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**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

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Title - Sujet CCGS Griffon -VLE	
Solicitation No. - N° de l'invitation F7049-200157/A	Amendment No. - N° modif. 021
Client Reference No. - N° de référence du client F7049-200157	Date 2023-08-07
GETS Reference No. - N° de référence de SEAG PW-\$\$MD-029-29039	
File No. - N° de dossier 029md.F7049-200157	CCC No./N° CCC - FMS No./N° VME
Solicitation Closes - L'invitation prend fin at - à 02:00 PM Eastern Daylight Saving Time EDT on - le 2023-08-30 Heure Avancée de l'Est HAE	
F.O.B. - F.A.B.	
Plant-Usine: <input type="checkbox"/> Destination: <input type="checkbox"/> Other-Autre: <input type="checkbox"/>	
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Signature	Date

Solicitation Amendment # 021

This amendment is hereby raised :

1. To update Annex A – Statement of Work (SOW), SOW item 10.12 – Emergency Generator.
 2. To update Annex A – Statement of Work (SOW), SOW item 17.3 – Buoy Crane.
 3. To update Annex A – Statement of Work (SOW), SOW item 14.11 – Electrical Studies.
 4. To update Annex A – Statement of Work (SOW), SOW item 12.2 – Main Engines Overhaul.
 5. To update Annex A – Statement of Work (SOW), SOW item 12.16 – Rudder and Steering Gear.
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1. To update Annex A – Statement of Work (SOW), SOW item 10.12 – Emergency Generator.

Delete the existing SOW item 10-12 – Emergency Generator in its entirety.

2. To update Annex A – Statement of Work (SOW), SOW item 17.3 – Buoy Crane.

Delete the existing SOW item 17.3 – Emergency Generator in its entirety.

3. To update Annex A – Statement of Work (SOW), SOW item 14.11 – Electrical Studies.

Delete SOW item 14.11 – Electrical Studies in its entirety.

4. To update Annex A – Statement of Work (SOW), SOW item 12.2 – Main Engines Overhaul.

Delete the existing SOW item 12.2 – Main Engines Overhaul and replace it with the following SOW item 12.2 – Main Engines **Overhaul_ REV 01**.

Edit is shown in bold italics and highlighted.

5. To update Annex A – Statement of Work (SOW), SOW item 12.16 – Rudder and Steering Gear.

Delete the existing SOW item 12.16 – Rudder and Steering Gear and replace it with the following SOW item 12.16 – Rudder and Steering Gear_ **REV 01**.

Edit is shown in bold italics and highlighted.

12.2 MAIN ENGINE OVERHAUL

12.2.A Identification

- A.1 The Contractor must employ the services of the Original Equipment Manufacturer (OEM) to perform a complete overhaul on main engine number one (#1 ME) and main engine number two (#2 ME).
- A.2 The Contractor must employ the services of the OEM FSR to implement Low Load Mechanical and Fuel System upgrades on #1 ME and #2 ME **all four (4) main engines.**
- A.3 Following completion of all work, the Contractor must provide CCG with complete five (5) year RO survey credits for #1 ME and #2 ME.
- A.4 In addition to the work on #1 ME and #2 ME, the Contractor must upgrade the crankshaft oil seal at the flywheel end **for all four (4) main engines. number 3 main engine (#3 ME) and number four main engine (#4 ME) to complete the in-progress Low Load – Mechanical and Fuel System upgrades on those two (2) main engines.** It is suggested for accessibility that this task is completed when the propulsion generators have been removed during SOW item 12.6 – Propulsion Generators Overhaul.
- A.5 The Contractor must provide the services of a certified Subcontractor to overhaul and balance the electrical motors fitted to the crankcase centrifugal mist collectors on all four (4) main engines.
- A.6 The work of this SOW item must be carried out in conjunction with the following SOW items:
- 12.4 – Main Engine Jacket Water;
 - 12.5 – Main Engine Silencers;
 - 12.6 – Propulsion Generator Overhaul;
 - 12.7 – Fiberglass Repairs;
 - 14.6 – Switchboards;
 - 14.9 – Propulsion Power Cables;
 - 15.8 – Auxiliary Cooling piping; and
 - 19.1 – Propulsion Control System.

12.2.B References

B.1 Equipment Data

- B.1.1 The following tables (**Tables 1-4**) outline the particulars of the Fairbanks 38D8 1/8 Engines and the crankcase centrifugal mist collectors:

Table 1: Fairbanks Morse 38D8 1/8 Engine Particulars

Manufacturer:	Fairbanks Morse (original 1970)
Model:	Opposed Piston 38D8 1/8 - AR3
Serial No. (Engine No. 1)	C481
Serial No. (Engine No. 2)	C480
Serial No. (Engine No. 3)	C482
Serial No. (Engine No. 4)	C483
Engine output	995 kW/1334 HP @ 750 RPM
Output per cylinder	124 kW
Cylinder Bore	206 mm
Piston Stroke	254 mm
Displacement per cylinder	8.5 l
Engine weight	19.3 ton
Speed	750 RPM
Fuel	Marine Diesel Oil (MDO) / Naval Distillate
Exhaust gas pipe diameter	500 mm
Starting air pressure (nom.)	14 bars
Lubricating Oil	Shell Rotella T1-30
Engine Coolant	Drew Marine Maxigard

Table 2: Main Engine #1 – Special Continuous Survey – Machinery Item Credits Required

ABS Asset ID	TC Div. 3	Asset Name	Inspection Type
29345171	3D001	#1 Main Engine Survey	Examination
29345173	None	#1 ME Crankcase	Examination
29345176	None	#1 ME Crankshaft	Deflection
29345177	3D002	#1 ME Unit No. 1	Examination
29345178	3D003	#1 ME Unit No. 2	Examination
29345179	3D004	#1 ME Unit No. 3	Examination
29345180	3D005	#1 ME Unit No. 4	Examination
29345181	3D006	#1 ME Unit No. 5	Examination
29345182	3D007	#1 ME Unit No. 6	Examination
29345183	3D008	#1 ME Unit No. 7	Examination
29345184	3D009	#1 ME Unit No. 8	Examination
29345185	None	#1 ME Engine Bedplate	Examination
29345187	3D010	#1 ME Upper Main Bearings & Journals	Examination
29345188	3D011	#1 ME Lower Main Bearings & Journals	Examination
29345189	None	#1 ME Manifold	Examination
TBD	3D012	#1 ME Camshaft & Drive	Examination
29345191	None	#1 ME Overspeed Protection	Examination
29345192	3D013	#1 ME Eng. Driven Raw Wat Circulating Pump	Examination
29345193	3D014	#1 ME Eng. Driven Fresh Wat Circulating Pump	Examination

29345194	3D015	#1 ME End Driven Lube Oil Pump	Examination
29345195	3D018	#1 ME Scavenge Blower	Examination
TBD	3D019	#1 ME Engine Control Gear Including Governor	Examination
TBD	3D020	#1 ME Vertical Drive	Examination
29345197	3D021	#1 ME Vibration Damper	Examination
29345198	None	#1 ME Thrust Bearing	Examination

Table 3: Main Engine #2 – Special Continuous Survey – Machinery Item Credits Required

ABS Asset ID	TC Div. 3	Asset Name	Inspection Type
29304622	3D024	#2 Main Engine Survey	Examination
29345173	None	#2 ME Crankcase	Examination
29345176	None	#2 ME Crankshaft	Deflection
29345145	3D025	#2 ME Unit No. 1	Examination
29345146	3D026	#2 ME Unit No. 2	Examination
29345147	3D027	#2 ME Unit No. 3	Examination
29345148	3D028	#2 ME Unit No. 4	Examination
29345149	3D029	#2 ME Unit No. 5	Examination
29345150	3D030	#2 ME Unit No. 6	Examination
29345151	3D031	#2 ME Unit No. 7	Examination
29345152	3D032	#2 ME Unit No. 8	Examination
29345153	None	#2 ME Engine Bedplate	Examination
29345155	3D033	#2 ME Upper Main Bearings & Journals	Examination
29345156	3D034	#2 ME Lower Main Bearings & Journals	Examination
29345157	None	#2 ME Manifold	Examination
TBD	3D035	#2 ME Camshaft & Drive	Examination
29345159	None	#2 ME Overspeed Protection	Examination
29345160	3D036	#2 ME Eng. Driven Raw Wat Circulating Pump	Examination
29345161	3D037	#2 ME Eng. Driven Fresh Wat Circulating Pump	Examination
29345162	3D038	#2 ME End Driven Lube Oil Pump	Examination
29345163	3D041	#2 ME Scavenge Blower	Examination
TBD	3D042	#2 ME Engine Control Gear Including Governor	Examination
TBD	3D043	#2 ME Vertical Drive	Examination
29345165	3D044	#2 ME Vibration Damper	Examination
29345168	None	#2 ME Thrust Bearing	Examination

Table 4: Donaldson Torit: Centrifugal Mist Collector

Manufacturer:	Donaldson Torit
Model:	E-300
Serial No. (Engine No. 1)	10230182L1-1
Serial No. (Engine No. 2)	10230182L1-4
Serial No. (Engine No. 3)	10230182L1-2
Serial No. (Engine No. 4)	10230182L1-3
Motor Manufacturer:	Leeson
Cat. No.	1110212.00
HP	1
Volts	220/440//190/380
Phase – Freq	3ph – 60//50 Hz
Duty	Continuous
Ins.	F4
FLA	3.4/1.7//3.8/1.9
SFA	3.8/1.9//4.2/2.1
Speed	3450//2850
Frame – IP	56CZ – IP 43
Service Factor	1.15
Amb. Temp	40 Celsius
Code	J
Design	B
Type	TF

B.2 Drawings and Documents

B.2.1 The following drawings are to be considered as Guidance Drawings only, as defined in the G.1.7 Drawings section of the General Notes.

Drawing Number	Drawing Title
732905	CCGS Griffon General Arrangement – 2 sheets; Sheet 1 – Rev K, Sheet 2 – Rev J
Document Number	Document Title
N/A	Fairbanks Morse, Opposed Piston Engines Instructions 3800D8-1/8 Model 38D8-1/8 Diesel Marine, Engine Manual, 1981 (en anglais seulement)
N/A	Fairbanks Morse, Opposed Piston Engines Renewal Parts 3800D8-1/8 Model 38D8-1/8 Diesel Marine (en anglais seulement)
N/A	Fairbanks Morse, Volume A, Service Information Letter (SIL) FM 38D 8-1/8 Series (en anglais seulement)
N/A	Interspec CCGS Griffon 2024-2025 VLE – Paint Specification (en anglais seulement)
N/A	#4 ME Overhaul Report – 2022 (en anglais seulement)
IOM 1B0510107 Rev 1	Donaldson Torit – Installation and Operation Manual

B.3 Regulations and Standards

B.3.1 The Contractor must ensure all work completed in this SOW item complies with the following Standards and Regulations and must take into account other applicable Federal/Provincial Regulations and/or Standards not specifically listed. It is the responsibility of the Contractor to ensure that all requirements specified in the General Notes (GN) are taken into consideration and applied to this SOW item's defined Work requirements. This SOW item may mention certain specific requirements from the General Notes. However, this does not exempt the Contractor from considering and including any other references from the GN that should also be applied and included for this SOW item's Work. ALL requirements must be assessed and included, when applicable, for the Work described in this SOW item:

	Title	Supplied By:
FSM Procedures		
7.B.5	CCG Fleet Safety Manual, Lockout and Tagout	CCG
Publications		
N/A	N/A	N/A
Standards		
N/A	N/A	N/A
Regulations		
CSA 2001	Canada Shipping Act 2001	Contractor
SOR/90-264	Marine Machinery Regulations, 2021	Contractor
Canada Labour Code	Canada Labour Code (R.S.C., 1985, c. L-2)	Contractor
SOR/2010-120	Maritime Occupational Health and Safety	Contractor
OHSA	Occupational Health and Safety Act, R.S.O. 1990, c. O.1 WebLink: OHSA or provincial equivalent	Contractor

12.2.C Statement of Work

C.1 General

C.1.1 The Contractor must supply all labour, equipment, and materials required to complete the work outlined herein.

