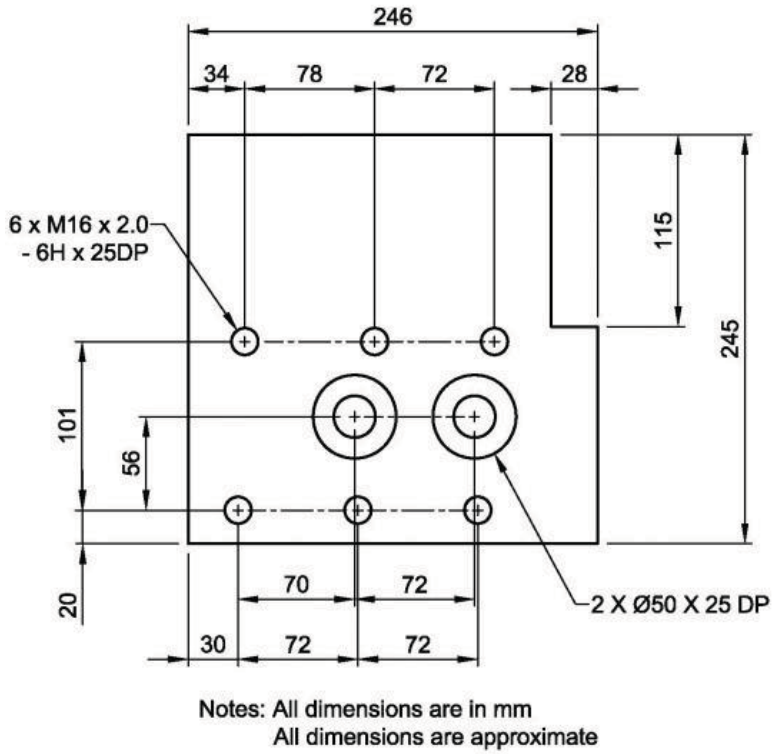

Figure 17: After Hydroplane RSU Baseplate Mounting Hole Dimensions

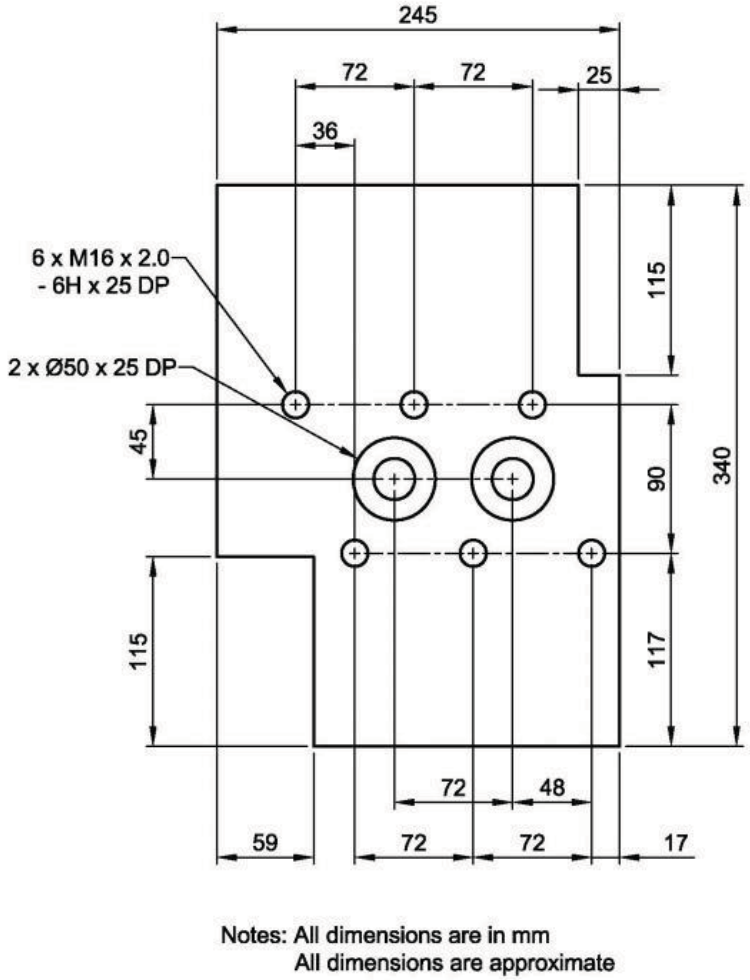

Figure 18: Rudder RSU Baseplate Mounting Hole Dimensions

6.3.9 Hydraulics

The forward hydroplanes RSU is supplied from the Main Hydraulic System (MH) while the after hydroplanes RSU and the rudder RSU are supplied from the Hydroplanes and Steering Hydraulic System (H&S) with back-up supply from the MH if required. Both hydraulic systems are powered by a dedicated three (3) stage internal gear pump with a rated output of 70 litres per minute with an oil temperature of 38°C, and a working system pressure between 176 and 207 bar using OX30 hydraulic oil as the medium. The hydraulic oil is held to an ISO 4406:1987 cleanliness standard of 19/11. Hydraulic system supply pipework is classified as submarine First Level QA while the return pipework is unclassified.

6.3.9.1 Forward Hydroplane RSU Piping

For the forward hydroplane RSU, both the hydraulic supply and return lines are 70/30 Copper Nickel pipe with 16mm outside diameter and 3mm wall thickness, terminated with a 16mm circumferential to 1/2 BSPP connector. For the centering

valve, both the hydraulic supply and return lines 70/30 Copper Nickel pipe with 12mm outside diameter and 3mm wall thickness, terminated with a 12 mm circumferential to 3/8 BSPP connector. The forward RSU connection to the forward hydraulic cylinder is with hydraulic seal flange inserts. Forward RSU piping is shown in Figure 19. Figure 20 shows the approximate position of incoming connectors with respect to the baseplate of the forward hydraulic cylinder without the forward RSU showing.

