KONGSBERG

Functional Design Specification

Machinery System

KM-Drill 8

Project:	12345678
Product	Integrated Control & Monitoring System
Synopsis:	This document describes the scope and functions of the Kongsberg Vessel Control system K-Chief as delivered to the specified vessel. This document when "as built" will serve also as operator manual to as operator documentation together with KM standard K-Chief Operator Manual.

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1 ABOUT THIS DOCUMENT

1.1 Document history

Revision	*Description of Change*
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1.2 References

No	*Doc No*	*Description*
1	MB10100	Piping Diagram for Engine Room Rev. D(Preliminary)
2	MB60100	Piping Diagram for Hull Part Rev. C
3	MB701.01	IO List Rev. C11
4	?	IO List Topside Rev. G

1.3 Definitions/Abbreviations

AFT	Afterwards
AUX	Auxiliary
ALC	Aquamaster Logic Controller
AVR	Automatic Voltage Regulation
CB	Circuit Breakker
CCR	Central Control Room
DC	Drillers Cabin
DCU	Drive Control Unit

DG	Diesel Generator
DGPS	Differential Global Positioning System.
ECR	Engine Control Room
E/R	Engine Room
ESM	Engine Safety Module
ERV	Mechanical Ventilation for Engine Room
FS	Field Station
FW	Freshwater
FWG	Freshwater Generator
FWD	Forward
DO	Diesel Oil
HT	High Temperature
HPR	Hydroacoustic Positioning System.
HPR-OS	Operator Station intended for the hydroacoustic system
HPU	Hydraulic Power Unit
HSV	Hull Spaces Ventilation System
HV	High voltage (11 kV systems)
IAS	Integrated Automation System
LER	Local Equipment Room
LIR	Local Instrument Room
LO	Lubrication Oil
LT	Low Temperature
LV	Low Voltage (440V/220V, 60Hz systems)
MACH	Machinery
MGE	Main Generator Engine
MRU	Motion Reference Unit
MSB(P,C,S)	Main Switchboard Room, Port, Centre and Starboard
OS	Operator Station (generally)
PMS	Power Management System
PS	Process Station, Process Control Cabinet
RCS	Remote Control System
RCU	Remote Control Unit
K-Pos	Kongsberg Dynamic Positioning
K-Pos OS	Operator Station intended for dynamic positioning (Previous SDP)
cJoy	Independent Joystick System
K-Thrust OS	Operator Station Thruster Control (Previous STC)

K-Thrust-400	Operator Station intended for manual thruster control (Previous STC400)
K-Chief	KM Vessel Control (equal to IAS in SHI documents) (Previous SVC)
K-Chief OS	Operator Station for KM Vessel Control system (Previous SVC)
SHI	Samsung Heavy Industries Limited
SW	Seawater
T/R	Thruster Room
TDCR	Total Drilling Control Room
VDU	Video Display Unit
VFD	Variable Frequency Drive
VMS	Vessel Management System
VRU	Vertical Reference Unit

2 INTRODUCTION

2.1 Purpose

This document describes the scope and functions of the Kongsberg Maritime Integrated Automation System IAS, Machinery Control System as delivered to the specified vessel. Functions within other systems are not described in this document.

This document serves also as operator documentation together with KM standard operator manual.

3 SANITARY AND FRESHWATER SERVICES

3.1 Aft Engine Rooms and Aft Thruster Rooms Freshwater Service

The freshwater is generated by three freshwater generator units located aft of the vessel.

3.1.1 Freshwater Generators

Three Freshwater Generators, of evaporator type, are installed in this drill ship. Each freshwater generator having a capacity 40-tons/day. The Freshwater Generators are installed, one in each engine room, namely Port, Centre and Starboard.

To continuously check the quality of the freshwater a salinometer is installed in the discharge line of the distillation pump. If the salinity of the produced water exceeds 10 ppm an alarm will sound and the solenoid valve will open and dump the water into the brine chamber of the distiller. Salinity indication is also transmitted to the IAS (SAH-042101, 042102 and 042103 for Port, Centre and Starboard Freshwater Generator respectively). Chemical dosing is done on seawater before it enters the evaporator chamber. A local control panel controls the Freshwater Generators and running feedback and abnormal alarm signals (XA-042101& MI-042101, XA-042102& MI-042102 and XA-042103& MI-042103 for Port, Centre and Starboard respectively) are transmitted to IAS. The local control panel also controls the Freshwater Generator ejector-pump.

Two R.O. type Freshwater Generators are also installed in this drill ship with a capacity of 80 tons/day. These R.O. type Freshwater Generators are installed in Centre Engine Room. There is no control or monitoring of these systems in IAS, except for an Abnormal Alarm (XA-042104 & XA-042105).

There is also an Auto-Chlorinator connected to the Starboard Engine Room Transfer Pump which chlorifies the freshwater to the tanks. An abnormal alarm (XA-042210) from the Auto-Chlorifier is interfaced to IAS

3.1.2 Aft Freshwater Tanks

The freshwater generated by the Freshwater Generators from each engine room deliver freshwater to two common headers that connects all the three engine rooms. The two common headers vertically rises in Port and Starboard Engine Room and then branches off to the freshwater tanks and to the distilled water tanks (No.2 Distilled Water Tank Port/Starboard) for local fire fighting in Port Engine Room. Both the distilled freshwater tanks are fitted with a sounding pipe. Remote level indications are interfaced to IAS through the Remote Sounding System, for No.2 Distilled Water Tank Port (LIAHL 042128) and for No.2 Distilled Water Tank Starboard (LIAH 042127)

3.1.3 Aft Freshwater System

The freshwater from No.2 Distilled Water Tank Port and Starboard is connected to a common suction header that runs across the engine rooms and provides suction for the transfer pumps that transfer freshwater to a re-hardening filter located in Starboard Engine Room. The Centre and Starboard Freshwater Transfer Pumps (MIC-042110 and MIC-042114) transfer water into a common header that is connected into the forward freshwater services.

The re-hardening filter adds calcium ions to the softened water to raise the pH and make it more drinkable. The re-hardening filter is filled with dolomite (calcium carbonate), which slowly leaches calcium ions to the stream.

The discharges from the Centre and Starboard Freshwater Transfer Pumps are again branched off twice. One branch is connected back to the freshwater tank through a normally closed manual valve. This valve is opened only when the Centre Engine Room is not available. Similarly the second branch is connected through a normally closed manual valve to the common header that runs through the engine rooms and connects on one end the Centre Engine Room freshwater header and on the other end the Starboard Engine Room freshwater header through check valves on either side. The Centre and Starboard Engine Room headers feed consumers on that side including supply to Aft Thruster Rooms and purifier units.

The Freshwater hydrophore unit located in the Centre Engine Room draws freshwater from the common suction head that runs across the engine rooms. The hydrophore unit consists of a pressurized freshwater tank and two freshwater pumps. The Freshwater Hydration Pumps No.1 and No.2 (MIC-042112 and 042113) operate on Lead – Lag mode and pumps freshwater into the pressurized hydrophore tank. A pressure transmitter (PIAL 042111) senses the hydrophore tank pressure. When the pumps are set to auto mode both pumps stop when the pressure reaches 4.0 bar. On falling pressure the lead pump starts at 3.0 bar and the lag pump starts at 2.5 bar. IAS will indicate an Low Pressure Alarm when the pressure drops below 2 bar for more than 30 seconds. The discharge from the hydrophore unit is branched off into three sections. The first and second branches are connected to the port freshwater consumers and Starboard freshwater consumers respectively. The third branch is connected to the Centre Engine Room freshwater consumers.

3.1.4 Controls

3.1.4.1 IAS Control

There is no IAS control for the freshwater generators. The start stop of freshwater generator is manual and has to be done locally. However Salinity High Alarm and Freshwater Generator running feedback and abnormal alarm are wired to IAS.

Aft Freshwater generators (P, C, S)		
Function	**Description**	**Tag Number**
Indication & Alarm	PORT E/R FW GEN SALINITY HIGH	SAH-042101
Indication & Alarm	CENT E/R FW GEN SALINITY HIGH	SAH-042102
Indication & Alarm	STBD E/R FW GEN SALINITY HIGH	SAH-042103
Alarm	PORT E/R FW GEN ABNORMAL	XA-042101
Alarm	CENT E/R FW GEN ABNORMAL	XA-042102
Alarm	STBD E/R FW GEN ABNORMAL	XA-042103

The Freshwater Hydrophore Pumps are controlled from IAS when the pumps are selected to remote mode (MIC-042112 & 042113) in the starter and when there is no motor fault (MA-042112 and 042113) in the starter. Pumps can be selected to auto mode or manual mode on the IAS screen. When in auto mode these pumps operate under Lead/Lag control based on the hydrophore tank pressure. When in manual mode the pumps can be started and stopped from the IAS screen independently. The priority (lead or lag) for each pump is selected in the IAS. The running signal is interfaced to IAS for status indication.

Auto Lead/Lag start/stop by pressure control	
Lead Auto Start	3.0 +/- 0.1 bar
Lag Auto Start	2.5+/- 0.1 bar
Both auto stop	4.0+/-0.1 bar.

Aft Engine Room Freshwater Hydration Pump No.1 (MIC-042112)		
Function	**Description**	**Tag Number**
Remote Auto Start MC-042112A	When the pressure is below 3.0 Bar (Lead mode) When the pressure is below 2.5 bar (Lag mode)	PIAL-042111 (SW) from PT-042111 PIAL-042111 (SW) from PT-042111
Remote Auto stop **MC-042112B**	When pressure is 4.0 bar and above (Any mode)	PIAL-042111 (SW) From PT-042111
Remote Manual Start MC-042112A	From IAS Screen when in Manual mode	
Remote Manual stop MC-042112A	From IAS Screen when in Manual mode	

Aft Engine Room Freshwater Hydration Pump No.2 (MIC-042113)		
Function	**Description**	**Tag Number**
Remote Auto Start MC-042113A	When the pressure is below 3.0Bar (Lead mode) When the pressure is below 2.5 bar (Lag	PIAL-042111 (SW) from PT-042111

Aft Engine Room Freshwater Hydration Pump No.2 (MIC-042113)		
Function	**Description**	**Tag Number**
	mode)	PIAL-042111 (SW) from PT-042111
Remote Auto stop MC-042113B	When pressure is 4.0 bar and above (Any mode)	PIAL-042111 (SW) From PT-042111
Remote Manual Start MC-042113A	From IAS Screen when in Manual mode	
Remote Manual stop MC-042113B	From IAS Screen when in Manual mode	

The Centre and Starboard Freshwater Transfer Pumps (MIC-042110 and 042114) are manually operated pumps from IAS when in manual mode.

Centre Engine Room Freshwater Transfer Pump (MIC-042110)		
Function	**Description**	**Tag Number**
Remote Manual Start MC-042110A	From IAS Screen when in Manual mode	
Remote Manual stop MC-042110B	From IAS Screen when in Manual mode	

Starboard Engine Room Freshwater Transfer Pump (MIC-042114)		
Function	**Description**	**Tag Number**
Remote Manual Start MC-042114A	From IAS Screen when in Manual mode	
Remote Manual stop MC-042114B	From IAS Screen when in Manual mode	

Centre Engine Room Freshwater Hydrophore Unit		
Function	**Description**	**Tag Number**
Alarm	When the pressure is below 2 bar for more than 30 Seconds	PIAL-042111 (SW) from PT-042111

Aft No.2 Freshwater tank (S)		
Function	**Description**	**Tag Number**
Indication	NO.2 FW Tank Level Aft Stbd	LIAH-042127

Aft No.2 Freshwater tank (P)		
Function	**Description**	**Tag Number**
Indication	NO.2 FW Tank Level Aft Port	LIAH-042128

Auto Chlorinator		
Function	**Description**	**Tag Number**
Alarm	STBD E/R - AUTO CHLORINATOR ABNORMAL	XA-042210

U.V Sterilizer		
Function	**Description**	**Tag Number**
Alarm	AFT E/R U.V STERILIZER ABNORMAL	XA-042203

3.2 Forward Auxiliary Machine Room and Forward Thruster Rooms Freshwater service

The freshwater from aft side is brought to the forward side through a header and stored in the Forward Potable Freshwater Tank Port and Starboard. The shore filling connections, both Port and Starboard, are connected to this header.

3.2.1 Port and Starboard Potable Freshwater Tanks

There are two potable freshwater tanks in the forward side, one at port side and the other at starboard side. These tanks are fitted with a local level indicator and also a remote level indication that is interfaced to IAS via the Remote Sounding System (LIAH-042126 and LIAH-042125 for Port and Starboard Potable Freshwater Tanks respectively).

3.2.2 Forward Freshwater System

The potable water tanks are connected by a common header, which provides suction for the Forward Freshwater Hydrophore Unit. This common header also feeds the Auto Chlorinator which transmits an abnormal alarm (XA-042211) signal to IAS.

The Freshwater Hydrophore Unit located in the Forward Auxiliary Machine Room draws freshwater from the common suction head. The hydrophore unit consists of a pressurized freshwater tank and two freshwater pumps. The Forward Freshwater Hydration Pumps No.1 and No.2 (MIC-042120 and 042121) operate on Lead – Lag mode and pumps freshwater into the pressurized hydrophore tank. A pressure transmitter (PIAL-042122) senses the hydrophore tank pressure. When the pumps are set to auto mode both pumps stop when the pressure reaches 7.5 bar. On falling pressure the lead pump starts at 6.5 bar and the lag pump starts at 4.5 bar.

The discharge from the hydrophore unit is connected to the U.V. Sterilizer Unit. The ultra-violet sterilizers are used to sterilize the cold-water flow to the accommodation block. The sterilizers are capable of sterilizing water flow up to 30 m^3/h. A local panel control each unit, with abnormal alarms (XA-042201 & XA-042202) interfaced to IAS. The unit is fitted with a U.V. level sensor and hour meter, which closes a valve in the outlet line in the event of abnormality detection. The sterilized water is supplied to accommodation and other consumers including forward thrusters drives. The sterilized water is also fed to the three calorifiers.

The Potable Water Header off the U.V. sterilizer supplies the makeup water to the three forward calorifier units. The calorifiers receive water from U.V sterilizer and the hot water return from the accommodation unit through the Hot Water Circulation Pump No.1 & No.2 (MIC-042124 & MIC-042125 respectively). These pumps can be started and stopped manually from local side as well as from IAS, when in remote. The calorifiers heat the water for use in the accommodation hot water system. The calorifiers are electric heating (70 kW) type with single step temperature control and capacity of 1.0 m3/H. They are fitted with drain, and vent valves, pressure gauge, temperature gauge and a pressure safety valve set to 9.7 bar. The calorifiers are controlled from a local control panel that show operational status and only abnormal alarms are transmitted to IAS (XA-042301, XA-042302 and XA-042303 for No.1, No.2 and No.3 Calorifiers respectively). The control panel controls the heating elements through three thermostats, First thermostat is set at 60°C for Auto Control On function , second thermostat is set at 70°C for an Auto Control Off function and the third thermostat is set at 90°C to provide a Safety Control Off function (Tripping of the Power Supply).

3.2.3 Controls

3.2.3.1 IAS Control

The Forward Freshwater Hydrophore Pumps are controlled from IAS when the pumps are selected to remote mode (MI-042120B and MI-042121B) in the starter and when there is no motor fault (MA-042120 and MA-042121) in the starter. Pumps can be selected to auto mode or manual mode on the IAS screen. When in auto mode these pumps operate under Lead/Lag control based on the hydrophore tank pressure. When in manual mode the pumps can be started and stopped from the IAS screen independently. The mode (lead or lag) for each pump is selected in the IAS. The priority (lead or lag) for each pump is selected in the IAS. The running signal is interfaced to IAS for status indication.

Auto Lead/Lag start/stop by pressure control	
Lead Auto Start	6.5+/- 0.1 bar
Lag Auto Start	4.5+/- 0.1 bar
Both auto stop	7.5+/-0.1 bar.