C.1.2 The Contractor must enlist the services of an OEM FSR to perform **the work in this SOW. a 5-year overhaul of #1 ME and #2 ME.** The recommended Field Service Representative (FSR) for the work defined herein is:

Fairbanks Morse Defense (FMD)

Josh Post

Service Supervisor

Work: 1 (713) 896-4971

Mobile: 1 (757) 947-5569

josh.post@fmdefense.com

Mission Critical Performance for Marine Defense, 12253 FM 529
Houston, TX 77041

C.1.3 The Contractor must include an allowance of ~~\$300,000~~ **\$150,000** per engine in its bid to cover the cost of the 2 FSRs (lead mechanic and apprentice **FSR services**), **overhaul parts**, and living expenses (accommodations, meals, transportation, etc.). Upon completion of work, the Contractor must submit the FSR's final invoice, along with copies of all supporting documentation attesting to the actual cost(s). The allowance will be adjusted up or down using a PWGSC 1379 Work Arising or New Work form, as required.

NOTE: ~~The financial allowance stated at Para. C.1.3 includes costing for parts required for the 5 year overhaul of #1 ME and #2 ME (ref. Error! Reference source not found. in para. C.2.7). In addition to these components,~~ a Low Load Fuel System Upgrade Kit ~~#1 ME and #2 ME~~ and an upgraded oil seal for **all four (4) main engines-#3 ME and 4 ME** will be supplied as Government Supplied Material (**GSM**) ~~for installation during the reassembly.~~ FSR labor for the installation **and commissioning** of the Low Load Fuel System Upgrade **and upgraded oil seals**, is included in the allowance at Para. C.1.3.

C.1.4 As advised by the FSR, the engine overhaul work defined herein (including installation of fuel system upgrade components) is expected to be completed in approximately ~~twenty one (21)~~ **two (2)** working days per each engine. Working schedule must be planned for twelve (12) hrs per day, seven (7) days per week (Monday – Sunday) excluding official company holidays.

C.1.5 The duration and allowance are based on the Contractor assigning supplementary mechanics to assist the FSR during the execution of work. Prior to commencement of work, the Contractor must convene a meeting with the FSR to ensure adequate resources are assigned.

C.1.6 All Contractor assigned supplementary mechanics must be supervised and work as directed by the FSR.

~~C.1.7 Following the completion of work, the Contractor must submit a report of all work completed to the AR for 5-year Special Continuous Survey Machinery credit. This report must include the as found condition of each engine, include photographs of any problematic area found during inspection, all component measurements, a complete list of new parts used, as well as a summary of all major maintenance/upgrade activities performed.~~

C.1.8 The Contractor must measure and record a full set of lower crankshaft deflections for all four (4) main engines prior to docking the vessel.

C.2 Engine Overhaul

- C.2.1 Prior to commencing any work, the Contractor must install/remove locks and tags accordingly during the scope of work. The TA will assist the Contractor in identifying the locations to perform the lockouts but will not perform the actual lockout. The Contractor/FSR must supply and install their own locking devices and retain all keys during the scope of this work. Upon completion of all work the TA must be in attendance when all locks/tags are removed.
- C.2.2 Prior to commencing work, the Contractor must drain each engine and all associated lines of all fuel, coolant, and engine oil. The Contractor must dispose of all waste liquids in accordance with all federal, provincial, and municipal environmental disposal regulations in effect. A copy of the disposal manifest must be provided to the TA. For estimating purposes, the Contractor must quote for the disposal of 1000 L coolant per engine, 1500 L of used engine oil per engine, and 50 L of diesel fuel oil per engine. Actual disposal costs will be negotiated via a PWGSC 1379 work arising or new work form and paid according to the waste manifests provided.
- C.2.3 The disassembly of the ~~main engines~~ **crankshaft seals** must be scheduled for a time when adjacent work in the engine room or engine casings is at a minimum in order to minimize damage and/or ingress of foreign object debris. Under no circumstances must the main engines be opened when shot blasting, removal of insulation, or cleaning activity in the casing is in progress.
- C.2.4 The ~~main engines~~ **crankshaft seals** must be stripped down in accordance with the recommendations of the FSR and with the procedures specified in Fairbanks Morse, Opposed Piston Engine Instruction Manual.
- C.2.5 Parts from each respective main engine must be clearly identified. No parts must be interchanged between the main engines. ~~Bearings and connecting rods are currently stamped on their control side (starboard aft) with a unique identifier code. During disassembly, the Contractor must verify that these components were in the correct location.~~ All components removed from the main engines must be thoroughly cleaned and stored in an appropriate manner to avoid the possibility of damage or being misplaced.
- C.2.6 The FSR must measure and record the following as-found readings prior/during disassembly:
- a) Full set of lower crankshaft deflections taken while on the dock prior to removal of the propulsion generator;
 - b) Upper and lower crankshaft thrust measurements;
 - c) Crankshaft pointer and crankshaft lead timing;

~~d) Camshaft (fuel injection) timing and timing chain slack;~~

e) Vertical drive backlashes and bump clearance (upper and lower);

f) Blower and blower drive backlash and clearances;

~~g) Fuel boost pump drive bevel gear backlash;~~

~~h) Lube oil (LO) pump freedom of movement or gear backlash;~~

~~i) Water pump (jacket water (JW) and raw water (RW)) gear backlash, and~~

~~j) Cross drive to flex drive backlash, drive shaft end float, and driven shaft end float.~~

C.2.7 The FSR must measure and record the following as-left readings at the completion of the overhaul and fitting of the propulsion generator to the main engine:

a) Full set of lower crankshaft deflections;

b) Upper and lower crankshaft thrust measurements;

c) Crankshaft pointer and crankshaft lead timing;

~~d) Camshaft (fuel injection) timing and timing chain slack;~~

e) Vertical drive backlashes and bump clearance (upper and lower);

f) Blower and blower drive backlash and clearances;

~~g) Fuel boost pump drive bevel gear backlash;~~

~~h) Lube oil (LO) pump freedom of movement or gear backlash,~~

~~i) Water pump (JW and RW) gear backlash; and~~

~~j) Cross drive to flex drive backlash, drive shaft end float, and driven shaft end float.~~

C.2.8 The FSR must perform, ~~at a minimum,~~ the following **work on all four (4) main engines.** ~~overhaul activities on # 1 ME and #2 ME in order to obtain a Special Continuous Survey Machinery credit from the AR.~~ Components **being removed are to be** ~~are to be removed,~~ inspected, measured, refurbished or replaced as determined by the FSR. Any additional repair items found during survey will be addressed via PWGSC 1379 New Work or Arising Form:

NOTE: All replacement components must be new, Contractor supplied (CFM) genuine OEM parts.

~~a) Main Engine Overhaul and Inspection:~~

- i) Upper and lower piston assemblies, connecting rods, rod bearings, rod bushings, piston pins, piston bushings and inserts, and piston ring gaps and side clearances;
- ii) Cylinder liner adapters and indicator/relief valves;
- iii) Upper crankshaft, blower drive, spring pack, and main bearings — complete inspection, renew blower drive leaf springs and dowels. FSR to determine if journal surfaces require lapping;
- iv) Lower crankshaft and main bearings — minimum sample inspection of three (3) main bearings including the thrust bearing. FSR to determine if journal surfaces require lapping;
- v) Exhaust manifolds — hydrostatic pressure testing and inspection;
- vi) Upper JW header and upper and lower water jumpers;
- vii) Control gear and timing chain stretch;
- viii) Engine driven pumps and drive gears (LO, RW, JW, governor drive, start air drive);
- ix) Start air distributor, start air piping and start air valves;
- x) Explosion doors;
- xi) Air filters — wash and reuse;
- xii) Vibration damper;
- xiii) In-place inspection of the camshaft and removal and overhaul of the tappets, and
- xiv) Clean and inspect lower crankcase.

b) Vertical Drive and Spring Pack

- i) Spring pack — complete overhaul (5-year survey);
- ii) Upper Vertical Drive — complete overhaul with new bearings (10-year survey);
and
- iii) Lower Vertical Drive — complete overhaul with new bearings (10-year survey).

c) Cylinder Liners:

- i) Clean, inspect and measure cylinder liners on #1 ME (5-year survey);
- ii) Renew and measure cylinder liners on #2 ME (10-year survey);
- iii) Clean and measure exhaust belts on #2 ME; and

- iv) If for any reason the cylinders on #1 ME are removed, then renew cylinder seals and hardware, and clean and measure the exhaust belts on #1 ME.

d) ~~Cylinder Block:~~

- i) Visually inspect engine blocks, bedplate, and foundations;
- ii) Re-tension engine hold-down bolts; and
- iii) Renew oil dipstick gaskets (accessible only when DC propulsion generator is removed).

e) Scavenge Blowers

- i) *The Contractor must remove the engine blower from each main engine, set it aside and cover the openings. The engine blowers may be temporarily stored on OEM frames (frames to be GSM) and secured to each of the engine blocks as indicated by the IA. When unsecured, blowers must be supported on wooden blocks and secured by chain fall. Wooden blocks and chain falls must be supplied by the Contractor. The blowers must be protected from damage and contamination (infiltration of debris, dust, dirt, etc.) for the duration of the work. The blowers must be situated in a location that will not impede the removal/reinstallation of the generator components, nor other work being carried out by the Contractor. Once the propulsion generators are removed, the contractor must unship the blowers and transfer and store them in a secure, heated, indoor facility. Overhaul blowers (10 Year Survey), and*
- ii) Visually inspect blower flex drive for wear (10 Year Survey).
- iii) *The Contractor must reinstall the blowers under the supervision of the FSR.*

f) ~~Lube Oil System:~~

- i) Clean and inspect crankcase sump;
- ii) Drain lube oil from piping and coolers;
- iii) Change oil filters;
- iv) Change oil basket strainer and ~~CFM~~ gasket;
- v) Overhaul oil filter housing isolation valves (two (2) of 6" Norris butterfly valves), and
- vi) Change engine oil.

g) Crankcase Seal (Flywheel end):

i) To be included as part of the Low Load Upgrade – Mechanical and Fuel System.

h) Fuel Injection Pumps and Injectors:

i) To be completed as part of the Low Load Upgrade – Mechanical and Fuel System.

j) Generator Coupling:

i) *Visually inspect blower flex drive for wear (10-Year Survey).*

C.2.9 In order to facilitate the work outlined at Para. C.2.8, a parts overhaul kit of **GSM** materials will be provided. For all parts identified as Repair & Return (suffix RR), the Contractor must arrange and supply all necessary shipping costs to and from the OEM facility, as well as the parts and repair costs invoiced by the OEM. For all parts marked Unit Exchange (suffix UE) the Contractor is responsible for procuring the UE parts from the OEM and returning the cores to the OEM for credit. The Contractor must invoice and credit via 1379. Any additional parts required during the overhaul, as determined by the FSR and TA, will be provided through the Contractor as **CFM** and invoiced via 1379.