6.3.9.2 After Hydroplane RSU Piping

For the after hydroplane RSU, both the supply and return lines are 70/30 Copper Nickel pipe with 20mm outside diameter and 3mm wall thickness, terminated with a 20mm circumferential to 5/8 BSPP connector. Hydraulic control oil for the bypass valve is supplied to the RSU via pipe, 70/30 Copper Nickel pipe with 12mm outside diameter and 3mm wall thickness, terminated with a 12 mm circumferential to 3/8 BSPP connector. The after RSU connection to the after hydraulic cylinder is with hydraulic seal flange inserts. After RSU piping is shown in Figures 21 and 22. Figure 23 shows the approximate position of incoming connectors with respect to the baseplate of the after hydraulic cylinder without the after RSU showing.

6.3.9.3 Rudder RSU Pipping

For the Distributor Valve, both the supply and return lines are 70/30 Copper Nickel with 30mm outside diameter and 4mm wall thickness, terminated with 30mm circumferential to 1" BSPP connectors. For the rate control valve, both the supply and return lines are 70/30 Copper Nickel pipe with 30mm outside diameter and 4mm wall thickness, terminated with a 30mm circumferential to 1" BSPP connectors. Two (2) hydraulic supplies are available via pipe, one (1) from the MH for normal operation of the emergency change over valve, while the other is to switch the emergency change over valve to rate control. Both pipes are 70/30 Copper Nickel with 12mm outside diameter and 3mm wall thickness, terminated with 12 mm circumferential to 3/8 BSPP connector. The rudder RSU connection to the rudder hydraulic cylinder is with hydraulic seal flange inserts. Rudder RSU piping is shown in Figures 24 and 25. Figure 26 shows the approximate position of incoming connectors with respect to the baseplate of the rudder hydraulic cylinder without the rudder RSU showing.

6.3.10 High Pressure (HP) Air

HP air is supplied to the after planes RSU at a working pressure between 207 to 280 bar for control of the after hydroplane air cylinder and for actuating the changeover of control from hydraulic supply to HP Air control.

Two (2) pipes supply HP Air to the after RSU air cylinder. Both pipes are 70/30 Copper Nickel with 20mm outside diameter and 3mm wall thickness, terminated with a 20mm circumferential to 5/8 BSPP connector. HP Air for the bypass valve is supplied to the RSU via pipe, a 70/30 Copper Nickel pipe with 12mm outside diameter and 3mm wall thickness, terminated with a 12mm circumferential to 3/8 BSPP connector.

