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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

Title - Sujet	
THRUSTERS CONTROL SYS. REPLACEMENT	
Solicitation No. - N° de l'invitation	**Amendment No. - N° modif.**
F2599-135057/A	001
Client Reference No. - N° de référence du client	**Date**
F2599-135057	2014-03-13
GETS Reference No. - N° de référence de SEAG	
PW-$$MC-024-24364	
File No. - N° de dossier	**CCC No./N° CCC - FMS No./N° VME**
024mc.F2599-135057	
Solicitation Closes - L'invitation prend fin at - à 02:00 PM on - le 2014-04-15	**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:	**Buyer Id - Id de l'acheteur**
Pilon(MC DIV), Chantal	024mc
Telephone No. - N° de téléphone	**FAX No. - N° de FAX**
(819) 956-4308 ( )	( ) -
Destination - of Goods, Services, and Construction: Destination - des biens, services et construction:	
See herein	

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

Instructions: See Herein

Instructions: Voir aux présentes

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

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

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

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

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K1A 0S5

Amendment 1:

Amendment 1 is raised to change the date of the bidder's conference and vessel viewing as well as to replace the original SOW due to minor technical changes.

_____

CHANGE #1

The minor technical changes are reflected in the attached revised SOW referred to as **Annex "A" - REVISION 1** dated 2014-03-10. The changes are hightlighted in yellow**.** The Annex "A" - REVISION 1 cancels and supersedes the previous SOW referred to as Annex "A" dated 2014-02-27.

CHANGE #2

DELETE:

PART 2 - BIDDER INSTRUCTIONS

6. Bidder's Conference

1. A bidders' conference will be held in Sarnia, Ontario at 520 Exmouth Street **on March 25**, 2014. The conference will begin at 8:30am, in room 117. The scope of the requirement outlined in the bid solicitation will be reviewed during the conference and questions will be answered. It is recommended that bidders who intend to submit a bid attend or send a representative.

2. Bidders are requested to communicate with the Contracting Authority before the conference to confirm attendance. Bidders should provide, in writing, to the Contracting Authority, the names of the person(s) who will be attending and a list of issues they wish to table at least **five (5) working days** before the scheduled conference.

3. Any clarifications or changes to the bid solicitation resulting from the bidders' conference will be included as an amendment to the bid solicitation. Bidders who do not attend will not be precluded from submitting a bid.

7. Mandatory Site Visit - Vessel

It is mandatory that the Bidder or a representative of the Bidder visit the work site. Arrangements have been made for site visit to be held on **March 25** at 11:30am in Sarnia, Ontario at the Government dock. Bidders must communicate with the Contracting Authority no later than **five**

(5) working days before the scheduled visit 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 will be included as an amendment to the bid solicitation.

REPLACE WITH:

PART 2 - BIDDER INSTRUCTIONS

6. Bidder's Conference

1. A bidders' conference will be held in Sarnia, Ontario at 520 Exmouth Street **on March 26**, 2014. The conference will begin at 8:30am, in room 117. The scope of the requirement outlined in the bid solicitation will be reviewed during the conference and questions will be answered. It is recommended that bidders who intend to submit a bid attend or send a representative.

2. Bidders are requested to communicate with the Contracting Authority before the conference to confirm attendance. Bidders should provide, in writing, to the Contracting Authority, the names of the person(s) who will be attending and a list of issues they wish to table at least **five (5) working days** before the scheduled conference.

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ALL OTHER TERMS AND CONDITIONS REMAINS THE SAME.

Annex “A” – REVISION 1

CCGS Samuel Risley Propulsion and Transverse Thruster Control Systems Replacement

Statement of Work No: 767.13

Date: 2014-03-10

Prepared by Marine Engineering
Prepared by
Marine Engineering
520 Exmouth St
Sarnia, ON
N7T 8B1

TABLE OF CONTENTS

1.0 PROPULSION AND THRUSTER CONTROL SYSTEMS REPLACEMENT

1.1 Overview

1.1.1 The Canadian Coast Guard (CCG) has a requirement for the replacement of the systems for automatic, remote, and local control of the propulsion engines, gearboxes, controllable pitch propellers, and transverse thrusters on the CCGS Samuel Risley. The Contractor must design, supply and install these new systems, performing the detailed engineering design and production work.

1.1.2 Notwithstanding any errors, omissions, or lack of clarity in these project requirements, it shall be the responsibility of the Contractor to ensure that the execution of the Work specified herein is to the satisfaction of the Approval Authorities, section 1.5. The Contractor must supply all items and work deemed necessary for the safe and satisfactory operation and seaworthiness of the vessel as required for a vessel of this type and class.

1.2 General Vessel Particulars Samuel Risley

1.2.1 The CCGS Samuel Risley is a four-engine twin-screw vessel, with two Wärtsilä Vasa 12V22MD medium speed Diesel engines driving each of two propulsion shafts via Valmet gearboxes. Each shaft drives a shrouded LIPS controllable pitch propeller. Each gearbox is fitted with two integral main input and two integral auxiliary power take off clutches. The power take off clutches drive a shaft generator and a fire monitor water pump. The shaft generators are primarily used to power the bow and stern thrusters, but are also used for ship's service. The bow thruster is a water jet type thruster. The stern thruster is a tunnel-type CPP stern thruster. The twin rudders are each fitted with independent electro-hydraulic steering gears.

Name	CCGS Samuel Risley
Type:	Type 1050 Medium Endurance Multitasked Vessel,
Ice Class	Lloyd's Register 1A Super
	Arctic Shipping Pollution Prevention Regulations, Arctic Class 2
Year Built	1985
Voyage Class	Near Coastal Class 1
Builder	Vito Steel Boat and Barge, Vancouver, BC
Principal Dimensions:	
Length	69.73 meters
Breadth	13.7 meters
Loaded	Draft5.817 meters
Tonnage	1967 GRT,
	2935 tonnes, displacement

1.3 Project Work

1.3.1 General

1.3.1.1 The intention of the CCG is to remove the entire ASEA FAMP-S control system and sub-systems; the ASEA Bow Thruster/Omnithruster control system; the Rolls Royce/Ulstein Stern Thruster control system and Saftronics motor starter, and the SAB NIFE Rectifiers and battery banks, and to replace this equipment with new equipment such that automatic remote control and manual remote control are available in the Wheelhouse (WH) and Machinery Control Room (MCR) with manual local control available in the machinery spaces in accordance with latest requirements of SOLAS 2009, Transport Canada Marine Safety (TCMS), and the Rules of an approved Classification Society (Class) for control of essential and safety critical systems. The new systems must be based on new, modern, modular programmable logic controller or modular microprocessor technology which is known and proven in the marine industry.

1.3.2 Scope of Work

1.3.2.1 The ASEA FAMP-S control system and sub-systems that must be removed and replaced are:

i. ASEA FAMP-S microprocessor system for propulsion control;
ii. ASEA TESY-1 Telegraphs;
iii. ASEA Safety System QHFS 102;
iv. Wartsila DESPEMES (Diesel Engine Speed Measuring);
v. Deuta Werka Clutch Slip Monitors;
vi. ASEA Torductor system;
vii. Woodward 723 Electronic governors and Woodward EGB-P fuel actuators.
viii. The Noris Norimos 3000 Alarm and Monitoring System

1.3.2.2 The ASEA Joystick system must be removed. The aft wheelhouse joystick control must be renewed while the forward wheelhouse joystick control must not be replaced.

1.3.2.3 The Transverse Thruster control systems that must be removed and replaced are:

i. Rolls Royce/ Ulstein Stern Thruster Control System, including pitch position feedback arrangement.
ii. The Saftronics SR6 2 HP – 500 HP (600/3/60) Stern Thruster motor starter

1.3.2.4 The Stern Thruster hydraulic systems and electric motor are to be retained.

1.3.2.5 The SAB NIFE 100 Series Battery Chargers/Rectifiers and Ni-Cad battery banks providing 24V DC power supply must be removed and replaced with new power supply arrangements.

1.3.2.6 The Machinery Control Room (MCR) console and the Wheelhouse (WH) forward, port, and starboard control consoles tops must be replaced with console tops accommodating the new and retained existing equipment.

1.4 References

Number	Description	Availability
SOLAS 2009	SOLAS 2009 Chapter II-I, Chapter V	SOLAS 2009 Consolidated edition, ISBN 978-92-801-1505-5
	Canada Shipping Act 2001 and Regulations	http://www.tc.gc.ca/eng/acts-regulations/acts-2001c26.htm
TP 127 E	Ships Electrical Standards	http://www.tc.gc.ca/eng/marinesafety/tp-menu-515.htm
IEEE-45-2008	IEEE Recommended Practice for Electrical Installations on Shipboard	ISBN 0-7381-3381-7
IACS UR E	IACS Unified Requirements Concerning Electrical Installations	http://www.iacs.org.uk/publications/publications.aspx?pageid=4&sectionid=3
	CIGENTEC BATTERY CHARGER	Reference CD
	FAMP-S Manual	Reference CD
	ULSTEIN MARITIME LTD_ INSTRUCTION MANUAL	Reference CD
	STERN THRUSTER WIRING DIAGRAM 161-624-18	
	STERN THRUSTER 400 HP SOLID STATE MOTER STARTERSCHEMATIC D-1115-2	
	VALMET NAVAID 1050, MANUAL	Reference CD
	ASEA JOYSTICK MANUAL	Reference CD
	ASEA MISCELLANEOUS SYSTEMS	Reference CD
	ASEA TORDUCTOR MANUAL	Reference CD
	ASEA BOW THRUSTER UNIT INSTRUCTIONS	Reference CD
	WOODWARD 723 INFORMATION	Reference CD
	WOODWARD - INSTRUCTION	Reference CD

	MANUALS	
	ASEA FAMP-S External Connections	Reference CD
	Joystick External Connections	Reference CD
	Samuel Risley General Arrangement	Reference CD
	Samuel Risley Machinery Arrangement	Reference CD
	Samuel Risley Wheelhouse General Arrangement	Reference CD
	Console Details and Wiring Diagrams	Reference CD
	Console Photographs	Reference CD

1.5 Approval and Approval Authorities

1.5.1 The Approval Authorities for regulatory and classification society purposes are TCMS and a Classification Society approved by Transport Canada and listed in the Marine Machinery Regulations Section 2 (1). All documentation for approval by TCMS must be first approved by the Classification Society.

1.5.2 The Contractor must ensure that the systems meet the requirements of TCMS and of a Transport Canada Approved Classification Society for integrated programmable electronic control systems for essential and safety critical systems and machinery for a vessel of the characteristics described in Specification Sections 1.2. Notwithstanding the actual or intended vessel voyage classification, systems must meet the requirements of TCMS and Class for a vessel engaged in unrestricted open ocean voyages.

1.5.3 The Contractor must engage the services of a TCMS Approved Classification Society to provide design assessment and approval according to the Class Rules and Regulations applicable to the specified systems. Notwithstanding any previous Class approval for a standard system or component the Contractor must obtain Class assessment and approval for the particulars of this project. The Contractor must ensure that all components have Class type approval. All assemblies of components and all systems must have the particular approval of Class.

1.6 General Technical Requirements

1.6.1 It is not the Owner's intention to replicate the existing systems in detail, but to replace the existing systems with new systems using modern control strategies and devices such that remote, automatic and local control are available from the same operator stations and provide the operator with the same capabilities. Throughout this specification the phrase "duplicate the functionality" must mean the same as "to provide the same operational capabilities".

1.6.2 Canada makes no warranty that the existing vessel drawings and device manuals are accurate and the Contractor is to satisfy himself in this regard with respect to structure, piping, machinery connections, electrical systems, device functionality and arrangements on which the Contractor shall be working.

1.6.3 The descriptions of the existing functionality in this specification are for the convenience of the Contractor only. The Contractor must review the documentation provided and examine the vessel and observe the vessel operation to satisfy themselves with the details and functionality of the systems described.

1.6.4 The Contractor must read each specification section in the context of the entire specification, the appropriate equipment manuals and drawings.

1.7 Flexible, Adaptable and Open Architecture

1.7.1 The new systems must be based on open architecture integrating the new and retained systems. The new system must be capable of interfacing with a modern steering control and adaptive auto-pilot system.

1.7.2 The new systems must have the capacity to expand to allow for future additional functionalities listed below for:

I. Engine performance analysis and optimization with real time reading and analysis of combustion cycle pressures for combustion and mechanical condition monitoring;
II. Vessel voyage monitoring and fuel consumption optimization;
III. Full data logging capability for I/O data, and control process data;
IV. Alarm and Monitoring, with trending and trend logging capability for all data;
V. Electrical Power Management with control of generators, generator diesel engines, and switchboards, circuit breakers, and compatible with the existing Caterpillar generator engine control systems;
VI. Joystick control;
VII. Dynamic positioning.

1.8 Maintainability

1.8.1 The new systems must utilize the same or similar processors and components wherever possible to reduce the number of spare processors and components to be carried in inventory.

1.8.2 The new systems and components must be fully supported with spare parts and components and full technical service support for at least 10 years following completion of installation. The Contractor must have a technical service department and network providing continuously available access to technical support technicians via telephone and e-mail based communication. Technical support technicians must be available for onsite support of critical systems from a North American service provider. The technical service department must provide service bulletins and notification of configuration changes, hardware upgrades, and software changes, including notification of no changes, on a bi-annual basis at no extra cost to Canada for 15 years after the end of the warranty period for the Work. The Contractor must allow for future capabilities of remotely

accessing the systems through secure internet connection, under CCG permissions, for diagnostics and software upgrades.

1.8.3 The modules for propulsion control, speed governors, safety systems and alarm systems, communication busses and bus controllers, and power supply, must each perform self-test fault monitoring for component fault, software fault, communication fault, power supply fault, I/O field sensor and actuator fault, line fault and ground fault. Fault indication must readily identify the fault origin to the lowest replaceable unit.

1.8.4 The new systems must have a maintenance laptop computer or other portable interface device for access and maintenance of the systems. The maintenance computer must be a stand-alone computer capable of plug-in and plug-out to the various system modules and must be supplied with software and operating system updates for the duration of technical service support period.