NOTE: All quantities listed in **Table 5** are per main engine.

Table 5: Main Engine Overhaul Parts List

PART NO.	DESCRIPTION	QTY PER ENGINE
MISCELLANEOUS ITEMS – NOT ALL FROM FAIRBANKS		
16107824	FUEL OIL FILTERS	2
13002395	LUBE OIL FILTERS – HILLIARD PL718-05-CN	14
ON1700031558	BUNA CORD, OIL FILTER HOUSING	10 FT
1027114	6" NORRIS BUTTERFLY VALVE REBUILD KIT, KIT BRK R200_6.00_A7_BUNA – AVAILABLE FROM ALBERTA OIL TOOLS	2
1027954	BFV OPERATOR TOPWORKS 1J 6-8" UNITIZED – AVAILABLE FROM ALBERTA OIL TOOLS	2
CAT. NO. 1 – CYLINDER BLOCK		
91109264	LOCKWASHER	22
91109204	NUT, ½"–20, PUMP MOUNTING PLATE	22
CAT. NO. 5 PISTON		
16101189	OIL RETAINER	16
16101190	RETAINER SPRING	16
16200274	PISTON PIN	16
16701767	BUSHING, FLOATING PISTON PIN	16
16704845	RING, PISTON COMPR STD WALL	48
16300217	RING, PISTON OIL SCRAPER CAFB5705B; ALT.VENDOR PERF.CIRC	16

16101191	RING, PISTON OIL DRAIN CAFB5705C	16
16103236	RING, PISTON OIL DRAIN SPR.LOADED DBL.EDGE	16
16101192	EXPANDER, PISTON OIL RING CAFB2684B; 500-040-0018-025A	8
16300358	BUSHING, INSERT	32
16101188	PIN, INSERT BUSHING	32
ON14012.02.10	LOCKPLATE	64
16703370	CAPSCREW, PISTON INSERT	16
CAT. NO. 18 CONNECTING ROD & BEARINGS		
81309957N	COTTER PINS, PL STL 1/8X1-3/4	32
16701707	BOLT AND NUT—CON ROD	8
16701708	BEARING, HALF, CON ROD (ASSY W/DOWEL 16701699)	16
CAT. NO. 25 CRANKSHAFT		
AFB3067A	SEAL OIL, FLYWHEEL	1
CAT. NO. 30 CAMSHAFT		
N/A	(NONE)	
CAT. NO. 62 SUBBASE		
N/A	(NONE)	
CAT. NO. 75 EXHAUST FITTINGS		
16205605	GASKET, EXH EXT TO EXH MANIFOLD	2
16113036	GASKET, NOZZLE DISCHARGE END	4
ND1257C	TUBE, FLEXIBLE, LOA 12", 5/8" THK FLANGES, 16-9/16" DIA, 15" PDCD, 16 BOLT HOLES, 11/16" DIA HOLES	2
81303136	CAPSCREWS, 5/8-18X2	64
81328541	NUTS, 5/8-18	64
CAT. NO. 80 GOVERNOR		
16102917	GASKET	1
CAT. NO. 117 IGNITION CELL & ADAPTERS		
16702098	ADAPTER COLLAR AND STUDS, AIR START	8
81328562	NUTS, 3/8-24, AIR START CHECK VALVE	16
16108791	ADAPTER, AIR START CHECK VALVE	8
16701147	GASKET, ADAPTER CAFB1549E	24
16204476	JACKET, ADAPTER WATER, AIR START AND RELIEF VALVE	16
16701278	RING, GLAND ADAPTER SEAL, O-RING, U/O AIR START AND IND COCKS	16
16102085	NUT, ADAPTER GLAND, AIR START AND RELIEF VALVE	16
10555177	RING, ADAPTER GLAND, AIR START AND RELIEF VALVE	16
16102313	NUT, ADAPTER GLAND, FO INJ	16
16108370	COLLAR, NOZZLE HOLDER, FO INJ	16
16200792	JACKET, ADAPTER WATER, FO INJ	16
16200895	ADAPTER, INDICATOR/RELIEF VALVE	8
16204186	ADAPTER, FO INJ	16
16701279	RING, ADAPTER SEAL, O-RING, U/O FO INJ	16
16701280	RING, ADAPTER LINER SEAL, O-RING, U/O ALL	32
16701952	RING, ADAPTER GLAND, FO INJ	16
16702197	COLLAR AND STUD ASSY, FO INJ	16

16701148	GASKET, ADAPTER CAFB1549D GRPS.4018;7505;8687 IND/RELIEF VV	8
16204189	ADAPTER, INDICATOR/RELIEF VALVE TO CYL LINER	8
16702422	COLLAR AND STUD ASSY, INDICATOR/RELIEF VALVE	8
16105781	VALVE, INDICATOR	8
91106620	NUT, COLLAR STUD, FO INJ	32
91124607	NUT, COLLAR STUD, INDICATOR/RELIEF VALVE	16
CAT. NO. 145 FUEL OIL PUMP		
16700286RR or UE	FUEL OIL PUMP (AR1-AR3) COMPLETE—REPAIR AND RETURN	1
16100322	GASKET, ADAPTER	1
16100615	GASKET, BEARING CAP	1
CAT. NO. 225 EXHAUST MANIFOLD		
81311010	STUD, MANIFOLD TO EXHAUST ELBOW	28
C-AFB5603A	PLUG, EXHAUST MANIFOLD JACKET BOLT HOLE	16
16701594	WASHERS, EXHAUST BELT JACKING HOLE PLUG	16
81334642	NUT, MANIFOLD TO EXHAUST ELBOW	28
16205601	GASKET, EXH MANFOLD BELT	16
16700892	CAPSCREW, EXHAUST MANIFOLD END	12
16113034	GASKET, EXH MANIFOLD COVER	16
91124609	NUTS, STAINLESS-STEEL HEX 1/2-20	140
16101459	NUT, EXH BELT TO MANIFOLD CND1830A #410	140
16701595	WASHER, EXH MAN PLUG	140
16701483	SVK GASKET AY.EXH.MAN.COV.PL.10CYL CA10FB3039-D;8- 1/8X10-OP (STRESS PLATE GASKET)	2
CAT. NO. 571 AIR START		
16101964	SPRING, AIR START DISTRIBUTOR	8
16700814	GASKET, PLUG, COPPER	8
16101241	GASKET, AIR START DIST MOUNT	1
16101984	GASKET, DISTRIBUTOR	1
16705400	GASKET, AIR START HEADER INLET	1
16701842	GASKET, AIR START PIPING TO CHECK VALVES	16
91610599	BALL BEARING, SKF 1208	1
	CAM, AIR START DISTRIBUTOR, 8 CYL	1
91123600	NUT, LOCK	1
16101897	GASKET, MOUNTING, AIR START	1
16701840	GASKET, AIR START	2
16701841	GASKET, AIR START PIPING	1
CAT. NO. 603 WATER PUMP		
16603512RR	REPAIR & RETURN WATER PUMP PTO-VOLUTE, CERAMIC SEAL—MARINE 8" (U/O RAW WATER)	1
16603342RR	REPAIR & RETURN WATER PUMP PTO-VOLUTE, STANDARD SEAL—MARINE 8" (U/O JACKET WATER)	1
10554744	GASKET-WP SUCTION	2
16102952	GASKET-WP DISCHARGE	6
16703754	GASKET, W.P. & W.P. MTG PL CAFB610A & GROUP 1987	2

16704442	GASKET, WP DISC FLANGE 12068317	2
16704432	GASKET, WP DISC FLANGE 12068318	2
CAT. NO. 652 TAPPET ASSEMBLY		
16106045	ORING	16
16600336	ROLLER ASSEMBLY (INCLUDES BUSHING 16100527)	8
16100528	PIN	8
16100529	GUIDE, PIN	8
16100524	SPRING	8
16100523	SPACER, PUSHROD SPRING	8
16100532	GASKET	32
16100530	GASKET	8
16100531	BOLT, PUMP AND TAPPET HOUSING	16
81334664	NUT, 5/8-18	32
16700345	SHIM, .007	30
16700346	SHIM, .0149	30
16700347	SHIM, .0598	30
CAT. NO. 805 MAIN BEARING		
81310017	COTTER PINS, PL STL 7/32X2-1/2	40
16701840	GASKET, FITTING CADD2223B & GRPS.1084;2389;4549	40
16706635	CAPSCREW, SELF-LOCKING 3/8-24 UNF CL.2A ,1-1/2"LG.	80
81309828N	3/8 SAE FLATWASHER	80
16300373	BEARING HALF, THRUST	2
16603841	BEARING HALF, MAIN - ASSY	4
CAT. NO. 853 AIR START CHECK VALVE		
16702100RR or UE	AIR START CHECK VALVE - COMPLETE - INCLUDES EVERYTHING BELOW	8
CAT. NO. 1084 LUBE OIL PUMP		
16100447	GASKET, L.O. SUCTION PIPING CAFB5773C	3
16102560	GASKET, L.O. PUMP TO MTG PL	1
17601202RR	LUBE OIL PUMP, REPAIR & RETURN	1
CAT. NO. 1096 C.C. BREATHER/EJECTOR		
10554844	GASKET, C'CASE BREATHER	4
10554845	GASKET, OIL SEPARATOR	1
16101292	GASKET, C'CASE BREATHER	1
CAT. NO. 1624 JACKET WATER PIPING		
16704442	GASKET	2
16704432	GASKET	2
CAT. NO. 1987 PUMP MOUNTING PLATE		
16200701	GASKET, L.O., F.O.&W.P.MTG.PL. CAFB2639B	1
16102029	GASKET, HANDHOLE COVER FRONT CAFB2894A	2
CAT. NO. 2115 WATER HEADER		
16300370	ELBOW, WATER INLET	16
81302995	CAPSCREW, WATER HEADER MOUNTING 1/2-20X1	7
81309830	WASHER, 1/2", WATER HEADER MOUNTING	7
10555032	GASKET ADAPTER TO EXH.MAN. CND2541A	16
16101325	WASHER, WATER INLET ELBOW	32