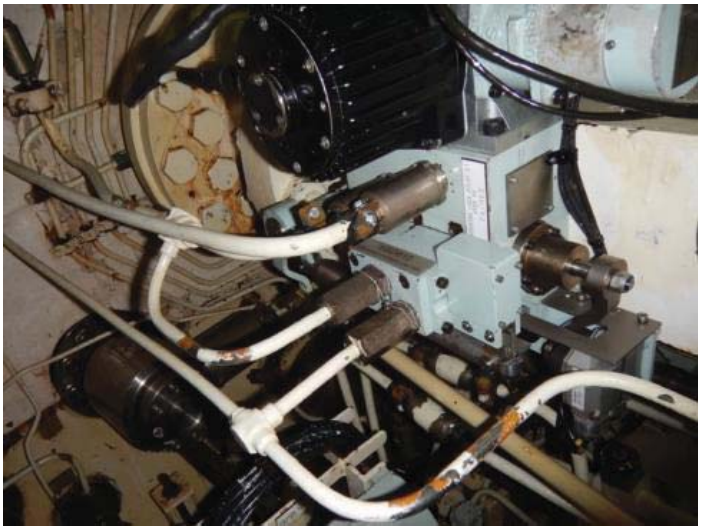

Figure 19: Forward Hydroplane RSU Hydraulic Connections

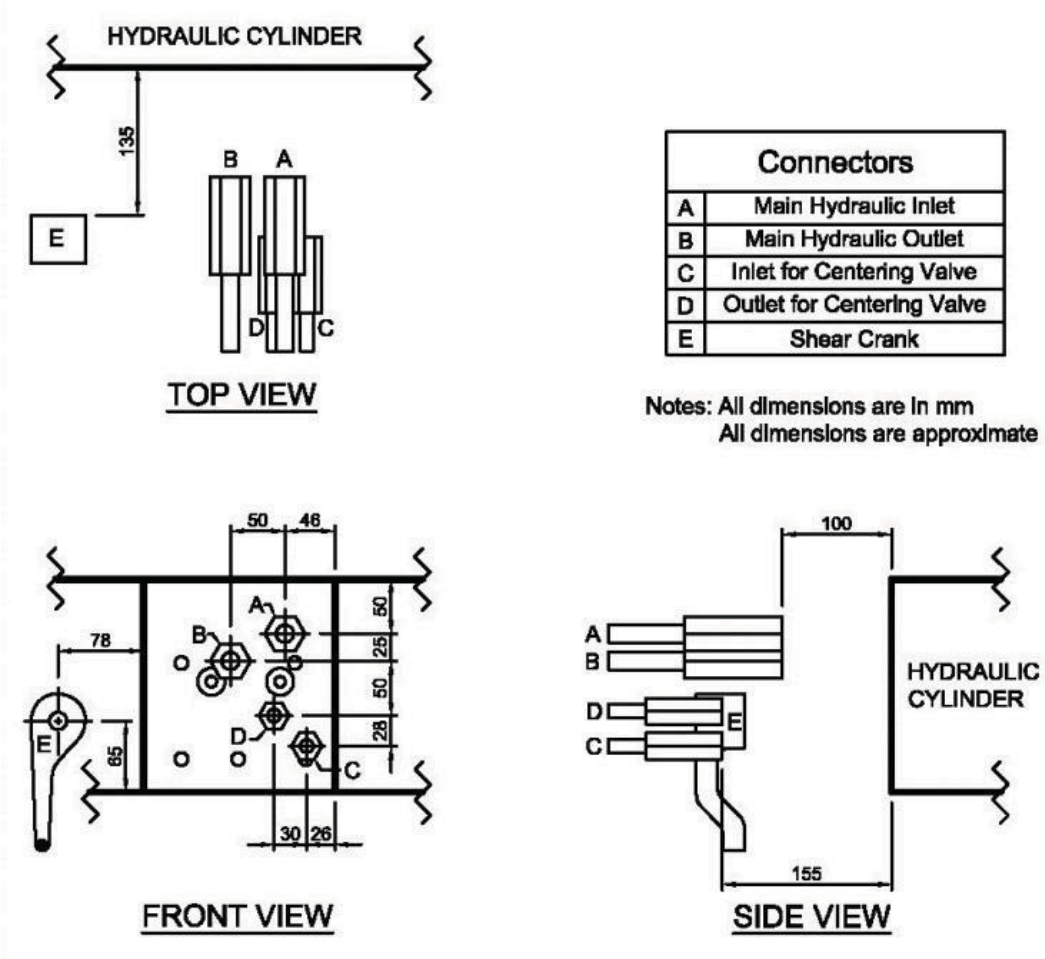

Figure 20: Position of External Connections for Forward Hydroplane RSU

Figure 21: After Hydroplane RSU Back End Hydraulic Connections

Figure 22: After Hydroplane RSU Front End Hydraulic Connections

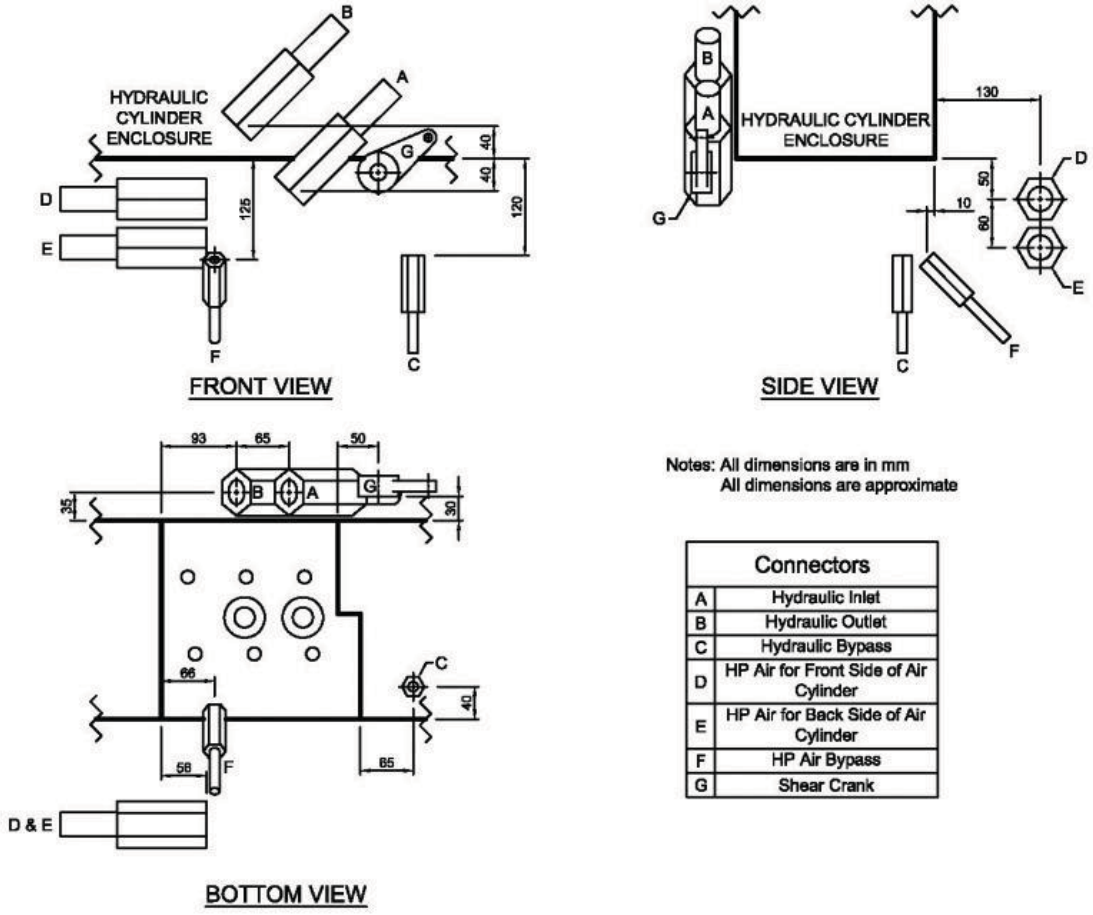

Figure 23: Position of External Connections for After Hydroplane RSU

Figure 24: Rudder RSU Hydraulic Connections Top View

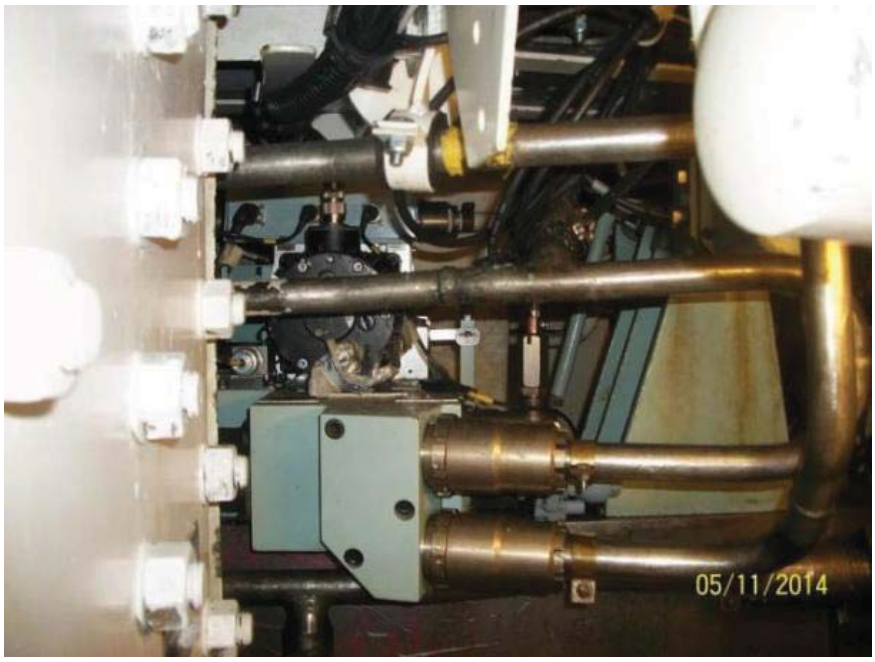

Figure 25: Rudder RSU Hydraulic Connections Side View

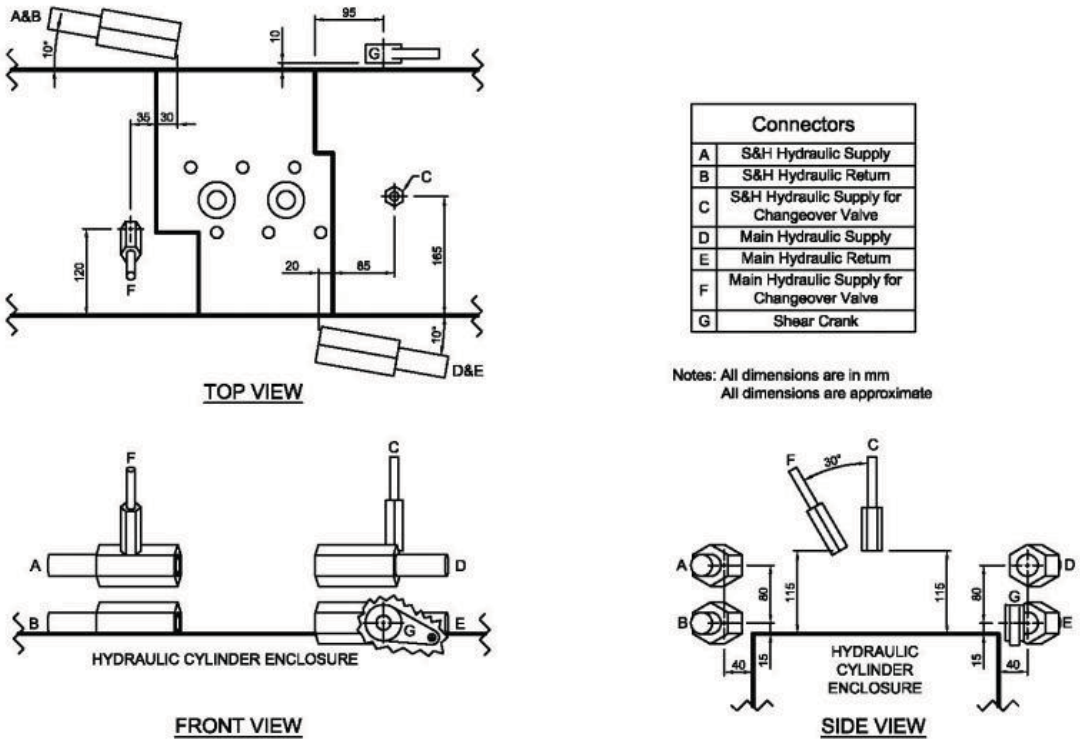

Figure 26: Position of External Connections for Rudder RSU

6.3.11 Ram Follower Linkage

A mechanical linkage interfaces with the RSUs which provides a mechanical feedback mechanism from the operating rams. Each ram following linkage connects to the RSUs through a shear crank mounted on a rod that is part of the distributor valve operating linkage. Information on the shear crank, including its radius, its default angle, and angle range, as well as the ratio of shear crank angular motion to the hydroplane angular motion are shown in Table 6. Drawings of the ram follower linkages are shown in Figures 27, 28, and 29, while interface locations relative to the hydraulic mounting plates are shown in Figures 20, 23, and 26. Note that the following Figures are the highest available quality.

Table 6: RSU Shear Crank Parameters

RSU	Shear Crank Radius (mm)	Angle for Centered Hydroplane*	Hard Rise/ Hardover Starboard*	Hard Dive/ Hardover Port*	Plane-to-RSU Ratio
Forward	114	262.7°	232.7°	292.7°	2:3
After	75	34.7°	4.7°	64.7°	5:6
Rudder	70	197°	162°	232°	1:1