1.8.5 The Contractor must grant to the CCG intellectual property and programming rights so that CCG personnel may freely and without restriction make adjustments to the operating conditions and foreground program changes, including updating control logic, installing and removing channels, changing graphic displays, exchanging channels, adjusting set points and alarm operating parameters. User and senior shipboard user accessible data, logic, and functions must be password protected for access and the software management system must automatically track and record changes.

1.8.6 The new systems must include a simulation or troubleshooting mode similar to the existing Simulation Mode such that simulated inputs and out puts for system set-up, electronic and mechanical calibration and adjustments, and fault-tracing may be performed with the main engines shut down and with the CPP and stand-by gearbox pumps running.

1.9 Replacement Alarm and Monitoring System

1.9.1 The Noris Norimos 3000 system and must be replaced with new alarm and monitoring system (AMS) mutually independent from the control systems. All new and existing systems and devices must interface with the new alarm and monitoring system.

1.9.2 The new AMS must handle all processing and control of alarm functions, with the exception of the Main Engine Safety Systems and the Fire Detection system. The processing and control of these systems must remain independent, but must feed and input signal to the AMS to identify when an alarm condition is triggered.

1.9.3 The new AMS must be a separate operating system from the Control System such that the AMS can fail without affecting the control, critical failure alarms or operation of the propulsion system. The AMS must have independent visual display screens (VDS) and they must not be used is substitution for the VDS displays and controls described in Section 2.3

1.9.4 The new Alarm system must comply with section 1.7.1

1.9.5 The new Alarm system must comply with section 1.7.2

1.9.6 The New AMS must use Classification Society approved components and devices in places where these components are considered to be critical components in the Alarm and Monitoring system.

1.9.7 The New AMS must provide for both visual and audible alarms. These alarms must differentiate between Major and Minor alarms and must not interfere or be confused with the existing General Alarm, telephone, ICS or FM 200 Discharge Alarm. The New Alarms must be visible and audible in all machinery spaces.

1.9.8 The new alarm system must supply all alarm and monitoring points as required by the new Propulsion Control system and include all the additional auxiliary alarm and sensor feedback points currently displayed on the existing Noris System. The New AMS must provide for interfacing with alarm and monitoring supplied by the CAT Ship Service Generators.

1.9.9 The new alarm and monitoring system must have the capability to log any data inputs managed by the system. The system must have the ability to record this data every 4 hours and store the information on a dedicated hard drive in .csv, *.txt file formats. The system must record the information and include the data and time each data point is collected. The hard drive must be installed in a secure, tamper proof case and have a provision to show data history to crew but be password protected to prevent altering of data. The system must be capable of recording this data for 5 years without changing the hard drive disk. The system must provide the capability to print out all data log during the four (4) hour period and plot it in a suitable log format. Log format must be determined in consultation with TA.

The new alarm and monitoring system must also be capable of recording all alarm points and record all triggered alarms including time stamp with date, the alarm is triggered, the time and date the alarm is acknowledged, any alarm overrides, the alarm name and the value of the data point that triggered the alarm. The system must be capable of print hard copies of all logged alarm data.

Critical alarms points and data points must be determined in consultation with the TA and the engine manufacturer’s operation manuals including all set-points for high and low limits.

1.9.10 The New AMS must be expandable and programmable to allow additional sensor inputs, alarm channels and graphics screens.

1.9.11 The New AMS must be integrated into the MCR and WH consoles with a third station in the Chief Engineers Cabin and a repeating station in the Senior Engineer’s cabin as in the existing system.

1.9.12 The New AMS must have graphic displays typical to the current AMS with any additions or graphic modification subject to TA approval.

1.9.13 The new AMS must be programmable to allow each alarm point to be modified by the user for: High Alarm Set Point, Low Alarm Set Point, Delay, and Alarm Blocking. Calibration of values must be possible for analog inputs such as tank soundings, RPM, Load, Temperature or Pressure feedback. Digital signals (on or off) must user

programmable for normally open or normally closed alarm response. Programming functions must be password protected for security purposes.

1.9.14 The majority of the as fitted (Noris) AMS I/O modules are fitted to three cabinets located in the main engine room. These cabinets must be replaced with new I/O cabinets as required by the new AMS. New installations must allow for ease of access to the I/O modules and comply with section 1.10.1. The new cabinets must be installed in the same location as the old cabinets to permit reuse of the existing sensor feedback cable. The Contractor must advise the TA and TI should the location of the I/O cabinets require relocation and must also identify all wiring to be replaced as a result of the need for relocation.

1.9.15 The New AMS must comply with section 1.6.

1.10 Wiring and Cables

1.10.1 The Contractor must develop a detailed wiring schedule. The wiring schedules must clearly identify:

i. Wires that will become redundant and will require strip out before completion of the project;
ii. Wires required to be added to the system as a result of the system replacement.
iii. The schedule must list the following for each wire:
iv. Conductor size;
v. Current rating;
vi. Voltage drop;
vii. Insulation level and type (voltage);
viii. Insulation type designation and maximum allowable temperature;
ix. Terminal strip originating and terminating;
x. Shielding requirements.

1.10.2 The wiring schedule must clearly identify all interconnecting wires required between the various sections of the new systems.

1.10.3 The wiring schedule must be submitted no later than four (4) weeks before installation commences to the TA and the IA for examination before new wires are installed. The schedule may be submitted in sections as the detailed design develops.

1.11 Existing Wiring

1.11.1 Control System: All new equipment must have new wiring. Existing wiring must only be reused for equipment that is being retained for use on the various control consoles. The Contractor must prepare a report detailing the terminal connections, continuity, insulation leakage to ground, insulation leakage between conductors, insulation visual condition, as well as the arrangement and efficacy of EMI and RFI shielding for all wiring proposed for reuse. The insulation test voltage between ground and between insulators must be at least 500V. The report is to be submitted to the TA and IA with the wiring schedule required in Section 1.10

1.11.2 Alarm and Monitoring System: All new Alarm and Monitoring sensors and equipment must have new wiring. Existing wiring must only be reused where current sensors are being retained and cable lengths are suitable for proper termination in the I/O cabinets. Cables musts not be extended by splicing. Cables found to be of insufficient length must be replaced.

1.12 Working Drawings

1.12.1 The Contractor must prepare all the working drawings necessary for the design and installation of the new systems. Working drawings which are also Class Approved drawings must not be altered without re-inspection and re-approval. The Contractor must furnish all drawings required by sub-contractors, trades and other consultants. Working drawings must include at a minimum the following items:

1.12.2 Working drawings must clearly indicate the materials and/or equipment being supplied, all details of construction, accurate dimensions, capacity, operating characteristics and performance. Each working drawing must give the identifying number of the specification Section(s) for which it was prepared. The Contractor must provide a list of the equipment and devices to be removed.

1.12.3 Arrangement and layout drawings showing physical locations for all components in consoles, racks, and panels and on machinery. Arrangement and layout drawings must accurately indicate the physical and electrical arrangement, including equipment location, and equipment mounting and securing arrangements for components and panels in consoles and on machinery. The drawings must be keyed to unique identification numbers on the components such that a positive identification of each component can be made.

1.12.4 Cable layout diagrams must specify the cables, cable runs, bulkhead and deck transits, and cable identification markings. Cable transits must meet TCMS and Class requirements for fire protection and watertight integrity as applicable to the particular bulkhead or deck penetration. Cable layout diagrams must specify the physical arrangement of the cable run including length of cable.

1.12.5 Cable layout diagrams and system interconnection diagrams must be keyed to accompanying cable identification lists. The identifications lists must specify the cable conductor size and numbers, device at each end of the cable, cable identification tags, key number and drawing sheet(s) on cable layout and interconnection diagrams where the cable appears, shielding attributes, and pertinent remarks.

1.12.6 System interconnection diagrams must contain the detailed terminal connection identification, and mating connector identification to permit positive and unique identification of each connection, and the units connected.

1.12.7 Wiring interconnections based on the interconnection and terminal identification drawings.

1.12.8 Details of cable shielding and grounding for each cable.

1.12.9 Details of cable runs, transits, and cable identification tags system and cable markings.

1.12.10 The Contractor must identify and record an overall wire numbering scheme for the propulsion control system. All wires are to be clearly identified at either end, on either side of transits and at terminations in terminal blocks. All wire terminations and terminal blocks are to be clearly identified in accordance with the overall wire numbering scheme for the propulsion control system.

1.12.11 Each working drawing for non-catalogue items must be prepared specifically for this project. Working drawings and brochures for catalogue items must be clearly marked to show the items being supplied.

1.12.12 Each working drawing or catalogue sheet must be stamped and signed by the Contractor to indicate that:

I. The drawing has been checked for conformance with all specification requirements;
II. The equipment has been coordinated with other equipment to which it is attached and/or connected;
III. All dimensions have been verified to ensure the proper installation of equipment within the available space.

1.12.13 The Contractor must prepare a schedule fixing the dates for the submission of working drawings for design review by Class and CCG and approvals by Class and TCMS.

1.12.14 The Contractor must keep one up-to-date copy of all working drawings of the vessel, in good order, available for review by Canada.

1.12.15 The Contractor must specify the means of blanking off cable transits through decks or bulkheads if they are not to be used for the retained equipment. The Contractor must specify the removal of redundant wiring. The Contractor must specify the means of filling in any area vacated by removed equipment and not reused in the new configuration. Where the Contractor finds it necessary to install new cable transits, approved cable transits systems must be installed that are of modular design and allow individual conductors of varying size to be installed. The transits must be sized in accordance the number and type of conductors passing through them and must have a 10% allowance for new conductors of the same type and size to be installed at a later date. The transits must be Roxtec or equivalent.

1.12.16 The Contractor must prepare the production schedule for removals, installation, testing, and commissioning of the new system. The production schedule must show the estimated duration and labor loading of major tasks. The production schedule must include critical path assessments.

1.12.17 The Contractor must submit with the working drawings a QA Inspections, Tests, and Trials Plan for the installation phase.

1.13 As Fitted Drawings

1.13.1 Upon completion of all project work, the Contractor must transfer all mark-ups from the working drawings where installation changes were made to a final revision of all vessel drawings affected by the project work. These drawing must become the “As Fitted”

drawings for the project work. The Contractor must be responsible for updating all vessel drawings affected by the project work. Prior to completion of the Contract, the Contractor must supply to the TA the following:

i. Five (5) plotted copies of the latest revision of each of the "As Fitted" drawings;
ii. Three (3) electronic copies of the latest revision of each "As Fitted" drawing on CD-ROM media in AutoCad 2002 DWG format. CD-ROM media must be supplied with detailed file lists for each CD-ROM.

1.13.2 All drawings shall become the property Canada.

1.13.3 Plotted drawings must be on standard ANSI paper sizes.

1.14 Factory Acceptance Trials, Installation, Commissioning, and Sea-Trials

1.14.1 The Contractor must conduct software and hardware Factory Acceptance Trials (FAT) of the assembled control systems with simulated inputs and outputs of the vessel main engines, clutches, propellers and thrusters. The FAT trials must be conducted with the actual hardware and software to be installed on the vessel. The Contractor must conduct the software and hardware factory acceptance and integration trials in the presence of the attending Class surveyor, the CCG Technical Authority (TA), and TCMS. The Contractor must provide ten (10) business days' notice of the start of the FAT trials to the CA, IA, TA, and TCMS at a minimum.

1.14.2 The FAT must demonstrate the satisfactory operation of all components and functions of the new systems to the requirements of Class and TCMS. The FAT must test the conclusions of the Functional Failure Analysis and Failure Mode and Effects Analysis (FMEA).

1.14.3 The FAT must include all operating conditions of the propulsion systems, thrusters, and steering systems in all modes of operation. The trials must include simulated electrical loads imposed by bow and stern thrusters during maneuvering, and thruster starting and stopping; propeller loads in ice-breaking, including the propeller becoming stalled in ice in order to test clutch slip and auto declutch conditions. The Contractor must demonstrate to the IA and the TA that all WH indications and visual display screens are capable of being dimmed from 100% to zero illumination during the FAT.

1.14.4 The Contractor must conduct software and hardware commissioning and sea-trials of the fully installed control systems. These trials must be conducted in the presence of the attending Class surveyor, the CCG Technical Authority (TA), and TCMS. The Contractor must provide 72 hours notice of the start of the trials to the CA, IA, TA, and TCMS at a minimum.

1.14.5 The commissioning and sea-trials must demonstrate the satisfactory operation of all components and functions of the new systems to the requirements of Class and TCMS. The trials must test the conclusions of the Functional Failure Analysis and Failure Mode and Effects Analysis (FMEA).

1.14.6 The commissioning and sea-trials must include all operating conditions of the propulsion systems, thrusters, and steering systems in all modes of operation. The trials must include loads imposed by thrusters during maneuvering, and thruster starting and stopping; simulate the propeller loads in ice-breaking, including the propeller becoming stalled in ice in order to test clutch slip and auto declutch conditions. The Contractor must demonstrate to the IA and the TA that all WH indications and visual display screens are capable of being dimmed from 100% to zero illumination.

1.15 Operator Stations - General

1.15.1 The operator stations in the Wheelhouse and MCR must be built with drop in panels containing the new equipment, and must include reconfiguring retained existing console equipment and devices. The existing console tops at each Wheelhouse and MCR operator stations are to be removed and replaced with new tops to accommodate all retained and new equipment. The console tops must be structurally sound to prevent vibration, and designed to be easily reconfigurable to accommodate future replacement of console devices and equipment.

1.15.2 The reconfigured consoles must group indications and controls logically by systems and equipment under control. The proposed configurations must be submitted to the IA and TA for review, comment and approval prior to construction.

1.15.3 The Contractor must reconfigure the Wheelhouse console layouts and ensure that control devices and instrumentation are laid out in a consistent manner between the various Wheelhouse operator stations with ergonomic consideration to user accessibility and comfort, and in an easily interpreted visual presentation. The port and starboard wing consoles shall be mirror images of each other.