Forward Freshwater Hydration Pump No.1 (MIC-042120)		
Function	**Description**	**Tag Number**
Remote Auto Start MC-042120A	When the pressure is below 6.5Bar (Lead mode) When the pressure is below 4.5 bar (Lag mode)	PIAL-042122 (SW) from PT-042122 PIAL-042122 (SW) from PT-042122
Remote Auto stop MC-042120B	When pressure reach 7.5 bar and above (Any mode)	PIAL-042122 (SW) From PT-042122
Remote Manual Start MC-042120A	From IAS Screen when in Manual mode	
Remote Manual stop MC-042120B	From IAS Screen when in Manual mode	

Forward Freshwater Hydration Pump No.2 (MIC-042121)		
Function	**Description**	**Tag Number**
Remote Auto Start MC-042121A	When the pressure is below 6.5Bar (Lead mode) When the pressure is below 4.5 bar (Lag mode)	PIAL-042122 (SW) from PT-042122 PIAL-042122 (SW) from PT-042122
Remote Auto stop MC-042121B	When pressure is 7.5 bar and above (Any mode)	PIAL-042122 (SW) From PT-042122
Remote Manual Start MC-042121A	From IAS Screen when in Manual mode	
Remote Manual stop MC-042121B	From IAS Screen when in Manual mode	

Forward Freshwater Hydrophore Unit		
Function	**Description**	**Tag Number**
Alarm	When the pressure is below 3 bar for more than 30 seconds	PIAL-042122

U.V. sterilizer		
Function	**Description**	**Tag Number**
Alarm	FWD U.V STERILIZER 1 ABNORMAL	XA-042201
Alarm	FWD U.V STERILIZER 2 ABNORMAL	XA-042202

Forward Calorifiers		
Function	**Description**	**Tag Number**
Alarm	FWD NO.1 CALORIFIER FAIL	XA-042301
Alarm	FWD NO.2 CALORIFIER FAIL	XA-042302
Alarm	FWD NO.3 CALORIFIER FAIL	XA-042303

Forward Potable Water Tanks (Port & Starboard)		
Function	**Description**	**Tag Number**
Indication & Alarm	NO.1 F.W.T (P) POTABLE(FWD)	LIAH-042126
Indication & Alarm	NO.1 F.W.T (S) POTABLE(FWD)	LIAH-042125

Auto Chlorinator		
Function	**Description**	**Tag Number**
Alarm	FWD AUX. MACH. -AUTO CHLORINATOR ABNORMAL	XA-042211

3.3 Purifier Operating Water

The Purifier Operating Freshwater is supplied from the L.O. Purifier Units located in the engine rooms.

3.3.1 Controls

3.3.1.1 IAS Control

No control from IAS.

3.4 Drill Water System (Hull)

There are two drilling water tanks located in the forward hull. The Drill Water Pump No.1 & No.2 (MIC-042401 & MIC-042402 respectively) draw water directly from a suction header connected across these two tanks and pump water to the topsides.

3.4.1 Drilling Water Tanks

The Drilling Water Tank Port & Starboard are fitted with a local level indicator and a also a remote level indication which is interfaced to IAS via the Remote Sounding System (LIAH-042405 and LIAH-042404 for port and starboard tanks respectively).

3.4.2 Controls

3.4.2.1 IAS Control

The drill water pumps are in normal operation controlled by the Mud Control System. They can and shall be manually operated from IAS during bunkering when the Mud Control System is set to IAS Control.

A pressure transmitter for the pumps common discharge header to topside is also interfaced to IAS (PI-042403).

Drilling water pump 1 (MIC-042401)		
Function	**Description**	**Tag Number**
Remote Auto Start MC-042401A	Not applied.	
Remote Auto stop MC-042401B	Not applied.	
Remote Manual Start MC-042401A	From IAS Screen when in Manual mode	
Remote Manual stop MC-042401B	From IAS Screen when in Manual mode	

Drilling water pump 2 (MIC-042402)		
Function	**Description**	**Tag Number**
Remote Auto Start MC-042402A	Not applied.	
Remote Auto stop MC-042402B	Not applied.	
Remote Manual Start MC-042401A	From IAS Screen when in Manual mode	
Remote Manual stop MC-042401B	From IAS Screen when in Manual mode	

Drilling water tanks		
Function	**Description**	**Tag Number**
Indication & Alarm	Drilling water tank (P)	LIAH-042405
Indication & Alarm	Drilling water tank (S)	LIAH-042404

A pressure regulating valve is fitted in the common discharge line of the drilling water pumps to bleed back the excess pressure in to the water tanks. The pressure regulating valve is set at 5 bar.

3.5 Sanitary Discharge System

The Sanitary Discharge Systems treatment plants are provided with the following capacity, one plant aft with 5 person capacity and one forward plant with a 230 person capacity.

The forward black water drains from various sources such as toilet units, urinals, hospital waste water etc. are collected into a common header that discharges to the sewage treatment plant. The black water mains feed into the main soil waste line, which is provided with blind flanges at each end to allow flushing or mechanical cleaning. The grey water drains from the washing machines, hospital and other sources are collected into a common header that discharges to the disinfection tank. The grey water is collected through the drains and directly discharged into the contact tank for chlorination and then pumped out overboard. The Galley wastewaters are collected into a common header that discharges directly overboard.

The raw sewage enters the aeration chamber where it is aerated by two vacuumarators. Microorganisms and bacteria break down the waste material into carbon dioxide, water, and inert material. The flow passes to the settling chamber where solid materials are precipitated to the bottom of the tank, for return to the aeration compartment, by airlift. The clear supernatant liquid is then displaced into the contact tank. The purpose of the contact tank is to destroy any remaining bacteria by chlorine before disposal to overboard. The contact tank is fitted with level switch. The level switch start and stop the Duty Sewage Discharge Pump according to the level. The pumps are 2 x 100% type, isolatable for maintenance with gate valves on suction and screw down stop check globe valves on discharge, and a pressure gauge on discharge common manifold. The flow from the pumps is routed to the overboard line. This is located below the light load water line, above ballasted water level to allow maintenance of the shipside valves. A line from the pumps discharge manifold leads to the upper deck and terminates in an IMO standard sewage international shore connection with blind flange. This line is a regulatory requirement. It is isolated by a “locked closed” gate valve.

The aft black waters are received into a small sewage treatment unit and treated sewage is discharged into overboard.

The entire sanitary unit is controlled from a local control panel. There is no automatic switch over from failed duty to the standby for either the pump or blower. In either case the standby unit is to be selected by the operator at the unit control panel. Contact Tank High Level alarm and the control panel abnormal alarms are interfaced to IAS for alarm indication.

3.5.1 Controls

3.5.1.1 IAS Control

IAS does not control the sewage treatment plants. The start stop of the plants is manual and must be done from the local panels. The following alarms are interfaced to IAS.

Engine Room Sewage Treatment Plant		
Function	**Description**	**Tag Number**
Alarm	E/R SEWAGE TANK LEVEL	LAH-042512
Alarm	E/R SEWAGE TREAT.PLANT FAIL	XA-042511

Forward Sewage Treatment Plant		
Function	**Description**	**Tag Number**
Alarm	FWD SEWAGE TK LEVEL	LAH-042502
Alarm	FWD SEWAGE TREAT PLANT FAIL	XA-042501
Alarm	FWD SEWAGE TRANSFER UNIT LEVEL	LAH-042503

4 DIESEL OIL SYSTEM

Diesel oil system shall provide Diesel Oil for the Main Generator Engines, Incinerator and Emergency Generator Engine. The system consists of:

-Diesel Oil Filling & Transfer System

-Diesel Oil Purifying System

-Diesel Oil Service System

-Diesel Oil Drain System

Diesel Oil Transfer and Purifying Systems shall be arranged independently in Port and Starboard side. Diesel Oil Service and Drain system in each engine room, Port, Centre and Starboard shall be independent of each other.

4.1 Diesel Oil Filling & Transfer System

The Diesel Oil received from supply vessel is filled into the diesel oil storage tanks through the bunkering inlets located on the main deck. Bunkering is done by manual control. The diesel oil can be filled into the port tanks, the starboard tanks or into all the four tanks by lining up the manual isolating valves located on main deck.

4.1.1 Diesel Oil Storage Tanks

There are four diesel oil storage tanks in this facility. Two of them are located in Port Engine Room (No.1 & No.2 Port Diesel Oil Storage Tank), the other two are located in Starboard Engine Room (No.1 & No.2 Starboard Diesel Oil Storage Tank). The No.1 diesel oil storage tanks (port & starboard) have the capacity of approximately 1905.8m³, The Port No.2 Diesel Oil Storage Tank has capacity of 1508m³ while the Starboard No.2 Diesel Oil Storage Tank has capacity of 1058m³. The tanks are fitted with level gauges for local indication and level transmitter for remote indication in IAS interfaced via the following signals in the Remote Sounding System:

LIAHL-072120 for Port No.1 Diesel Oil Storage Tank
LIAHL-072123 for Starboard No.1 Diesel Oil Storage Tank
LIAHL-072108 for Port No.2 Diesel Oil Storage Tank
LIAHL-072110 for Starboard No.2 Diesel Oil Storage Tank

The overflow from the diesel oil storage tanks is routed through a pipeline to the Diesel Oil Overflow Tank. A flow sensor is fitted in this line to indicate that the Diesel Oil is being drained into the overflow tank. This alarm is interfaced to IAS (FAH-071108 for the Port Engine Room overflow-line and FAH-071107 for the Starboard Engine Room overflow-line).

4.1.2 Diesel Oil Service Tanks

There are two main diesel oil service tanks and an emergency generator engine diesel oil service tank in this facility. The Port Diesel Oil Service Tank is located in Port Engine Room, the Starboard Diesel Oil Service Tank is located in the Starboard Engine Room and the Emergency Generator Engine Diesel Oil Service Tank is located in the Emergency Generator Room. Each main tank has a capacity of approximately 113.4m³ and the Emergency Generator Engine Diesel Oil Tank has a capacity of approximately 7m³. The tanks are fitted with level transmitters for remote indication in IAS interfaced via the Remote Sounding System (LIAHL-072107 for Port Diesel Oil Service Tank, LIAHL-072109 for the Starboard Diesel Oil Service Tank and LIHAL-072113 for Emergency Generator Engine Diesel Oil Service Tank). Each of the main service tanks are also fitted with a high level switch (LCH-072101 for port and LCH-072103 for starboard) for alarm indication and automatic stop of the two diesel oil transfer pump in IAS. When the high alarm is active, the diesel oil transfer pumps will be blocked from starting and will automatically stop if running. These high level switches have a set time delay of 2 seconds.

4.1.3 Diesel Oil Transfer Pumps.

There are four diesel oil transfer pumps in this facility, two for hull side use and two for topside use. Hull side pumps are named as Port Engine Room Diesel Oil Transfer Pump and Starboard Engine Room Transfer Pump. These are each located in the respective engine room. These pumps draw their suction from the respective diesel oil storage tank located in each engine room and are used for transfer of diesel oil from storage tanks to service tanks and for transferring diesel oil from storage tanks to supply vessel through the bunkering station. All the above transfers can be arranged by lining up the manual valves. The pumps are controlled manually from IAS when set to remote. The two engine room transfer pumps are also automatically stopped from IAS when the service tank level reaches high limits (LCH-072101 for port and LCH-072103). The operator can however inhibit the automatic stop of each pump by pushing the button on IAS. The running indication is also interfaced to IAS. Diesel oil transfer to supply vessel shall be done when the pumps are in local mode.

The topside diesel oil transfer pumps, Port Engine Room Diesel Oil Transfer Pump For Topside and Starboard Engine Room Diesel Oil Transfer Pump For Topside, are located in the respective engine rooms. These pumps draw their suction from the respective diesel oil storage tank located in each engine room and pump the diesel oil to the Emergency Generator Engine Diesel Oil Service Tank and to topside. These pumps are started/stopped manually from IAS screens when the pumps are selected for remote control in the starter panel. The running indication is also interfaced to IAS.

4.1.4 Controls

4.1.4.1 IAS Control

The pumps are manually controlled from IAS screen when in remote manual mode. The hull pumps are automatically stopped from IAS when the Diesel Oil service tank level reaches high limit and the auto-stop function is not inhibited.

Port Engine Room Diesel Oil Transfer Pump (MIC-072102)		
Function	**Description**	**Tag Number**
Remote Manual Start	From IAS Screen (Inhibited when LCH-072101 is active)	
Remote Manual Stop	From IAS Screen	
Auto Stop, Start Block	When the Diesel Oil service tank (P) level is high (Inhibited when operator pushes the button)	LCH-072101

Starboard Engine Room Diesel Oil Transfer Pump (MIC-072104)		
Function	**Description**	**Tag Number**
Remote Manual Start	From IAS Screen (Inhibited when LCH-072103 is active)	
Remote Manual Stop	From IAS Screen	
Auto Stop, Start Block	When the Diesel Oil service tank (P) level is high (Inhibited when operator pushes the button)	LCH- 072103

Port Engine Room Diesel Oil Transfer Pump For Topside (MIC-073201)		
Function	**Description**	**Tag Number**
Remote Manual Start	From IAS Screen	
Remote Manual stop	From IAS Screen	

Starboard Engine Room Diesel Oil Transfer Pump For Topside (MIC-073202)		
Function	**Description**	**Tag Number**
Remote Manual Start	From IAS Screen	
Remote Manual stop	From IAS Screen	

4.2 Diesel Oil Purifying System

The Diesel Oil Purifying System consists of diesel oil purifier feed pumps, diesel oil purifiers and purifier sludge tanks. There are four purifiers for diesel oil and these are located in Port- and Starboard Engine Room, with two in each engine room. These two systems are separate systems and work independent of each other. Diesel oil from the diesel oil storage tanks is drawn by the purifier feed pumps through an air operated emergency valve (air to close type). The purifier unit purifies the feed by centrifuging and discharges the cleaned diesel to the diesel oil service tank. The sludge removed is discharged into the purifier sludge tank.

4.2.1 Emergency valves on diesel oil tanks

For the two service tanks there are four outlets: One for the purifier feed pumps, one for the respective engine room diesel oil service No.1, one for the respective engine room diesel oil service No.2 and one for the Centre Engine Room diesel oil service. These outlets provide suction for:

- Purifier feed pumps through emergency quick-closing valves
- Respective engine room diesel oil service through quick closing valves.
- Centre Engine Room diesel oil service through emergency quick-closing valves located in Centre Engine Room on both the service and return line.

There is one outlet in each diesel oil storage tank that provide suction for:

- All transfer pumps through quick-closing valves and purifier feed pump if required by opening manual valve.

These emergency closing valves are air operated and are air to close type. Once closed, the valves cannot be opened without resetting them manually at the valve. These valves are grouped as a set for each engine room and they are activated by respective SOV's located in Water Mist & Inergen System Room. These SOV's for each engine room also close the emergency quick-closing valves on lube oil line for that engine room. These SOV's (VCC-124101, 02 for Port Engine Room, VCC-124103, 04 for Centre Engine Room and VCC-124105, 06 for Starboard Engine Room and Incinerator Room) can be activated either from Fire Control Station through fire damper control panel or from the Water Mist & Inergen System Room through manual lever in the solenoid valve skid.

The Port Engine Room SOV control:

- One (1) emergency quick closing valve on No.1 & 2 diesel oil storage tanks.
- Three (3) on diesel oil service tank.
- One (1) each for lube oil storage tank and lube oil settling-tank.

The Centre Engine Room SOV control:

- Four(4) emergency quick closing valves on the Diesel Oil lines.
- One (1) for diesel oil service tank on both port and starboard side.

The Starboard Engine Room SOV control:

- One (1) emergency quick closing valve on No.1 & 2 diesel oil storage tanks.
- Three (3) on diesel oil service tank.
- One (1) each for lube oil storage tank and lube oil settling-tank.
- One (1) on Incinerator waste oil tank.