16604505	PIPE, LINER TO HEADER	8
16102158	ADAPTER, LINER WATER	16
16701282	GASKET, WTR HDR-INLET ELBOW & CAFB9477A; (5200) TURBO.PIPE-GS	8
81302819	CAPSCREW, HEADER INLET ELBOW, 3/8-24X2	16
81302861	CAPSCREW, ELBOW, 3/8-24X2-1/2	32
92002580	PLUG, 1/8	2
CAT. NO. 2435 VERTICAL DRIVE SHAFTS		
16114272	BEARING, VD THRUST	2
CND1683A	BEARING, VD RADIAL, PINION ROLLER	2
91109280	LOCKWASHER, BEARING	2
16102050	LOCKWASHER, COUPLING HUB	2
81334614	KEYS, STRAIGHT SQUARE, BEVEL PINION	2
CAT NO 2435 VERTICAL DRIVE SPIDER COUPLING		
16102034	EXTENSION SPACER, SPIDER COUPLING	1
16102063	BUSHING, SPIDER COUPLING	1
16102059	BUSHING, SPIDER COUPLING	1
16102088	PLATE, SPRING WEAR	16
16102072	BOLT, VERTICAL DRIVE TAPER HUB	8
16102991	WASHER, VERTICAL DRIVE TAPER HUB	8
81140814 /81322545	CAPSCREW, VERTICAL DRIVE	16
16102051	PLATE, DOWEL RETAINING	8
16102030	SPRING, FLEX COUPLING DRIVE	16
16102994	RETAINER, DRIVE SPRING PLAIN	8
16102093	RETAINER, DRIVE SPRING THREADED	8
16102041	BOLT, DRIVE SPRING	8
THERMOCOUPLE — NOT FROM FAIRBANKS		
AF-2027291	WATLOW MINERAL INSULATED TYPE J THERMOCOUPLE # AF-2027291 .250" X 17" OVERALL SHEATH LENGTH — 316 STAINLESS STEEL 90 DEGREE BEND, L=15" 10 FOOT LEADS WITH OVERBRAID	8
CAT. NO. 3541 BLOWER		
16300553	GASKET, BLOWER END COVER	1
CAFB4305A	RING SEAL. OIL RETAINER	4
16104623	BEARING, IMPELLER SHAFT, INNER	2
CAFB3859A	SHIELD, INNER BEARING OIL	2
16200293	BEARING, IMPELLER SHAFT, OUTER	2
16701935	SHIM, OUTER BEARING REATINER 0.003	2
16701934	SHIM, OUTER BEARING REATINER 0.005	2
16701933	SHIM, OUTER BEARING REATINER 0.010	2
16300560	GASKET, BEARING PLATE TO HOUSING	3
16200991	GASKET, BRG PLATE TO CYL BLK CAFB2930A 4-10CYL.	1
16300553	GASKET, BLOWER END COVER	1
16102079	GASKET, HANDHOLE COVER	1

CAT. NO. 3624 MISC. COVERS		
17302907	GASKET 16100825, VD INSPECTION COVER	2
16200398	GASKET, END COVER LOWER HALF CAFB1361B	1
16200399	GASKET, END COVER UPPER HALF CAFB1360B	1
16100829	GASKET, F.W. END COVER PARTING CAFB1362A	2
16100824N	GASKET US CONTENT	13
16200403	GASKET, CYL BLK AIR REC COVER A12FE2958A	2
16100822	GASKET, AIR RECEIVER INSPECTION COVER	14
CAT. NO. 4018 CYLINDER LINER		
16612229	LINER, CYLINDER, ASSY KIT	8
16107826	LOCKPLATE, CYL LINER TO BLOCK	32
91125658	CAP SCREW, LINER TO BLOCK	32
CAT. NO. 4038 CRANKCASE COVER		
K6J	EXPLOSION DOOR REBUILD KIT	2
17105108	GASKET, RUBBER, CRANKCASE DOORS – CORK REPLACEMENT????	20
16101087	GASKET, CRANKCASE DOORS – ORIGINAL CORK	20
CAT. NO. 4549 LUBE OIL HEADER		
10555057	GASKET, OIL HEADER PIPING	5
CAT. NO. 4868 CONTROL END COVERS		
10554736	GASKET, CONTROL, DRIVE END	2
16101006	GASKET, CONTROL END	1
16101010	GASKET, INSPECTION COVER, DRIVE END	1
16200497	GASKET, CONTEND COV TO TOPCOV CAFB2908C (UPPER)	1
16200498	GASKET, CONT END COV TO CYL BLK CAFB4111C (LOWER)	1
17302915	GASKET-16200473 – CONTROL END COVER	1
CAT. NO. 5644 TIMING CHAIN AND SPROCKETS		
16103054	LINK, TIMING CHAIN, MASTER LINK	1
CAT. NO. 6038 OIL PAN		
10555062	GASKET, OIL GAGE (DIP STICK)	2
16100447	GASKET	3
16100429	GASKET, OIL STRAINER	1
CAT. NO. 7126 TOP COVER		
81302007	CAPSCREW, TOP COVER, ½-13X1-1/2	90
81309830	WASHER, TOP COVER CAPSCREW, 1/2	90
81302005	CAPSCREW, INSPECTION COVER, ½-13X1	50
81302857	CAPSCREW, TOP COVER TO BLOWER, 3/8-24X1-1/2	15
81309828	WASHER, TOP COVER CAPSCREW, 3/8	15
17302914	GASKET-16200338 – TOP COVER INSPECTION PLATE	6
17302905	GASKET-16100649 – TOP COVER TO BLOWER	1
16700549	GASKET, TOP COVER	2
CAT. NO. 7399 TORSIONAL DAMPER		
C-AFB7300AH	BUSHING, SPIDER 5TH ORDER	4
C-AFB7300AJ	BUSHING, SPIDER 3RD, 4TH, 8TH ORDER	12
C-A8FB7260A	DAMPER, 3RD ORDER	2

C-AFB7260X	DAMPER, 4TH ORDER	2
C-AFB7260Y	DAMPER, 5TH ORDER	2
C-AFB7260Z	DAMPER 8TH ORDER	2
C-A8FB7261A	PIN, 3RD ORDER	2
C-A8FB7261B	PIN, 4TH ORDER	2
CA8FB7261C	PIN, 5TH ORDER	2
CA8FB7261D	PIN, 8TH ORDER	2
81303813	CAPSCREW — 3/8 16 X 3/4	32
90300002	LOCKWIRE — ROLL	1
CAT. NO. 8005 A/R COMP. PLUG		
17112104	O-RING-16704650-V70-330	16
91100561	COTTER PIN, 3/32 X 1	16
16702201	SEAL, COMPARTMENT	16
16100530	GASKET, TAPPET HSG CAFB2121B	16
16700768	GASKET, CAPSCREW AND BOLT	16
16100532	GASKET, FLANGE BOLT (531&8005) CAFB6270A	32
CAT. NO. 8562 BLOWER DRIVE		
16102838	SPRING, LEAF	192
16702363	SHIM, LEAF SPRING PACKING (0.003")	60
16702364	SHIM, LEAF SPRING PACKING (0.010")	60
16102837	PIN, DRIVING	24
CAT. NO. 8628 GOVERNOR DRIVE		
16101241	GASKET	1
16706114	GASKET	1
91610941	BEARING, GOVERNOR DRIVE SHAFT BALL	2
91610948	BEARING, VERTICAL DRIVE SHAFT BALL	1
16102915	BUSHING, VERTICAL DRIVE SHAFT	1
10555283	GASKET, GOVERNOR DRIVE COVER	1

C.2.10 All measurements taken must be neatly recorded on standard OEM forms provided to suit the model of engine. The Contractor must create summary reports for the RO detailing each component Survey Credit being sought. Summary reports must include vessel name, official number, equipment details, component name, RO asset ID, inspection date, inspectors name, name(s) of the person performing the work, measurements, inspection photos, description of the component condition, and lists of any parts replaced. An example of an acceptable format together with typical information required is included in the reference documents. The Contractor may contact the TA for editable Word or Excel copies as required. Copies of all measurements taken must be submitted to the TA and AR as part of the Contractor's Final Report.

Low Load Upgrade – Mechanical and Fuel System – #1 ME & #2 ME

C.2.11 Upon reassembly of the main engines, the Contractor must upgrade the fuel systems for #1 ME #1 and #2 ME to the Fairbanks Low Load Package fuel system as follows:

- a) Install Low Load Package fuel injector nozzle assemblies with matching nozzle tips and leak-off piping;
- b) Install Low Load Package fuel pumps and associated fuel injection and leak-off piping, and
- c) Adjust fuel racks to pumps to balance cylinders.
- d) Removed fuel pumps, injectors, and lines must be drained of fuel, securely boxed and strapped to a pallet, and shipped to CCG Base Prescott.
- e) **Install new crankshaft oil seals at the drive end of each main engine. This will be easiest to complete while the propulsion generators are removed.**

C.2.12 The Contractor must calibrate and set the blower bypass system to the fuel rack settings and the governor actuator position.

C.2.13 In order to facilitate the work outlined below at Para. C.2.11, the Contractor will be supplied with **four (4) two (2)** sets of components listed in **Table 6** as Government Supplied Material (GSM).

NOTE: All quantities listed in **Table 6** are per main engine.

Table 6: Low Load Package Upgrade Parts List

Part #	Description	Qty
16611472	NOZZLE ASSY., PINTLE 2400PSI	16
16611116	PUMP ASSY, GASKETLESS	8
AFB3067A	SEAL-OIL, FLYWHEEL	1
10555062	GASKET, OIL GAGE (DIP STICK)	2
16609808	FUEL INJECTIONS LINES, KIT	1

Low Load Upgrade – Mechanical and Fuel System – #3 ME and #4 ME

C.2.14 The Contractor must remove and dispose of a sufficient amount of lube oil from **each** sump to facilitate this work. The Contractor must quote on 500L of oil per engine.

C.2.15 The Contractor must remove the fitted oil seal at the flywheel end of **all four (4) main engines #3-ME and #4-ME** and install the upgraded oil seal from the Low Load Package Upgrade Parts List – AFB3067A (GSM).

C.2.16 The Contractor must renew oil dipstick gaskets **on all four (4) main engines** (accessible only when DC propulsion generator is removed).

C.2.17 The Contractor must refill the lube oil sump to working level with Shell Rotella T1-30 (**GSM**).

Crankcase Centrifugal Mist Collector

C.2.18 The Contractor must provide the services of a certified Subcontractor to overhaul and balance the electrical motors fitted to the crankcase centrifugal mist collectors on all 4 (four) main engines.

C.2.19 The Contractor must disassemble the electric motor and drum assembly, perform and record readings for insulation resistance testing (megger) of each phase winding, renew bearings, and balance with drum to ISO standard G2.5 or better. An overhaul report including details of work performed must be provided to the TA/IA or designate.

C.2.20 The Contractor must also renew the filter material (**GSM**) and prove piping clear.

12.2.D Proof of Performance

D.1 Inspection Points

D.1.1 Hold Point 1: Prior to commencement of work, the Contractor must convene a meeting between the TA **and the** FSR, **and AR** to ensure the **RO** expectations for **issuing 5-year survey credit(s) for #1 ME and #2 ME this SOW item** are clearly understood. Following this, the Contractor must provide the TA **and AR** with 24 hours' notice of each necessary **RO** inspection point.