1.15.4 The port and starboard wing console tops shall be removed and replaced with new console tops accommodating retained existing equipment and new equipment. The new console tops must have the forward one half to one third of the surface raised at an angle such that light reflecting from the indicator lens fronts does not obscure the indicators when viewed from aft of the console.

1.16 Visual Displays and User Input Devices

1.16.1 The operator stations must have a clean logically organized and ergonomically designed layout. Direct access User Input Devices (UID) such as levers, pushbuttons, rotary and toggle switches and indicating devices such as analogue style gauges and indicator lamps must be utilized for controls and indications as specified in Section 2.0. Indicator lamps must employ LED technology.

1.16.2 VDS, keyboard, and track-ball or wheel type pointer devices, or touch type VDS are acceptable for controls and indications not required to be available in direct access UIDs, analogue style gauges and indicator lamps.

1.16.3 VDS must be of TFT-LCD type, and touch screens must be of the dual resistive/capacitive type.

1.16.4 VDS must have Class Type Approval, and the arrangement and number at each operator station must have Class Approval.

1.16.5 UID or combined UID with indicating elements must be easily distinguishable from elements used for indicating only. UID devices such as levers and rotary switches must be arranged for one hand operation and avoid the need for fine operator motor movements.

1.16.6 Alarm messages for essential, safety, and emergency alarms must , when initiated, be given priority over any other information presented on the VDS. Alarms must be time tagged with a time stamp synchronized so that the true sequence of events may be traced in the alarm list.

1.16.7 All wheelhouse illuminated devices and indicators, including VDS must be progressively dimmable from full to zero illumination, individually or in groups. All such illuminated devices and indicators must not emit any light when dimmed to zero illumination. Zero illumination is defined as no emission of light in conditions of total darkness. Dimming for the active alarm must be automatically by-passed when an alarm is activated. Acknowledging the alarm must restore the dimming function.

1.17 Documentation

1.17.1 The Contractor must prepare all documentation for the design, approval, installation, inspections, tests, trials and control of the Work. The Contractor is responsible for the accuracy, revision and distribution control of all such documentation. The Contractor must submit all documentation required by the Approval Authorities for information and approval. The Contractor must also submit all such documentation to the IA and TA for review and comment.

1.17.2 All drawings and documents required for inspection and approval by TCMS are to be submitted to TCMS with Class component and device certificates and Class approved particulars and drawings.

1.17.3 The Contractor must designate a project team member responsible for managing the distribution and revision of all documents and drawings for this project. The designated member must manage distribution and revision tasks according to a defined procedure identifying the roles and responsibilities of all parties involved. The Contractor must submit the document management procedure to the IA and TA for review and comment.

1.17.4 Documentation Types and Content

1.17.4.1 Documentation Types and Content must be as described in Appendix A to this specification. Provided the Contractor submits all the required information a document submitted may cover more than one Documentation Type and Content.

1.17.5 Documentation Format

1.17.5.1 The Contractor must submit documentation and drawings in the following general formats or in the particular formats required elsewhere in this specification.

1.17.5.2 Each drawing and document must include a title field stating:

i. Vessel Name;
ii. Name of document issuing company;
iii. Name and signature of originator and verifier;
iv. Drawing or document number;
v. Drawing or document title;
vi. Revision record and revision number;
vii. Issue date;
viii. Scale.

1.17.5.3 The document title must not include the vessel name. The document title must include the function or component covered.

1.17.5.4 Reports and documents prepared for the Work of this Specification must be typewritten or printed on 8 1/2" X 11" paper and securely bound in standard 3-ring binders. Hand written notations are not acceptable on final documents and final drawings. Electronic copies of reports, certificates, manuals, instruction sheets, must be in Adobe PDF format on CD-ROM media. The CD-ROM media must contain an index with file name, document title, and full description of the file contents in MS-Excel spreadsheet format.

1.17.5.5 Electronic copies of drawings must be in AutoCAD DWG format, 2002 or later. Electronic versions of new drawings prepared for the Work of this Specification must be vector drawings.

1.17.5.6 The Contractor must revise each of the supplied vessel drawings which require revision as a result of the Work. All vessel drawings supplied to the Contractor and required to be revised must be updated in AutoCAD .DWG format, 2002 or later, and must be in vector format.

1.17.6 Drawings – General

1.17.6.1 All drawings produced by the Contractor or its sub-contractors must be 100% AutoCad 2002 DWG format compatible. Drawings supplied in electronic format must become the property of the CCG. Drawings must not be electronically protected so as to be Read Only files.

1.17.6.2 A complete list of layer names and brief description of each layer’s use must accompany all files. Where possible, layer names, layer colour codes, and layer line types must be standardized across the various drawings.

1.17.6.3 Fonts for text must be AutoCAD 2002 standard. Custom fonts, shapes, files, etc. are not to be used.

1.17.6.4 Blocks are not to be grouped. All text included in a block must be an attribute.

1.17.6.5 All disks must be clearly labeled with the CCG requisition number F2599-135057, and project name. A table of contents in a “readme.txt” file in ASCII format must also be provided with each disk. The table of contents must cross reference the file name with the name of the drawing or document contained in the file. A printed

copy of the readme file must accompany each disk. Disks must be labeled "As Fitted" drawings for those drawings that have been approved and finalized.

1.17.6.6 A complete list of symbol (block) names with a description of each symbol must be provided. Blocks must be provided in electronic format suitable for use with AutoCAD 2002.

1.17.6.7 Special effort must be made to ensure that drafting in AutoCAD is accurate: i.e. appropriate lines are indeed horizontal and vertical; lines that should intersect do but not over-intersect and ensure that entities are placed on correct layers.

1.17.6.8 Drawing sheet sizes, including where possible vendor drawings, must be ANSI standards with standard border and title block in the layout section.

1.17.7 Documentation Submission

1.17.7.1 The Contractor must submit documentation according to the schedule in Appendix A

1.17.8 Final Report

1.17.8.1 The Contractor must supply a Final Report for the Work of this specification within four (4) weeks of the commissioning date. The Final Report must consist of the final approved as-fitted versions of each drawing, and all other documentation produced for the Work.

1.17.8.2 The Final Report must contain bills of materials containing full data identifying the make, model, serial numbers and component ratings. The Contractor must provide bills of materials and spare and maintenance parts lists in the MS-Excel spreadsheet format of the provided file, or CSV .txt file in addition to the paper and PDF format versions required in Section 1.17.5. The provided MS-Excel spread sheet is arranged for direct importation of data into the CCG maintenance and inventory management data base.

1.17.8.3 The Final Report must be submitted in paper and electronic versions. The paper version must be bound and arranged in a logical presentation according to systems and subsystems, with tables of contents, and securely bound in one or more volumes. The electronic version must be similarly arranged in a logical presentation according to systems and subsystems, with tables of contents. Electronic file names must indicate clearly the contents of the file.

1.17.8.4 The Contractor must provide four (4) copies of the paper version and two (2) copies of the electronic version.

1.17.9 Integration Management

1.17.9.1 The Contractor must designate a project team member who must be responsible for managing the integration of all new and retained existing systems and components for the Work of this project. The designated project team member must manage integration tasks according to a defined procedure identifying the roles and

responsibilities of all parties involved. The management procedure must be submitted to Class for approval and to the IA and TA for review and comment.

1.17.9.2 The designated project team member must have technical training and recent experience in the integration of programmable electronic systems and marine propulsion equipment and the resources to enable a controlled integration process.

1.17.10 Environmental Service Conditions

1.17.10.1 The Contractor must ensure that all components and assemblies of components meet at a minimum the requirements of IACS UR E Concerning Electrical Installations Section E10, latest revision. The Contractor must provide Class certification of compliance with this standard. If Class Rules require a more stringent test procedure the Contractor must provide Class certification of compliance with the Class requirement.

1.17.10.2 In addition the Contractor must ensure and provide Class certification that engine mounted fuel actuators must operate satisfactorily in 9G and greater environmental vibration, tested according to IACS E10, and that all other components and assemblies of components must operate satisfactorily when subjected to repeated shock loads of ±4 G vertical and ±4 G horizontal, tested according to IACS E10.

1.17.11 Enclosures

1.17.11.1 Enclosures for the equipment must be made of steel or other flame retardant material capable of providing protection from electro-magnetic interference and satisfy the minimum enclosure requirements below. Electrical terminals must be protected to prevent inadvertent contact.

1.17.11.2 Consoles, cabinets, and panels mounted in the WH or MCR must meet NEMA 4 rating at a minimum. Consoles, cabinets, and panels mounted in the Engine Room or machinery spaces must meet NEMA 4.

1.17.11.3 Equipment mounted below floor plates must meet NEMA 4X.

2.0 PROPULSION CONTROL SYSTEM

2.1 The propulsion control systems provide automatic remote control, manual remote control, manual local control and emergency control of the main engines, gear boxes, clutches and controllable pitch propellers. Automatic remote control and manual remote control must be available from the WH and MCR operator stations. Local control must be available at the local engine panels and OD boxes.

2.2 For clarity, manual remote control refers to the directly hard-wired controls for speed, pitch, and clutch engage and disengages which by-pass the Propulsion Control Systems (PCS) for use when the PCS or portions are in failure. Emergency control refers specifically to the direct, hard wired controls for main engine stop and for clutch disengage for use in an emergency. Manual remote control and emergency control must be available from the WH and the MCR as required below.

2.3 Technical

2.3.1 The Contractor must design the new systems such that the engine speed, load and propeller pitch relationships provide optimum fuel economy in combinator mode and in constant speed mode. The design must provide optimum load control and propeller pitch response in ice-breaking mode. The Contractor must ensure that the new systems operate the equipment under control (EUC) within the safe torque limits of propellers, shafting, gearing and prime movers.

2.3.2 Components for Removal and Replacement

2.3.2.1 The entire FAMP-S system and subsystems including local panels and control stations:

i. Tesy-1 Telegraph Controls system;
ii. Torductor system;
iii. Woodward 723 governors, and Woodward fuel rack actuators;
iv. ASEA Safety Panel QHFS 102 and shut downs;
v. Deuta Werka clutch slip monitoring systems;
vi. Wartsila DESPEMES systems/Deutz speed monitoring system;
vii. Main and PTO clutch control systems;
viii. Emergency pitch control systems;
ix. Field instrumentation and field instrumentation wiring.

2.3.2.2 The entire electronic control system is to be removed and replaced with the exception of the forward Joystick Control System, which is not being replaced.

2.3.2.3 The components of the Joystick Control System are to be removed. The Joystick panel at the WHA operator station must be renewed with an updated system with similar capabilities to the existing. The existing Joystick junction box in the Electronics Room, and the Joystick panel and processor at the WHF operator station are to be removed. All Joystick system wiring is to be removed.

2.3.3 Propulsion Control Systems

2.3.3.1 In summary, the Propulsion Control Systems perform the functions listed below. The Contractor must refer to the full descriptions of the functions, control stations, device locations and logic in the CCGS Samuel Risley systems manuals and drawings before proceeding with detailed design work.

2.3.3.2 The general layout of the FAMP-S systems can be seen in the cable diagrams ASEA DWG L4678.1006 X1 800 034-AD s 1-2, and cable list L4678.1006 X1 800 034-AE s 1-9. The interconnection diagrams can be found in L4678.1006 X1 800 034-AF s 1-75, and the technical descriptions in the ASEA manuals.

2.3.4 FAMP-S

2.3.4.1 The central processor components of the FAMP-S system are in the Port and Starboard DS-8 cabinets in the Machinery Control Room. There is one cabinet per shaft line. The cabinets contain the AC power supply; DS-8 based microprocessor; relay and diode cards; and terminal blocks.

2.3.4.2 The FAMP-S performs the following functions:

i. Pitch regulation;
ii. RPM regulation;
iii. Engine and Pitch Control according to six selectable speed/pitch curves in response to engine commands from the Tesy-1 Telegraph system and the Joystick control system. There are 6 speed/ pitch curves since each of the modes Combinator, Constant, and Ice-Breaking may be operated with one or two engines per shaft;
iv. Automatic load control to ensure optimized and stable loading of the main engines, and prevent overloading of the engines in heavy sea states and icebreaking;
v. Remote Main Engine start and stop functions in normal operation and emergency overrides;
vi. Safety guard system;
vii. Wrong Way Pitch alarm;
viii. Main and PTO Clutch engage and disengage functions in normal operation and emergency operation;
ix. Engine order communication via the TESY-1 Telegraphs in MCR and manual control;
x. Order Communication System, for control station transfer, operation mode selection;
xi. Alarm and Indication System, internal function and fault monitoring, alarm signal outputs to the Noris system (Note: Engine Load, Engine RPM, Shaft RPM and Pitch Feedback originally supplied by FAMP have been replaced with independent sensor feedback to Noris Alarm System due to compatibility issues);
xii. Parameter signal outputs to MCR and Wheelhouse operator stations;
xiii. Fault Tracing Aids, Memory check and Simulation;
xiv. Fault indications for remote control failure or pitch failure;
xv. Load increase Time Program including program bypass;
xvi. Steering Control System Interface;
xvii. Load and Temperature dependent system;
xviii. Joystick Interface.

2.3.5 Speed and Pitch Curves

2.3.5.1 The operation of the current FAMP-S control system allows for the following Pitch and RPM\load matching Control Modes with one or two engines per shaft:

2.3.5.2 COMBINATOR MODE: The FAMP-S system varies both engine speed and propeller pitch to drive the vessel at optimum fuel efficiency. RPM and PITCH curves are matched to avoid system imbalance of low pitch and high RPM, or main engine overload condition of high pitch and low rpm.

2.3.5.3 CONSTANT RPM MODE: The FAMP-S system operates the main engine(s) at 900 RPM and varies propeller pitch to achieve desired thrust. This mode is also used to operate the shaft generators for the thrusters or for ship's service at sea. The power to operate the shaft generator breakers is taken from the Shaft Generators such that the breakers cannot be closed below 900 RPM +/- 10%. Closing either Shaft Generator Breaker shifts the FAMP-S system to Constant RPM mode for the specific generator's shaft line. An electrical interlock prevents the generators from being automatically declutched once the breakers are closed.