The pneumatic control shutoff valves are installed on diesel oil service (VCO-124107) and return (VCO-124108) line between both diesel oil service tank and normally closed. These valves shall be opened when one of the emergency quick-closing valves (VZC-124103A, VZC-124103B, VZC-124104A and VZC-124104B is closed by the ESD System.

4.2.2 Purifier Feed pumps

There are two purifier feed pumps located in Port Engine Room and two purifier feed pumps located in Starboard Engine Room. These pumps feed diesel oil to the purifiers. These pumps are designates as one pump for each purifier. The local start and stop PB are located near the pumps. Operator shall start the pump as required locally at the time of starting that purifier. The pumps circulate the oil through the 3-way valve back to the tank till the purifier operations are switched on. Once switched on then the 3-way valve directs the oil to the centrifuge for purification.

4.2.3 Purifier Units

There are two purifier units each working in parallel in Port Engine Room and Starboard Engine Room. The Diesel purifying system cleans the “as received” diesel to a standard acceptable to be used by the various users. The equipment is installed in the purifier rooms which is located in the aft Port Engine Room and Starboard Engine Room. The system includes diesel purifier feed pumps, diesel purifiers, and a diesel purifier sludge tank. Operation of the diesel fuel purifying system is essentially automatic, controlled by the local control panel, once the system has been lined up and started manually from the local control panel. The piping is configured to flow diesel fuel from the storage tank, via purifier feed pumps, treat it in centrifugal purifiers, and feed either “purified” diesel fuel to the service tank, or “un-purified” diesel fuel back to the storage tank. The purifiers are each capable of treating about 6000 l/h of diesel oil. The diesel purifier feed pumps are operating in a 2 x 100% configuration. Each pump can be dedicated to its associated purifier; however the discharge piping configuration is such that any pump can feed the other purifier. The pumps are installed with duplex strainers on the inlet and have isolation valves on their suction and discharge lines. The purifiers are manually operated in a batch mode and the local control panel starts the feed pumps before the purifiers are started. A three-way valve directs the diesel fuel from the pumps. This valve directs diesel fuel forward to the purifier when the purifier is de-sludgeing or back to the storage tanks when the purifier is starting the operations or, in fault. As the flow from the feed pumps may be slightly in excess of the purifier capacity, a trim valve is installed on the diesel fuel feed line to allow adjustment of the flow to the purifier, if required, to maintain output quality. The diesel fuel purifier feed pumps can be stopped and started locally. The suction and discharge pressures are indicated locally. The purifier feed-pumps are protected by internal pressure bypass protection.

The flow from the pump to the purifier passes through a flow indicator. The purifiers are the conventional centrifugal type purifiers each with a local control panel. They are operated locally at the control panel and normally only one purifier is in operation. Freshwater required for operation of the purifier bowl opening, bowl closing and sealing water, is supplied from the freshwater system via solenoid valves. A leakage monitor that indicates a failed water seal is fitted on the purified diesel discharge line to the service tank line. In the event of water leakage being detected, at the outlet of the purifier, the local control panel would divert the un-purified diesel back to the diesel storage tank. The purifier running status (in operation), the purifier abnormal status and the temperature status are interfaced to IAS for indication and alarm (MIC-051102, MI-051202, MI-051302 and MI-051402 for running, XA-051101, 051201, 051301 and 051401 for abnormal alarm and TIAH-051103, 051203, 051303 and 051403 for temperature).

The two diesel oil purifier sludge tanks (Port & Starboard) lie below the purifiers and receives sludge from the sludge removal operation. Each tank has a capacity of 15.5 m^3 and is emptied by the sludge pump, when required. The diesel oil purifier sludge tank is fitted with a level switch, which provides a remote high-level alarm. (LAH-051501 and LAH-051502)

4.2.4 Controls

4.2.4.1 IAS Control

There are no IAS controls for purifiers. Only alarms and status are interfaced to IAS as explained above.

Diesel Oil Purifying System		
Function	**Description**	**Tag Number**
In operation	Port E/R NO.1 DO Purifier	MI-051102
Fail	Port E/R NO.1 DO Purifier	XA-051101
Temperature	Port E/R NO.1 DO Purifier	TIAH-051103
In operation	Port E/R NO.2 DO Purifier	MI-051202
Fail	Port E/R NO.2 DO Purifier	XA-051201
Temperature	Port E/R NO.2 DO Purifier	TIAH-051203
In operation	Stbd E/R NO.1 DO Purifier	MI-051302
Fail	Stbd E/R NO.1 DO Purifier	XA-051301
Temperature	Stbd E/R NO.1 DO Purifier	TIAH-051303
In operation	Stbd E/R NO.2 DO Purifier	MI-051402
Fail	Stbd E/R NO.2 DO Purifier	XA-051401
Temperature	Stbd E/R NO.2 DO Purifier	TIAH-051403
Alarm	Port E/R DO Purifier Sludge Oil Tank	LAH-051501
Alarm	Stbd E/R DO Purifier Sludge Oil Tank	LAH-051502

4.3 Main Generator Engine Diesel Oil Service

Two 7MW Main Generator Engines are installed, two in each engine room, in Port, Centre and Starboard (total 6). These engines run on diesel oil. The fuel is supplied by dedicated main generator engine diesel oil supply pumps. Each engine room is fitted with two dedicated diesel oil supply pumps (MIC-011407, MIC-012407, MIC-013407, MIC-014407, MIC-015407 and MIC-016407) each having the capacity of 5.5 m^3/h and provide a head of 8.0 bar. These pumps can be remotely controlled when pump starter is selected as remote. These pumps are manually controlled from IAS when set in remote on the local control panel. If one pump fails to operate, the other one can supply fuel temporarily by locally opening a crossover valve. The same philosophy is also applied to the Centre and Starboard engine room fuel oil pumps.

PMS shall ensure that the fuel pressure (PIAL-011412, PIAL 012412, PIAL-013412, PIAL-014412, PIAL-015412, PIAL-016412) is normal before a main generator engine start command is processed. The same applies for manual start of the engine.

One air driven diesel oil pump (3.0 m^3/h and 6 bar head) is also provided parallel to the electric diesel oil supply pumps for starting the engines after the blackout situation. The supply air for this pump is provided from the Starting Air Compressor in the respective Engine Room. The air driven pump can be started and stopped by manually opening and closing an on/off valve (SOV-011410, SOV-013410 and SOV-015410) in the air supply line to the air driven motor. During blackout, the valve (SOV-011410, SOV-013410 and SOV-015410) will be automatically opened by IAS to start the air driven diesel oil pump as long as the valve are in auto mode. This pump will have to be manually stopped by the operator when the diesel oil supply pumps are running again.

The diesel oil supply pumps draw their suction from the diesel oil service tank through a simplex strainer. The pumps' discharge is fed to the diesel oil feed pumps. Local pressure indication is provided on the suction and discharge lines for each pump and each auto filter.

Discharge of diesel oil feed pumps are fed to each engine through fine filter. A differential pressure indication is provided on this filter to provide filter dirty alarm to IAS (DPAH-011402, DPAH-012402, DPAH-013402, DPAH-014402, DPAH-015402and DPAH-016402).

A diesel oil level indicator is provided in each engine to provide level high alarm to IAS (LAH-011414, LAH-012414, LAH-013414, LAH-014414, LAH-015414, LAH-016414).

For the further main generator engine function description, see function design specification from the engine maker, Doosan.

4.3.1 Controls

4.3.1.1 IAS Control

Alarms and status are interfaced to IAS as explained above. The diesel oil supply pumps can be started and stopped from IAS when the pumps are in remote mode. Running indication is interfaced to IAS.

Function	Description	Tag Number
Monitoring	PORT E/R MGE 1 DO FILTER DIFF PRESS	DPAH-011402
Monitoring	PORT E/R MGE 1 DO PRESS	PIAL-011412
Monitoring	PORT E/R MGE 1 DO LEVEL HIGH	LAH-011414
Monitoring	PORT E/R MGE 2 DO FILTER DIFF PRESS	DPAH-012402
Monitoring	PORT E/R MGE 2 DO PRESS	PIAL-012412
Monitoring	PORT E/R MGE 2 DO LEVEL HIGH	LAH-012414
Monitoring	CENT E/R MGE 1 DO FILTER DIFF PRESS	DPAH-013402
Monitoring	CENT E/R MGE 1 DO PRESS	PIAL-013412
Monitoring	CENT E/R MGE 1 DO LEVEL HIGH	LAH-013414
Monitoring	CENT E/R MGE 2 DO FILTER DIFF PRESS	DPAH-014402
Monitoring	CENT E/R MGE 2 DO PRESS	PIAL-014412
Monitoring	CENT E/R MGE 2 DO LEVEL HIGH	LAH-014414
Monitoring	STBD E/R MGE 1 DO FILTER DIFF PRESS	DPAH-015402
Monitoring	STBD E/R MGE 1 DO PRESS	PIAL-015412
Monitoring	STBD E/R MGE 1 DO LEVEL HIGH	LAH-015414
Monitoring	STBD E/R MGE 1 DO FILTER DIFF PRESS	DPAH-016402
Monitoring	STBD E/R MGE 1 DO PRESS	PIAL-016412
Monitoring	STBD E/R MGE 1 DO LEVEL HIGH	LAH-015414

Port Engine Room Main Generator Engine Diesel Oil No.1 Supply Pump (MIC-011407)		
Function	**Description**	**Tag Number**
Remote Auto Start	Not Applicable	
Remote Auto stop	Not Applicable	
Remote Manual Start	From IAS Screen	
Remote Manual stop	From IAS Screen	

Port Engine Room Main Generator Engine Diesel Oil No.2 Supply Pump (MIC-012407)		
Function	**Description**	**Tag Number**
Remote Auto Start	Not Applicable	
Remote Auto stop	Not Applicable	
Remote Manual Start	From IAS Screen	
Remote Manual stop	From IAS Screen	

Centre Engine Room Main Generator Engine Diesel Oil No.1 Supply Pump (MIC-013407)		
Function	**Description**	**Tag Number**
Remote Auto Start	Not Applicable	
Remote Auto stop	Not Applicable	
Remote Manual Start	From IAS Screen	
Remote Manual stop	From IAS Screen	

Centre Engine Room Main Generator Engine Diesel Oil No.2 Supply Pump (MIC-014407)		
Function	**Description**	**Tag Number**
Remote Auto Start	Not Applicable	
Remote Auto stop	Not Applicable	
Remote Manual Start	From IAS Screen	
Remote Manual stop	From IAS Screen	

Starboard Engine Room Main Generator Engine Diesel Oil No.1 Supply Pump (MIC-015407)		
Function	**Description**	**Tag Number**
Remote Auto Start	Not Applicable	
Remote Auto stop	Not Applicable	
Remote Manual Start	From IAS Screen	
Remote Manual stop	From IAS Screen	

Starboard Engine Room Main Generator Engine Diesel Oil No.2 Supply Pump (MIC-016407)		
Function	**Description**	**Tag Number**
Remote Auto Start	Not Applicable	
Remote Auto stop	Not Applicable	
Remote Manual Start	From IAS Screen	
Remote Manual stop	From IAS Screen	

The air driven diesel oil supply pump (Port, Centre and Starboard) can be started and stopped by opening and closing an on/off valve (SOV-011410, SOV-013410 and SOV-015410) in the air supply line to the pneumatic motor.

Port Engine Room Main Generator Engine Emergency Diesel Oil Pump		
Function	**Description**	**Tag Number**
Remote Auto Start	Blackout confirmed	XA-033214
Remote Auto stop	Power restored	XA-033214
Remote Manual Start	Open valve From IAS screen	SOV-011410
Remote Manual Stop	Close valve From IAS screen	SOV-011410

Centre Engine Room Main Generator Engine Emergency Diesel Oil Pump		
Function	**Description**	**Tag Number**
Remote Auto Start	Blackout confirmed	XA-033318
Remote Auto stop	Power restored	XA-033318
Remote Manual Start	Open valve From IAS screen	SOV-013410
Remote Manual Stop	Close valve From IAS screen	SOV-013410

Starboard Engine Room Main Generator Engine Emergency Diesel Oil Pump		
Function	**Description**	**Tag Number**
Remote Auto Start	Blackout confirmed	XA-033414
Remote Auto stop	Power restored	XA-033414
Remote Manual Start	Open valve From IAS screen	SOV-015410
Remote Manual Stop	Close valve From IAS screen	SOV-015410

4.4 Incinerator

One incinerator is installed in this facility. The Incinerator system consists of an incinerator (700,000 Kcal per hour), one incinerator waste oil tank (2.0 M3) and one waste oil circulation pump. The incinerator diesel oil service pump (0.45M3/H with 3.0 bar) located in starboard purifier room supplies the diesel oil required for the burner. The waste oil circulation pump, the diesel oil supply pump and the sludge pump are controlled by the local control panel for incinerator unit and incinerator waste oil tank by direct interface with the switchboard.

The Incinerator start is interlocked towards the Incinerator Room Ventilation Fans (XC-064103). That means that the fans need to be running before the operator can start the Incinerator. In addition, if the fans stop while the Incinerator is running, the Incinerator will be shut down.

The waste oil tank is fitted with a level switch (LAH-064201) and the high level is interfaced to IAS for alarm indication. When this alarm is active the sludge pump shall be stopped if running and shall be start blocked if not running.

A low level switch is also fitted on the waste oil tank. This switch is interfaced to the local control panel. When this low alarm is active the waste oil circ. pump is stopped.

4.4.1 Controls

4.4.1.1 IAS Control

There are no controls from IAS for incinerator. Only alarms and status are interfaced to IAS.

Incinerator		
Function	**Description**	**Tag Number**
Shutdown/Interlock	Incinerator Local Start Interlock	XC-064103
Running	Incinerator Running	MI-064102
Alarm	Incinerator Abnormal	XA-064101
Alarm	Incin. Waste Oil Tank High Level	LAH-064201
Alarm	Incin. Waste Oil C/P Abnormal	XA-064202

5 LUBE OIL SYSTEM

5.1 Transfer & Purifying for Port Engine Room

Lubrication Oil bunkering station is located on the main deck. The bunkering points are available both port and starboard side. The received lube oil is stored in either Port or Starboard Main Lube Oil Storage Tank with 52.3 m^3 and 43.6 m^3 capacity respectively. Port and Starboard Engine Room Lube Oil System consists each of one storage tank, one settling tank (43.6 m^3 capacity). Each system is also equipped with one lube oil transfer pump (5m^3/h and a head of 2.5 bar), two purifier feed pumps(1.7 m^3/h and a head of 2.5 bar), two purifier units working in parallel, two lube oil pre-heaters, one lube oil purifier sludge tank (2.0 m^3) and two cross flow heaters. There is also one Main Generator Engine Lube Oil Sump Tank attached to each engine.

5.1.1 Lube Oil Storage and Settling Tanks

The lube oil storage tanks receives the lube oil from the supply vessel through the bunkering stations. The storage tanks are fitted with a level transmitter for remote indication in IAS interfaced via the Remote Sounding System (LIAL-072204 for port and LIAL-072205 for starboard respectively). The settling tanks are fitted with a heater failure alarm (XA-052141 for port and XA-052341 for starboard). The electric heater is controlled by the local control panel and is set to maintain a lube oil temperature of 60°C. The heater is tripped at 70°C or by a low level switch.

The lube oil transfer pump installed in Port and Starboard Engine Room has a capacity of 5 m^3/h and a head of 2.5 bar. The transfer pump is used to transfer the lube oil from storage tank into settling tank and also used to transfer from the main generator engine lube oil sump tanks back to the supply vessel through bunkering station. The pump can also be used to transfer lube oil from storage tank and settling tank to supply vessel through bunkering station. Lining up manual valves is required for this operation. The lube oil transfer pumps can be controlled manually from IAS (MIC-052151 for port and MIC-052351 for starboard). On discharge side of the lube oil transfer pumps in Port and Starboard Engine Room, a flow transmitter (FI-052151 for port and FI-052351 for starboard) for each pump is installed and interfaced to IAS to monitor lube oil flow. Accumulated flow can be set by operator in IAS and the pump will stop automatically when the flow reaches the set point.