D.1.2 Hold Point 2: Prior to commencement of work, the Contractor must provide the TA, **IA,** or designate with the opportunity to ensure that all relevant systems are locked out/tagged out in accordance with Para. C.2.1. The Contractor must provide at least 24 hours' notice.

D.1.3 Hold Point 3: The Contractor and FSR must provide the TA **and the AR** with the opportunity to inspect all components disassembled, cleaned, measured and laid out for inspection. The Contractor must clearly demonstrate to the TA which components will be re-used, and which will be replaced with new. The Contractor must provide at least 24 hours' notice.

D.1.4 Hold Point 4: Prior to reinstallation of all covers **(specifically the main engine top covers),** the Contractor must provide the TA with the opportunity to inspect the completed area. The Contractor must provide at least 24 hours' notice.

D.2 Testing / Trials

D.2.1 Following overhaul and reassembly of all 4 (four) centrifugal mist collectors, the Contractor must perform a runup of the equipment. The Contractor must provide the TA, **IA** or designate the opportunity to witness this test and must provide 24 hours' notice.

D.2.2 Following **overhaul and** reassembly of all 4 (four) main engines, the Contractor must perform an initial runup of all 4 (four) main engines in accordance with the FSR's

recommendations and established procedures. The Contractor must prove all safeties and shutdowns. The Contractor must provide all necessary instructions, test procedures, and equipment (as required) to conduct the testing. The Contractor must provide the TA and AR the opportunity to witness this test and must provide 24 hours' notice.

D.2.3 ~~The Contractor must perform a run-in of #1 ME and #2 ME as detailed in the Service Information Letter (SIL) Volume A, Issue 5, Rev 3 – Run-In Procedures – OP Engines. The Contractor must record and report all data from this procedure in the final reports. The Contractor must provide the TA and AR the opportunity to witness this test and must provide 24 hours' notice.~~

D.2.4 The Contractor must test, calibrate/tune and certify, to the satisfaction of the FSR and TA all control systems, including but not limited to those located in the Engine Control Room and Alarm and Monitoring System. The FSR must demonstrate to the TA and AR that full functionality has been restored across the system. The Contractor must provide all necessary instructions and test procedures.

D.3 Certification

D.3.1 The Contractor must supply the TA ~~and AR~~ with OEM certifications for all FSRs actively participating in overhaul activities specified herein. OEM certifications must clearly state approval to conduct work on model 38D8-1/8 FBM Opposed Piston Engines.

D.3.2 The Contractor must supply the TA with copies of all valid calibration certificates for tools used to take measurements during the ~~work on overhaul and upgrade of~~ the main engines.

D.3.3 The Contractor must supply the TA with copies of all valid calibration certificates for tools used to take measurements during the ~~work on overhaul and upgrade of~~ the crankcase centrifugal mist collectors.

D.4 Documentation

D.4.1 ~~The Contractor must~~ Following completion of all work described herein, the Contractor/FSR must submit to the TA ~~and AR~~ for approval a Final Report of all work completed. This report must include observances of any problematic areas found during overhaul, all repair actions taken, all parts used, as well as a summary of all ~~overhaul and~~ testing activities performed. The Contractor must provide a separate summary report for each individual engine.

D.4.2 The Final Reports detailed at Para. D.4.1 must include copies of all OEM and CCG provided measurement sheets completed during overhaul ~~and upgrade~~ activities. ~~This includes but is not limited to those outlined in the reference sample report.~~

D.4.3 ~~Following completion of all work, the Contractor must provide the TA with complete special continuous machinery survey credits from the AR for all component inspections.~~

D.4.4 The Contractor must supply the overhaul report of the crankcase centrifugal mist collectors to the TA.

D.5 **Training**

D.5.1 Not used.

12.16 RUDDER AND STEERING GEAR

12.16.A Identification

- A.1 The Contractor must remove the rudder and rudder stock from the vessel for regulatory inspection and RO Survey credit.
- A.2 The Contractor must renew the rudder pintles and stern frame bushings.
- A.3 The Contractor must repair the fit between the rudder stock and tiller.
- A.4 The Contractor must repair the fit between the rudder stock palm flange and the mating flange of the rudder.
- A.5 The Contractor must remove and repair/rebuild the main steering gear rams.
- A.6 The Contractor must inspect, overhaul and calibrate the steering gear telemotor and autopilot systems.
- A.7 The work of this SOW item must be carried out in conjunction with the following SOW items:
 - 11.12 – Ballast Tanks;
 - 11.14 – Hull Painting Below Waterline;
 - 11.15 – Hull Painting Above Waterline;
 - 11.28 – Hull Cut-Outs ;
 - 12.17 – Propulsion Tail Shafts;
 - 12.22 – Propellers; and
 - 17.10 – Stern Windlass.

12.16.B References

B.1 Equipment Data

- B.1.1 Hastie’s Electro-hydraulic Steering Gear – 4 Ram
- B.1.2 Main steering gear Pumps: Hastie HP 6 Hele-Shaw type
 - Port Pump S/N 15918,
 - Starboard Pump S/N 15917.
- B.1.3 Main steering gear Motors: Hugh J Scott 276019 and 276020, Frame C324, Output 12 BHP, 440V, 690RPM, 19.4Amps, 3 Phase 60Hz.
- B.1.4 Telemotor Systems

The systems are Sperry hydraulic pump unit assemblies. They consist of a hydraulic tank, hydraulic pump and motor, pressure control valve, directional control valve, and hydraulic rams.

- Sperry Hydraulic Pump Unit Assemblies (Motor, pump, tank) - P/N 03936 1885255-1
- Hydraulic Pumps Details: Bosch-Rexroth Model PVC PSSF 09ERM-01
Port Telemotor Pump, 3H032
Starboard Telemotor Pump, 3H033
- Coupling: Lovejoy L-095 NBR
- Electric Motors: Lincoln A.C. Motor - Frame 1451 - S/N 2445332
- Directional Valve: Parker D3W8CNYC45
- Pressure Control Valve: Sperry-Vickers 391649 - Model RG 06 Y3 23
- Hydraulic Rams: Sperry 1888131-1 - Wabco Fluid Power Division American-Standard PC P159251, Model MD52-HH, 3-1/4 x 15, LO53 - Port #82 - Starboard #81
- Steering gear heading control system: Sperry Marine Navipilot 4000
- Manual steering system: Navinet 4000 steering control network.

B.1.5 Replenishing Hydraulic Oil types:

- a) Steering system hydraulics - Hydrex AW 100
- b) Hastie pump motor bearings – Turboflow R&O 68
- c) Telemotor system – Hydrex AW 22

B.1.6 **Steering Gear (FSR)**

The Contractor must engage the services of a MMH Marine FSR for all work related to the rudder and steering gear, including sea trials. The Contractor must include an allowance of \$50,000 for the FSR services. Travel and living expenses must be billed at cost without added overhead or profit. The \$50,000 allowance must form part of the overall bid and must be adjusted up or down, using a PWGSC 1379 work arising or new work form, upon receipt of the final FSR's invoice, supported by copies of all related documentation, to verify the actual expenses.

MMH Marine Inc.

1011 Upper Middle Road Suite 1202

Oakville, Ontario, L6H 5Z9

Phone: 905-842-5995

Cell: 905-301-0692

Contact: Martin or Gary Higgins

Email: mmhmarineinc@gmail.com

B.1.7 Sperry Electronic Steering Equipment (FSR)

The Contractor must engage the services of a **Sperry Electronic Steering Equipment FSR** for all work related to the electronic steering controls. The Contractor must include an allowance of \$10,000 for the FSR services. Travel and living expenses must be billed at cost without added overhead or profit. The \$10,000 allowance must form part of the overall bid and must be adjusted up or down, using a PWGSC 1379 work arising or new work form, upon receipt of the final FSR's invoice, supported by copies of all related documentation, must be supplied to verify all actual expenses.

Alliance Nav Inc.

6535 Chemin St Francois

St Laurent, Quebec

H4S 1B6

Phone: (514) 338-1960

Fax: (514) 338-196

Contact: Tony Dos Santos

Email: tdossantos@alliancnav.com

B.1.8 VapCor Marine (FSR)

The Contractor must engage the services of a **VapCor Marine FSR** for all work related to the rudder float coating. The Contractor must include an allowance of \$3,000 for the FSR services. Travel and living expenses must be billed at cost without added overhead or profit. The \$3,000 allowance must form part of the overall bid and must be adjusted up or down, using a PWGSC 1379 work arising or new work form, upon receipt of the final FSR's invoice, supported by copies of all related documentation, must be supplied to verify all actual expenses.

VapCor Inc.

530A Eastchester Ave.

St. Catherines, Ontario

L2M 7P3

Phone: (905) 346-2638

Contact: Angus Kennedy

Email: apkennedy@vapcor.com

B.2 Drawings and Documents

B.2.1 The following drawings are to be considered as Guidance Drawings only, as defined in the G.1.7 Drawings section of the General Notes.

Drawing Number	Drawing Title
664-31-1	Rudder Plan
664-31-2	Rudder Stock
664-30-1	Stern frame
EN12537-01	Rudder Pintles & Bushings Replacement
16022-400-S01	Rudder Stock Drawing – Detail Drawing
Document Number	Document Title
N/A	Interspec CCGS Griffon 2024 – 2025 VLE – Paint Specification
N/A	Hastie Steering Gear Manual Griffon
N/A	Sperry Marine Navipilot 4000 and Naviguide 4000

B.3 Regulations and Standards

B.3.1 The Contractor must ensure all work completed in this SOW item complies with the following Standards and Regulations and must take into account other applicable Federal/Provincial Regulations and/or Standards not specifically listed. It is the responsibility of the Contractor to ensure that all requirements specified in the General Notes (GN) are taken into consideration and applied to this SOW item’s defined Work requirements. This SOW item may mention certain specific requirements from the General Notes. However, this does not exempt the Contractor from considering and including any other references from the GN that should also be applied and included for this SOW item’s Work. ALL requirements must be assessed and included, when applicable, for the Work described in this SOW item:

	Title	Supplied By:
FSM Procedures		
CCG/5737	Fleet Safety Manual	CCG
7.B.3	Entry into Confined Space	CCG
7.B.4	Hotwork	CCG
7.B.5	Lockout and Tagout	CCG
Publications		
N/A	N/A	N/A
Standards		
CAN/CGSB 48.9712	National Non-Destructive Testing Certification Body of Natural Resources Canada	Contractor
Regulations		
Canada Labour Code	Canada Labour Code (R.S.C., 1985, c. L-2)	Contractor
SOR/2010-120	Maritime Occupational Health and Safety	Contractor
OHSA	Occupational Health and Safety Act, R.S.O. 1990, c. O.1 WebLink: OHSA or provincial equivalent	Contractor