2.3.5.4 ICEBREAKING MODE: The FAMP-S system operates similar to CONSTANT RPM MODE with engines maintaining 900 RPM. There are some changes in the load control to prevent overload when ice-breaking and increase engine fuel position and pitch reaction time. In addition the FAMP-S will signal the steering control system to center the rudders when the propeller is in astern pitch.

2.3.5.5 SIMULATION MODE: This is a non-operational mode that allows the user to operate the propulsion and telegraph system without rotating the shafts for diagnostics and system set-up with the CPP system pressurized.

2.3.6 Woodward Governors

2.3.6.1 Each main engine is fitted with a Woodward 723 electronic governor. The governors are fitted in the MCR, with hydraulic rack position actuators fitted on each engine. The governors control engine speed from speed setting signals from the FAMP-S. Load limiting is performed by the FAMP-S system and load sharing between two engines clutched to one shaft is performed by the governors.

2.3.7 Telegraph System

2.3.7.1 The existing TESY-1 telegraph system is an integrated system for both engine order communication between the WH and MCR and local stations when the machinery is in manual control and for pitch command input to the FAMP-S system from the WH when the vessel is in automatic and remote control.

2.3.7.2 The TESY-1 telegraphs have LED indicators arranged such that the in control lever position is indicated at each telegraph.

2.3.7.3 The TESY-1 telegraphs permit control transfer between WH stations only when the command setting is matched within 20% of load.

2.3.7.4 The TESY-1 stations are located at the WHF, WHP, WHS and MCR operator stations consoles, and at each pair of engines. The telegraph operating mode selection switch is at the MCR operator station. See ASEA DWG L4678.1006 X1 800 034-AF sheets 57 to 69.

2.3.7.5 The existing ASEA panels QHFB 101 at the WHF and QHFB 102 at the MCR operator stations contain a sub-telegraph function for ordering and activating various control modes, and for indicating various control mode status conditions. There is one pair of panels for each shaft line. The control modes are:

i. BC Control (Bridge Control);
ii. CRC Control (Control Room Control);
iii. Stand-by;
iv. Finished With Engines;
v. Combinator;
vi. Constant Speed;
vii. Ice-breaking.

2.3.7.6 The control mode commands are input to the FAMP-S by the QHFB 102 panel.

2.3.7.7 Control transfer between the WH and MCR is effected by the QHFB-101, QHFB-102 panels in conjunction with the BC/CRC control selector switch on the MCR console. The order communication and execution logic is described at the FAMP-S Manual, Section 5, pages 25 and following.

2.3.7.8 Additional control at the MCR in the QHFB 102 panel is Load Limit command to FAMP-S.

2.3.7.9 Additional controls at the WHF station in the QHFB 101 panel are for:

i. Emergency stop;
ii. Pitch control via the TESY-1 levers;
iii. Load Increase/Decrease program override.

2.3.8 Wärtsilä DESPEMES System

2.3.8.1 The DESPEMES panel mounted on each engine measures main engine and turbocharger speed by inductive pick up probes, and mechanical over speed device trip by a contact switch.

2.3.8.2 The panels send an alarm signal to the ASEA Safety Panel QHFS 102 for mechanical over speed trip. The turbocharger RPM signals are processed and sent to the MCR console. The main engine RPM signals were disused at the installation of the Woodward governors. RPM signals are also sent to the local panels for indication.

2.3.9 Torque Measuring

2.3.9.1 There is one ASEA Torductor mounted on each shaft. Torque signals are sent to the FAMP-S system for load control and gearbox control purposes. The Torductor torque signals to the FAMP-S form an integral portion of the existing load control logic.

2.3.10 Gearbox Clutch Control and Clutch Slip Monitoring Systems

2.3.10.1 The FAMP-S system interfaces with the Woodward 723 governors and the Valmet Gearbox solenoid operated hydraulic valve system to engage and disengage the main and PTO clutches. Clutch Automation is described in Section 6 of the ASEA FAMP-S Manuel and is to be read in conjunction with the appropriate sections and drawings of the Valmet Manual. The Wheelhouse cannot perform normal clutch engage or disengage functions as described in the FAMP-S manual, but can perform an emergency disengage.

2.3.10.2 There is one Deuta Werka panel mounted for each Gearbox. The Deuta Werka clutch slip monitoring functions are described in Section 10 of the Valmet Manual. The system has three speed sensor inputs: one from each Engine Clutch Pack and one from the Main Shaft Drive. Comparator cards are used to monitor Drive shaft and Clutch RPM. Should a 3% difference in speed exist FAMP will receive a clutch out signal after 8 seconds and the Slip Alarm will be indicated. Should a 5% or greater mismatch exist then a signal to FAMP will occur after 5 seconds.

2.3.10.3 The Torductor signal is used by the FAMP system for clutch disengage on over torque. The Woodward governor RPM signal is used at relay SJ135 to disengage the main clutches, or prevent engaging the main clutch when engine speed is below 400 RPM.

2.3.11 Controllable Pitch Propeller Control Systems

2.3.11.1 The FAMP-S system directly controls the propeller pitch via the OD box electrically actuated hydraulic valves. The Combinator function program is contained within the FAMP-S programming.

2.3.12 Propulsion Control Systems

2.3.12.1 The Contractor must design and supply new systems such that the control functions and capabilities of the existing systems are retained with such changes as are necessary to meet the current requirements of the Approval Authorities, and such changes as required by this specification.

2.3.12.2 In summary, existing operator stations have the following capabilities for operator command:

i. Pitch and speed via TESY-1 to the FAMP-S at WHF, WHP, WHS and WHA;
ii. Pitch and speed via the Joystick system to the FAMP-S at the WHA panel, and a portable panel with plug in connection at WHP and WHS;
iii. Pitch only via TESY-1 at the WHF, by selecting “Emergency Pitch on panel QHFB 101;
iv. Pitch only via Emergency Pitch Bypass panels, at all WH and MCR;
v. Pitch and speed at MCR, manual to FAMP-S and governors;
vi. Local control at ME governors and OD box.

2.3.13 Pitch and RPM Matching and Load Control

2.3.13.1 The Contractor must provide in the new systems new pitch, RPM and engine load curves based on the existing pitch, RPM and load curves, and on the Contractor’s

direct observation of vessel, propeller, and engine operating characteristics. The existing pitch, RPM and load control is described in the FAMP Manual Section 5. The new pitch, RPM and load curves must be based on both one (1) and two (2) engines per shaft. The pitch, RPM and load curves must be incorporated into the software of the new systems, and must be capable of adjustment and fine tuning based on sea trials and post installation operational data.

2.3.13.2 The Load Control function must include the functionality of the existing system as described at FAMP Manual Section 5, sub-section 1.5.3.

2.3.13.3 The PCS must also include load sharing functionality such that engine load on an engine pair is shared equally, except in the case of an uneven running up load as described in FAMP Manual Section 5 sub-section 1.5.9. The PCS load sharing function must also force the de-clutch of an engine which is operating below idle load when clutched into a gearbox with another engine.

2.3.13.4 The Contractor must design and perform trials of ship maneuvering and propulsion characteristics and machinery performance to gather data for the design of the new pitch, RPM and engine load curves.

2.3.13.5 The Combinator mode must be arranged to provide maximum fuel efficiency. The Constant speed mode must be arranged such that a constant 900 RPM is maintained. The Constant Speed mode must also be arranged such that when a shaft generator main breaker is closed the speed setting signal is taken from the frequency of the shaft generator bus, and a constant 60 Hz +/- 0.5 Hz is maintained.

2.3.13.6 The Ice-Breaking mode must be arranged to prevent the high load and high engine speed overshoots typical in ice-breaking service, and to provide more rapid adjustments to fuel rack position and to propeller pitch position in ice-breaking. The Contractor must provide the rudder centering feature of the Ice-breaking Mode with an operator selectable override.

2.3.13.7 The Load Increase/Decrease program must limit the actual load of the engine to prevent damage due to excessive loading before the engine is fully warmed up. The Load Increase/Decrease program must be based on individual engine temperature and load memory similar to the existing program, and must permit individual running up of two engines coupled to the same shaft. The Load Increase/Decrease program must have an operator selectable override to permit full loading of the engines in emergency conditions.

2.3.13.8 The propeller shaft output power and torque calculation device must include the direct measurement of shaft strain or deflection. Calculation from pitch, speed and fuel rack setting alone is not acceptable.

2.3.14 Governors and Actuators

2.3.14.1 The new systems must include individual systems for main engine speed governor and fuel rack actuator for each main engine. The existing Woodward governors must not be reused. The new governor systems, governor, fuel rack actuator, and

power supplies must be mutually independent from all connected systems, and must be independent of the PCS such that a full failure of the PCS processor, power supply, and communication bus links must not impair the governor and fuel rack actuator function, and such that engine speed local control is available.

2.3.14.2 The governors must be capable of receiving speed inputs from all operator stations, with manual fuel and RPM limiting adjustable from the MCR control panel; automatic tuning of the fuel rack actuator; internal self-checking and fault alarm. Each governor must have two mutually independent engine speed measuring sensors and sensing loops.

2.3.15 PCS Telegraph, Emergency Telegraphs, Sub-telegraphs

2.3.15.1 The engine telegraphs for command input to the PCS for automatic and remote control from the WH and the MCR must be a lever type unit with detent positions for stop, ahead full and astern full. The PCS telegraphs must also be marked with a scale of 0 to 10 ahead, and 0 to 10 astern, and the levers must be capable of being set and fixed at any point along the scale. A separate pushbutton or rotary dial emergency telegraph with the same markings for stop, ahead full, half, slow, dead slow and astern full, half, slow, dead slow must be provided for emergency engine order communication between the WH and MCR, and between the WH and local station when in emergency manual remote or local control.

2.3.15.2 The PCS telegraphs must be at the WHF, WHP, WHS, WHA and MCR operator stations. The emergency telegraphs must be at the WHF, MCR, and local control stations.

2.3.15.3 When in automatic and remote control from the WH the WH PCS telegraphs must input speed and pitch maneuvering command signals to the PCS. The PCS telegraphs must also be capable of inputting pitch commands only, similar to the existing “Emergency Pitch Control” available at WHF QHFB 101 Panel.

2.3.15.4 When in automatic and remote control from the MCR the PCS telegraphs must communicate maneuvering orders and operator responses between the WH and MCR. The MCR operator action of matching the order with the PCS lever must input speed and pitch maneuvering command signals to the PCS.

2.3.15.5 When in manual remote control from the WH the WH operator must manually input pitch commands through the by-pass manual remote controls to the OD box solenoids.

2.3.15.6 When in manual remote control from the MCR the emergency telegraph must communicate maneuvering orders and responses with the MCR emergency telegraph, and the MCR operator must manually input speed and pitch commands through the by-pass manual remote controls to the governors and OD box solenoids.

2.3.15.7 When in local control the system must be capable of receiving manual operator input speed commands to the governor and manual input pitch commands to the

OD box. When in local control the emergency telegraph must communicate maneuvering orders and responses with the local emergency telegraph, and the MCR operator must manually input speed and pitch commands directly to the governors and OD box solenoids.

2.3.15.8 The control strategy for manual remote or local control must be to set the engine speed at 900 RPM and maneuvering must be done by changing pitch.

2.3.15.9 The PCS telegraphs must have LED indicators arranged such that the in control lever position is indicated at each telegraph and must permit control transfer between WH stations only when the command setting is matched within 20% of load. The MCR PCS telegraphs must indicate the WH in control lever position at all times, and be capable of receiving control with unmatched command settings.

2.3.15.10 When in MCR control the PCS telegraphs must communicate the WH command via flashing LED lamps, an audible buzzer in the MCR and WH, and a continuously ringing bell in the ER. When in MCR remote manual or local control the emergency telegraphs must communicate the command via flashing pushbuttons, an audible buzzer in the MCR and WH, and a continuously ringing bell in the ER. In all cases, acknowledging the command must change the LED to steady on, and silence the audible alarms

2.3.16 Operator Initiated Start/Stop Functions

2.3.16.1 The PCS must have a start and stop function initiated by an operator command available from the MCR operator station similar to the FAMP-S start and stop functionality. The PCS must have start blocking similar to the existing system. The FAMP-S Start and Stop functions are described in the FAMP-S manual Section 7.

2.3.16.2 Engine starting and stopping must require a two-step UID input sequence similar to the existing start and stop execute push button arrangement.

2.3.16.3 The original ASEA starting fuel limiting function was disabled at the installation of the Woodward governors. The PCS must have a starting fuel limiting function to limit poor combustion and exhaust smoke at engine start.

2.3.16.4 There must be an Emergency Start function available from the MCR operator station duplicating the FAMP-S Emergency Start functionality. The Emergency Start function must be accessible through a keyed switch and pushbutton, similar to the existing system.

2.3.16.5 There must be an Emergency Stop function by-passing the PCS and directly hardwired to the engine shutdown solenoid. The Emergency Stops must be activated by illuminated push buttons in the MCR and each WH operator station. The push buttons must show no illumination in normal operation, and red when activated. The Emergency Stop button must be protected against inadvertent operation by a clear hinged cover. Only the activated pushbutton must illuminate.

2.3.17 Clutch Control Functions

2.3.17.1 The clutch control functions must be similar to the FAMP-S clutch control logic for automation and monitoring, and for clutch disengage on external, internal and safety system disengage commands with the modifications required to accommodate the input shaft modifications.

2.3.17.2 The existing clutch control functions are described at the FAMP-S manual, Section 6, with logic diagram, and the Valmet Manual, Section 8, for clutch operation, and Section 10 Deuta Werka, for slip monitoring. The new PCS must include within its functions the functions of time relay SA105, Item 220 on Valmet drawing 5K036-3030 Rev C.

2.3.17.3 Normal clutch engagement and disengagement must require a two step input sequence for operator commands similar to the existing arrangement.

2.3.17.4 The new system must have a two (2) stage indication of engage and disengage actions similar to the existing system. When an operator input command is made the clutch lamp flashes to indicate that the clutch will be engaged or disengaged when all conditions are fulfilled. The lamp becomes steady when the clutch is detected as safely engaged or disengaged, respectively. The new system must have a similar arrangement for indicating system checking of conditions and detecting the clutch safely engaged and disengaged.