5.1.2 Lube Oil Purifier Feed pumps

There are two purifier feed pumps located in each engine room that supply lube oil to the purifier units. These pumps are designated as one pump for each purifier. The local start and stop push buttons are located near the pumps. Operator shall start the pump as required locally when starting the respective purifier. The pumps circulate the oil through the 3-way valve back to the tank till the purifier operations are switched on. At that time the 3-way valve directs the oil to the centrifuge for purification. The running indication of the purifier feed pumps (MI-052101, 052111,052201,052211,052301, and 052311) is interfaced to IAS from the switchboard.

5.1.3 Lube Oil Purifiers

The lubricating oil purifying system cleans the "as received" lubricating oil from the diesel generator crankcase lube oil sump tank. The equipment is installed in the respective engine rooms and includes lubricating oil purifier feed pumps, lubricating oil heaters, lubricating oil purifiers, cross flow heaters and a lubricating oil purifier sludge tank. The local control panel automatically controls operation of the lubricating oil purifying process, once the system has been lined up and started. The piping is configured to flow lubricating oil from the diesel generator engines crankcase sump, via the lubricating oil purifier feed pump, cross flow heater, lubricating oil purifier heater, treat it in a centrifugal purifier, and feed the "purified" lubricating oil back to the engine crankcase sump. The lubricating oil purifier feed pumps operating in a 1 x 100% configuration with 1.7 l/h capacity and has a head of 2.5 bar. The pumps are installed with simplex strainer on the inlet and are isolatable on suction and discharge. The lubricating oil purifier feed pump is stopped and started locally from the local control panel. The lubricating oil purifier heater is a 1 x 100% electric heating type with thermostatically controlled through valve, which heats the oil to around 95 ºC. The heater is isolatable at suction and discharge. The purifier local control panel continuously monitors the oil temperature from the heater to the purifier. This includes temperature indication, alarm, and high temperature for shutdown. A three-way valve directs the feed to the purifier. This directs the flow back to the engine sump when the purifier is in start-up, or in sludge removal phase during operation or when the flowing temperature of the lube oil is below the set point. The diverter valve can also be used to divert the oil back into the storage tank when required. The purifier is a conventional centrifugal purifier operating in 1 x 100% mode. Freshwater required for operation of the purifier bowl opening, bowl closing and sealing water, is supplied from the freshwater system via two solenoid valves. A leakage monitor that indicates a failed water seal is fitted on the purified lubricating oil discharge line to the service tank line. In the event of water leakage being detected at the oil outlet of the purifier, the local control panel diverts the un-purified oil back to the diesel generator engine sump tank. It also sends an abnormal alarm signal back to the IAS (XA-052103, 052113). The temperature of the incoming fluid to the purifier is indicated at the IAS (TIAH-052102, 052112) and also at local panel. The purifier "in operation" indication is interfaced to IAS (MI-052104, 052114).

The lubricating oil purifier sludge tank lies below the purifier and receives sludge from the sludge removal operation. The tank has a capacity of 2 m^3 and is emptied by the sludge pump when required. A sounding point is provided to allow monitoring of the level. Additionally the lubricating oil purifier sludge tank is fitted with a level switch, which provides a remote high-level alarm (LAHL-052121) and a heater fail alarm (XA-052131) in IAS. The electric heater is controlled by local control panel to maintain lube oil temperature at 45°C and tripped at 55°C or by low level switch.

5.1.4 Main Generator Engine Lube Oil Sump Tanks

These tanks are attached to the respective engine crank casing. The lube oil from the storage & settling tank can be taken into the main generator engine sump tanks by gravity or by the lube oil transfer pump. The generator engine attached sump is provided with level switch and is interfaced to IAS for alarm.

5.2 Transfer & Purifying for Centre Engine Room

The Centre Engine Lube Oil Purifying System does not have storage and settling tanks nor the transfer pump. The main generator engine sump tanks receive the lube oil from both the Port and Starboard Engine Room storage tanks. Also the Port and Starboard Engine Room transfer pumps can be used for the transfer of lube oil back to the supply vessel through the bunkering station. There are two lube oil purifiers located in the Centre Engine Room. The operation of these purifiers, purifier heaters and the purifier feed pumps is the same as that of Port Engine Room described in the chapter above. The alarms and indications from the Centre Engine Room Lube Oil purifier units are tagged TIAH-052202 and 052212 for lube oil temperature, XA-052203 and 052213 for lube oil purifier abnormal alarms, MI-052204 and MI-052214 for lube oil purifier running indication and sludge tank level LAH-052221 and heater fail XA-052231 alarm. In addition, the purifier feed pump running signal is also interfaced to IAS (MI-052201 and 052211).

5.3 Transfer & Purifying for Starboard Engine Room

The lube oil purification and transfer equipment in Starboard Engine Room is exactly same as that of Port Engine Room. The operation of this equipment is also exactly the same as that described in the respective chapter. The lube oil storage tank level is transmitted to the IAS (LIAH-072205). The lube oil temperatures that are transmitted to IAS are TIAH-052302 and 052312. The abnormal alarms and running signals are tagged XA-052303, MI-052304 and XA-052313, MI-052314. The Sludge tank high level alarm is tagged as LAHL-052321 and heater failure alarm as XA-052341. In addition, the purifier feed pump running signal is interfaced to IAS (MI-052301 and MI-052311).

5.4 IAS Control

There are no IAS controls for lube oil purifiers. The local control panel has all the control. Only alarms and status are interfaced to IAS as explained above.

Lube Oil Purifying System		
Function	**Description**	**Tag Number**
In operation	Port E/R NO.1 LO Purifier	MI-052104
Fail	Port E/R NO.1 LO Purifier	XA-052103
In operation	Port E/R NO.2 LO Purifier	MI-052114
Fail	Port E/R NO.2 LO Purifier	XA-052113
In operation	Cent E/R NO.1 LO Purifier	MI-052204
Fail	Cent E/R NO.1 LO Purifier	XA-052203
In operation	Cent E/R NO.2 LO Purifier	MI-052214
Fail	Cent E/R NO.2 LO Purifier	XA-052213
In operation	Stbd E/R NO.1 LO Purifier	MI-052304
Fail	Stbd E/R NO.1 LO Purifier	XA-052303
In operation	Stbd E/R NO.2 LO Purifier	MI-052314
Fail	Stbd E/R NO.2 LO Purifier	XA-052313
Alarm	Port E/R LO Purifier Sludge Oil Tank	LAHL-052121
Alarm	Port E/R LO Purifier Sludge Heater Fail	XA-052131
Alarm	Stbd E/R LO Purifier Sludge Oil Tank	LAHL-052221
Alarm	Stbd E/R LO Purifier Sludge Heater Fail	XA-052231
Alarm	Cent E/R LO Purifier Sludge Oil Tank	LAHL-052321
Alarm	Cent E/R LO Purifier Sludge Heater Fail	XA-052331
Alarm and Indication	Port E/R NO.1 LO Purifier inlet temp	TIAH-052102
Alarm and Indication	Port E/R NO.2 LO Purifier inlet temp	TIAH-052112
Alarm and Indication	Cent E/R NO.1 LO Purifier inlet temp	TIAH-052202
Alarm and Indication	Cent E/R NO.2 LO Purifier inlet temp	TIAH-052212

Lube Oil Purifying System		
Function	**Description**	**Tag Number**
Alarm and Indication	Stbd E/R NO.1 LO Purifier inlet temp	TIAH-052302
Alarm and Indication	Stbd E/R NO.2 LO Purifier inlet temp	TIAH-052312
Running	Port E/R NO.1 LO Purifier Feed Pump	MI-052101
Running	Port E/R NO.2 LO Purifier Feed Pump	MI-052111
Running	Cent E/R NO.1 LO Purifier Feed Pump	MI-052201
Running	Cent E/R NO.2 LO Purifier Feed Pump	MI-052211
Running	Stbd E/R NO.1 LO Purifier Feed Pump	MI-052301
Running	Stbd E/R NO.2 LO Purifier Feed Pump	MI-052311
Alarm	Port E/R NO.1 MGE LO Sump Tk Low	LAL-011206
Alarm	Port E/R NO.2 MGE LO Sump Tk Low	LAL-012206
Alarm	Cent E/R NO.1 MGE LO Sump Tk Low	LAL-013206
Alarm	Cent E/R NO.2 MGE LO Sump Tk Low	LAL-014206
Alarm	Stbd E/R NO.1 MGE LO Sump Tk Low	LAL-015206
Alarm	Stbd E/R NO.2 MGE LO Sump Tk Low	LAL-016206

5.5 Port Engine Room Main Generator Engine Lube Oil Service

The purified lube oil is stored in the lube oil sump tank attached to the engine casing for each engine. During normal working condition a shaft driven pump draws the lube oil from the sump tank and then passes the oil through two branches, one returning the oil through a pressure control valve and filters and the other through a cooler and a through a thermostatic 3-way control valve (set at 66°C). Depending on the temperature of the lube oil, a part of the lube oil passes through the 3 way valve into the lube oil cooler and the cooled lube oil enters through the 2nd port of the 3 way valve and enters the engine through a filter for lubricating the engine parts. The lube oil cooler is fitted with local temperature gauges.

The lube oil pressure and temperature at the engine inlet are transmitted to IAS (PIAH-011201 and TI-011202). The lube oil passes through an auto filter and the differential pressure is transmitted to IAS (PIAL-011204). The sump level is fitted with a level switch for low alarm to IAS (LAL-011206A).

One oil mist detector is installed in the engine for detecting the crankcase oil mist. The oil mist detector fail alarm is interfaced to IAS (XA-011102). In the event of oil mist high in crankcase one signal from oil mist detector give alarm in IAS (DAH-011101A) and another signal will shut down the engine through ESM module located on the engine and then send an alarm to IAS that this engine is not ready for operation till the alarm is reset (DAHH-011101).

When the engine is not running an electric motor driven priming lubrication oil pump (MI-011205),50m^3/h, draws the oil from the Lube Oil Sump Tank and passes the oil through the same lubricating circuit as described above. The pre-lubrication oil pump is started and stopped automatically by engine local control module based on internal logic when there is no failure in the starter (XA-011205 and XA-011205A). IAS only monitor Running status and abnormal condition on the pump.

The system is the same for the No. 2 Main Generator Engine in Port Engine Room. However the alarms and status tags will be different, according to tables in IAS Control description.

5.5.1 Controls

5.5.1.1 IAS Control

Pre lube oil pump auto-start/stop is controlled by main engine safety module which is located in engine local control panel. Running status and failure alarm are interfaced to IAS.

The following alarms and status signals are interfaced to the IAS from Lube Oil System of the main generator engine.

Port Engine Room No.1 Main Generator Engine Lube Oil Service		
Function	**Description**	**Tag Number**
Alarm	Oil Mist Detector Fail	XA-011102
Alarm	Oil Mist High Alarm	DAH-011101A
Alarm	Oil Mist High High Alarm	DAHH-011101
Indication & Alarm	MGE LO Inlet Pressure	PIAH-011201
Indication & Alarm	MGE LO Inlet Temperature	TI-011202
Alarm	MGE LO Sump Tank Low	LAL-011206A
Alarm	Auto Filter Diff. Pressure	PIAL-011204
Indication	MGE Pre Lube Pump Running	MIC-011205A
Alarm	MGE Pre Lube Pump Starter Fail	XA-011205
Alarm	MGE Pre Lube Pump Starter Main Power Fail	XA-011205A

Port Engine Room No.2 Main Generator Engine Lube Oil Service		
Function	**Description**	**Tag Number**
Alarm	Oil Mist Detector Fail	XA-012102
Alarm	Oil Mist High Alarm	DAH-012101A
Alarm	Oil Mist High High Alarm	DAHH-012101
Indication & Alarm	MGE LO Inlet Pressure	PIAH-012201
Indication & Alarm	MGE LO Inlet Temperature	TI-012202
Alarm	MGE LO Sump Tank Low	LAL-012206A
Alarm	Auto Filter Diff. Pressure	PIAL-012204
Indication	MGE Pre Lube Pump Running	MIC-012205A
Alarm	MGE Pre Lube Pump Starter Fail	XA-012205
Alarm	MGE Pre Lube Pump Starter Main Power Fail	XA-012205A

5.6 Centre Engine Room Main Generator Engine Lube Oil Service

The Centre Engine Room Lube Oil Service is same as that of Port Engine Room.

5.6.1 Controls

5.6.1.1 IAS Control

Pre lube oil pump auto-start/stop is controlled by main engine safety module which is located in engine local control panel. Running status and failure alarm are interfaced to IAS.

The following alarms and status signals are interfaced to the IAS from Lube Oil System of the MGE.

Centre Engine Room No.1 Main Generator Engine Lube Oil Service		
Function	**Description**	**Tag Number**
Alarm	Oil Mist Detector Fail	XA-013102
Alarm	Oil Mist High Alarm	DAH-013101A
Alarm	Oil Mist High High Alarm	DAHH-013101
Indication & Alarm	MGE LO Inlet Pressure	PIAH-013201
Indication & Alarm	MGE LO Inlet Temperature	TI-013202
Alarm	MGE LO Sump Tank Low	LAL-013206A
Alarm	Auto Filter Diff. Pressure	PIAL-013204
Indication	MGE Pre Lube Pump Running	MIC-013205A
Alarm	MGE Pre Lube Pump Starter Fail	XA-013205
Alarm	MGE Pre Lube Pump Starter Main Power Fail	XA-013205A

Centre Engine Room No.2 Main Generator Engine Lube Oil Service		
Function	**Description**	**Tag Number**
Alarm	Oil Mist Detector Fail	XA-014102
Alarm	Oil Mist High Alarm	DAH-014101A
Alarm	Oil Mist High High Alarm	DAHH-014101
Indication & Alarm	MGE LO Inlet Pressure	PIAH-014201
Indication & Alarm	MGE LO Inlet Temperature	TI-014202
Alarm	MGE LO Sump Tank Low	LAL-014206A
Alarm	Auto Filter Diff. Pressure	PIAL-014204
Indication	MGE Pre Lube Pump Running	MIC-014205A
Alarm	MGE Pre Lube Pump Starter Fail	XA-014205
Alarm	MGE Pre Lube Pump Starter Main Power Fail	XA-014205A

5.7 Starboard Engine Room Main Generator Engine Lube Oil Service

The Starboard Engine Room Lube Oil Service is same as that of Port Engine Room.

5.7.1 Controls

5.7.1.1 IAS Control

Pre lube oil pump auto start/stop is controlled by main engine safety module which is located in engine local control panel. Running status and failure alarm are interfaced to IAS.

The following alarms and status signals are interfaced to the IAS from Lube Oil System of the MGE.

Starboard Engine Room No.1 Main Generator Engine Lube Oil Service		
Function	**Description**	**Tag Number**
Alarm	Oil Mist Detector Fail	XA-015102
Alarm	Oil Mist High Alarm	DAH-015101A
Alarm	Oil Mist High High Alarm	DAHH-015101
Indication & Alarm	MGE LO Inlet Pressure	PIAH-015201
Indication & Alarm	MGE LO Inlet Temperature	TI-015202
Alarm	MGE LO Sump Tank Low	LAL-015206A
Alarm	Auto Filter Diff. Pressure	PIAL-015204
Indication	MGE Pre Lube Pump Running	MIC-015205A
Alarm	MGE Pre Lube Pump Starter Fail	XA-015205
Alarm	MGE Pre Lube Pump Starter Main Power Fail	XA-015205A

Starboard Engine Room No.2 Main Generator Engine Lube Oil Service		
Function	**Description**	**Tag Number**
Alarm	Oil Mist Detector Fail	XA-016102
Alarm	Oil Mist High Alarm	DAH-016101A
Alarm	Oil Mist High High Alarm	DAHH-016101
Indication & Alarm	MGE LO Inlet Pressure	PIAH-016201
Indication & Alarm	MGE LO Inlet Temperature	TI-016202
Alarm	MGE LO Sump Tank Low	LAL-016206A
Alarm	Auto Filter Diff. Pressure	PIAL-016204
Indication	MGE Pre Lube Pump Running	MIC-016205A
Alarm	MGE Pre Lube Pump Starter Fail	XA-016205
Alarm	MGE Pre Lube Pump Starter Main Power Fail	XA-016205A

5.8 Thruster Service

5.8.1 Hydraulic Steering Pumps

The steering hydraulic unit consists of 2 x 50% capacity pumps. Both pumps must be running for steering. The hydraulic pump motors will be stopped immediately when the 'too low level steering oil' alarm is active.