12.16.C Statement of Work

C.1 Rudder Inspection

- C.1.1 The Contractor must supply all materials, tools, equipment and labour required to complete the work in SOW item.
- C.1.2 The Contractor must fit and secure sufficient lifting arrangements on the hull of the vessel to remove the rudder and rudder stock.
- C.1.3 The Contractor must be responsible for marking all items on the rudders and associated equipment prior to disassembly. All marked items must be re-assembled to the same position from which they were disassembled.
- C.1.4 The Contractor must remove the fairwater and closing plates at the front of the rudder to allow access to the internal diaphragm plates. The Contractor must fabricate and install new bolt-on fairwater plates (as per original design) to replace the removed welded ones. The new fairwater plates must be fabricated out of Steel plate Grade A36/44W. The Contractor must grind off all old weld and clean the bolt holes to prepare for bolting the new plates in place with new fasteners **(CFM)**.
- C.1.5 The new fairwater and closing plates must be grit blasted to bright metal and coated as detailed in the "Interspec CCGS Griffon 2024-2025 VLE – Paint Specification" for SOW item "11.14 - Hull painting below waterline".
- C.1.6 The Contractor must remove the diaphragm plates.
- C.1.7 The Contractor must measure and record all pintle bearing clearances in the fore-aft and port-stbd directions using feeler gauges prior to unshipping the rudder. A complete set of measurements is to be taken three (3) times: once with the rudder midships, once with the rudder hard to port and once with the rudder hard to starboard. The measurements must be taken in the presence of the TA and AR and included in the Contractor's report.
- C.1.8 The Contractor must remove the main rudder drain plug and the drain plug of the small aft section of the rudder to verify the internal rudder structure is free of water, prior to unshipping the rudder.
- C.1.9 The Contractor must subject the rudder and rudder extension to an air pressure test as per Para. D.2.1.
- C.1.10 The Contractor must disconnect the rudder from the rudder stock at the palm and remove the tapered locking key.
- C.1.11 The Contractor must unship the rudder. **NOTE:** the upper pintle is a locking pintle.

C.1.12 Following the inspection of the rudder, the internals of the rudder and the rudder extension must be float coated with VapCor Marine Coat SeaGuard corrosion prevention coating. The float coating must be carried out under the supervision of an authorized Field Service Representative (**FSR**) of the manufacturer, as per Para. B.1.7. The Contractor must quote on providing one 201 litre drum of VapCor Marine Coat Sea Guard (**CFM**).

C.2 Rudder Stock

C.2.1 The Contractor must remove, clean out, and dispose of all grease and debris in the rudder trunk before commencing work on the rudder stock. The Contractor must quote on disposal of 1 drum (205L) of grease and debris.

C.2.1 The Contractor must provide the TA with copies of manifests showing that the grease and debris removed were disposed of in accordance with Federal, Provincial and Municipal regulations in effect at the time.

C.2.2 Access to the rudder trunk is gained from the inspection manhole located inside the upper portion of the aft peak tank.

C.2.3 The inspection manhole in the aft peak tank must be re-installed with a new Contractor supplied ¼" neoprene fiber re-enforced gasket upon completion of the inspection (**CFM**).

C.2.4 Where the rudder carrier bearing and steady bearing inspections are performed after the hydrostatic testing of the aft peak as per SOW item "11.12 - Ballast Tanks", the hydrostatic test of the aft peak must be repeated.

C.2.5 The Contractor must identify and mark all items on the steering gear and associated equipment prior to disassembly. All marked items must be re-assembled to the same position from which they were disassembled.

C.2.6 The Contractor must remove and mechanically and electrically isolate any components from the steering gear required to remove the rudder stock. This includes the hunting gear, tiller blocks, and feedback devices. **NOTE:** some of the feedbacks fitted are welded to the steering gear structure.

C.2.7 The Contractor must supply and install all lifting points required to unship the rudder stock.

C.2.8 The Contractor must unship the tiller head from the rudder stock.

C.2.9 The Contractor must unship the main carrier bearing including spacer sleeves, packing, and grease piping. The Contractor must dispose of the packing.

C.2.10 The Contractor must unship the intermediate bearing including all grease piping.

C.2.11 The Contractor must remove the lower carrier bearing halves, the upper half of carrier bearing, the retaining ring from the rudder stock, spacer ring and tiller bolts.

- C.2.12 Once free, the Contractor must lower the rudder stock from the rudder trunk.
- C.2.13 All components must be cleaned of grease and presented to the AR and the TA.
- C.2.14 Measurements must be taken (minimum 6 places per component) of the rudder stock at the bearing surfaces. Further inspection and analysis of the rudder stock in way of the lower bearing must be conducted in accordance with Para C.3 (Rudder Stock inspection).
- C.2.15 The carrier and intermediate bearings must be re-assembled and diametric clearances at a minimum 6 places per component must be taken to determine the bearing clearances.
- C.2.16 The Contractor must flush and prove clear all rudder carrier bearing grease lines. The grease lines and grease cups must be filled with new Contractor supplied EP 2 grease **(CFM)**.

C.3 **Rudder Stock Inspection**

- C.3.1 While the rudder stock is removed the Contractor must carry out a radiographic NDT inspection of the rudder stock in way of the lower bearing and keyway as per Para D.2.2. This inspection must be completed by a suitable third party.
- C.3.2 The Contractor must deliver the report to the TA within 5 business days of completing the inspection and NDT examination and include the results in the final report as per Para D.4.2.
- C.3.3 Within 5 business days of receiving the report the TA must complete the required calculations and determine if the rudder stock is adequate or requires cladding.

C.4 **Rudder Pintles and Securing Nuts**

- C.4.1 The Contractor must measure the alignment of the existing pintles as they rest in the rudder in both the fore-aft and port-starboard directions prior to commencing any machining of the new pintles.
- C.4.2 The Contractor must machine new pintles and pintle nuts **(CFM)**.
- C.4.3 The pintles and nuts must be machined as per the reference drawings "664-31-1 – Rudder Plan" and "EN12537-01 – Rudder Pintles and Bushings Replacement".
- C.4.4 The Contractor must verify the fit of the new pintles using the blueing process as per Para D.1.6.
- C.4.5 The Contractor must quote on 5 blueing fits per pintle.
- C.4.6 The Contractor must measure the alignment of the new pintles as per Para. D.1.7.
- C.4.7 Final fit of the casting and tapers must be witnessed by the AR and the TA.
- C.4.8 Copies of all readings must be included in the provided Final report to the TA.

- C.4.9 The Contractor must use the pintle stock to fabricate a new convex disk for installation in the lower gudgeon of the stern frame – detail shown on stern frame drawing.
- C.4.10 The Contractor is to supply a slugging wrench to fit the new pintle nuts. This wrench is to be handed to the Coast Guard at the end of the contract.
- C.4.11 At the completion of the work, the Contractor is to return the old pintles, old pintle nuts, and any unused new pintle stock material to the TA.

C.5 Rudder Pintle Bushings

- C.5.1 The Contractor must measure the fitted pintles and pintle bushings to provide a baseline. A minimum of 6 measurements per item must be taken to determine the clearances.
- C.5.2 The Contractor must machine and install 3 new bronze pintle bushings. The material for the pintle bushings will be supplied by CCG.
- C.5.3 The pintle bushings must be machined as per the provided drawings leaving the inside bores undersized to allow line boring after installation in the stern frame boss.
- C.5.4 The Contractor must provide the TA with a plan for approval for line boring the new pintle bushings in the stern frame. Once approved the Contractor is to install the new pintle bushings and bore to the correct dimensions as per the provided drawings.
- C.5.5 The Contractor must machine and install 3 new bearing pads (**CFM**) in accordance with the stern frame drawing (664-30-1). Bearing pads are to be installed using new hardware (**CFM**).

C.6 Rudder Stock Palm – Tiller and Keys - Machining and Blue Fits

- C.6.1 The Contractor must in situ machine the upper portion of the rudder stock in way of the tiller contact area in order to ensure a perfectly round surface. The Contractor must remove as little metal as possible in order to achieve a true contact surface.
- C.6.2 The Contractor must machine the tiller mating faces to reduce the bore size of the tiller. If required, the tiller bore may have to be built up with weld metal in some areas. The tiller must then be assembled and bored to match the new rudder stock dimensions.
- C.6.3 The Contractor must machine the key to suit the new tiller to stock fit.
- C.6.4 Following the Completion of the tiller and key machining repairs, the Contractor must verify the fit of the key to the tiller and rudder stock. The Contractor must also verify the fit of the tiller and rudder stock. The Contractor must perform the blueing process for verification of the fits as per Para D.1.9, witnessed by the AR and TA. Copies of all readings must be provided to the TA.
- C.6.5 For bid purposes the Contractor must quote 5 fits for the key and 5 fits for the tiller.

C.6.6 The Contractor must in situ machine and repair the true contact surface area of the rudder stock palm flange and the mating flange of the rudder. The Contractor must also machine the rudder stock palm key and verify the fit of the tapered palm key to the machined rudder and rudder stock palms. The Contractor must perform the blueing process for the verification of the fits as per Para D.1.9, witnessed by the AR and TA. Copies of all readings must be provided to the TA.

C.6.7 For bid purposes the Contractor must quote 5 fits for the key and 5 fits for the rudder palm flange.

C.7 Rudder Tiller Trunnion Bearing Clearances

C.7.1 The Contractor must renew the two trunnion pins and four trunnion blocks. Dimensions and stock materials to be determined by the FSR.

C.7.2 The Contractor must machine the trunnion pin ram bores to accept the new trunnion pins.

C.7.3 The Contractor must take all clearance measurements and provide a report to the TA.

C.8 Re-installation

C.8.1 The Contractor must install the rudder stock, intermediate and carrier bearings.

C.8.2 The Contractor must supply and install new packing in the carrier bearing similar to what was originally installed (308 mm square graphite – 2 turns at 2286 mm long each turn) **(CFM)**.

C.8.3 The Contractor must pack all grease lines and cups with Petro-Canada EP2 grease **(CFM)**.

C.8.4 The Contractor must install the rudder. The pintles and bushings must be greased prior to lowering the rudder in place with EP grease **(CFM)**.

C.8.5 The Contractor must ensure that rudder coupling bolts, pintle bolts and nuts and other fasteners are locked in the same manner as prior to disassembly. Only stainless-steel locking wire must be used where applicable.

C.8.6 The Contractor must harden up all rudder drain and vent plugs in the presence of the TA.

C.8.7 The Contractor must re-install all rudder diaphragm and new fairwater plates. All disturbed hull coating areas must be re-coated as per SOW item "11.14 – Hull Painting Below Waterline".

C.9 Steering Gear and Telemotor Systems

C.9.1 The Contractor is responsible for the **draining, removal, and** disposal of all hydraulic oil as required for this SOW item. Disposal manifests must be submitted to the TA.