2.3.17.5 The PCS must display on the MCR VDS a mimic of the clutch control logic with indications of the logical states such that the operator can readily determine the status of the clutch controls, control actions, permissive states and all automatic and manual engage and disengage commands.

2.3.17.6 During normal operation the normal clutch disengage command must be blocked when the respective shaft generator breaker is closed.

2.3.17.7 There must be by pass emergency clutch disengage controls for each shaft line at each WH operator station.

2.3.17.8 The input shaft arrangement for the inboard main engines has been modified on the CCGS Samuel Risley only. The original arrangement includes a quill shaft such that the inboard main engine was rigidly connected to the quill shaft at all times. The PTO clutch at the aft end of the quill shaft could then be engaged to drive the shaft generator without engaging the main clutch. This allowed the vessel to use the shaft generator without turning the propeller. The input shaft has been changed to a solid shaft, with the PTO clutch at the aft end, and the main clutch at the forward end in order that either the inboard or outboard main engine can drive the shaft generator. This will require changes to the clutch control logic.

2.3.18 Emergency Panel MCR Console

2.3.18.1 The manual remote controls for by-pass clutch control, Emergency Start and Emergency Stop with indication LED lamps must be grouped on the MCR console as on the existing console. There must be a keyed switch for controlling the

clutches and emergency start similar to the existing panels such that the switch must be in the on position for these controls to function. The Emergency Stop buttons must be as required in 2.3.16.5.

2.3.19 Control Mode Selection and Transfer

2.3.19.1 Control mode selection for Combinator, Ice-Breaking, Constant Speed must be available at the MCR operator station. The selected mode must be indicated at the WHF operator station by LED lamps.

2.3.20 Control Transfer

2.3.20.1 The control station order of priority from highest to lowest must be local control, MCR control, WH control. The control transfer system between the MCR, and the WH must be arranged such that in normal operating conditions control cannot be sent to the other station without transfer being requested at the receiving station. The control transfer system must be arranged such that when control is taken from a position of lower priority without prior communication the control transfer is alarmed at the station losing control.

2.3.20.2 The control station in control must always be indicated at all operator stations, with the exception that the “WH in control” indications in the MCR and at the local stations must be group indications for all WH positions. Each WH position must indicate which WH position is in control.

2.3.20.3 There must be an arrangement of push-button sub-telegraphs and selector switches similar to the existing ASEA system, for communication of WH orders to the MCR, and input of command signals from the MCR to the PCS for the following control functions:

i. WH in Control;
ii. MCR in Control;
iii. Combinator mode;
iv. Constant RPM mode;
v. Ice-breaking mode
vi. Load Increase Program bypass.

2.3.20.4 Propulsion control transfer and sub-telegraph communication logic coupled with the use of a selector switch for control transfer between the WH and MCR must be similar to the existing arrangement. In the existing system the WH or MCR initiates control transfer by pressing the “Bridge Control” sub-telegraph pushbutton. The WH or MCR then acknowledges the order by pressing the corresponding “Bridge Control” button. This action also functions as the required acknowledgment of control transfer such that control is transferred immediately on the MCR selector switch being subsequently moved to the “Bridge Control” position by the MCR operator.

2.3.20.5 The existing selector switch has three positions “”BC”, “ERC Auto”, and “ERC Man”.

2.3.20.6 The WH request and MCR selection of Combinator, Constant Speed, or Ice-breaking mode must be similar to the existing system. The existing system uses mode selection push buttons in combination with indicator lamps and an Execute push button. The MCR will request a mode change by pressing the desired mode beside indicator lamp as labeled:

i. COMBINATOR MODE
ii. CONST. RPM MODE
iii. ICE BREAKING MODE

2.3.20.7 The WH acknowledges the mode change by pressing their corresponding button, or denies the change by pressing a different mode button. Once the bridge acknowledges new mode change the MCR operator depresses the mode button desired and the EXECUTE button to establish new MODE.

2.3.20.8 The PCS must automatically select the appropriate load and speed curves based on the number of main engines clutched into each gearbox.

2.3.20.9 The sub-telegraph must include push-buttons for order communication between the WHF and MCR for:

i. Stand-by;
ii. Finished With Engines;

2.3.20.10 These pushbuttons and functions must be for order communication only, and must not be a part of the engine control interlocks and blocking.

2.3.20.11 Control transfer between the local stations and the MCR must be by a covered changeover switch, “Local”/”Remote” at the local stations. Selection of “Local” must disable the PCS input to the governor and CPP controls and allow manual setting of the governor and CPP OD box. Activation of local control must cause an alarm at the MCR and WH.

2.3.20.12 Control transfer for propulsion control between the Wheelhouse operator stations must be by a single pushbutton at each station, similar in function to the existing transfer system. The Wheelhouse operator station in control must be indicated at each operator station in the Wheelhouse. Control transfer between Wheelhouse stations must incorporate control transfer for Propulsion Control, Bow Thruster, and Stern Thruster control such that a single pushbutton command transfers control. The Contractor must incorporate into the control transfer system switch contacts and wiring between the switches and the new system components such that control transfer for joystick control may be added. Transfer between WH stations must only be possible when the propulsion and thruster control positions are matched.

2.3.21 Data Communication

2.3.21.1 The PCS response delay for propulsion control, safety system functions and alarm display data communication must not exceed 0.010 seconds during the system’s worst data overload operating condition. The response delay is to be taken as the

time between detection of an alarm or safety critical condition and the display of the alarm or actuation of the safety system.

2.3.21.2 Data communication must be based on industry standard bus communication protocols.

2.3.21.3 Data communication is to be automatically restored within 45 seconds in the event of a single component failure, with priority given to updating safety critical data and control, alarm, and safety related data for essential services. The FAT must test and demonstrate the assembled systems response delay and restoration of data communication characteristics.

2.3.21.4 Data communication must follow a priority sequence of:

i. Safety System data and actions;
ii. Controlled machinery parameters and control actions;
iii. I/O data changes.

2.3.22 Main Engine Safety Systems

2.3.22.1 ASEA Safety System QHFS 102 panels are mounted in the MCR console and perform the following functions. The existing safety systems are described in the FAMP-S Miscellaneous Systems manual Section 2.

i. System activates at RPM rising above 400 RPM on starting;
ii. Internal self-check and loop monitoring;
iii. Shutdown signals and alarms are sent in response to these inputs:
iv. Mechanical over speed trip from DESPEMES;
v. Major governor fail from Woodward 723;
vi. Engine JW temperature high;
vii. Engine LO pressure low;
viii. Gearbox LO pressure low;
ix. Emergency Declutch;
x. Emergency stop push buttons from Wheelhouse, MCR and local stations.

2.3.22.2 The safety system resets are at the engine local panels, and on the safety system panels in the MCR.

2.3.22.3 The shutdown signals are also used to prevent engine starting in these conditions:

i. Low engine pre-lubrication oil pressure low;
ii. Engine turning gear engaged;
iii. Start blocking is active.

2.3.22.4 And to prevent engine remote starting in these conditions:

i. Corresponding clutch is engaged;
ii. The emergency start control is active;
iii. “Stop” is pressed at the same time as “Start” with the mimic panel execute button.

2.3.23 Replacement Safety Systems

2.3.23.1 The Contractor must design into the new PCS safety system functionality that provides the same functions of the existing system with such changes as are described below.

2.3.23.2 In order to approximate the latest requirements of SOLAS for Load Reduction in the special operating circumstances of ice-breaking and close escort in ice-breaking the safety system must have a two (2) stage response to an impending safety system action coupled with an initial alarm monitored and annunciated via the new Alarm and Monitoring system.

2.3.23.3 The first level of warning must be the New AMS alarms, and must correspond to the threshold warning of an impending safety system function. The Contractor must consult with the EUC manufacturers and the TA to determine suitable threshold warning set points such that the alarm must be activated in sufficient time for the WH operator to assess the navigational circumstances. The Contractor must program the set points into the new Alarm and Monitoring system.

2.3.23.4 The first stage of the safety system action must correspond to the Load Reduction function except that load must not be reduced; instead, the safety system must have a second level alarm with the indication “Load Reduction Required”. This alarm must be annunciated and acknowledged by the safety system on the safety system panels.

2.3.23.5 The second stage safety system action must be engine shutdown, or engine declutch.

2.3.23.6 The safety system load reduction request functions must include:

i. Engine LO inlet pressure low; 1st stage;
ii. Gearbox thrust bearing temperature high;
iii. Gearbox LO inlet pressure low; 1st stage;
iv. HT JW inlet temperature high, 1st stage;
v. Exhaust Gas temperature high, turbocharger outlet.

2.3.23.7 The main engine shutdown functions must include:

• Over speed measured via two mutually independent inductive pick-ups and speed sensing loops;

i. Over speed measured via a contact switch for the mechanical over speed trip;
ii. ME LO inlet pressure low; 2nd stage;
iii. Gearbox LO inlet pressure low; 2nd stage (must cause engine declutch but not engine shut down);
iv. HT JW inlet temperature high, 2nd stage;
v. Activation of an Emergency Stop button.

2.3.23.8 Main engine shut down function for over speed and activation of an Emergency Stop button must be without override. The remaining shut down functions must have an operator selectable override. The WH overrides must only function in WH control.

2.3.23.9 There must be safety system panels at the WH operator stations and at the MCR operator station with the following indications and controls:

i. Load reduction required alarm and indication;
ii. Shutdown activated alarm and indication;
iii. Shutdown override.

2.3.23.10 Means must be provided in the safety systems to indicate the cause of the safety action.

2.3.23.11 Safety system alarms must indicate at the WH operator stations, the MCR, and at the safety system local modules. The safety system displays for the cause of safety action must be indicated by LED display on each safety system module and at the MCR operator station VDS such that the operator can make an immediate determination of the safety action cause.

2.3.23.12 The safety systems must be self-monitoring for internal fault, power fault, actuator fault, sensor fault, line break, ground, and data communication fault on all channels and loops . The safety systems must log and time stamp alarms, events, and faults to 0.001 seconds accuracy and must be clocked such that the first occurring fault in a failure sequence is the first logged.

2.3.23.13 The safety system field instrumentation for shutdown functions must be independent of other systems such that a failure in the other system must not impair the safety system functions.

2.3.23.14 Propulsion safety shutdowns must not restart automatically unless manually reset. The declutch command on loss of gearbox LO pressure must likewise require the safety system to be reset before allowing clutch engagement.

2.3.24 Consoles and Operator Stations

2.3.24.1 The MCR operator station must be the master operator station. The maximum information display and control input devices must be available at the MCR such that the operator has available all information for monitoring and interpreting machinery and controls system operations and give input commands. The MCR must have VDS for display of the propulsion machinery condition and status, and for the display of the PCS I/O data, condition and status as required below.

2.3.24.2 Existing console drawings are found in the reference CD Folder: ASEA Consoles

2.3.24.3 The Contractor must prepare proposed detailed layouts of each console, control panel, cabinet and rack. These must be drawn to a scale of 1:10 and submitted to the TA for review and comment. The layout drawings must show the physical locations of all components, including terminal blocks, cable and wire runs, cable and wire entries. The Contractor is responsible for finalizing a list of all components to be accommodated within the various Consoles and panels, and submitting the list to the TA with the proposed detailed layout drawings. Final component layout must be determined based on the new system requirements and the equipment selection based on the detailed engineering requirements.

2.3.24.4 Where specified, UIDs must be direct access devices such as switches, push buttons, illuminated pushbuttons, levers; and visual displays (indications, indicators) must be dial analogue style gauges, indicating lamps, graphical mimics, pointers, similar to the existing consoles. Where not required to be direct access the UIDs may be an optical track wheel or track ball device, keypad, keyboard, with associated VDS, or touch screen VDS.

2.3.24.5 All optical track wheel or track ball devices, keypads, keyboards, and VDS must be Type Approved by Class. The arrangements of these UID and VDS must meet Class requirements of redundancy for control and display of any essential and safety functions controlled and displayed through them. In no case must there be less than two (2) such VDS in the MCR.

2.3.24.6 Frequently used operations must be available in the upper menu level, on dedicated software or hardware buttons. All menus and displays must be self-explanatory or provided with appropriate help-functions. When in dialogue mode, update of essential information and processes must not be blocked. If relevant fields for entry of data must occur with the current or a default value, a valid data range must be defined for each field.

2.3.24.7 The systems must indicate the acceptance of a control action to the user without undue delay. Confirmation of a command must be used when the action requested has a critical consequence. It must be possible for the user to recognize whether the system is busy executing an operation, or waiting for additional user action. When the system is busy, buffering of more than one user input is not allowed. Manually initiated time-consuming operations must be possible to cancel.

2.3.25 MCR Operator Station

2.3.25.1 Reconfiguration of the MCR operator station must include at a minimum the following existing indications and controls:

i. FAMP-S panels replacement;
ii. Integrated Propulsion Control and Telegraphs;
iii. Engine manual speed setting panels;
iv. Safety System Panels;
v. Woodward Governor control panel replacement;
vi. Lamp Test and Lamp Dimmer;
vii. Emergency clutch control panels;
viii. Shaft RPM, power and torque indications;
ix. Pitch indication;
x. Pitch wrong way indication;
xi. Engine Load in %;
xii. Emergency pitch control panels;
xiii. Electrical System Mimic Panel.
xiv. Alarm and Monitoring system replacement
xv. MCR Controls and Indications

2.3.25.2 The following direct access controls and indications must be available at the MCR operator station:

i. PCS Telegraphs, lever arm length 200 mm;
ii. Sub-Telegraph with control mode selection and control transfer function port and starboard;
iii. Emergency Telegraphs, port and starboard;
iv. Emergency Panel for each engine with:
v. Keyed switch, and switched on indication red LED;
vi. Engine overload indication, amber LED;
vii. Clutch In illuminated pushbutton, green;
viii. Clutch Out illuminated pushbutton, red;
ix. Emergency Start pushbutton; and indication;
x. Emergency Stop pushbutton and indication.
xi. PCS By-Pass speed command input for each governor for manual remote control;
xii. PCS By-Pass Pitch Control panels, Port and Starboard for manual remote control;
xiii. Safety system panels, each safety system;
xiv. Wrong Way alarm, each shaft;
xv. Lamp Test;
I. Alarm acknowledgment.
II. Alarm and monitoring user interfaces

2.3.25.3 The following controls must be available at the MCR operator station as direct access controls, or trackball/track wheel and VDS or touch screen VDS:

i. Main Engine Start and Stop in normal mode, each engine;
ii. Load control via the PCS;
iii. Load control via individual engine governors;
iv. Manual adjustment to load sharing between engines;
v. Manual command input to the PCS for Engine speed, each engine;
vi. Manual command input to the PCS for propeller pitch, each propeller;
vii. Normal Clutch control for automatic control, each main and each PTO clutch, including indications for clutch slip action, and control for clutch slip reset;
viii. Control Mode selection, Combinator, Constant Speed, Ice-breaking.