5.8.2 Lubrication system

At the local control cabinet, as well as by the IAS, the lubrication system can be started and stopped. The lubrication system has two pump sets. A primary pump set for cooling when the oil temperature is above a certain level (40°C) and a secondary pump set for filtering. Each pump set consist of an E-motor, oil pump and pressure filter. The primary pump is controlled by a frequency converter.

Before the thruster can be used for propulsion, the secondary pump set must be running. The main function of this pump set is for filtering the lubrication oil. When the secondary pump set is started and the thruster is used for propulsion (propeller torque), the lubrication oil temperature will increase. As soon as this lubrication oil temperature is above a certain level, the primary pump will start automatically. The primary pump will be stopped automatically when the oil temperature is below this level. To avoid hunting, the switching is configured with a hysteresis. When the primary pump is started (by the frequency converter) it will run at 60% of max RPM (adjustable). When the temperature is increasing the primary pump will ramp up and will reach maximum RPM of 70% (adjustable).

5.9 Forward Thruster Service

There are three bow thrusters on this vessel. These are located and numbered as under:

Thruster No.	Description	Tag Number of concerned instruments and signals
1	Centre Bow Thruster	XX-021XXX
2	Port Bow Thruster	XX-022XXX
3	Stbd Bow Thruster	XX-023XXX

Note: *The following is the tagging and control for Thruster No.1. The signals and functions below are similar for Thruster number 2 and 3 with the series starting with 022 for Thruster No.2 and 023 for Thruster No.3 instead of 021 used for Thruster No.1.*

Thruster Drain Pump No.1 is common for all bow thrusters and running, remote and failure indication(MI-081225A, MI-081225B and MA-081225) are interfaced to IAS as well as the Drain Pump Abnormal Trip Alarm(XA-081233)

The steering power pack motors (MIC-021401 and 021402) is started and stopped from IAS, before the thrusters is started. The following are permissive signals and alarms

- Clogged steering oil pressure filter alarm (PAH-021420 and 021421)
- High temperature of steering oil (TAH-021411)
- Steering Gear Box & Steering Oil Tank Level Low (LAL-021413, LAL-02141)

The Primary Lube Oil Pump (MIC-021301) is started and stopped from IAS, before the thrusters is started, it also runs with a secondary lube oil pump (MI which is started/stopped automatically from local control. The following are permissive signals and alarms

- Lube Oil Header Tank LAH (LAH-021501B)
- Lube Oil Header Tank LAL (LAL-021501A)
- Primary & Secondary Lube Oil Pressure Low (PAL-021305, PAL-021306)

5.9.1 Controls

5.9.1.1 IAS Control

The primary lube oil pump and the two steering oil pumps are started and stopped from the IAS, and needs to be running before the thrusters can be started as per the requirement (MIC-021301 and MIC-021401/2).

Note: *The following is the tagging and control for Thruster No.1. The signals and functions below are similar for Thruster number 2 and 3 with the series starting with 022 for Thruster No.2 and 023 for Thruster No.3 instead of 021 used for Thruster No.1.*

No.1 Thruster Lube Oil Pump (MIC-021301)		
Function	**Description**	**Tag Number**
Remote Auto Start MC-021301A	From The Thruster control	
Remote Auto stop MC-021301B	From The Thruster control	
Remote Manual Start MC-021301A	From IAS Screen	
Remote Manual stop MC-021301B	From IAS Screen	

No.1 Thruster Steering Oil Pumps (MIC-021401 & 021402)		
Function	**Description**	**Tag Number**
Remote Auto Start MC-021401/2A	From The Thruster control	
Remote Auto stop MC-021401/2B	From The Thruster control	
Remote Manual Start MC-021401/2A	From IAS Screen	
Remote Manual stop MC-021401/2B	From IAS Screen	

5.10 Aft Thruster Service

There are three stern thrusters on this vessel. These are located and numbered as under:

Thruster No.	Description	Tag Number
4	Port Stern Thruster	XX-024XXX
5	Stbd Stern Thruster	XX-025XXX
6	Centre Stern Thruster	XX-026XXX

Note: *The following is the tagging and control for Thruster No.6. The signals and functions below are similar for Thruster number 4 and 5 with the series starting with 024 for Thruster No.4 and 025 for Thruster No.5 instead of 026 used for Thruster No.6.*

Thruster Drain Pump No.2 is common for all stern thrusters and running, remote and failure indication (MI-081235A, MI-081235B and MA-081235) are interfaced to IAS as well as the Drain Pump Abnormal Trip Alarm(XA-081243)

The steering power pack motors (MIC-026401 and 026402) is started and stopped from IAS, before the thrusters is started. The following are permissive signals and alarms

- Clogged steering oil pressure filter alarm (PAH-026420 and 026421)
- High temperature of steering oil (TAH-026411)
- Steering Gear Box & Steering Oil Tank Level Low (LAL-026413, LAL-02641)

The Primary Lube Oil Pump (MIC-026301) is started and stopped from IAS, before the thrusters is started, it also runs with a secondary lube oil pump (MI which is started/stopped automatically from local control. The following are permissive signals and alarms

- Lube Oil Header Tank LAH (LAH-026501B)
- Lube Oil Header Tank LAL (LAL-026501A)
- Primary & Secondary Lube Oil Pressure Low (PAL-026305, PAL-026306)

5.10.1 Controls

5.10.1.1 IAS Control

The primary lube oil pump and the two steering oil pumps are started and stopped from the IAS, and needs to be running before the thrusters can be started as per the requirement (MIC-026301 and MIC-026401/2).

Note: *The following is the tagging and control for Thruster No.6. The signals and functions below are similar for Thruster number 4 and 5 with the series starting with 024 for Thruster No.4 and 025 for Thruster No.5 instead of 026 used for Thruster No.6.*

No.6 Thruster Steering Oil Pump (MIC-026401 & 026402)		
Function	**Description**	**Tag Number**
Remote Auto Start MC-026401/2A	From The Thruster control	
Remote Auto stop MC-026401/2B	From The Thruster control	
Remote Manual Start MC-026401/2A	From IAS Screen	
Remote Manual stop MC-026401/2B	From IAS Screen	

No.6 Thruster Lube Oil Pump (MIC-026301)		
Function	**Description**	**Tag Number**
Remote Auto Start MC-026301A	From The Thruster control	
Remote Auto stop MC-026301B	From The Thruster control	
Remote Manual Start MC-026301A	From IAS Screen	
Remote Manual stop MC-026301B	From IAS Screen	

6 COOLING WATER SYSTEM

6.1 Seawater Cooling for Port Engine Room

The Seawater Cooling Service System provides seawater to the Freshwater Cooling System, and the freshwater Generator. MGPS unit anodes are located in the inlet strainer located on the cross-over line.

The system consists of an inlet system header, and uses electrically driven centrifugal pumps to distribute seawater to the users. The system flow is at approximately 720 m^3/h for the engine room during normal operations. The purpose of the inlet header, also known as the seawater cross-over line, is to maintain an adequate supply of clean seawater to the various users. The 400 mm seawater inlet header provides seawater to the cooling seawater pumps and the freshwater generator ejector pump. It runs laterally between the port and starboard sea chests on the floor deck.

The system includes sea chests on port and starboard sides, inlet strainers, MGPS anode and manual valves. The valves have to be lined up manually. MGPS failure alarm (XA-063114) is interfaced to IAS.

Manually operated isolation valves are installed between each sea chest and it's inlet strainer. The inlet strainers, installed on port and starboard sides adjacent to the sea chests are isolatable with manual valves, and drainable, for cleaning and maintenance. The header operates from either the port or starboard side sea chest as lined out by the operator. The main cooling seawater pumps and the freshwater coolers are both located on the floor deck. The pumps are electrically driven, single suction centrifugal pumps. The freshwater coolers are plate heat exchangers with integral inlet filter. The Seawater Header System supplying seawater to the 2 x 100% main cooling seawater pumps (MIC-063106 and MIC-063107), which in turn feed the freshwater coolers. The seawater from the coolers is dumped back into the sea. The cooling seawater pumps are set up with an automatic duty/standby capability.

No.1 Cooling Seawater Pump is fitted with emergency bilge suction pipe to allow it to pump directly from below the floor plates in the event of machinery space flooding. One common differential pressure transmitter (DPAL-063105) is fitted to measure differential pressure between suction and discharge header to indicate low differential pressure and remotely trigger the standby pump start. This differential switch has a time delay of 2 sec. A pressure transmitter (PIAL-063105A) is also fitted in pump discharge for remote indication of the discharge pressure in IAS. The pump suction and discharge are also fitted with local pressure indicators for indication at the local control panel.

The two freshwater coolers are fed from a common header or from bilge, ballast and GS pumps, through mesh insert filters installed directly on the seawater inlet to the coolers. The coolers are isolatable with manual valves and drainable for maintenance. The freshwater coolers are each fitted with pressure and temperature indication on each inlet and outlet for indication on local control panel. The port engine room seawater cooling system flows 720 m^3/h of seawater at a pump differential pressure of 2.2 bar.

The crossover line also provides suction for port engine room fire pump and bilge and GS pumps.

6.1.1 Controls

6.1.1.1 IAS Control

There is no IAS control for the Freshwater Generator Ejector Pump. Duty standby control is applied for the cooling seawater pumps. The operator may select which pump he wants to have in duty and standby. If the duty pump is unavailable or fails the standby pump starts automatically and an alarm will be given as "Standby Unavailable"

Port Engine Room Main Cooling Seawater Pump No.1 (MIC-063106)		
Function	**Description**	**Tag Number**
Remote Auto Start MC-063106A	Duty mode: Not applied Standby mode: When the Diff pressure is below 1.4 bar at High Speed mode (or is below 0.5bar at low speed mode) Or when the pump 2 is on duty and not running.	DPAL- 063105 and/or Pump 2 Duty mode + Unavailable/Failure
Remote Auto stop MC-063106B	Duty mode: When standby (pump 2) is started Standby mode: Not applied	
Remote Manual Start MC-063106A	From IAS Screen when in Manual mode	
Remote Manual stop MC-063106B	From IAS Screen when in Manual mode	

Port Engine Room Main Cooling Seawater Pump No 2 (MIC-063107)		
Function	**Description**	**Tag Number**
Remote Auto Start MC-063107A	Standby mode: When the Diff pressure is below 1.4 bar at High Speed mode (or is below 0.5bar at low speed mode) Or when the pump 1 is on duty and not running.	DPAL-063105 and/or Pump 1 Duty mode + Unavailable/Failure
Remote Auto stop MC-063107B	Duty mode: When standby (pump 2) is started Standby mode: Not applied	
Remote Manual Start MC-063107A	From IAS Screen when in Manual mode	
Remote Manual stop MC-063107B	From IAS Screen when in Manual mode	

6.2 Seawater Cooling for Centre Engine Room

The Centre Engine Room Cooling Seawater System is similar to that of Port Engine Room except providing suction for two R.O. type freshwater generators (80 ton/day). The tag numbers for Centre Cooling Seawater Pump No.1 & No.2 shall be read as 063109 in place of 063106 and 063110 instead of 063107 and the pressure alarm/transmitters as DPAL-063108/PIAL-063108A in the place of DPAL-063105/PIAL-063105A. MGPS alarm tag shall be XA-063115.

6.3 Seawater Cooling for Starboard Engine Room

The Starboard Engine Room Cooling Seawater System is similar to that of Port Engine Room The tag numbers for Starboard Cooling Seawater Pump No.1 & No.2 shall be read as 063112 in place of 063106 and 063113 instead of 063107 and the pressure alarm/transmitters as DPAL-063111/PIAL-063111A in the place of DPAL-063105/PIAL063105A. MGPS alarm tag shall be XA-063116.

6.4 Seawater Cooling System for Forward Auxiliary Machine Room and Thruster Room

The Cooling Seawater Service System for the forward spaces is divided into 3 separate independent systems. They are for Forward Auxiliary Machinery Room, Thruster Room No.2 and Thruster Room No.3. These systems provide seawater to the freshwater coolers located in each room for cooling of the freshwater. The Forward Auxiliary Machinery Room Cooling Seawater System also provides cooling seawater to forward fire pumps and forward bilge & GS pumps. MGPS unit anodes are located in the inlet strainer located on the cross-over line for Forward Auxiliary Machine Room and in the inlet line strainer for the two thruster rooms. Thruster No.1 uses the cooled freshwater from the Forward Auxiliary Machinery Room freshwater coolers.

6.4.1 Seawater Cooling System for Forward Auxiliary Machine Room

The system consists of an inlet system header, and uses electrically driven centrifugal pumps to distribute seawater to the users. The system flows app. 1000 m^3/h during normal operations. The purpose of the inlet header is to maintain an adequate supply of clean seawater to the users. The 500 mm seawater inlet header provides seawater to cooling seawater pumps, forward fire pumps as well as the forward bilge and GS pumps. It runs laterally between the port and starboard sea chests on the floor deck. The system includes sea chests on port and starboard sides, inlet strainers, MGPS anodes and manual valves. The valves have to be lined up manually or remotely from IAS.

Both port and starboard sea chests are fitted with air blowing valves. Manually operated isolation valves are installed between each sea chest and it’s inlet strainer. Air blowing valve can be operated from floor deck. The inlet strainers, installed on port and starboard sides adjacent to the sea chests are isolatable with manual valves, that can also be controlled from IAS, which is drainable for cleaning and maintenance. The header operates from either the port or starboard side sea chest as lined out by the operator. The main cooling seawater pumps and the freshwater coolers are both located on the floor deck. The pumps are electrically driven, single suction centrifugal pumps. The freshwater coolers are plate heat exchangers with integral inlet filters. The seawater header system supplying seawater to the 2 x 100% Forward Auxiliary Cooling Seawater Pump No.1 & No.2 (MIC-021702 and MIC-021703). The pumps in turn feed the freshwater coolers. The discharge header also branches off into 2 lines with isolating valves to feed Sewage treatment plant and the second one connects to freshwater coolers. Flowing seawater temperature is measured on the cross over line and is indicated remotely in IAS (TI-063101). The seawater from the coolers is dumped back into the sea. The cooling seawater pumps are set up with an automatic duty/standby capability.

Forward Auxiliary Cooling Seawater Pump No.1 is fitted with an emergency bilge suction pipe to allow it to pump directly from below the floor plates in the event of machinery space flooding. One common differential pressure switch (DPAL-021701) is fitted to measure differential pressure between suction header and discharge header to indicate low differential pressure and remotely trigger the standby pump start. It has a time delay on 2 seconds in IAS. The pump suctions and discharges are also fitted with local pressure indicators indicated in the local control panel.

The freshwater coolers are fed from a common header or from bilge, ballast and GS pumps, through mesh insert filters, installed directly on the seawater inlet to the coolers. The coolers are isolatable with manual valves and drainable for maintenance. The freshwater coolers are each fitted with local pressure and temperature indication on each inlet and discharge. The Forward Auxiliary Cooling Seawater System has an approximate flow of 1000 m^3/h of seawater at a pump differential pressure of 1.4 bars.

The cross-over line also provides suction for the forward fire water pumps as well as bilge and GS service pumps.