* Angles are from the right horizontal going counter clockwise

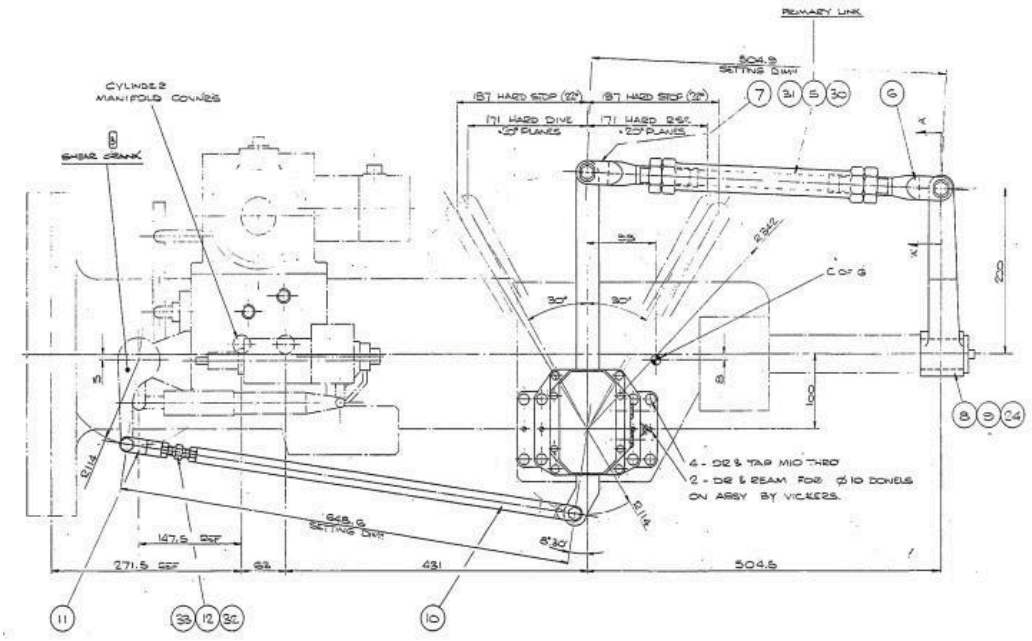

Figure 27: Forward Ram Follower Linkage

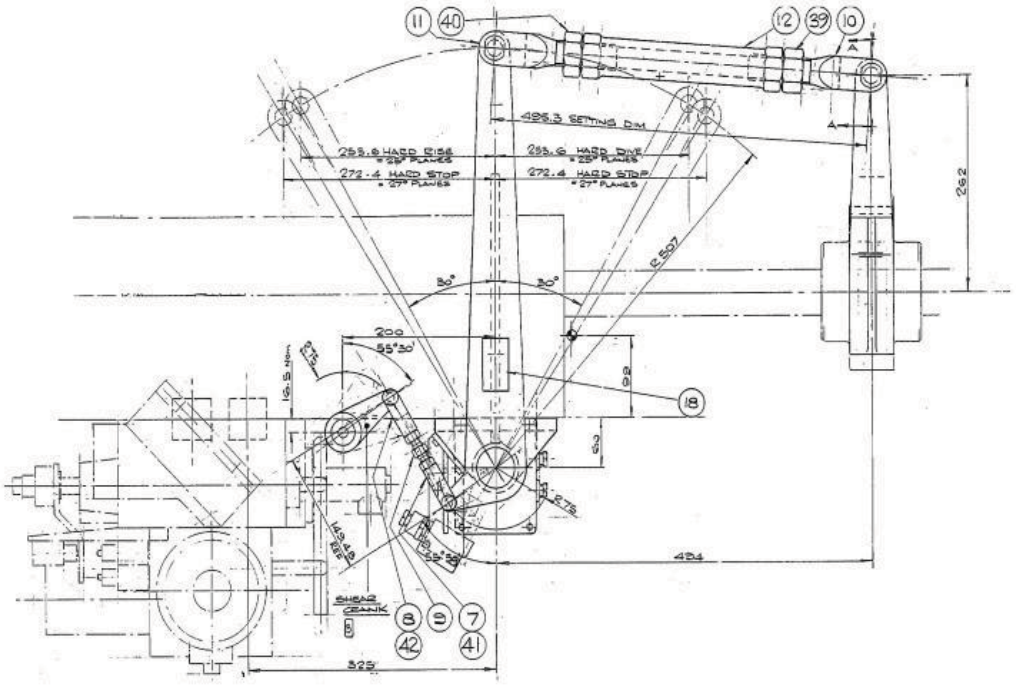

Figure 28: After Ram Follower Linkage

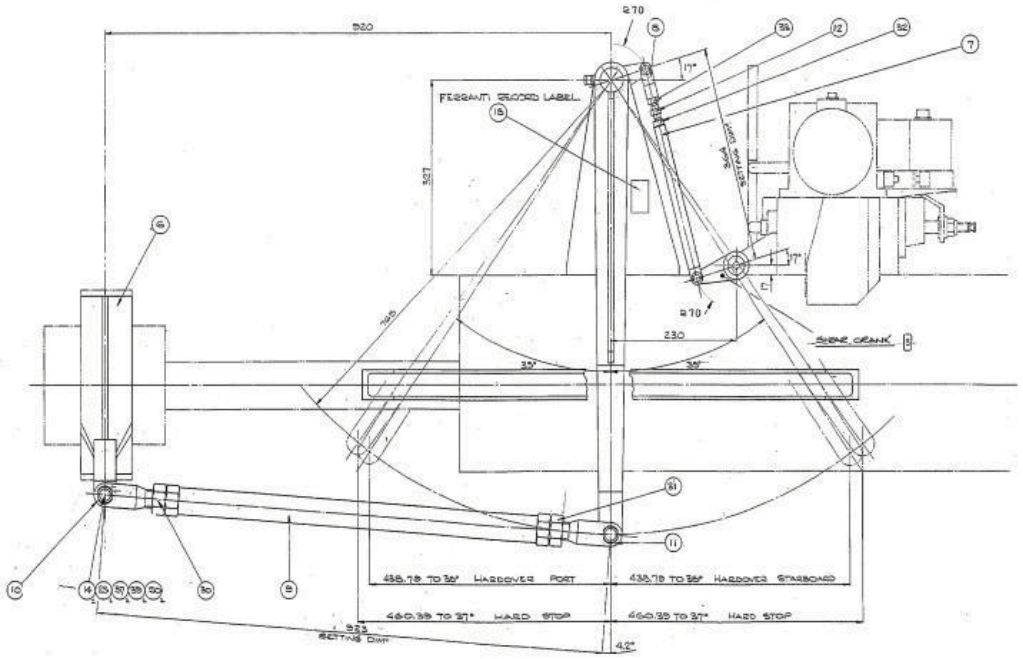

Figure 29: Rudder Ram Follower Linkage

6.3.12 Torque Motor Electrical Parameters

The RSUs torque motors has the following parameters:

Table 7: Torque Motor Characteristic Parameters

Static Friction Torque	k_S	0.22 [N m]
Torque Constant	k_T	1.07 [N m/A]
Armature Resistance	R_a	2.5 [Ω]
Motor Inductance	L	0.856 [H]
Damping Coefficient	ζ	0.01376 [N m/(r/s)]
Dynamic Friction Torque	k_F	0.20606 [N m]
Rotating Inertia	I	0.00125 [kg m^2]

6.3.13 Electrical Interfaces

Command signals from the autopilot or stickwheel are fed via S-cubed data links and manual transmission lines respectively to the RSUs. A positional feedback loop from the RSUs is provided to the EE via PL3 connectors. The RSUs electrical control supplies and feedback are fed via PL1 and PL2 connectors. Three (3) feedback devices are fitted, currently LVDT's, one (1) each for port, stbd and a feedback monitor.

For the forward hydroplane RSU, indication is provided from a limit switch via cable SS921 to the indicating lamp at the OMC and at the forward hydroplane HIP from the forward hydroplane RSU to indicate that the RSU is in "Position" control. Indication is provided from another limit switch via cable SS291 from the forward hydroplanes RSU to the centering control indicating lamp on the HIP when the RSU is in centering control. The forward hydroplanes RSU includes an interlock switch which prevents the operation of tilting lock pilot valve, to ensure the RSU is under centering control before the tilting locks are engaged, via cable SS291. A 24Vdc supply is available for solenoid valve operation from cable SS294. Interface of OMC to Air/Oil bypass valve which is interlocked with the forward hydroplanes such that when the emergency air is selected the automatic depth control of the forward hydroplanes is cancelled and transfers control to manual stickwheel.