- C.9.2 The Contractor must remove the main rams and cylinders, under the direct supervision of the attending FSR.
- C.9.3 Before disassembly, the Contractor must take detailed measurements of telemotor connections, hunting gear connections, floating lever positions, port and stbd pump linkage, etc. in order to have a good reference for re-assembly. Cylinder base positions on the support frame must be accurately punched on all sides to check for alignment on re-assembly. **Linkage measurements must be captured on a detailed drawing clearly identifying the components, center-to-center linkage length, buffer spring compression, linkage angles, etc. and these measurements must be used as the baseline data for reassembly.**
- C.9.4 Telemotor system Measurements must include at a minimum and must be included in the Contractor's Final report:
- Time from hard-over to hard-over each direction on port **steering** pump;
 - Time from hard-over to hard-over each direction on starboard **steering** pump;
 - Time from hard-over to hard over each direction on both **steering** pumps;
 - Time for Port telemotor ram to move through its full range;
 - Time for Starboard telemotor ram to move through its full range;
 - Motor / pump coupling parallel and angular alignment;
 - Rod length center to center from Port ram to port feedback unit;
 - Rod length center to center from Stbd ram to Stbd feedback unit;
 - Rod length between each telemotor ram and the floating lever.
- C.9.5 The Contractor must provide a price for collecting and disposing of the oil from **the main steering gear and both the port and starboard** telemotor systems (**350L per telemotor system for a total of 700L approximately 700L**).
- C.9.6 The Contractor must open, **empty**, and clean the interior of the **steering pump hydraulic oil** tanks using lint free cloths. The clean tanks must be presented to the TA and AR for inspection and acceptance.
- C.9.7 The Contractor must repair and rebuild the scored surfaces of the main steering gear rams by machining, re-chroming and changing four (4) cylinder neck bushes (Lloyd's Register Certified bushings) which will return all to original sizes. The Clearances must be determined by the attending **MMH FSR**.
- C.9.8 The hydraulic cylinders are cast integral with their support bases. They are bolted together in pairs (2 port halves and 2 starboard halves) and the 2 rams are continuous cylinders between them.
- C.9.9 The Contractor must perform the following in order to split the system and remove the rams:

- Remove the cylinder hold down bolts;
- Jack-up clear of the collision chocks (welded on the outboard sides of the rams) the cylinder bases;
- Pull the Starboard side Cylinders outboard until the ram comes free of the cylinder half;
- Split the FWD and AFT rams halves; and
- Pull the rams and the Portside Cylinders outboard.

C.9.10 Before splitting the cylinders, the following items must be removed clear of the steering gear:

- Steering gear pumps and motors;
- Hydraulic piping, hoses, brackets, supports;
- Hunting gear, connections to telemotor rams and controls, hand wheel, feedback linkages, main Steering Gear hydraulic oil reservoir tank (starboard side bulkhead), hand wheel and ram, cylinder pressure relief valves (2 of), cylinder isolation valves (12 of), rudder angle indicator strips (2 of). Rudder angle indicators (electronic boxes – 2 of), and associated wiring must be pulled back and made secure;
- Aft Windlass MG set control panel must be removed to provide more space to work in the steering gear compartment; and
- General interference items in the deckhead such as perforated steel sheeting, insulation, lights, 1 steam pipe, fire alarms and wiring, CO2 piping (local only) etc.

C.9.11 The Contractor must supply and install four (4) main ram packings and four (4) packing gland sleeves **(CFM)**.

C.9.12 The Contractor must replenish the main hydraulic systems with new CCG supplied hydraulic oil **(GSM)**. The Contractor must wipe clean the internal surfaces of the hydraulic reservoir and submit the tank for inspection by the TA and AR. The Contractor must renew all the hydraulic filters with new **(CFM)**.

C.9.13 The Contractor must close up each of the two telemotor hydraulic tanks **and the steering pump hydraulic oil tank** using new **(CFM)** nitrile rubber (NBR) seals. The Contractor must refill each hydraulic tank to working level prior to the start of the system. The oil must be new **(GSM)** Hydrex AW 22 **for the telemotor tanks (approx. 25L each) and (GSM) Hydrex AW 100 for the steering pumps (approx. 225 L). The hydraulic oils** ~~and~~ must be filtered into the systems via a Contractor supplied filtration system to ISO 16/14/11, as per ISO Standard 4406/2017.

- C.9.14 The Contractor must verify the correct functioning of the telemotor system and autopilot system.
- C.9.15 The Contractor must purge any air trapped within the hydraulic system that makes the **steering gear and** telemotor systems react erratically and repair all leaks from the **steering gear and** telemotor systems. **Any additional oil required will be GSM and must be pre-filtered by the contractor as described in C.9.13.**
- C.9.16 The contractor must engage the services of a Sperry Electronic Steering Equipment (FSR) as per Para. B.1.6, to calibrate the steering gear telemotor and autopilot systems.
- C.9.17 Any abnormal behavior of the steering gear system or the hunting gear system as a result of the Contractor's work must be repaired at the Contractor's Expense.
- C.9.18 The Contractor must remove, inspect and prove clear all grease lines. Any damaged grease lines must be replaced by new and the cost will be negotiated via a PWGSC 1379 work arising or new work form, upon receipt of the final invoice.
- C.10 **Steering Gear Hydraulic System and Telemotor Systems - Valves**
- C.10.1 The Contractor must remove, inspect, and lap all four fitted suction valves. After lapping, the valves must be re-assembled with new packing and gaskets **(CFM)**.
- C.10.2 The Contractor must remove, open, inspect, and lap as required the hydraulic system relief valve assemblies (FWD and AFT main system relief valves). After lapping, the valves must be reassembled using new gaskets and packing **(CFM)**.
- C.10.3 The Contractor must remove, open, inspect, and lap as required the hydraulic isolation valve assemblies (FWD and AFT main system relief valves). After lapping, the valves must be reassembled using new gaskets and packing **(CFM)**.
- C.10.4 The Contractor must remove, open, inspect, and lap as required the emergency hand pump related valves. After lapping, the valves must be reassembled using new gaskets and packing **(CFM)**.
- C.10.5 The Contractor must remove, open, inspect, and lap as required the fixed cylinder related valves (4 smaller and 8 larger). After lapping, the valves must be reassembled using new gaskets and packing **(CFM)**.
- C.1.1 The Contractor must release and remove the telemotor system pressure control and directional control valves from the vessel to the Contractor's facility. The Contractor must overhaul the valves according to manufacturer's recommendations using new OEM approved parts **(CFM)**.
- C.10.6 The Contractor must test all valves as per Paras. D.2.12 - D.2.15.

C.11 Steering Gear and Telemotor Systems Pumps and Motors

- C.11.1 *The Contractor must remove and retain for reinstallation the two (2) main steering gear pump assemblies, the two (2) telemotor rams, and all associated linkages, hydraulic fittings, electrical cabling, and other items as interference items as defined in C.9.10. The two (2) telemotor pump assemblies and telemotor reservoir tanks may remain in place.*
- C.11.2 *The Contractor must cover and protect all steering gear and telemotor system components throughout the duration of the contract. The Contractor must ensure all parts are protected from dirt and damage and that all parts are free of used hydraulic oil, dirt and burs, adhesive and shipping and/or machining protective coating prior to assembly.*
- C.11.3 *Prior to releasing any fittings or connections, the Contractor must identify and mark all hydraulic and electrical connections related to this work. The Contractor must identify and label the correct direction of rotation of each electric motor. The Contractor must identify, label, disconnect, release and pull back the hydraulic fittings and electrical wires of the steering gear and telemotor system. The hydraulic lines and fittings must be capped and set aside for reinstallation. All wires and terminals must be marked, and terminations recorded by the Contractor such that all wires can be returned to their original positions upon reassembly.*
- C.11.4 *The Contractor must measure and record the shaft and coupling alignment of each steering gear pump and motor. The Contractor must identify and mark the mounting location of each steering gear pump and motor assembly. The Contractor must identify, mark, label and retain for reuse all shims, dowels, or fitted bolts that may be used in the steering gear pump and motor installation.*
- C.11.5 *The Contractor must identify, label, and remove the steering gear motors, pumps, and couplings from the ship and store them in a dry, heated Contractor's facility until the Contractor is ready to reinstall them.*
- C.11.6 *The Contractor must identify and mark the Port and Starboard telemotor rams' mounting position and all hydraulic and mechanical connections on the telemotor rams and steering linkages.*
- C.11.7 *The Contractor must release the rams and steering linkages and remove them to a dry, heated Contractor's facility until ready for reinstallation. The Contractor must cover and protect the telemotor rams and related components throughout the work.*
- C.11.8 *The Contractor must re-install the telemotor rams on the vessel and re-connect them to the steering linkage. All disturbed cotter pins and lock-nuts must be replaced with new CFM materials.*
- C.11.9 *The Contractor must install the steering pumps back in the steering gear and reassemble all piping and control linkages. New gaskets must be installed for the hydraulic lines*

(CFM). Alignment of the pumps to the steering gear frame assembly is critical as the hydraulic lines are rigid, and the port and starboard steering gear pumps share a linear linkage. The pumps must be aligned first, and the motors must be aligned to the pumps. The Contractor must use laser alignment tools to verify installation.

C.11.10 The Contractor must verify the coupling alignment of the pumps and motors as per D.1.10.

C.11.11 The Contractor must reinstall the hydraulic lines and fittings to the pumps and all electrical connections.

C.11.12 The Contractor must verify the direction of rotation of each electric motor (i.e. bump test).

C.11.13 The Contractor must adjust the control linkages to the main pumps to obtain the desired performance.

C.11.14 The Contractor must release and remove the existing port and starboard telemotor pumps. The Contractor must keep the existing telemotor pumps on-site until the end of the Contract.

C.11.15 Prior to releasing any fittings or connections, the Contractor must identify and mark all hydraulic and electrical connections related to this work. The Contractor must disconnect and release the hydraulic fittings and electrical wires of the telemotor system. The lines must be capped to prevent contamination. The lines must be and set aside for reinstallation.

C.11.16 The Contractor must release and remove the telemotor electric motors to a Contractor's facility for overhaul. The overhaul must consist of opening, cleaning and inspection, bearing replacement and reassembly. The Contractor must degrease the electric winding using an electrical cleaning solvent suitable for Class B insulation machines. Repairs outside of this scope will be considered extra work and must be approved by the TA through the PWGSC 1379 form prior to the repairs taking place.

C.11.17 The Contractor must install the repaired telemotor pumps and existing couplings using laser alignment. Two new (CFM) coupling inserts must used. The pump coupling alignments must be within the tolerances of the coupling manufacturer. The alignment tool must have been calibrated within 12 months prior to this work. Proof of valid and current calibration must be provided to the TA prior to commencement of the work. The Contractor must afford the TA the opportunity to witness the alignment.

C.11.18 The Contractor must reinstall the hydraulic lines and fittings to the pumps and all electrical connections.

C.11.19 The Contractor must retain the services of MMH Marine to set the pump working pressures to 500 psi and adjust the flow rate of the telemotor pumps so that the function of the

steering system (i.e., reaction time of the telemotor ram) is identical to the as fitted data measurements taken prior to the start of the work.