6.4.2 Controls

6.4.2.1 IAS Control

The Forward Auxiliary Cooling Seawater Pump No.1 & No.2 are set up in a duty/standby configuration. When operating the “On” software button, both pumps will be switched to auto mode and the pump selected as duty will automatically start. Operating the “Off” button will stop the running pump and both will be switched to manual mode. While running, duty and standby pump priority can be changed, again by operating a software button. One pump will then start and when confirmed running the other will stop. At the same time, duty and standby indication will be switched. The duty pump will be stopped automatically after parallel running with stand by pump.

The standby pump may also start due to a trip or failure at the duty pump. The operator may select which pump he wants to have in duty and stby. Should the duty pump be unavailable, the standby pump automatically starts up. An alarm will be given “Standby Unavailable”

Forward Auxiliary Cooling Seawater Pump No.1 (MIC-021702)		
Function	**Description**	**Tag Number**
Remote Auto Start MC-021702A	Duty mode: Not applied Standby mode: When the Diff pressure is below 1.4 bar OR when pump 2 is in duty and not running	DPAL-021701 and/or Pump 2 Duty mode + Unavailable/Failure
Remote Auto stop MC-021702B	Duty mode: When standby (pump 2) is started Standby mode: Not applied	
Remote Manual Start MC-021702A	From IAS Screen when in Manual mode	
Remote Manual stop MC-021702B	From IAS Screen when in Manual mode	

Forward Auxiliary Cooling Seawater Pump No.2 (MIC-021703)		
Function	**Description**	**Tag Number**
Remote Auto Start MC-021703A	Duty mode: Not applied Standby mode: When the Diff pressure is below 1.4 bar OR when pump 1 is in duty and not running	DPAL-021701 and/or Pump 1 Duty mode + Unavailable/Failure
Remote Auto stop MC-021703B	Duty mode: When standby (pump 2) is started Standby mode: Not applied	
Remote Manual Start MC-021703A	From IAS Screen when in Manual mode	
Remote Manual stop MC-021703B	From IAS Screen when in Manual mode	

6.4.3 Seawater Cooling System for Thruster Room No.2

The system consists of an inlet system header, and uses electrically driven centrifugal pumps to distribute seawater to the users. The system flow is at approximately 130 m^3/h during normal operations. The purpose of the inlet header is to maintain an adequate supply of clean seawater to the users. The 125 mm seawater inlet header provides seawater to Thruster Room No.2 Cooling Seawater Pump No.1 & No.2. The system includes a sea chest on port side, inlet strainers, and manual valves. The valves have to be lined up manually.

Sea chest is fitted with air blowing valves. Manually operated isolation valve is installed between each sea chest and it's inlet strainer. The inlet strainer installed adjacent to the sea chests are isolatable with manual valves, and drainable for cleaning and maintenance purposes. The main cooling seawater pumps and the freshwater coolers are both located on the floor deck. The pumps are electrically driven, single suction centrifugal pumps. The freshwater coolers are plate heat exchangers with integral inlet filters. The system configuration has the header system supplying seawater to the 2x100% Thruster Room No.2 cooling seawater pumps(MIC-022702 and MIC-022703), which in turn feed the freshwater coolers. The cooling seawater pumps are set up with an automatic duty/standby capability.

One common differential pressure switch (DPAL-022701) is fitted to measure diff pressure between suction header and discharge header to indicate low differential pressure and remotely trigger the standby pump start. It has a time delay on 2 seconds in IAS. The pump suction and discharge are also fitted with local pressure indicators indicated in the local control panel.

The two freshwater coolers are fed from a common header through mesh insert filters, installed directly on the seawater inlet to the coolers. The coolers are isolatable with manual valves and drainable for maintenance purposes. The freshwater coolers are each fitted with local pressure and temperature indication on each inlet and discharge. The Thruster Room No.2 Cooling Seawater System flows 130 m^3/h of seawater at a pump differential pressure of 2.0 bars.

6.4.4 Controls

6.4.4.1 IAS Control

The Thruster Room No.2 Cooling Seawater Pump No.1 & No.2 are operated on duty/standby mode from IAS. The operator may select witch pump he want to have in duty and stby. Should the duty pump be unavailable, the stby pump automatically starts up instead. An alarm will be given "Standby Unavailable".

Thruster Room No.2 Cooling Seawater Pump No.1 (MIC-022702)		
Function	**Description**	**Tag Number**
Remote Auto Start MC-022702A	Duty mode: Not applied Standby mode: When the Diff pressure is below 1.2 bar OR when pump 2 is in duty and not running	DPAL-022701 and/or Pump 2 Duty mode + Unavailable/Failure
Remote Auto stop MC-022702B	Duty mode: When standby (pump 2) is running Standby mode: Not applied	
Remote Manual Start MC-022702A	From IAS Screen when in Manual mode	
Remote Manual stop MC-022702B	From IAS Screen when in Manual mode	

Thruster Room No.2 Cooling Seawater Pump No.2 (MIC-022703)		
Function	**Description**	**Tag Number**
Remote Auto Start MC-022703A	Duty mode: Not applied Standby mode: When the Diff pressure is below 1.2 bar OR when pump 1 is in duty and not running	DPAL-022701 and/or Pump 1 Duty mode + Unavailable/Failure
Remote Auto stop MC-022703B	Duty mode: When standby (pump 2) is running Standby mode: Not applied	
Remote Manual Start MC-022703A	From IAS Screen when in Manual mode	
Remote Manual stop MC-022703B	From IAS Screen when in Manual mode	

6.4.5 Seawater Cooling System for Thruster Room No.3

The Seawater Cooling System for Thruster Room No.3 is similar to that of Thruster Room No.2. The tag numbers shall be read as MIC-023702 & MIC-023703 in place of MIC-022702 & 022703 for pump control and DPAL-023701 in the place of DPAL-022701.

6.5 Freshwater Cooling for Port Engine Room and Thruster Room No.4

The cooling freshwater is received from the freshwater system into the Port Low Temperature Cooling Freshwater Tank.

The Port Low Temperature Cooling Freshwater Expansion Tank has a capacity of 1.0 m^3 and is connected by a 50 mm line to the pump suction line on the floor deck. This establishes the pressure datum at the pump suction and minimizes the possibility of pump cavitation. A smaller 25 mm line is taken off the return lines upstream of the coolers and feeds into the tank via an orifice. As this water is at a higher total pressure than the pressure at the main 50 mm off take (by the frictional head loss across the coolers) there will be a slight circulating flow through the tank, which will prevent stagnation occurring and provides de-aeration. The tank is fitted with a man way, drain plug, and a fill point to supply make up water from the freshwater service line. The expansion tank is fitted with a level switch for low-level alarm (LAL-063201) interfaced to IAS.

The low temperature cooling freshwater is circulated through the engines and other users by Port Engine Room Low Temperature Cooling Freshwater Pump No.1 & No.2 (MIC-063243 and 063244, common for both engines) pumping 285 m^3/h at 2.5 bar. These pumps operate on duty/standby mode. The standby pump starts in the event of drop of discharge pressure measured by PAL-063242 or when the pump in duty trips or stops due to failure. PAL-063242 has a time delay on 2 sec. The pumps provide low temperature cooling water to unit coolers, Port Main Generator Engine No.1 & No.2, starting air compressors, GS and control air compressor and the Thruster Room No.2 coolers in Port Engine Room.

The circulation low temperature cooling water circulates through the main generator engines in Port Engine Room and is used for bearing lube oil cooler, diesel oil cooler, drain cooler and charge air cooler. The diesel oil cooler and drain cooler are common for both the engines in the engine room. The return from the charge air cooler is circulated through the lube oil cooler and jacket cooler through a thermostatic control valve(Set at 90°C) that diverts the hot water to the return line based on the temperature measured at the outlet of the jacket cooler.

See Main Generator Engine control function descriptions for further details.

The hot water from these coolers is put into a high temperature circulating system for jacket cooling. The hot water from the jacket cooling system is diverted by a thermostatic valve based on the temperature measured at the outlet of the jacket cooler. This return hot water is branched off to the suction of the Port Engine Room Freshwater Generator to heat the evaporator plates on the freshwater generator. The return from the freshwater generator joins the high temperature cooling circuit. The second branch provides suction for the Port Main Generator Engine Jacket Preheat Pump that circulates high temperature water through a jacket pre-heater (electrical) and provides high temperature water for engine jacket pre-heating. Main Generator Engine Local Panel controls the jacket-preheating pump and running status (MI-017601) is interfaced to IAS, this pump is common for both port side main generator engines. An abnormal alarm (XA-017603) from the pre-heater panel is interfaced to IAS.

The cooling freshwater temperature is normally controlled at 36°C (set-point is adjustable by the operator). The cooling freshwater temperature is measured by a temperature transmitter (TIC-063245) located in the cooling freshwater pump discharge common header. The temperature controller (PID-063245) is implemented in IAS and actuates a three way bypass temperature control valve (TCV-063245) that in turn will regulate the flow through the freshwater coolers. Bypassing the coolers increases the cooling freshwater temperature. The control valve is pneumatically actuated and in case of air failure the valve opens the flow from the coolers to the cooling freshwater pump suction common header.

Additional temperature sensors are installed in line for Port (TIAH-063245A), Starboard (TIAH-063255A) and Centre Engine Room (TIAH-063265A) and also for Forward Auxiliary Machinery Room (TIAH-021602A). These sensors will work as backup for the main sensors in case of malfunction.

6.5.1 Control

6.5.1.1 IAS Control

The Port Engine Room Low Temperature Cooling Freshwater Pump No.1 & No.2 are operated on duty/standby mode. PID-regulation control is applied for the temperature measured by TIC-063245. The operator may select which pump he wants to have in duty and stby. Should the duty pump be unavailable, the stby pump automatically starts up. An alarm will be given “Standby Unavailable”.

Port Engine Room Low Temperature Cooling Freshwater Pump No.1 (MIC-063243)		
Function	**Description**	**Tag Number**
Remote Auto Start MC-063243A	Duty mode: Not applied Standby mode: When the discharge is below 2.0 bar OR when pump 2 is in duty and not running	PAL-063242 and/or Pump 2 Duty mode + Unavailable/Failure
Remote Auto stop MC-063243B	Duty mode: When standby (pump 2) is running Standby mode: Not applied	
Remote Manual Start MC-063243A	From IAS Screen when in Manual mode	
Remote Manual stop MC-063243B	From IAS Screen when in Manual mode	

Port Engine Room Low Temperature Cooling Freshwater Pump No.2 (MIC-063244)		
Function	**Description**	**Tag Number**
Remote Auto Start MC-063244A	Duty mode: Not applied Standby mode: When the discharge is below 2.0 bar OR when pump 1 is in duty and not running	PAL-063242and/or Pump 1 Duty mode + Unavailable/Failure
Remote Auto stop MC-063244B	Duty mode: When standby (pump 2) is running Standby mode: Not applied	
Remote Manual Start MC-063244A	From IAS Screen when in Manual mode	
Remote Manual stop MC-063244B	From IAS Screen when in Manual mode	

Low Temperature Cooling Freshwater Temperature Control		
Function	**Description**	**Tag Number**
PID control	Temperature of the LT CFW to be maintained at the suction of LTCFW pumps at 36°C.	TIC-063245 and TV 063245(When air fail the 3 way valve opens the flow from the coolers to the cooling freshwater pump suction common header.)

Port Low Temperature Cooling Freshwater Expansion Tank		
Function	**Description**	**Tag Number**
Alarm	C.F.W TK 1 LEVEL LOW	LAL-063201

6.6 Freshwater Cooling for Centre Engine Room and Thruster Room No.6

The Cooling Freshwater System is the same as that of the Port Engine Room. The tag numbers shall be read as MIC-063263 and MIC-063264 for pump control, TIC-063265, PID-063265 & TCV-063265 for valve control and XA-017613/MI-017611 for jacket pre-heater abnormal and pump running indication. The expansion tank alarm is LAL-063206.

6.7 Freshwater Cooling for Starboard Engine Room and Thruster Room No.5

The Cooling Freshwater System is the same as that of the Port Engine Room. The tag numbers shall be read as MIC-063253 and MIC-063254 for pump control, TIC-063255, PID-063255 & TCV-063255 for valve control and XA-017623/MI-017621 for jacket pre-heater abnormal and pump running indication. The expansion tank alarm is LAL-063211.

6.8 Freshwater Cooling for Forward Auxiliary Machine Room and Thruster Room No.1

The Forward Auxiliary Machine Room Cooling Freshwater Expansion Tank has a capacity of 1.71 m^3 and is connected by a 50 mm line to the pump supply line on the floor deck. This establishes the pressure datum at the pump suction and minimizes the possibility of pump cavitation. A smaller 15 mm line is taken off the return lines upstream of the coolers and feeds into the tank. The tank is connected via fill point to a supply of make up water from potable water line (15 mm) in accommodation and the ball float valve is installed inside the tank at 1/3 tank height for automatic filling of cooling water. The expansion tank is fitted with two level switch for low-level alarm LAL-021601 and for low low-level alarm LALL-021601A.

The cooling freshwater is circulated through the Forward Auxiliary Machine Room cooling freshwater coolers (3 x 50%) and fed to users, by Forward Auxiliary Machine Room Cooling Freshwater Pump No.1, No.2 and No.3 (MIC-021604, 021605 and 021606), at an approximate flow of 940 m^3/h at 4.0 bar. These pumps operate on duty/duty/standby mode. The pump in standby-mode starts in the event of drop of discharge pressure measured by PAL-021603A, B and C or when the pump in duty mode trips or stops due to failure. The discharge pressure has a delay of 2 seconds in IAS. These pumps provide cooling water to accommodation unit coolers, topsides cooling freshwater service, air condition plants, provision and refrigeration plants, AC440 Transformer No.1 & No.2, and for Thruster No.1 coolers.

Temperature control is applied for the cooling freshwater that circulates through the freshwater coolers. In the event where the circulating water temperature is raised above a set point of 36°C the TIC-021602 (IAS) opens the return port of the 3 way valve through the freshwater cooler and maintains the temperature at set-point. The failure position of the 3-way valve (TCV-021602) is through the freshwater cooler.

6.8.1 Control

6.8.1.1 IAS Control

Forward Auxiliary Machine Room Cooling Freshwater Pump No.1 & No.2 are operated on duty/duty/standby mode. PID control is applied for TIC-021602. The operator may select which pumps he wants to have in duty and stby. Should one of the duty pump be unavailable, the standby pump automatically starts up. An alarm will be given "Standby Unavailable".

Forward Auxiliary Machine Room Cooling Freshwater Pump No.1 (MIC-021604)		
Function	**Description**	**Tag Number**
Remote Auto Start MC-021604A	Duty mode: Not applied Standby mode: When the discharge is below 2.5 bar OR when either pump 2 or 3 is in duty and not running	PAL-021603B or C and/or Pump 2 or 3 Duty mode + Unavailable/Failure on one pump
Remote Auto stop MC-021604B	Duty mode: When standby (pump 2 or 3) is started Standby mode: Not applied	
Remote Manual Start MC-021604A	From IAS Screen when in Manual mode	
Remote Manual stop MC-021604B	From IAS Screen when in Manual mode	

Forward Auxiliary Machine Room Cooling Freshwater Pump No.2 (MIC-021605)		
Function	**Description**	**Tag Number**
Remote Auto Start MC-021605A	Duty mode: Not applied Standby mode: When the discharge is below 2.5 bar OR when either pump 1 or 3 is in duty and not running	PAL-021603A or C and/or Pump 1 or 3 Duty mode + Unavailable/Failure on one pump
Remote Auto stop MC-021605B	Duty mode: When standby (pump 1 or 3) is started Standby mode: Not applied	
Remote Manual Start MC-021605A	From IAS Screen when in Manual mode	
Remote Manual stop MC-021605B	From IAS Screen when in Manual mode	

Forward Auxiliary Machine Room Cooling Freshwater Pump No.3 (MIC-021606)		
Function	**Description**	**Tag Number**
Remote Auto Start MC-021606A	Duty mode: Not applied Standby mode: When the discharge is below 2.5 bar OR when either pump 1 or 2 is in duty and not running	PAL-021603A or B and/or Pump 1 or 2 Duty mode + Unavailable/Failure on one pump
Remote Auto stop MC-021606B	Duty mode: When standby (pump 1 or 2) is started Standby mode: Not applied	
Remote Manual Start MC-021606A	From IAS Screen when in Manual mode	
Remote Manual stop MC-021606B	From IAS Screen when in Manual mode	

Forward Auxiliary Machine Room Cooling Freshwater Temperature Control		
Function	**Description**	**Tag Number**
PID control	Temperature of the CFW to be maintained at the suction of CFW pumps at 36°C	TIC-021602 and TCV 021602

Forward Auxiliary Machine Room Low Temperature Cooling Freshwater Expansion Tank		
Function	**Description**	**Tag Number**
Alarm	Fwd Aux. Mach. Rm. C.F.W Exp. Tk. level low	LAL-021601
Alarm	Fwd Aux. Mach. Rm. C.F.W Exp. Tk. level low low	LALL-021601A

6.9 Freshwater Cooling for Thruster Room No.2 and Thruster Room No.3

Thruster Room No.2 & No.3 Cooling Freshwater Expansion Tanks have a capacity of 0.3 m^3 each and are connected by a 25 mm line to the pump suction line on the floor deck. This establishes the pressure datum at the pump suction and minimizes the possibility of pump cavitation. The expansion tanks are fitted with a level switch for low-level alarm LAL-022601 and LAL-023601.