For the after hydroplane RSU, indication is provided from a limit switch via cable SS308 to the indicating lamp at the OMC from the after planes RSU to indicate that the RSU is in "Position" control. Indication is provided via cable SS308 from the after hydroplanes RSU switch, in conjunction with a pressure switch, to light the air emergency indicating lamp at the OMC when the after hydroplanes are in air emergency control. The after hydroplanes RSU is interlocked with the MMSU to ensure that when air emergency control is in operation automatic depth control of the forward hydroplanes is cancelled and control is transferred to the manual

stickwheel. When this occurs the forward hydroplanes are automatically centered or moved to a position selected on the balance angle unit, via cable SS308.

For the rudder RSU, indication is provided from a limit switch via cable SS309 to the indicating lamp at the OMC when the emergency changeover valve is set to position control. Indication is provided via cable SS309 from the rudder RSU switch, in conjunction with pressure switches, to light an indicating lamp at the OMC indicating when rudder emergency control is available to the operator.

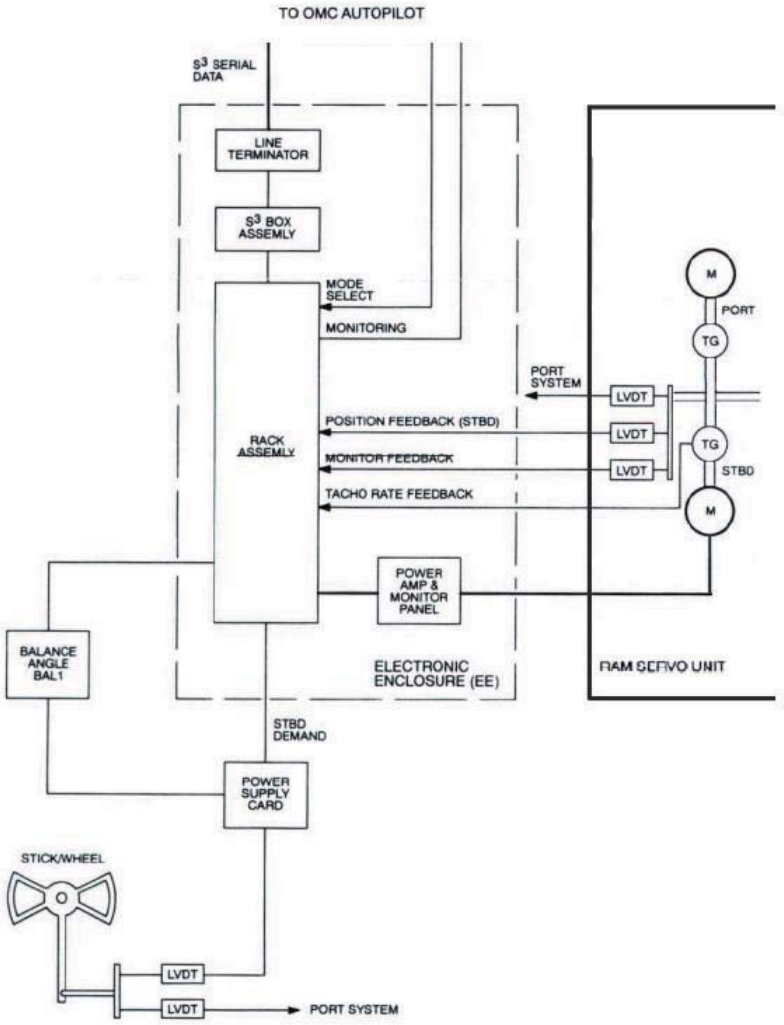

Figure 30: Electronic Enclose System Diagram

Details of the ships cabling interface are detailed in the Tables below.

Table 8: Forward Hydroplane RSU Cable Interfaces

Cable #	Description	Core	Signal	From/To
SS942	Port Torque Motor Drive	1,2	+/-5V	PL1-RSU, cable splice, SS321-EE
	Port Torque Motor Drive	3,4	+/-5V	
	Port Tacho Feedback	5,6	+/-5V	
SS943	STBD Torque Motor Drive	1,2	+/-5V	PL2-RSU, cable splice, SS322-EE
	STBD Torque Motor Drive	3,4	+/-5V	
	STBD Tacho Feedback	5,6	+/-5V	
SS944	Port Feedback Supply	1,2	+/-10V	PL3-RSU, cable splice, SS323-EE
	Port Feedback Signal	3,4	+/-5V	
	Monitor Supply	5,6	+/-10V	
	Monitor Feedback Signal	7,8	+/-5V	
	STBD Feedback Supply	9,10	+/-10V	
	STBD Feedback Signal	11,12	+/-5V	
	Earth	13		
SS291	Position Control Indication	1,2	24V DC	PL4-JB3, 24V DC
	Centering Indication	3,4	24V DC	
	Tilting Lock Pilot Valve	5,6	24V DC	
SS294	Centering Pilot Valve	1,2	24V DC	PL5-JB3, 24V DC

Table 9: After Hydroplane RSU Cable Interfaces

Cable #	Description	Core	Signal	From/To
SS929	Port Torque Motor Drive	1,2	+/-5V	PL1-RSU, cable splice, SS316-EE
	Port Torque Motor Drive	3,4	+/-5V	
	Port Tacho Feedback	5,6	+/-5V	
SS930	STBD Torque Motor Drive	1,2	+/-5V	PL2-RSU, cable splice, SS317-EE
	STBD Torque Motor Drive	3,4	+/-5V	
	STBD Tacho Feedback	5,6	+/-5V	
SS941	Port Feedback Supply	1,2	+/- 10V	PL3-RSU, cable splice, SS318-EE
	Port Feedback Signal	3,4	+/-5V	
	Monitor Supply	5,6	+/- 10V	
	Monitor Feedback Signal	7,8	+/-5V	
	STBD Feedback Supply	9,10	+/- 10V	
	STBD Feedback Signal	11,12	+/-5V	
	Earth	13		

SS308	Position Control Indication	1,2	24V DC	PL4-JB12
	Centering Indication	3,4	24V DC	
	Forward hydroplane. Auto Pilot Interlock	5,6	24V DC	