2.3.25.4 The following parameters must be indicated on individual dial faced analogue style gauges or represented as individual dial faced analogue style gauges on VDS at the MCR operator station:

i. Engine speed, each engine, RPM;
ii. Engine load, each engine, in %;
iii. Turbocharger Speed, each turbocharger, RPM;
iv. Shaft speed, port and starboard, RPM;
v. Propeller Pitch, port and starboard;
vi. Shaft torque port and starboard, in kNm;
vii. Shaft power port and starboard, in kW.

2.3.26 Graphical Mimic Panel

2.3.26.1 The MCR console must include VDS for a graphical mimic for Main Engine, Gearbox, and CPP system condition display. The VDS for the mimic may be integrated with VDS for control. The mimic must be well laid out with machinery logically grouped, in a clear, concise, and easily interpreted fashion, similarly to the existing mimic.

2.3.26.2 Indicated conditions must include:

i. For each engine, gearbox, clutch, and shaft;
ii. By-pass control active;
iii. Ready to start, running, normal stopped;
iv. Manual speed setting in auto control active;
v. Overload;
vi. Emergency Stop;
vii. Safety System shutdown;
viii. Gearbox turning gear in;
ix. Engine pre-lubrication pressure low;
x. Clutch position in/out;
xi. Clutch disengage on Auto declutch
xii. Emergency declutch from WH;
xiii. Clutch oil pressure low;
xiv. Load program active (that is, forcing a load reduction);
xv. Load program by-passed.

2.3.26.3 The following conditions and process data must be displayed on the VDS:

i. Engine start permissive interlock status of each interlock;
ii. Clutch control interlock status of each interlock;
iii. Governor and load control processes, with graphical representation;
iv. Safety system self-monitoring alarms and indications, and Safety System activation alarms and indications;
v. PCS self-monitoring status and condition for control system monitoring, alarm and indication of system power, communication network status and internal faults.

2.3.26.4 The VDS must be type approved by Class, and minimum 19” nominal size.

2.3.27 WH Operator Stations

2.3.27.1 The WHF must be the master WH operator station. Control transfer between the WH and MCR must take place at the WHF station.

2.3.27.2 All emergency controls must be arranged to prevent inadvertent operation.

2.3.27.3 The Wheel House Operator Stations must also be configured to allow for ease of access to the additional navigation and safety equipment currently in place.

2.3.27.4 The Joystick control panel at the WHF operator station must be removed and the voids reconfigured, or suitably sealed with a steel plate finished to match the console, or a drop in panel blank matching the drop in panels of the new system.

2.3.27.5 Reconfiguration of the Forward Operator Station must include the following existing indications and controls:

i. FAMP-S panels replaced;
ii. Safety System Panels;
iii. Integrated Propulsion Control Panels and Telegraphs;
iv. Lamp Test and Lamp Dimmer;
v. Alarm and Alarm acknowledgment;
vi. Central Control Takeover and Station in Control push buttons and indicators;
vii. Emergency declutch pushbutton;
viii. Shaft over torque indication;
ix. Shaft RPM, power and torque indications;
x. Pitch indication;
xi. Pitch wrong way indication and alarm;
xii. Engine Load in %;
xiii. Emergency pitch control panels;
xiv. Joystick master control panel to be removed;
xv. Bow thruster operational indicator light;
xvi. Stern Thruster operational indicator light;
xvii. CPP pump running indicator lights.

2.3.27.6 The following controls and indications must be available at the WHF operator station.

i. Direct access controls and indications:
ii. PCS Telegraphs, lever arm length minimum 200 mm;
iii. Shaft speed, port and starboard, RPM;
iv. Sub-Telegraph with control mode selection and control transfer function port and starboard;
v. Propeller Pitch, port and starboard;
vi. Emergency Stop each engine, covered push button;
vii. Emergency Declutch, port and starboard, covered push button;
viii. Emergency Pitch Control panels, Port and Starboard for manual remote control;
ix. Safety system panels;
x. Lamp Test; Illuminated device and lamp dimmer controls(s);
xi. Pitch Wrong Way indication and alarm, each shaft;
xii. Control Takeover and Station in Control push buttons and indicators for control transfer between WH stations;
xiii. Load Increase/Decrease program active (that is, forcing a load reduction);
xiv. Load Increase/Decrease program by-passed;
xv. Ice-breaking mode rudder centering feature by-passed;
xvi. Shaft generator circuit breakers status open/closed.

2.3.27.7 The following controls and indications must be available at the WHF and may be direct access controls and indications, or trackball/track wheel and VDS.

i. Shaft power and torque indications, dial face gauges;
ii. Engine running each engine, indication;
iii. Engine stopped, each engine, indication;

iv. Alarm acknowledgment(s);
v. Engine Load in kW and % dial face gauges;
vi. Bow thruster operational indication;
vii. Stern Thruster operational indication;
viii. CPP pump running, each shaft, indication.

2.3.27.8 The following Auxiliary Controls and Indications must be refitted to the WHF console in conjunction with the new control system installation:

i. Stellar Marine Fuel Computer repeater
ii. Wynn control for forward wipers
iii. Depth Sounder Repeater
iv. Gyro Repeater
v. Steering system controls, Rudder Angle indication gauges, rudder toggle control and Ships Wheel
vi. Phone Station
vii. Search Light Controls Port and Starboard
viii. Wagner Auto Pilot
ix. Ship's Whistle Controls
x. Ice Breaking Siren Control
xi. Sound Powered Phone
xii. Air to Ground Radio
xiii. General Alarm control
xiv. The Vessel Builders Plaque

2.3.27.9 The following controls and indications must be available at the WHP and WHS operator station.

2.3.27.10 Direct access controls and indications:

i. PCS Telegraphs, lever arm length minimum 200 mm;
ii. Shaft speed, port and starboard, RPM;
iii. Propeller Pitch, port and starboard;
iv. Emergency Stop each engine, illuminated push button;
v. Emergency Declutch, port and starboard, covered and illuminated push button;
vi. Emergency Pitch Control panels, Port and Starboard for manual remote control;
vii. Safety system panels;
viii. Lamp Test; Illuminated device and lamp dimmer controls(s);
ix. Pitch Wrong Way indication each shaft;
x. Control Takeover and Station in Control push buttons and indicators for control transfer between WH stations;
xi. Bow thruster control panel;
xii. Stern Thruster control panel.

2.3.27.11 The following Auxiliary Controls and Indications must be refitted to the WHP and WHF consoles in conjunction with the new Control System installation:

i. Steering controls
ii. Rudder Angle indicators for Port and Starboard
iii. Search light Controls

iv. Ice Breaking Siren Control
v. Ship's Whistle
vi. General Alarm Control
vii. Aldebarren VDU, Keyboard and trackball

2.3.27.12 The following controls and indications must be available at the WHA operator station:

i. Direct access controls and indications:
ii. PCS Telegraphs, lever arm length minimum 200 mm;
iii. Shaft speed, port and starboard, RPM;
iv. Propeller Pitch, port and starboard;
v. Control Takeover and Station in Control push buttons and indicators for control transfer between WH stations;
vi. Emergency Pitch Control panels;
vii. Emergency declutch push button.
viii. Single joystick control installed that must control all of the following equipment within one input device; Bow thruster, Stern Thruster, Main propellers and Rudders. This system must have the same capability as the existing system. Setup must be permanently mounted into the WHA console.

2.3.27.13 The Following Auxiliary Controls and Indications must be refitted to the WHA console in conjunction with the new Control System installation:

i. Rudder Angle indication Port and Starboard
ii. Steering System Failure Indication
iii. Gyro Compass Repeater
iv. Depth Sounder Repeater
v. Ships Whistle Control
vi. General Alarm control
vii. Search Light Controls Port and Starboard
viii. Aft WYNN wiper Control
ix. Gauge Dimmer Control

2.4 Documentation

The documentation required in Section 1.17.5 specific to the systems and sub-systems pertaining to Section 2.0 must be submitted to the IA and TA for review and to Class and TCMS for Approval

3.0 MAIN, EMERGENCY AND BACK-UP POWER SYSTEMS

3.1.1 SAB NIFE 100 Series Battery Chargers/Rectifiers and Ni-Cad battery banks.

3.1.2 The Contractor must give consideration in this specification Section to all the AC and DC power supply requirements of the new systems and retained existing equipment for Main, Emergency, and Back Up power supply.

3.1.3 The 24V DC power supplies must be based on a strategy of centralized On-line DC UPS units. The Contractor must design the system with the minimal number of On-line DC UPS units consistent with the requirements for redundancy in power supplies.

3.1.4 The existing SAB NIFE 100 Series Battery Chargers/Rectifiers and Ni-Cad battery banks must be removed. The Contractor must perform load analysis for the new systems and for the retained existing equipment, and design, and supply the new power supply systems and components.

3.1.5 The Contractor must determine the device particulars for main, emergency, and back- up power supply for the new system and for the retained existing equipment. The particulars must include AC and DC supplies, voltage and current loads, and device tolerances for power supply variations, power supply harmonic distortion, DC voltage ripple, power supply failure, and power supply surge voltage.

3.1.6 The Contractor must survey the existing vessel electrical distribution circuits for AC power distribution to determine the arrangement, number, and location of AC circuits available for use and reuse. The Contractor must design the new power supplies with minimal requirements for new AC circuits, consistent with meeting requirements for supply from main and emergency AC power distribution.

3.1.7 The Contractor must be aware of the space and location limitations and must design the system within the same footprint as the existing system.

3.1.8 Definitions

3.1.8.1 Main:

Main power supply refers to an AC or DC power supply which is connected to the vessels main switchboard, or a distribution panel connected to the main switchboard.

3.1.8.2 Emergency:

Emergency power supply refers to an AC or DC power supply which is connected to the vessels emergency switchboard, or a distribution panel connected to the emergency switchboard.

3.1.8.3 Back-up:

Back-up power supply refers to a DC power supply which is connected to an electrical energy storage system or device and supplies power in the event that the main or emergency power supply voltage is outside the supplied system’s requirement. Back-up power supplies must be capable of supplying the supplied systems with operating voltage for a minimum of 30 minutes in the event of a failure of Main power supply and

Emergency power supply. A Back-up power supply is fed from Main or Emergency supply.

3.1.9 References

161-624-20	ASEA 24VDC Wiring Diagram	

3.1.10 Technical

3.1.10.1 Two (2) sets of SAB NIFE Battery Chargers/Rectifiers and two SAFT Ni-Cad battery banks on the Samuel Risley provide 24VDC power for the following systems and devices:

i. FAMP-S;
ii. Tesy-1 Telegraph Controls;
iii. Torductor;
iv. Joystick System;
v. Noris Alarm and Monitoring system;
vi. Bow thruster controls;
vii. Woodward 723 main engine governors;
viii. ASEA Safety system and shut downs;
ix. Emergency propulsion control panels;
x. Deuta Werka Slip monitoring;
xi. Despemes;
xii. Main and PTO clutch controls;
xiii. Control room electrical distribution mimic panel;
xiv. Generator governors and on-board electronic systems;
xv. Emergency pitch control;
xvi. Shaft brake and Turning Gear status indication;
xvii. Engineer's call system.

3.1.10.2 Power supply components for removal and replacement must also include:

i. Power supply circuit breakers from the ship's main and emergency distribution system supplying power to the SAB NIFE system;
ii. All circuit breakers feeding 24VDC power circuits and sub-circuits to final powered devices from the SAB NIFE Battery Charger/Rectifiers and batteries.

3.1.10.3 One SAB Nife Rectifier is fed from the Emergency distribution system, and supplies Emergency, 24V DC Power. Its associated battery bank supplies Back-up power. The other SAB Nife Rectifier is fed from the Main distribution system, and supplies Main 24V DC Power. Its associated battery bank supplies Back-up power. Either rectifier/battery set can supply 100% of the load. The Contractor must refer to DWG 161-624-20 for clarity.

3.1.11 Retained Existing Equipment Power Supply

3.1.11.1 The Contractor must remove and replace the SAB NIFE Battery Charger/Rectifiers and Power Supply and SAFT Ni-Cad battery banks with a power supply system that must duplicate the control strategy and functionality of the existing system with such changes as are necessary to meet current TCMS and Class requirements, and the requirements of the retained existing equipment for 24 V DC power.

3.1.11.2 The Contractor must design and supply a power supply arrangement for the retained existing equipment fed from the SAB Nife central 24V DC system. This power supply arrangement must incorporate a central 24V DC system in a similar strategy to the existing installation. This 24V DC system consist of two duplicate systems of solid state rectifiers with connected banks of sealed gel type Nickel-Cadmium batteries. The duplicate systems must normally be operated in parallel supplying port and starboard retained existing equipment. However, each system must be capable of supplying the full load of the units powered by the central 24V DC system. The central system is to be located on the aft engine room flat.

3.1.11.3 Retained equipment that will require 24V DC power are:

i. Bow Thruster Control System:
ii. MCR electrical distribution mimic panel;
iii. Ship Service Generators Shaft brake and Turning Gear status indication;
iv. Engineer’s call system.

3.1.11.4 The Replacement Power Supply Systems must meet the general criteria of specification Section 1.5 and the following criteria.