The cooling freshwater is circulated through the respective thruster room freshwater coolers and is fed to Thruster No.1 for cooling by Thruster Room No.1 Cooling Freshwater Pump No.1 & No.2 (MIC-022604 & MIC-022605) pumping 130 m^3/h at 2.0 bar. Similarly the Thruster Room No.2 Cooling Freshwater Pump No.1 & No.2 (MIC-023604 & MIC-023605) feed the cooling freshwater consumers in Thruster Room No.2. These pumps operate on duty/standby mode. The pump in standby-mode starts in the event of drop of discharge pressure measured by PAL-022603 and PAL-023603 respectively or when the pump in duty mode trips or stops due to failure. PAL-022603 and PAL-023603 has a time delay on 2 sec in IAS.

Temperature control is applied for the cooling freshwater that circulates through the freshwater coolers. In the event where the circulating water temperature is raised above a set point of 36°C the TIC-022602 (port) and TIC-023602 (starboard) opens the return port of the 3 way valve through the freshwater cooler and maintains the set point. The failure position of the 3-way valve (TCV-022602 and TCV-023602) is through the freshwater cooler.

6.9.1 Control

6.9.1.1 IAS Control

Thruster No.1 & No.2 cooling freshwater pumps are operated on duty/standby mode. PID control is applied for TIC-022602 and TIC-023603. The operator may select which pump he wants to have in duty and stby. Should the duty pump be unavailable, the standby pump automatically starts up. An alarm will be given “Standby Unavailable”.

Thruster Room No.2 Cooling Freshwater Pump No.1 (MIC-022604)		
Function	**Description**	**Tag Number**
Remote Auto Start MC-022604A	Duty mode: Not applied Standby mode: When the discharge is below 1.5 bar OR when pump 2 is in duty and not running	PAL-022603 and/or Pump 2 Duty mode + Unavailable/Failure
Remote Auto stop MC-022604B	Duty mode: When standby (pump 2) is started Standby mode: Not applied	
Remote Manual Start MC-022604A	From IAS Screen when in Manual mode	
Remote Manual stop MC-022604B	From IAS Screen when in Manual mode	

Thruster Room No.2 Cooling Freshwater Pump No.2 (MIC-022605)		
Function	**Description**	**Tag Number**
Remote Auto Start MC-022605A	Duty mode: Not applied Standby mode: When the discharge is below 1.5 bar OR when pump 1 is in duty and not running	PAL-022603 and/or Pump 1 Duty mode + Unavailable/Failure
Remote Auto stop MC-022605B	Duty mode: When standby (pump 2) is started Standby mode: Not applied	
Remote Manual Start MC-022605A	From IAS Screen when in Manual mode	
Remote Manual stop MC-022605B	From IAS Screen when in Manual mode	

Thruster Room No.3 Cooling Freshwater Pump No.1 (MIC-023604)		
Function	**Description**	**Tag Number**
Remote Auto Start MC-023604A	Duty mode: Not applied Standby mode: When the discharge is below 1.5 bar OR when pump 2 is in duty and not running	PAL-023603 and/or Pump 2 Duty mode + Unavailable/Failure
Remote Auto stop MC-023604B	Duty mode: When standby (pump 2) is started Standby mode: Not applied	
Remote Manual Start MC-023604A	From IAS Screen when in Manual mode	
Remote Manual stop MC-023604B	From IAS Screen when in Manual mode	

Thruster Room No.3 Cooling Freshwater Pump No.2 (MIC-023605)		
Function	**Description**	**Tag Number**
Remote Auto Start MC-023605A	Duty mode: Not applied Standby mode: When the discharge is below 1.5 bar OR when pump 1 is in duty and not running	PAL-023603 and/or Pump 1 Duty mode + Unavailable/Failure
Remote Auto stop MC-023605B	Duty mode: When standby (pump 2) is started Standby mode: Not applied	
Remote Manual Start MC-023605A	From IAS Screen when in Manual mode	
Remote Manual stop MC-023605B	From IAS Screen when in Manual mode	

Thruster Room No.2 Cooling Freshwater Temperature Control		
Function	**Description**	**Tag Number**
PID control	Temperature of the CFW to be maintained at the suction of CFW pumps at 36Deg C	TIC-022602 and TCV-022602

Thruster Room No.3 Cooling Freshwater Temperature Control		
Function	**Description**	**Tag Number**
PID control	Temperature of the CFW to be maintained at the suction of CFW pumps at 36Deg C	TIC-023602 and TCV - 023602

Thruster Room No.1 & No.2 Cooling Freshwater Expansion Tank		
Function	**Description**	**Tag Number**
Alarm	No.2 Thr. Rm. C.F.W Exp. Tk. Level Low	LAL-022601
Alarm	No.3 Thr. Rm. C.F.W Exp. Tk. Level Low	LAL-023601

7 COMPRESSED AIR SYSTEM

7.1 Compressed Air System for Port Engine Room

The Compressed Air System provides air for control and general service as well as air for starting purposes. The Compressed Air System for Port Engine Room supplies the main air at a pressure of 30 bar and general service- and control air at 9 bar pressure to the end users in the Port Engine Room. It is also branched off into other engine rooms with manual isolating valves.

Control and general service air is provided by two electrically driven air compressor packages, each having the capacity of 2520 m^3/h at 9 bars. This feeds into the Port Engine Room Control Air Receiver with 1.0 m^3 of volume capacity and into Port Engine Room General Service Air Receiver with 5.5 m^3 of volume capacity. Both control and general service air is supplied to the entire engine room from this reservoir. The control air is passed through a desiccant type dryer of capacity 2700 Nm^3/h at 9 bar before being supplied to the reservoirs.

Main air for starting etc. is provided by one reciprocating compressor, electrically driven, of capacity 141 Nm^3/h at 30 bar. This feeds directly into Port Engine Room Main Air Receiver of 4.7 m^3 of volume. The electrically driven compressor provides starting air to both 7 MW diesel generators in the engine room. This air is connected to the general service air system via a self-acting pressure reducing station that reduces the following air pressure to 9 bar. This Pressure reducing station is isolatable and can be bypassed. This unit is normally kept closed and is opened when in need at operator discretion. (Operator training and intervention is required).

7.1.1 Control and General Service Air System

The control and general service air system provides dried control air 9 bar nominal pressure to all instrumentation and control needs and general service air at 9 bar nominal pressure for other needs. The main equipment including compressors, dryers, and receivers are installed adjacent to each other in the floor deck of the engine room.

Port Engine Room General Service & Control Air Compressor No.1 & No.2 (MIC-061201 & MIC-061202) can be started/stopped from IAS screen when the compressor is selected in remote mode in the local control panel. Once started either from IAS or locally from local panel, the operation of the compressor is automatically controlled from the local control panel. In normal operation, the air compressors is started from the local control panel by the operator and then on the compressor load, unload and lead/lag start based on the system pressure as measured by the vendor package supplied pressure sensors. The compressor safety, for example, high temperature and pressure shutdown logic is built into the local control panel.

The air reservoir is fitted with pressure relief valve set at 9.9 bar and the reservoir drain works automatically and is connected to the Separator Bilge Oil Tank. The control air reservoir feeds the air to Port/Centre/Starboard Engine Room control air service and the Forward Auxiliary Machine Room for DP control. The general service air reservoir feeds the air to Port/Centre Engine Room, Thruster Room No.4, Port Deck Service, Port Secondary Escape Way and to top side for various consumers. The air reservoir is fitted with a pressure transmitter and the signal is interfaced to IAS for indication and alarm (PIAL-061203 for Port Engine Room General Service Air Reservoir and PIAL-061204 for Port Engine Room Control Air Reservoir). A local panel controls the two dryers and dryer common alarm is interfaced to IAS (XA-061301 & XA-061302) as well as dew point alarm (XIAL-061304 & XIAL-061305). The dryer discharge line is branched off into control air reservoir and the general service air reservoir. Each reservoir has a bypass valve on the inlet line for maintenance or emergency purposes.

The compressed air is connected to Starboard Engine Room and Centre Engine Room and these lines are isolatable with manual valves.

7.1.2 Main Air System (Starting Air Compressors)

The Main Air System provides starting air at 30 bar to the two 7 MW diesel generator engines in the engine room. The compressor and receiver are located in the floor deck of the Port Engine Room.

The Port Engine Room Starting Air Compressor (MIC-061101) can be started and stopped from IAS. The local starter panel handles the safety shutdown of the starting air compressor. The high air temperature and low LO-pressure switches are wired to the local starter panel and the starter panel shuts down the compressor on low lube oil pressure and high air temperature. Shutdown/abnormal status shall be sent to IAS.

The compressor can be set to either manual or auto mode in IAS. When in auto mode the compressor will start and stop based on the reservoir pressure (PIC-061103). The compressor will be automatically started when the pressure drops to 26 bar and will stop when the pressure reaches 30 bar. A low alarm will be raised in IAS when the pressure drops below 22 bar. This alarm has no time delay in IAS.

The air reservoir is fitted with a pressure relief valve set at 33.0 bar and the reservoir drain works automatically and is connected to the Seperator Bilge Oil Tank. The reservoir has three outlets. One outlet is connected with Port Engine Room General Service Air Header through pressure reducing unit. The second feeds the air to the two main generator engines in the Port Engine Room and is also connected to the Centre Engine Room via a manual valve for isolation. The third feeds the air to the two main generator engines for control. The air reservoir is fitted with a backup pressure transmitter and the signal is interfaced to IAS for indication and alarm at 22 bar (PIAL-061102).

Compressed air from the reservoir is connected to Port Engine Room Main Generator Engine No.1 & No.2. Low-pressure alarms from the engines are interfaced to IAS. PIAL-011105A and PIAL-011801A for Port Engine Room Main Generator Engine No.1 and PIAL-012105A and PIAL-012801A for Port Engine Room Main Generator Engine No.2.

7.1.3 Controls

7.1.3.1 IAS Control

IAS starts and stops the starting air compressor based on reservoir pressure when the compressor is in auto mode.

Port Engine Room Starting Air Compressor (MIC-061101)		
Function	**Function**	**Tag number**
Remote Auto Start MC-061101A	When the reservoir pressure is at low control point (26 bar)	PIC-061103
Remote Auto Stop MC-061101B	When the reservoir pressure is at high control point (30 bar)	PIC-061103
Remote Manual Start MC-061101A	From IAS Screen when in Manual mode	
Remote Manual Stop MC-061101B	From IAS Screen when in Manual mode	

Port Engine Room General Service & Control Air Compressor No.1 (MIC-061201)		
Function	**Function**	**Tag Number**
Remote Auto Start	Not Applicable	
Remote Auto Stop	Not Applicable	
Remote Manual Start MC-061201A	From IAS Screen	MC-061201A
Remote Manual Stop MC-061201B	From IAS Screen	MC-061201B

Port Engine Room General Service & Control Air Compressor No.2 (MIC-061202)		
Function	**Function**	**Tag Number**
Remote Auto Start	Not Applicable	
Remote Auto Stop	Not Applicable	
Remote Manual Start MC-061202A	From IAS Screen	MC-061202A
Remote Manual Stop MC-061202B	From IAS Screen	MC-061202B

Function	Description	Tag Number
Alarm & Indication	G/S Air Reservoir Press	PIAL-061203
Alarm & Indication	Control Air Reservoir Press	PIAL-061204
Alarm	Control Air Dryer 1 Abnormal	XA-061301
Alarm	Control Air Dryer 1 Dew Point	XIAL-061303
Alarm	Control Air Dryer 2 Abnormal	XA-061302
Alarm	Control Air Dryer 2 Dew Point	XIAL-061304
Indication & Control	Starting Air Receiver	PIC-061103
Alarm & Indication	Starting Air Receiver	PIAL-061102
Alarm & Indication	MGE 1 Starting Air Pressure	PIAL-011105A
Alarm & Indication	MGE 1 Control Air Pressure	PIAL-011801A
Alarm & Indication	MGE 2 Starting Air Pressure	PIAL-012105A
Alarm & Indication	MGE 2 Control Air Pressure	PIAL-012801A

7.2 Compressed Air System for Starboard Engine Room

The compressed air system for the Starboard Engine Room is similar to that of the Port Engine Room. However the tag numbers for indication and alarms are different (refer to 7.2.1.1).

7.2.1 Controls

7.2.1.1 IAS Control

IAS starts and stops the starting air compressor based on reservoir pressure when the compressor is in auto mode.

Starboard Engine Room Starting Air Compressor (MIC-061121)		
Function	**Function**	**Tag number**
Remote Auto Start MC-061121A	When the reservoir pressure is at low control point (26 bar)	PIC-061123
Remote Auto Stop MC-061121B	When the reservoir pressure is at high control point (30 bar)	PIC-061123
Remote Manual Start MC-061121A	From IAS Screen when in Manual mode	
Remote Manual Stop MC-061121B	From IAS Screen when in Manual mode	

Starboard Engine Room General Service & Control Air Compressor No.1 (MIC-061221)		
Function	**Function**	**Tag Number**
Remote Auto Start	Not Applicable	
Remote Auto Stop	Not Applicable	
Remote Manual Start MC-061221A	From IAS Screen	
Remote Manual Stop MC-061221B	From IAS Screen	

Starboard Engine Room General Service & Control Air Compressor No.2 (MIC-061222)		
Function	**Function**	**Tag Number**
Remote Auto Start	Not Applicable	
Remote Auto Stop	Not Applicable	
Remote Manual Start MC-061222A	From IAS Screen	
Remote Manual Stop MC-061222B	From IAS Screen	

Function	**Description**	**Tag Number**
Alarm & Indication	G/S Air Reservoir Press	PIAL-061223
Alarm & Indication	Control Air Reservoir Press	PIAL-061224
Alarm	Control Air Dryer 1 Abnormal	XA-061321
Alarm	Control Air Dryer 1 Dew Point	XIAL-061323
Alarm	Control Air Dryer 2 Abnormal	XA-061322
Alarm	Control Air Dryer 2 Dew Point	XIAL-061324
Indication & Control	Starting Air Receiver	PIC-061123
Alarm & Indication	Starting Air Receiver	PIAL-061122
Alarm & Indication	MGE 1 Starting Air Pressure	PIAL-015105A
Alarm & Indication	MGE 1 Control Air Pressure	PIAL-015801A
Alarm & Indication	MGE 2 Starting Air Pressure	PIAL-016105A
Alarm & Indication	MGE 2 Control Air Pressure	PIAL-016801A

Note: *The compressed air is connected to Port engine room and Centre Engine Room and these lines are isolatable with manual valves The Main air is connected to Port/Centre Engine room and is isolatable with manual valves.*

7.3 Compressed Air System for Centre Engine Room

The system in Centre Engine Room is different from that of Port & Starboard Engine Rooms as there is no control air compressor in the Centre Engine Room. The control air compressors in Port & Starboard Engine Room supply air to the Centre Engine Room through a connected common header.