Table 10: Rudder RSU Cable Interfaces

Cable #	Description	Core	Signal	From/To
SS926	Port Torque Motor Drive	1,2	+/-5V	PL1-RSU, cable splice, SS312-EE
	Port Torque Motor Drive	3,4	+/-5V	
	Port Tacho Feedback	5,6	+/-5V	
SS927	STBD Torque Motor Drive	1,2	+/-5V	PL2-RSU, cable splice, SS313-EE
	STBD Torque Motor Drive	3,4	+/-5V	
	STBD Tacho Feedback	5,6	+/-5V	
SS928	Port Feedback Supply	1,2	+/-10V	PL3-RSU, cable splice, SS314-EE
	Port Feedback Signal	3,4	+/-5V	
	Monitor Supply	5,6	+/-10V	
	Monitor Feedback Signal	7,8	+/-5V	
	Stbd Feedback Supply	9,10	+/-10V	
	Stbd Feedback Signal	11,12	+/-5V	
	Earth	13		
SS309	Position Control Indication	1,2	24V DC	PL4-JB12
	Emergency Control Indication	3,4	24V DC	

7 RSU Technical Requirements

At a minimum, the new RSUs shall meet all the existing operational requirements as described in Section 6. More detailed specifications of the existing RSUs and on the operational characteristics of the control surfaces shall be provided at the Request for Proposal (RFP) stage.

The RSU's are classified as submarine First Level IAW C-23-VIC-000/AM-001 (Quality Assurance For Safety in Submarines – Victoria Class) and hence the new RSU must meet this certification, which will be verified by the Technical Authority (TA) or its representative.

7.1 Environmental

The RSUs shall meet the following environmental requirements as per Table 11.

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 11: Environmental Requirements

Item	Environmental Condition	Requirements	Standard (reference) and Comments
1	Storage Temperature	All RSU 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	1°C to + 75°C continuous	MIL-STD-810F, method 501.4, Procedure II Duration of this temperature test can be minimum of 2 hours
3	Humidity	30 to 80% condensing (wet bulb) at 38°C	MIL STD 810F: 507.4 To meet prescribed tests, steady temperature.
4	Salt Fog	a) Relative Humidity 95% b) Temperature 35°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	Shock*	Design Accelerations: a) 200g upwards b) 100g athwartships c) 50g longitudinal Shock Testing	D-03-003-007/SG-001 - Specification For Design And Test Criteria For Shock Resistant Equipment In Naval Ships**, or MIL STD 901-D
7	Vibration*	Vibration testing for frequencies varying from 5 Hz to 52Hz, vibration amplitudes up to 138±1 Vdb (rms) for up to a maximum of two (2) hours	D-03-003-019/SG-001 - Standard For Vibration Resistant Equipment**, or MIL-STD-167-1A
8	Noise*	Acceptable noise levels**	D-03-003-021/SG-001 - Design & Installation Of Noise Shock And Vibration Reduction**
9	Compartment Pressure	a) Operational: 750-1310 mbar b) Abnormal: 713 mbar for 5 min with no detrimental effects c) Non Operational: 500 - 2300 mbar	
10	Hydraulic Pressure	Shall resist and not leak when subjected to a hydraulic working pressure of 310 bar	
11	EMI General		MIL STD 461E
12	Water ingress (Watertight)	RSUs shall be watertight @ 1 bar (1.5PSI)	

* Note that RSUs will be hard mounted the ram cylinders
** DND Standards and unspecified requirements shall be supplied at RFP stage

7.2 Construction

The RSUs shall not use any hazardous materials with the exception when no other acceptable, effective and less hazardous substitute is not available, to be reviewed and approved by TA.

7.3 Mechanical

The new RSUs equipment shall fit into the same total space envelopes and be within the same total weight and located in the same space. The replacement RSUs shall, at a minimum, meet the same operational characteristics of the existing RSUs along with the requirements as per Table 11.

The RSUs shall connect to the existing mounting arrangement, to the existing hydraulic connections, and it shall connect and operate with the existing ram follower linkage interface, defined in sections 6.3.8, 6.3.9, and 6.3.11 respectively. Relative location and interface with the mounting plate and ram follower linkage shall be the same as with the old RSUs. For the pipe fittings, the contractor shall keep the same relative locations and interface as the old RSUs.

A modular design shall be used to allow for easily interchangeable components of the RSUs instead of replacing the whole unit for minor defects. The design shall also incorporate replaceable filters at the inlet flow that are easily accessible. The filter design must take into account the smallest gap between internal hydraulic components. If the pressure differential through the filter goes above its maximum design pressure differential, there shall be a bypass mechanism that will allow hydraulic oil to flow around the filter. In the event that the bypass mechanism is activated, the RSU shall produce a visible and audible alarm using existing power input configurations. Dedicated isolating valves aren't required as each RSU has its own isolating valve.

The RSUs shall use, as a minimum, HNBR seals.

Canada will not accept the environmentally tested RSUs as deliverables to be installed on the submarines or as spares. The Contractor shall deliver the environmentally tested RSUs to the training school; they shall be identified in accordance. For training purposes, the environmentally tested RSUs aren't required to function with pressurized oil but they shall be in an acceptable state where all maintenance functions are possible. Therefore, they shall be refurbished for this purpose if required.

7.3.1 Weight and Size

The RSUs weights and size shall not be more than the current RSU weights and sizes.

Table 12: RSU Equipment, Location, Weights and Dimensions

Equipment	Location	Weight (kg)	Dimensions (mm) *
Forward Hydroplane RSU	Air Turbine Space on 2 deck	55	415 x 360 x 475
After Hydroplane RSU	Port side of Motor Room	115	490 x 385 x 490
Rudder RSU	Stbd side of Motor Room	125	510 x 500 x 525

*Dimensions and weights are approximate measurements.

7.3.2 Flow Rates

The RSUs shall be designed for a maximum hydraulic flow rate of 70L/min. They shall also be designed to a hydraulic working pressure range of 176 to 207 bar.

The after planes RSU shall be designed to a working air pressure in the range of 207-280 bar.

7.3.3 Emergency Local Control

In the event of failure of all methods of remote or electric control, the RSUs will have the ability to be controlled locally by a manual operating handle or other mechanism deemed appropriate. This facility will also be used during setting up procedures.

7.3.4 Special Purpose Tools and Test Equipment (SPTATE)

The contractor shall design, develop and test any SPTATE that shall be required to provide 1st and 2nd level maintenance support for the RSUs. The SPTATE sets shall be containerized so that it can be handled by one (1) person in a submarine environment, and shall incorporate all necessary test equipment with an emphasis on ease of use and storage.