- C.11.20 The Contractor must identify and mark the Port and Starboard telemotor ram's mounting position and all hydraulic and mechanical connections on the telemotor rams.
- C.11.21 The Contractor must release the rams and remove them to a Contractor's facility for inspection by the TA (opening, inspecting the rods and chambers, cleaning of all components). Repairs outside of this scope will be considered extra work and must be approved by the TA through the PWGSC 1379 form prior to the repairs taking place.
- C.11.22 The Contractor must provide the TA with a detailed "as-found" condition report of the disassembled telemotor rams components within 24 hours of disassembly. The report must include labeled pictures of the disassembled components and identify all recommended repairs in the report.
- C.11.23 The Contractor must re-chrome the piston rods. The piston rods nominal diameter is 1 3/8". The hard chrome thickness must be at minimum 20 microns and the finished diameter of the rods, including the 20 microns chromed thickness, must be within manufacturer's tolerances. Upon completion of the re-chroming, the Contractor must provide the TA with a copy of the re-chroming thickness and hardness measurements for each ram.
- C.11.24 The Contractor must ensure all parts are protected from dirt and damage and that all parts are free of used hydraulic oil, dirt and burrs, adhesive and shipping and/or machining protective coating prior to assembly. The Contractor must assemble, and bench test the rams to full working pressure in both directions.
- C.11.25 The Contractor must re-install the rams on the vessel and re-connect them to the steering linkage. All disturbed cotter pins and lock nuts must be replaced with new CFM materials.
- C.11.26 The main steering gear pumps and motors require overhaul. Pumps and motors details are provided in Paras. B.1.2 and B.1.3 of this SOW item.
- C.11.27 The pumps must be disassembled. The Contractor must remove all required piping and control linkages from the pumps and remove the pumps to the deck.
- C.11.28 The Contractor must install new OEM CCG-supplied parts including fitting of new slippers, new cylinder body and replace all roller bearings.
- C.11.29 The Contractor must take measurements and record all clearances with the new parts.
- C.11.30 The Contractor must drain, clean, inspect and replenish the emergency Hand pump oil tank (approx. 20litres). The CCG will provide the replenishing oil.
- C.11.31 The Contractor must overhaul the emergency hand pump.

- C.11.32 The Contractor must present the overhauled pumps to the AR to obtain a survey credit.
- C.11.33 The Contractor must install the pumps back in the steering gear and reassemble all piping and control linkages. New gaskets must be installed for the hydraulic lines **(CFM)**.
- C.11.34 The Contractor must remove the steering gear motors from the ship and send them to a certified workshop for full overhaul (Cleaning of Rotor and windings and replace of motor bearings).
- C.11.35 The Contractor must disconnect all electrical cables to the steering gear motors. All wires and terminals must be marked, and terminations recorded by the Contractor such that all wires can be returned to their original positions upon reassembly.
- C.11.36 The steering gear motors must be megger tested as per Para. D.2.6 of this SOW item.
- C.11.37 A Polarization Index (PI) must be completed on the steering gear motors as per Para. D.2.7 of this SOW item.
- C.11.38 The Contractor must verify the coupling alignment of the pumps and motors as per D.1.10.
- C.11.39 The Contractor must adjust the control linkages to the main pumps to obtain the desired performance.
- C.11.40 The Contractor must provide the following spare parts (custom built by MMH) for the Hastic steering gear pumps:
- a) Two sets of pump bearings (8 total). FSR to provide specifications for quality standards for the new bearings.
 - b) Two cylinder body assemblies.
 - c) Two sets of pump slippers (28 total)
- The parts must be delivered to the TA at the completion of the final contract.

12.16.D Proof of Performance

D.1 Inspection Points

- D.1.1 ***Hold Point: The Contractor must allow the TA to view and verify the "as-found" steering gear alignment measurements prior to disassembly. The Contractor must add any additional measurements that the TA considers essential for reassembly.***
- D.1.2 Hold Point 1: The Contractor must notify the TA and provide the opportunity to be view the rudder carrier bearings, steady bearings, pintle bearings, the rudder pintles, and the rudder stock while the Contractor is performing the measurements.

- D.1.3 Hold Point 2: The Contractor must record all bearing and pintle clearances. Readings must include the reading, date taken and by whom. Due to the nature of work the rudder is not to be operated until the pintle bearing clearances have been reviewed by the Technical Authority (TA).
- D.1.4 Hold Point 3: The Contractor must harden up all rudder and aft rudder section drain and vent plugs in the presence of the TA. The Contractor must test the deflection of the rudder to full port and full starboard to verify that all fairwater plates are clear and do not interfere with the operation of the rudder.
- D.1.5 Hold Point 4: The Contractor is to measure the tiller height from doubler plate in the steering gear compartment to determine carrier wear prior to work commencing on the rudder stock. (Original measurement 600 mm from the plate to the bottom of the tiller).
- D.1.6 Hold Point 5: The Contractor must center the rudder and verify that the position of the rudder corresponds to the rudder angle indicator readings in the steering gear compartment and in the wheelhouse.
- D.1.7 Hold Point 6: The Contractor must verify the fit of the new pintles using the blueing process. The minimum contact surface allowable between the rudder casting and pintle tapers must be 75% to 80%.
- D.1.8 Hold Point 7: The Contractor must measure the alignment of the new pintles as they sit in the rudder in both the fore-aft and port-Stbd directions. This must be completed prior to any boring of the pintle bushings.
- D.1.9 Hold Point 8: Final fit of the casting and tapers must be witnessed by the AR and the TA as per Para. C.2.7.
- D.1.10 Hold Point 9: The minimum surface contact area allowable must be 75%. Final fit must be witnessed by the AR and the TA. Copies of all readings must be provided to the TA.
- D.1.11 Hold Point 10: The Contractor must verify the coupling alignment of the pumps to the motors and record the alignment measurements.
- D.1.12 Hold Point 11: The Contractor must present both telemotor tanks to the TA and AR for inspection and acceptance.
- D.1.13 Hold Point 12: The Contractor must afford the TA the opportunity to witness the laser alignment of the new telemotor pumps.

D.2 Testing/Trials and Steering Gear Set up

- D.2.1 The Contractor must subject the rudder and the rudder extension to an air pressure test not in excess of 0.1 Bar for a duration specified by the attending AR. Both pressure tests must be witnessed by the AR and TA.

- D.2.2 The NDT inspection of the Rudder Stock must consist of the following:
- a) Clean the rudder stock surface in way of the lower bearing of all debris and surface corrosion. The lower bearing area has already been repaired with Belzona.
 - b) The Contractor must analyze the rudder shaft in way of the lower bearing in four places around the shaft using radiographic NDT inspection.
 - c) The Contractor must use ultrasonic NDT inspection as a secondary check of the inspected area. A minimum of 10 shots must be taken within inspection area.
 - d) A report must be developed to determine the depth and extent of the pitting on the rudder shaft as well as analysis to determine if crevice corrosion is present and the depth of the crevice corrosion.
 - e) The Contractor must check tiller keyway, the key and the keyway in the rudder stock with dye penetrant as per ASTM E-165-80 standard and submitted for inspection by the attending AR. A QA report must be generated for the dye penetrant inspection
 - f) Any defects found during the NDT inspection of the Rudder Stock must be repaired by the Contractor. The cost of repairs will be negotiated via a PWGSC 1379 work arising or new work form.
- D.2.3 The Contractor must verify the set up and alignment of all linkages for the hunting gear system. The Contractor must set up the hunting gear such that all remote rudder angle indicators and the actual rudder position correspond. All hunting gear linkages must be verified as being free to move and that there is no binding in any of the linkages after assembly.
- D.2.4 The Contractor must test the hunting gear linkages and the movement of the rudder together prior to the floating of the vessel. The hunting gear must be adjusted so that the rudder does not hit any of its mechanical stops and that the rudder rams do not bottom out in their respective cylinders and cause the hydraulic system safety valves to be lifted.
- D.2.5 The rudder must be moved in increments of 5 degrees off center position in both the port and starboard direction through the full swing of the rudder to the hard over positions at 35.5 degrees. At each increment of 5 degrees, the hunting gear system and linkages must be verified to ensure that the adjustment of the linkages does not cause the system to hunt or behave erratically. As the rudder approaches the requested helm position, the hunting gear should cause the pumps to come off stroke and not cause any undue over-swing or compensation in the operation of the hydraulic pumps.
- D.2.6 ~~The steering gear motors must be megger tested based on IEEE43-2013 and TP 127 requirements. Contractor must inform the TA of any Megger readings below the limits as set in TP 127.~~

D.2.7 A Polarization Index (PI) must be completed on the steering gear motors based on IEEE43-2013. The temperature of the equipment being tested must be recorded and the readings must be corrected as per IEEE43-2013. The Contractor must inform the TA of any readings outside the limits of this test as set down by IEEE43-2013.

D.2.8 The Contractor must verify the operation of the steering gear during sea trials.

D.2.9 The Contractor must schedule and co-ordinate the commissioning of the steering gear upon completion of the repairs.

D.2.10 The Contractor must verify the correct functioning of the telemotor system and autopilot system. The Sperry FSR must verify and calibrate all the rudder angle indicators, telemotor ram feed backs and limits, and the autopilot system. The telemotor system testing must include at a minimum the following measurements:

- a) Time from hard-over to hard- over each direction on port **steering** pump.
- b) Time from hard-over to hard-over each direction on starboard **steering** pump.
- c) Time from hard-over to hard over each direction on both **steering** pumps.
- d) Time for Port telemotor ram to move through its full range.
- e) Time for Starboard telemotor ram to move through its full range.

D.2.11 The Contractor must demonstrate that the offline filtration system is functional.

D.2.12 The Contractor must test the four fitted suction valves to 2200 psi.

D.2.13 The Contractor must test the main FWD and AFT relief valves to 1200 psi.

D.2.14 All the remaining steering gear valves to be tested as per instruction provided by the attending FSR.

D.2.15 All of the above tests and trials must be witnessed and accepted by the TA and AR.

D.3 **Certification**

D.3.1 At the completion of all work, the Contractor must submit to the TA a copy of the RO Survey Credit for the rudder and steering gear assembly. Attestations must include the date of the survey, name and signature of the attending AR.

D.3.2 The tools for the Telemotor pumps and **motor** couplings alignment must have been calibrated within 12 months prior to this work. Proof of valid and current calibration must be provided to the TA prior to commencement of the work.

D.3.3 Persons performing and interpreting Liquid Penetrant (LP), Magnetic Particle (MP), Radiographic (RT) and Ultrasonic Inspections (UT) must be currently qualified by the

National Non-Destructive Testing Certification body of Natural Resources Canada (NRCAN) to CAN/CGSB 48.9712 Level 2 or Level 3. Level 1 personnel may observe or assist.

D.4 Documentation

- D.4.1 The Contractor must provide a report of the rudder and steering gear work done to the TA. This report must include all work performed, measurements/clearances recorded, abnormalities and recommendations for rectification, alignment readings, test and trial results, mill certificates for all new materials used for the pintles and bushing and any other pertinent information.
- D.4.2 The Contractor must provide the TA with a plan for approval for line boring the new pintle bushings in the stern frame as per Para C.3.4.
- D.4.3 The Contractor must provide the TA with copies of disposal manifests.
- D.4.4 What about Certificate of calibration for all measurement tools used in this SOW item.

D.5 Training

- D.5.1 Not Used.

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End of Solicitation Amendment #021.