3.1.11.5 The Replacement Power Supply Systems must meet the operating requirements of downstream devices for continuity and cleanliness of supplied power.

3.1.11.6 The battery charging circuits must include temperature sensing circuits for the batteries and thermal cutout functionality to prevent overcharging. The battery charging circuits must be capable of variable charging rates from trickle and float charge to full charge suitable for the batteries to be installed.

3.1.11.7 Each of the retained existing equipment systems and devices are to be supplied from a separate circuit. Each of these circuits must be protected for short circuit. Essential and safety service circuits must be monitored for voltage failure.

3.1.11.8 The power supply systems must meet Class and TCMS requirements for supply from the vessels main and emergency switchboards, and for separate distribution circuits protected against short circuit and monitored for voltage failure for essential and safety critical systems. At a minimum the new arrangements must have the same level of segregation of power supply circuits to the systems, sub-systems, and individual devices as the existing system.

3.1.11.9 The power supply systems must actuate an internal alarm and signal an external alarm to the new AMS for mains and emergency distribution power supply failure and for power supply changeover to the Back-up power supply.

3.1.11.10 The Contractor must determine power supply consumption requirements for 100% simultaneous load on each circuit and size the back-up power supply battery bank to supply this load for a minimum time of 30 minutes.

3.1.12 New Systems Power Supplies

The Contractor must design for the new systems the Main, Emergency, and Back-up power systems and supply all required components.

The power supply arrangements must meet the general criteria of specification Section 1.6 and the following criteria.

The Replacement Power Supply Systems must meet the operating requirements of downstream devices for continuity and cleanliness of supplied power.

The power supply systems must meet Class and TCMS requirements for supply from the vessels main and emergency switchboards, and for separate distribution circuits protected against short circuit and monitored for voltage failure for essential and safety critical systems. At a minimum the new arrangements must have the same level of segregation of power supply circuits to the systems, sub-systems, and individual devices as the existing system.

The battery charging circuits must include temperature sensing circuits for the batteries and thermal cutout functionality to prevent overcharging. The battery charging circuits must be capable of variable charging rates from trickle and float charge to full charge.

The power supply systems must actuate an internal alarm and signal an external alarm to the New AMS for mains and emergency distribution power supply failure and for power supply changeover to the Back-up power supply.

The Contractor must determine power supply consumption requirements for 100% simultaneous load on each circuit and size the back-up power supply to supply this load for a minimum time of 30 minutes.

3.1.13 Inspections, Tests and Trials

3.1.13.1 The Contractor must present the device particulars for main, emergency, and back-up power supply for the retained equipment and for the new systems in tabular form correlated with the particulars of the main, emergency, and back-up power supply arrangements. The Contractor must prepare explanatory schematic diagrams to accompany the table. The table and drawings must describe in full the main, emergency, and back-up power supply arrangements for the new system and the retained existing equipment and must be submitted to Class and TCMS for Approval and to the IA and TA for review.

3.1.13.2 The Factory Acceptance Trials of the assembled new system must include the testing of the power supply arrangements in accordance with the Class Approved trials schedule. The FAT trials must include a load test of the assembled power

supply systems. The load tests must include tests of the back-up power supply devices and their capability to provide power for the specified length of time after loss of main and emergency power supplies.

3.1.14 Documentation

The documentation required in Section 1.17.5 specific to the power supplies and the tables and drawings required in Section 1.12 must be submitted to the IA and TA for review and to Class and TCMS for Approval.

4.0 STERN THRUSTER SYSTEM

4.1 Rolls Royce/ Ulstein Stern Thruster Control System

4.2 Technical

4.2.1 The entire electronic system is to be removed and replaced. This includes, but is not limited to:

i. The WHP and WHS control panels;
ii. Main Stern Thruster control processor in the Engine Room;
iii. Pitch position feedback field instrumentation.
iv. Motor Starter unit

4.2.1.1 In summary the Ulstein Stern Thruster Control system modes are listed below. The Contractor must refer to the full descriptions of the functions, control stations, device locations and logic in the referenced CCGS Samuel Risley systems manuals.

i. Thruster motor Start/Stop control is at the MCR Electrical Mimic Panel and at the motor starter panel in the engine room:
ii. Thruster servo pump start/stop is on the MCR Electrical Mimic Panel;
iii. Control Transfer to the Wheelhouse is at the MCR Electrical Mimic Panel with acceptance at the WHP and WHS operator stations;
iv. Zero Pitch Start and Hydraulic Servo pump operating interlock;
v. Servo pump running indication;
vi. Main motor running indication;
vii. pitch indication.

4.2.2 Replacement Thruster Control System

4.2.2.1 The Contractor must remove and replace the Ulstein Stern Thruster Control System

4.2.2.2 with a replacement system that must duplicate the operation of the existing system.

4.2.2.3 The new system must meet the general criteria of Specification Section 1.0 and the following criteria:

i. Interfaces with the ASEA Electrical System Mimic Panel such that the existing electrical mimic panel indications and controls are retained;
ii. Interfaces with the replacement motor starter;
iii. Includes a Joystick interface for ready/accept/demand/feedback signals for joystick control of the main engines, propellers, thrusters, and rudders.

4.2.2.4 Normal stop and start functions must be at the MCR operator station. The MCR does not control thrust direction but control of the thruster must be available at the WH after control is made available. Control transfer must not require acknowledgement at the Wheelhouse.

4.2.2.5 Control transfer between WH operator stations must be effected by the central control transfer system required in Section 2.3.20

4.2.2.6 Thruster controls must be full follow up proportional type. Thruster controls must be lever type, similar but smaller than the telegraphs, and mounted athwart ships such that the lever moves in the desired direction of ship movement. The lever must move in a linear fashion; the lever must not move in a rotary fashion.

4.2.2.7 Wheelhouse control panels must contain:

i. Main motor overload indicator;
ii. Thruster available;
iii. Main motor stop pushbutton;
iv. Thrust control lever - port/starboard/neutral;
v. Thrust direction and magnitude indicator;
vi. Main motor stopped/running indication.

4.2.2.8 The Stern Thruster replacement system must contain starting interlock logic to prevent the main motor from starting unless the following conditions are met:

CB 14 is closed, and power is available;
Thruster blades at zero pitch;
Hydraulic power pack is operating.

4.2.2.9 The replacement system must interface with the existing hydraulic power pack to provide proportional control of the thruster pitch from the Wheelhouse control levers.

4.2.2.10 The replacement system must include safety system functions for thruster shutdown on loss hydraulic power pack pressure, and stop command from the Wheelhouse operator stations.

4.2.3 Replacement Stern Thruster Motor Starter

4.2.3.1 The Contractor must remove and replace the current Stern Thruster Motor Starter and replace it with a new starter unit that is compliant with section 1.5.

4.2.3.2 The Original Starter Unit is a SAFTRONICS 2HP-500HP (600/3/6) SR6. The Contractor must supply and install a new replacement unit that meets the specifications required:

i. Capable of soft starting 400 HP @1800 RPM ASEA Model 90TV 600 Volt 3 phase electric drive motor
ii. New Starter Cabinet must comply with section 1.17.11
iii. Maximum cabinet dimensions: 915mm W x 2210 mm H x 508 mm D
iv. Starter Cabinet must include indication gauges for Voltage and Current
v. Starter Cabinet must include indication for Motor Overload, Motor Over Temperature, Motor Winding Heater On, RUN, and Starter Failure
vi. Motor Starter Cabinet must provide for local START, STOP and RESET
vii. New Starter Cabinet must be located in the original starter cabinet location.

4.2.3.3 Original power supply wire (600 volt 3 phase) may be re-used provided that the length of the wire is suitable such that no splices are required. In addition the

Contractor must perform insulation testing (Megger) and provide this report to the TA and TI for review and approval prior to re-using the power cables.

4.3 Inspections, Test and Trials

4.3.1 The Contractor must conduct Software and Hardware Factory Acceptance Trials of the assembled Stern Thruster Controls in accordance with the Class Approved trials schedule. The Contractor must conduct Software and Factory Acceptance Trials in the presence of the attending Class surveyor, the IA, the TA, and TCMS.

4.3.2 The Factory Acceptance Trials must demonstrate the satisfactory operation of all components and functions of the new system to the requirements of Class and TCMS.

4.4 Documentation

4.4.1 The documentation required in Section 1.17.5 specific to the Stern Thruster Control system must be submitted to the IA and TA for review and to Class for Approval.

5.0 TRAINING MATERIALS, AND OPERATOR AND MAINTENANCE MANUALS

5.1 Identification

5.1.1 The Contractor must provide Operator's and Maintenance manuals as well as training material and training based directly on the new system as designed for this Specification.

5.1.2 The manuals and the training material must be written and edited for clarity and direct comprehensibility in both the English and French languages.

5.1.3 The Contractor must submit draft Operator and Maintenance Manuals and training materials to the IA and TA for review and comment before training is delivered.

5.1.4 The Contractor must deliver a total of 30 contact hours of training in two 15 hour training periods for Wheelhouse and ER Operators. The training must be conducted by the Contractor's Technical Service Representative or the Contractor's specialized training personnel.

5.2 Training Timeframe

5.2.1 The Contractor must also deliver an additional minimum of 30 contact hours of training in two 15 hour training periods for shipboard maintenance personnel. The training must be conducted by the Contractor's Technical Service Representative or the Contractor's specialized training personnel.

5.2.2 The training sessions must be delivered in two sets. The first set must be completed before sea trials for the CCG staff who will be on board during the trials. The second set must be completed after sea trials and immediately after the next crew change for the opposite shift crew. The Contractor must supply the Contractor's TSR as ride along for three days operation after the crew change.

5.3 References

IEEE 45-2002 clause 9.2		

5.4 Operator's Manuals

5.4.1 The Operator's Manual must be a single volume with all descriptions and diagrams contained together and securely bound.

5.4.2 The Operator's Manual must be prepared specifically for this specification, and must not contain information on equipment or functions not present in the systems.

5.4.3 The Operator's Manual must provide a clear description of the operation of the new system in all modes of operation. The Operator's Manual must consist of narrative descriptions and be accompanied by explanatory diagrams which must be based on the

control system logic and signal flow such that the operator can understand the system action and function in response to operator commands.

5.4.4 The Operator's Manual must explain the meanings of the alarms and indications in terms of the control logic and signal flow such that the operator can know what operational conditions will result in a given alarm or indication. The explanations must be accompanied by a table of alarm indications and causes for each alarm.

5.4.5 The Operator's Manual must contain a section describing the redundancy features of the Propulsion Controls Systems. This section must give clear guidance to the vessel staff about the operation of the redundancy features, and how to effectively and speedily put the redundancy features into service in the event of the loss of normal propulsion control capability.

5.4.6 The description of the redundancy features must include the following, as a minimum:

i. Simplified diagram and description of the propulsion systems in normal condition;
ii. Simplified diagram and descriptions of the propulsion systems redundancy features;
iii. Step by step instructions for the use of the redundancy features;
iv. Description of the communication systems, including telegraphs and signaling features of the new system;
v. Detailed descriptions for local propulsion machinery control.

5.5 Maintenance Manuals and Equipment

5.5.1 The Maintenance Manuals must provide detailed descriptions of the systems for the use of shipboard and technical service personnel. The Maintenance Manuals must be prepared specifically for this specification. The component manufacturer's installation, operation, and maintenance manuals and product data bulletins must be included as reference material.

5.5.2 The Maintenance Manual must include the technical information required by CCG personnel and the Contractors technical service representatives to commission, service and maintain the equipment. It must contain sections concerning the following:

i. Maintenance Schedules;
ii. Adjustment Procedures;
iii. Equipment Checkout/Fault Isolation Procedures and diagnostic procedures;
iv. Detailed commissioning procedures;
v. Detailed test procedures and necessary equipment for testing components;
vi. Detailed test procedures and necessary equipment for testing field I/O devices;
vii. Procedures for removing and installing components and reloading software;
viii. Procedures for modifying software;
ix. Procedures for software version control;
x. Procedures for testing of Emergency Systems;
xi. Signal flow diagram of the system at the level of the major assembly interfaces;
xii. Signal flow diagram of each major assembly, at the level of its major functional blocks;
xiii. Theory of operation of the system and its assemblies, based upon the signal flow diagrams;

xiv. Ladder Logic diagrams for each system and processor;
xv. Schematic and Layout Diagrams;
xvi. Critical Spare parts list;
xvii. Parts Lists Material data, including:
xviii. Component Identifiers, keyed to Schematic and Layout diagrams;
xix. Component descriptions;
xx. Commercial Part Numbers; and
xxi. Supply source.

5.5.2.1 Procedure details must contain all information required to allow the vessel staff to re-establish the correct function of the system after failure, mal-adjustment, or replacement of components. The information must include data on test point locations, adjustment locations, range of adjustment, and expected results. The manuals must include drawings, photographs and screen shots as required to positively identify test points and components.

5.5.2.2 The Contractor must also input the bills of material and parts lists into the MS-Excel spreadsheet format supplied by the TA for direct loading into the CCG electronic inventory system.

5.5.2.3 The maintenance manual must contain a periodic test procedure for the new control systems field I/O devices. The test procedure section must be a schematic document, preferably a spreadsheet or table, detailing the following information for all field I/O devices related to the control and monitoring in the new systems:

5.5.2.4 I/O device unique identification corresponding to the system schematics tag number;

Service description;
i. Measuring range and unit;
ii. Limits for alarm, slowdown and shutdown test intervals;
iii. Test method (keyed to the detailed descriptions in the maintenance manual);
iv. Expected result (e.g. shutdown, alarm etc.);
v. Fields for recording of tests performed.

5.5.2.5 The Contractor must supply all instruments, software, hardware, and computer workstation and the instructions and specialty tools necessary for the set-up, calibration, and system troubleshooting and maintenance.

5.5.3 Operator Training

5.5.3.1 The Contractor must prepare Operator training sessions and training notes specifically for new system. The operator training objective must be to familiarize the operators with normal and emergency operations such that the operators are able to correctly operate the control systems and machinery under control, and accurately interpret the responses and indications of the new system.