7.4 Electrical

The replacement RSUs shall connect to the existing electrical connectors defined in section 6.3.13. Each RSU is to have a method for manual (local) override in the event of electrical failure. The manual override must be capable of actuating the control surfaces via the hydraulic circuit.

7.5 RSU Design Verification and Validation

The RSUs design shall be verified and validated in numerous steps as described in the following sections.

7.5.1 RSUs Factory Acceptance Testing (FAT)

The Contractor shall conduct the RSUs FAT, to be witnessed by TA or its representative, as per the FAT procedures reviewed and approved by TA. The performance parameters for this testing shall be provided at RFP stage.

7.5.2 RSUs Removal and Installation Set To Work (STW)

The Contractor shall conduct the STW of the RSUs which includes removing the existing RSUs equipment, the necessary field wiring and cables; installing the new RSUs equipment, installing the field wiring and cables onboard the submarines. The STW also includes the checking, verification, and testing of all the RSUs equipment and all its interfaces as per STW test procedures reviewed and approved by the TA. Local Shipyard will be responsible for rigging equipment on and off the submarines.

7.5.3 Harbour Acceptance Testing (HAT)

Upon successful completion of the STW, the HAT shall be completed as per HAT procedures to prove that the RSUs meets all the SOW requirements as per HAT test

procedures reviewed and approved by TA. The performance parameters for this testing shall be provided at RFP stage.

7.5.4 RSU Sea Acceptance Testing (SAT)

Upon successful completion of the HAT, the SAT shall be completed as per the SAT procedures to prove that the RSUs meets all the SOW requirements as per SAT test procedures reviewed and approved by TA. The Contractor shall conduct sea tests at various manoeuvers, speeds and depths that will be provided at the RFP stage.

7.6 Engineering Changes (ECs)

The ECs are sets of instructions used for installing the new RSUs on the submarines. The ECs shall include a baseline EC for the submarines and if required four (4) particularized ECs for each of the submarines.

8 Acronyms and Abbreviations

AFT	After
BSPP	British Standard Pipe Parallel
CA	Contracting Authority
CDRL	Contract Deliverable Requirements List
CFTO	Canadian Forces Technical Orders
CMP	Configuration Management Plan
COTS	Commercial Off The Shelf
DID	Data Item Descriptions
DND	Department of Defence
DVDU	Distributor Valve Drive Unit
EC	Engineering Change
EE	Electronic Enclosure
FAT	Factory Acceptance Test
FMF	Fleet Maintenance Facility
FWD	Forward
HAT	Harbour Acceptance Testing
HIP	Housing Indication Panel
HNBR	Hydrogenated Nitrile Butadiene Rubber
HP	High Pressure
H&S	Hydroplane & Steering Gear Hydraulic System
IAW	In Accordance With
ILS	Integrated Logistics Support
IPC	Illustrated Parts Catalogue
LMS	Limit Switch
LOI	Letter Of Interest
LVDT	Linear variable Voltage Transformer
MH	Main Hydraulic System
MMSU	Monitor and Mode Selection Unit
MS	Microsoft
NATO	North Atlantic Treaty Organization
NSN	NATO Stock Number
OEM	Original Equipment Supplier
OMC	One Man Console
PDF	Portable Document Format
PS	Project Schedule
QA	Quality Assurance
RFP	Request for Proposals
RMP	Risk management Plan

RSU	Ram Servo Unit
SAT	Sea Acceptance Testing
SOW	Statement Of Work
SPTATE	Special Purpose tools and Test Equipment
Stbd	Starboard
STW	Set To Work
TA	Technical Authority
VCS	VICTORIA Class Submarines
Vdc	Volts of direct current
WBS	Work Breakdown Structure

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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: DND	2. Branch or Directorate / Direction générale ou Direction: DGMEPM
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

Victoria Class Ram Servo Unit (RSU) Replacement Project

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

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

Canada ☑	NATO / OTAN ☐	Foreign / Étranger ☐

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

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

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

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

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

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

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

Short Title(s) of material / Titre(s) abrégé(s) du matériel :
Document Number / Numéro du document :

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

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

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

Special comments:
Commentaires spéciaux : _____

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

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

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

INFORMATION / ASSETS / RENSEIGNEMENTS / BIENS

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

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

PRODUCTION

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

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

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

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

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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	COSMIC TOP SECRET / COSMIC TRÈS SECRET	PROTECTED / PROTÉGÉ A	PROTECTED / PROTÉGÉ B	PROTECTED / PROTÉGÉ C	CONFIDENTIAL / CONFIDENTIEL	SECRET	TOP SECRET / TRÈS SECRET
Information / Assets / Renseignements / Biens	✓															
Production	✓															
IT Media / Support TI	✓															
IT Link / Lien électronique																

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

☑ No / Non ☐ Yes / Oui

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

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

☑ No / Non ☐ Yes / Oui

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

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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)	Title - Titre	Signature
Mandar Avsare	DNPS 4-3-7	M.S. Avsare

Telephone No. - N° de téléphone	Facsimile No. - N° de télécopieur	E-mail address - Adresse courriel	Date
819-939-3155	819-939-3023	mandar.avsare@froces.gc.ca	

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

Name (print) - Nom (en lettres moulées)	Title - Titre	Signature
Sasa Medjovic - DDSO - Industrial Security Senior Security Analyst Tel: 613-996-0286 E-mail: sasa.medjovic@forces.gc.ca		

Telephone No. - N° de téléphone	Facsimile No. - N° de télécopieur	E-mail address - Adresse courriel	Date
			2016-June 23 SM

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

16. Procurement Officer / Agent d'approvisionnement

Name (print) - Nom (en lettres moulées)	Title - Titre	Signature
GERARD CLÉMENT	MANAGER	Gérard Clément

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

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

Name	Signature
Paul Lepinski Agent à la Sécurité des contrats | Contract Security Officer Programme de la Sécurité industrielle | Industrial Security Program *Paul.Lepinski@tpsgc-pwgsc.gc.ca* Téléphone : 613 957-1294	

Teleph	Iress - Adresse courriel	Date
		19-JUL-2016