5.5.4 Maintenance Training

5.5.4.1 The Contractor must prepare Maintenance training notes specifically for this Specification, and based on the new system as installed.

5.5.4.2 The Maintenance Training must be focused on component and system trouble shooting and component replacement, component identification, software verification and upgrading, and on routine testing and verification of system condition and functions. Training must include material on the PLC, controls, and electronics systems involved in the system. Training must also include descriptions of the system processes and troubleshooting diagnostics.

5.5.5 Inspections, Test and Trials

5.5.5.1 The Contractor must submit draft Operator and Maintenance Manuals to the IA and TA for review and comment before training is delivered. The Contractor must submit a final version for ongoing CCG use in the Final Report.

5.5.6 Documentation

5.5.6.1 The Contractor must submit the final Operator and Maintenance Manuals in the Final Report in paper and electronic versions in the formats required in Section 1.17.5. The Contractor must supply four (4) paper copies and two (2) electronic copies of the Operator and Maintenance manuals.

6.0 APPENDIX A DOCUMENTATION TYPE AND CONTENT

1.0 DOCUMENTATION FOR INFORMATION, ASSESSMENT, AND APPROVAL

1.1 The Contractor must submit to Class all documentation required by Class for information, assessment, and approval. The Contractor must at a minimum submit the following drawings, particulars and descriptions to Class, and IA and TA for each system. Drawings, particulars and descriptions must be specific to the Work of this specification. Where catalogue pages and equipment manuals are submitted they must be clearly marked showing the equipment, features and details relevant to this specification.

1.2 The following descriptions of document content must all be understood as the minimum content for each documentation type.

1.3 Documentation Types Overview for Information

1.3.1 The Contractor must prepare and submit the following overview documentation to Class, the IA and TA for information.

1.3.2 Control and Alarm and Monitoring Systems Philosophy Description

1.3.2.1 System strategy or philosophy, describing the distribution and allocation of functions in the systems;

1.3.2.2 Tasks allocated to each sub-system, divided between system tasks and manual tasks, including emergency recovery tasks;

1.3.2.3 Principles that will be used in the technical implementation of each system;

1.3.2.4 The rules and regulations of the Approval Authorities governing the system.

1.3.3 General Arrangements

1.3.3.1 General Arrangement Drawing of the Ship;

1.3.3.2 General Arrangement Drawing of the Engine Room;

1.3.3.3 Specification of main electro/mechanical equipment describing the make and type, rating, and number for the following:

1.3.3.4 Main and shaft driven electric power generation;

1.3.3.5 Main propulsion lines with machinery and essential auxiliaries;

1.3.3.6 Bow Thruster;

1.3.3.7 Stern Thruster.

1.3.4 Documentation Types for System Assessment and Class Approval

1.3.4.1 The Contractor must prepare and submit the following design documentation to Class for approval, and to the IA and TA for review and comment.

1.3.5 Control and Alarm System Functional Description

1.3.5.1 Clear text descriptions with explanatory diagrams of:

i. System hardware and software requirements specification;
ii. System configuration;
iii. Functional description of system operation with ladder logic diagrams and rung by rung clear text description of function;
iv. Scope of supply;
v. Equipment under control and monitoring and how the equipment is controlled and monitored;
vi. Safe state(s) for each function in the system;
vii. Redundancies in control, monitoring, and power supply;
viii. Switching mechanisms for system redundancies;
ix. Power supply and back- up power supply requirements and strategy.

1.3.6 System Block Diagrams

1.3.6.1 A drawing showing all connections between components (units, modules) of the systems and interfaces with other systems, including input/output schedules;

1.3.6.2 Hardware certification details to the applicable standards of Class, TCMS, IEC, IEEE, IACS, EU MED;

1.3.6.3 Details of instrumentation and control system cabling requirements;

1.3.6.4 Cable routing requirements and arrangements for instrumentation, control, communication and power supply between the various items of machinery, Thruster compartments, the MCR, and the Wheelhouse showing cable specifications, physical lengths and runs for installation, cable penetrations, and wire and terminal identification.

1.3.7 User Interface Documentation

1.3.7.1 A description of the functions allocated to each operator station, and local station, and the arrangement of command transfer between stations.

1.3.8 Power Supply Arrangement

1.3.8.1 Electrical Supply diagram showing connection to distribution boards, batteries, converters, or UPS for Main, Emergency, and Back Up power supply.

1.3.8.2 Cable type, cross sectional area and fuse and circuit breaker sizes must be indicated for each circuit from the existing distribution panels to the lowest level circuit.

1.3.9 Safety Functions

1.3.9.1 List of safety functions, details of any overrides, and consequences of use.

1.3.10 Software Quality Plans

1.3.10.1 Software quality plans and procedures for software life cycle activities must contain at minimum procedures for:

i. Software requirements specification;
ii. Identification of functions implemented in each specific application software;
iii. Identification of software version;
iv. Modification index;
v. Software validation testing;
vi. Parameters data requirements;
vii. Software function test;
viii. Parameter data test;
ix. System project files stored at the manufacturer;
x. Software change handling and revision control.

1.3.11 System Integration Plan

1.3.11.1 System integration plans must include at a minimum:

i. Designation of the single party responsible for managing integration tasks;
ii. Specification of the responsible manufacturer for each of the partial systems to be integrated in the total integrated system;
iii. Specification of manufacturers responsible for the physical networks (field, process, system and administrative);
iv. Specification of the manufacturer responsible for the interface from each partial system to the relevant physical net;
v. For each partial application utilizing data from another application or system, the required data quality must be specified;
vi. For each partial application providing data to another application the provided data quality must be specified;
vii. A plan for integration testing.

1.3.12 Functional Failure Analysis

1.3.12.1 The purpose of the functional failure analysis is to document that for single failures, essential systems will fail to safety and that systems in operation will not be lost or degraded beyond acceptable performance criteria required by regulatory authorities.

1.3.12.2 The following aspects must be covered:

i. Block diagram descriptions of the boundaries of the system, including power supplies;
ii. A list of items which are subject to assessment with a specification of probable failure modes for each item with references to the system documentation;
iii. Description of the system response to each of the above failure modes identified and comment to the consequence of each of these failures.

1.3.13 Failure Mode and Effect Analysis

1.3.13.1 A failure modes and effect analysis (FMEA) must be carried out for each system. The FMEA must be sufficiently detailed to cover all the systems' major components and must include but not be limited to the following information:

i. Identify systems, sub-systems, and equipment;
ii. A description of all the systems' major components and a functional block diagram showing their interaction with each other;
iii. All significant failure modes;
iv. Evaluate the effects on the system of each failure mode;
v. Identify measures for reducing the risks associated with each failure mode;
vi. The most predictable cause associated with each failure mode;
vii. The effect of each failure on the vessel's maneuverability;
viii. The method of detecting that the failure has occurred;
ix. The effect of the failure upon the rest of the system's ability to maintain functionality;
x. An analysis of possible common failure modes;
xi. Identification and detail of trials and tests necessary to prove conclusions;
xii. Identification of the acceptance criteria for essential services performance in the presence of one or more failures.

1.3.13.2 Failure Mode and Effects Analysis must be carried out in accordance with IEC 60812 Analysis Techniques for system reliability – Procedure for failure mode and effects analysis (FMEA) or IMO MSC Resolution 36 (63) Annex 4 - Procedures for Failure Mode and Effects Analysis. The report and worksheets must be submitted to the IA and TA for review, and to Class and TCMS for Approval. The FMEA report(s) are to demonstrate that new systems in the Work of this specification and systems affected by the Work will "fail-safe" and that essential services in operation will not be lost or degraded beyond the acceptable performance criteria specified by Class and TCMS.

1.3.13.3 The FMEA must be presented in a tabular format as presented in LR Rules Part 5 Table 22.2 .1 or equivalent format.

1.3.14 Line Diagrams with I/O Lists

1.3.14.1 The Contractor must provide:

i. Lists and Line diagrams of all controlled, monitored, and alarmed points
ii. A list and or index with line diagrams identifying all input and output signals, field I/O devices, and actuators in the systems containing at least the following information:
iii. Line diagrams of control circuits;
iv. List of monitored points;
v. List of control points;
vi. List of alarm points, description of alarm display and acknowledgment, and assessment of alarm for criticality;
vii. Service description;
viii. Instrument tag-number;

ix. System (control, safety, alarm, indication, propulsion, thruster, power supply);
x. Type of signal (digital / analogue input / output);
xi. Logical address.

1.3.15 Circuit Diagrams

1.3.15.1 For essential hardwired circuits (for emergency stop, shutdown, starting interlocking) details of input and output devices and power source for each circuit.

1.3.16 Factory Acceptance Trials, Dock Trials, and Sea Trials Test Programs

1.3.16.1 Test program for Factory Acceptance Trials, Dock Trials and Sea Trials

1.3.16.2 A description of FAT test configuration and test simulation methods. FAT trials must include hardware and software integration trials, and hardware and software validation and verification trials.

1.3.16.3 Based upon the functional description, each test must be described specifying:

Initial condition;
How to perform the test;
What to observe during the test and acceptance criteria for each test;

1.3.16.4 The tests must cover all normal modes as well as failure modes identified in the functional failure analysis, and the FEMA, including power and communication failures.

1.3.16.5 Dock and Sea Trails must be designed to validate and to verify the design and installation on board the vessel. The Trials plans must be approved by TCMS.

1.3.17 Environmental Specifications

1.3.17.1 Data sheets with environmental specifications and certification for components and equipment satisfactory operation under the environmental conditions stipulated in Sections 1.17.10.1 and 1.17.10.2.

1.4 Submission Schedule

1.4.1 Preliminary Design Review

1.4.1.1 The Contractor must submit a preliminary design review package (PDP) within four (4) weeks of contract award to the IA and TA for CCG review and comment.

1.4.1.2

1.4.1.3 The PDP must contain the following documents and documentation types:

i. Main Specification
ii. Document Management Plan

iii. Integration Management Plan
iv. Speed, pitch and load curves
v. Operator station layouts and bills of materials;
vi. Component and system installation, operation and maintenance manuals;
vii. Bills of Materials;
viii. Annex A
ix. Control System Philosophy Description
x. General Arrangements
xi. Control Systems Functional Descriptions
xii. System Block Diagrams
xiii. User Interface Documentation
xiv. Power Supply Arrangement
xv. Safety Functions
xvi. Software Quality Plans
xvii. System Integration Plan
xviii. Environmental Specifications

1.4.2 Approval Design Review

1.4.2.1 The Contractor must submit the final design package for Class and TCMS approval to the IA and TA within 12 weeks of contract award for CCG review and comment. This submission must include the PDP incorporating the latest revisions and the following documents and documentation types:

Annex A
i. Functional Failure Analysis
ii. Failure Mode and Effect Analysis
iii. Line Diagrams with I/O Lists
iv. Circuit Diagrams
v. Factory Acceptance Trials, Dock Trials, and Sea Trials Test Programs
vi. Critical spare parts identification

1.4.3 Working Drawings

1.4.3.1 The Contractor must submit the documents and documentation types required in Sections 1.5, 1.12 and 1.17 along with the QA ITT Plan before installation commences.

1.4.4 As Fitted Drawings, Final Report

1.4.4.1 The Contractor must submit the as fitted drawings, Final Report and any other outstanding documentation within four (4) weeks after the commissioning date.

2.0 APPENDIX B DEFINITIONS

AMS	Alarm and Monitoring System

Alarm	A warning of an abnormal condition and is a combined visual and audible signal, where the audible part calls the attention of personnel, and the visual part serves to identify the abnormal condition. Alarms must be annunciated by visual indication and audible signal. It must be possible to see and distinguish different statuses of the alarms e.g. normal, active, unacknowledged, acknowledged and blocked. Silencing and acknowledgement of alarms must be arranged as follows: Silencing the audible signal: —Silencing the alarm must cause the audible signal to cease, in addition to extinguishing any related light signals. — The visual alarm indication must remain unchanged. Acknowledgement of an alarm: — When an alarm is acknowledged the visual indication must change. An indication must remain if the alarm condition is still active. An active alarm signal must not prevent indication of any new alarms, with related audible signal and visual indication. This requirement must also apply for group alarms. In case the alarms are presented on a screen, only visible alarms may be acknowledged.
CA	PWGSC Contracting Authority
CCG	Canadian Coast Guard
Direct Access UID or display	A UID or display that is a discreet single or limited use device such as a pushbutton, lever, switch, switch, indicating LED, or similar device but not a soft key.
Class	Classification Society identified in the bid documents, its Rules, and Regulations
EUC	Equipment Under Control
FAT	Factory Acceptance Trials
FMEA	Failure Modes and Effects Analysis
Field instrumentation	Field instrumentation comprises all instrumentation that forms an integral part of the control and monitoring necessary to maintain a function, and includes: sensors, actuators, local control loops and related local processing as required to maintain remote and local control and monitoring of the equipment under control, and operator interface for manual operation (when required).
IA	The Government of Canada Inspection Authority as identified in the Contract under Contract Authorities
IACS	International Association of Classification Societies
Independent, mutually independent	System B is independent of system A when any single system failure occurring in system A has no effect on the maintained operation of system B. A single system failure occurring in system B may have an effect on the maintained operation of system A. Two systems are mutually independent when a single system failure occurring in either of the systems has no consequences for the maintained operation of the other system according to the above definition.
JW	Jacket Water
LO	Lubrication Oil
MCR	Machinery Control Room
Monitor, monitoring	Monitoring includes indication, alarming and/or protective safety functions.

PWGSC	The Department of Public Works and Government Services Canada
Redundancy	Redundancy is defined as two mutually independent systems that can maintain a function.
TA	The CCG Technical Authority
TCMS	Transport Canada Marine Safety
UID	User Input Device, any device from which a user may issue an input including handles, buttons, switches, keyboard, joystick, pointing device and other control actuators.
VDS	Visual Display Screen, a computer monitor or similar display screen.
WH	Wheelhouse
WHA	Wheelhouse aft operator station
WHF	Wheelhouse forward operator station
WHP	Wheelhouse port operator station
WHS	Wheelhouse starboard operator station