The main air compressor system is similar to that of the Port Engine Room main air system.

7.3.1 Controls

7.3.1.1 IAS Control

Starting air compressor is controlled from IAS.

Centre Engine Room Starting Air Compressor (MIC-061111)		
Function	**Function**	**Function**
Remote Auto Start MC-061111A	When the reservoir pressure is at low control point	PIC-061113
Remote Auto Stop MC-061111B	When the reservoir pressure is at high control point	PIC-061113
Remote Manual Start MC-061111A	From IAS Screen when in Manual mode	
Remote Manual Stop MC-061111B	From IAS Screen when in Manual mode	

Function	Description	Tag Number
Indication & Control	Starting Air Receiver	PIC-061113
Alarm & Indication	Starting Air Receiver	PIAL-061112
Alarm & Indication	MGE 1 Starting Air Pressure	PIAL-013105
Alarm & Indication	MGE 1 Control Air Pressure	PIAL-013801
Alarm & Indication	MGE 2 Starting Air Pressure	PIAL-014105
Alarm & Indication	MGE 2 Control Air Pressure	PIAL-014801

7.4 Compressed Air System for Forward Auxiliary Machine Room and Thruster Rooms

The general service and control air from Port & Starboard Engine Rooms are interconnected and routed via the deck service line to Forward Auxiliary Machine Room spaces as well as to the bow thruster rooms for air supply to various consumers.

7.4.1 Controls

7.4.1.1 IAS Control

There are no IAS controls or indications or alarms for this service.

7.5 Control Air for Aft Engine room

The distribution system of control air for the aft engine rooms is independent in each engine room. The control air is received into air pots and connected to the consumers through outlet lines fitted with manual valves for isolation. The air pots can be drained manually. Closing a manual valve at the inlet shall close the inlet air to the air-pot.

7.5.1 Controls

7.5.1.1 IAS Control

There are no IAS controls or indications or alarms from this service.

7.6 Emergency Shutoff System(Valve Control Air)

Each engine room has diesel oil and lube oil tanks. These tank outlets are fitted with emergency quick closing valves. These valves are air to close type and are normally kept open. These valves have a manual mechanical reset and once closed these valves cannot be opened unless the manual latch is reset locally at the valve. The valves close on control air pressure.

The control air for these valves is stored in an air bottle that is located in the Water Mist & Inergen System Room. This reservoir is filled with the control air from general service air receivers (Port & Starboard Engine Room).This general service air is interconnected with Centre Engine Room starting air compressor through a pressure reducing unit.

The air from the air bottle is connected to the emergency quick closing valves through normally de-energized solenoid valves (VCC-124101 & VCC-124102 for Port Engine Room, VCC-124103 & VCC-124104 for Centre Engine Room and VCC-124105 & VCC-124106 for Starboard Engine Room and Incinerator Room), two for each engine room. The Forward Emergency Head Quarter is fitted with fire damper control panels. These damper control panels are also fitted with control switches for closing these quick closing valves. AC-230 V power supply is provided to these panels. The valves can be closed from Forward Emergency Head Quarters through the Fire & Gas System. In case of closing the switch the engine room solenoid valve will be energized and the air is then admitted into the valve actuators tripping the valves. Reset of fire incident and then manual reset of each valve locally is required to open these valves again. Operator intervention and training are required for these operations. The air bottle low pressure alarm (PAL-061303) is interfaced to IAS.

The pneumatic-control shutoff valves are installed on diesel oil service (VCO-124107) and return (VCO-124108) line between both diesel oil service lines and are normally closed. These valves shall be opened when one of emergency quick closing valves (VZC-124103A, VZC-124103B, VZC-124104A and VZC-124104B) are closed by ESD system.

7.6.1 Controls

7.6.1.1 IAS Control

The solenoid valves are controlled from IAS through the ESD or in local.

Function	Description	Tag Number
Control	SHUT-OFF P E/R DO/LO VALVE, N0.1 MGE	VCC-124101
Control	SHUT-OFF P E/R N0.2 MGE DO VALVE	VCC-124102
Control	SHUT-OFF C E/R DO VALVE FROM PORT E/R	VCC-124103
Control	SHUT-OFF C E/R DO VALVE FROM STBD E/R	VCC-124104
Control	SHUT-OFF S E/R DO/LO VALVE, N0.2 MGE	VCC-124105
Control	SHUT-OFF S E/R N0.1 MGE DO VALVE	VCC-124106
Control	CENT E/R DO SUPPLY EM'CY SHUTOFF VLV(OD035F) OPEN	VCO-124107
Control	CENT E/R DO RETURN EM'CY SHUTOFF VLV(OD294F) OPEN	VCO-124108
Indication	CENT E/R DO EM'CY SHUTOFF VLV(OD031F) PORT SIDE CLOSED	VZC-124103A
Indication	CENT E/R DO RETURN EM'CY SHUTOFF VLV(OD290F) PORT SIDE CLOSED	VZC-124103B
Indication	CENT E/R DO EM'CY SHUTOFF VLV(OD032F) STBD SIDE CLOSED	VZC-124104A
Indication	CENT E/R DO RETURN EM'CY SHUTOFF VLV(OD291F) STBD SIDE CLOSED	VZC-124104B
Alarm	AFT EM'CY SHUTOFF VALVE AIR TK LOW PRESS	PAL-061303

7.7 Emergency shutoff system (Fire Damper Control)

The forward machinery and thruster rooms and the engine rooms fire dampers are controlled by the Fire & Gas System. When the Fire & Gas System is reset, all the fire dampers in forward machinery and thruster rooms and aft engine rooms are opened as the corresponding group solenoid valve that controls a set of dampers is energized by the Fire & Gas System.

Note: *For detailed description see Fire & Gas Cause & Effect diagram and Kongsberg Safety Functional Design Specification.*

7.7.1 Forward Auxiliary Machine Room & Thruster Room No.1, No.2 & No.3

The Forward Auxiliary Machine Room and Thruster Room No.1, No.2 & No.3 dampers are divided into 7 groups. The groups are:

- Forward Auxiliary Machine Room supply and exhaust dampers (NCC-123301)
- Thruster Room No.1 supply damper (NCC-123302)
- Thruster Room No.1 exhaust damper (NCC-123302A)
- Thruster Room No.2 supply damper (NCC-123303)
- Thruster Room No.2 exhaust damper (NCC-123303A)
- Thruster Room No.3 supply damper (NCC-123304)
- Thruster Room No.3 exhaust damper (NCC-123304A)

7.7.2 Port Engine Room

The port engine room dampers are divided into 7 groups.

- Port Purifier Room dampers (NCC-123306)
- Port Engine Room supply damper No.1 and exhaust damper (NCC-123305)
- Port Engine Room supply damper No.2 (NCC-123305A)
- Thruster Room No.4 supply damper (NCC-123307)
- Thruster Room No.4 exhaust damper (NCC-123307A)

- Port MSBD Room supply damper (NCC-123316)
- Port MSBD Room exhaust damper (NCC-123316A)

7.7.3 Centre Engine Room

The centre engine room dampers are divided into 9 groups.

- Centre Engine Room supply damper No.1and exhaust damper (NCC-123308)
- Centre Engine Room supply damper No.2 (NCC-123308A)
- Thruster Room No.6 supply damper (NCC-123309)
- Thruster Room No.6 exhaust damper (NCC-123309A)
- Engine Control Room supply and air condition supply and exhaust dampers (NCC-123310)
- Engine Control Room exhaust damper (NCC-123310A)
- Centre MSBD Room supply damper (NCC-123317)
- Centre MSBD Room exhaust damper (NCC-123317A)
- Welding space exhaust damper (NCC-123319)

7.7.4 Starboard Engine Room

The port engine room dampers are divided into 8 groups.

- Starboard Purifier Room dampers (NCC-123313)
- Starboard Engine Room supply damper No.1 and exhaust damper (NCC-123312)
- Starboard Engine Room supply damper No.2 (NCC-123312A)
- Thruster Room No.5 supply damper (NCC-123314)
- Thruster Room No.5 exhaust damper (NCC-123314A)
- Starboard MSBD Room supply damper (NCC-123318)
- Starboard MSBD Room exhaust damper (NCC-123318A)
- Incinerator Room dampers (NCC-123311)

One dire damper control panel is located in the Forward Emergency Head Quarters that has can close any of the group fire dampers. This panel has 7 control switches for the forward machinery and thruster rooms, 7 control switches for Port Engine Room, 9 control switches for Centre Engine Room and 8 control switches for Starboard Engine Room. These switches are configured as normally open contacts and wired to Fire & Gas System as input with line monitoring. These switches can be selectable for either auto or close mode in local panel. In auto mode, dampers will be controlled by Fire & Gas System based on the cause and effect matrix. In close mode, dampers can be closed manually through Fire & Gas System regardless of Fire & Gas System internal logic condition.

7.7.5 Water Mist System

Both manual and automatic activation of water mist system is possible.

Automatic activation is performed by the Fire & Gas System according to Fire & Gas Cause & Effects.

refer to FDS for ESD & F&G System chapter 5.2. (doc. Nr 1222011).

From IAS Machinery system, it is possible to control and monitor the Water Mist/Inergen Room Supply Fan, MIC-062626.

There is also “Running” indication for the Water Mist SPU Pumps

7.7.5.1 Water Mist System Control

No IAS control for this system, only monitoring.

Function	Description	Tag Number
Indication	WATER MIST UNIT NO.1 ACTIVATED	MI-091502
Alarm	WATER MIST UNIT NO.1 FAULT	XA-091502
Alarm	WATER MIST UNIT NO.1 FRESH WATER LOW LEVEL	LAL-091503
Alarm	WATER MIST UNIT NO.2 FAULT	XA-091512
Alarm	WATER MIST UNIT NO.2 FRESH WATER LOW LEVEL	LAL-091513
Alarm	WATER MIST UNIT NO.3 FAULT	XA-091502
Alarm	WATER MIST UNIT NO.3 FRESH WATER LOW LEVEL	LAL-091503

Indication	WATER MIST SPU1 M-1 PUMP MOTOR RUNNING	MI-091571
Indication	WATER MIST SPU1 M-2 PUMP MOTOR RUNNING	MI-091572
Indication	WATER MIST SPU1 M-3 PUMP MOTOR RUNNING	MI-091573
Indication	WATER MIST SPU1 M-4 PUMP MOTOR RUNNING	MI-091574
Indication	WATER MIST SPU1 M-5 PUMP MOTOR RUNNING	MI-091575
Indication	WATER MIST SPU1 M-6 PUMP MOTOR RUNNING	MI-091576
Indication	WATER MIST SPU1 M-8 PUMP MOTOR RUNNING	MI-091578
Indication	WATER MIST SPU1 M-9 FEED WATER PUMP MOTOR RUNNING	MI-091579
Indication	WATER MIST SPU2 M-1 PUMP MOTOR RUNNING	MI-091581
Indication	WATER MIST SPU2 M-2 PUMP MOTOR RUNNING	MI-091582
Indication	WATER MIST SPU2 M-3 PUMP MOTOR RUNNING	MI-091583
Indication	WATER MIST SPU2 M-4 PUMP MOTOR RUNNING	MI-091584
Indication	WATER MIST SPU2 M-5 PUMP MOTOR RUNNING	MI-091585
Indication	WATER MIST SPU2 M-6 PUMP MOTOR RUNNING	MI-091586
Indication	WATER MIST SPU2 M-7 PUMP MOTOR RUNNING	MI-091587
Indication	WATER MIST SPU2 M-9 FEED WATER PUMP MOTOR RUNNING	MI-091589
Indication	WATER MIST SPU3 M-1 PUMP MOTOR RUNNING	MI-091591
Indication	WATER MIST SPU3 M-2 PUMP MOTOR RUNNING	MI-091592
Indication	WATER MIST SPU3 M-3 PUMP MOTOR RUNNING	MI-091593
Indication	WATER MIST SPU3 M-4 PUMP MOTOR RUNNING	MI-091594
Indication	WATER MIST SPU3 M-5 PUMP MOTOR RUNNING	MI-091595
Indication	WATER MIST SPU3 M-6 PUMP MOTOR RUNNING	MI-091596
Indication	WATER MIST SPU3 M-7 PUMP MOTOR RUNNING	MI-091597
Indication	WATER MIST SPU3 M-9 FEED WATER PUMP MOTOR RUNNING	MI-091598

8 EXHAUST GAS SYSTEM

8.1 System Description

The engine room exhaust pipes are taken through the funnel casing and the exhaust is let out to atmosphere.

The Exhausts from the main generator engines are taken through the silencers with spark arrestors. The exhaust from the incinerator are taken directly to the weather deck.

8.1.1 Controls

8.1.1.1 IAS Control

No separate IAS controls for this system, only monitoring.

Port Engine Room Main Generator Engine No.1		
Function	**Description**	**Tag Number**
Indication & Alarm	Exh. Gas Temp. before T/C A	TIAH-011701
Indication	Exh. Gas Temp. after T/C A	TI-011702
Indication & Alarm	Exh. Gas Temp. before T/C B	TIAH-011703
Indication	Exh. Gas Temp. after T/C B	TI-011704
Indication	Charge Air Cylinder Row A	PI-011705
Indication	Charge Air Cylinder Row B	PI-011706

Port Engine Room Main Generator Engine No.2		
Function	**Description**	**Tag Number**
Indication & Alarm	Exh. Gas Temp. before T/C A	TIAH-012701
Indication	Exh. Gas Temp. after T/C A	TI-012702
Indication & Alarm	Exh. Gas Temp. before T/C B	TIAH-012703
Indication	Exh. Gas Temp. after T/C B	TI-012704
Indication	Charge Air Cylinder Row A	PI-012705
Indication	Charge Air Cylinder Row B	PI-012706

Centre Engine Room Main Generator Engine No.1		
Function	**Description**	**Tag Number**
Indication & Alarm	Exh. Gas Temp. before T/C A	TIAH-013701
Indication	Exh. Gas Temp. after T/C A	TI-013702
Indication & Alarm	Exh. Gas Temp. before T/C B	TIAH-013703
Indication	Exh. Gas Temp. after T/C B	TI-013704
Indication	Charge Air Cylinder Row A	PI-013705
Indication	Charge Air Cylinder Row B	PI-013706

Centre Engine Room Main Generator Engine No.2		
Function	**Description**	**Tag Number**
Indication & Alarm	Exh. Gas Temp. before T/C A	TIAH-014701
Indication	Exh. Gas Temp. after T/C A	TI-014702
Indication & Alarm	Exh. Gas Temp. before T/C B	TIAH-014703
Indication	Exh. Gas Temp. after T/C B	TI-014704
Indication	Charge Air Cylinder Row A	PI-014705
Indication	Charge Air Cylinder Row B	PI-014706

Starboard Engine Room Main Generator Engine No.1		
Function	**Description**	**Tag Number**
Indication & Alarm	Exh. Gas Temp. before T/C A	TIAH-015701
Indication	Exh. Gas Temp. after T/C A	TI-015702
Indication & Alarm	Exh. Gas Temp. before T/C B	TIAH-015703
Indication	Exh. Gas Temp. after T/C B	TI-015704
Indication	Charge Air Cylinder Row A	PI-015705
Indication	Charge Air Cylinder Row B	PI-015706

Starboard Engine Room Main Generator Engine No.2		
Function	**Description**	**Tag Number**
Indication & Alarm	Exh. Gas Temp. before T/C A	TIAH-016701
Indication	Exh. Gas Temp. after T/C A	TI-016702
Indication & Alarm	Exh. Gas Temp. before T/C B	TIAH-016703
Indication	Exh. Gas Temp. after T/C B	TI-016704
Indication	Charge Air Cylinder Row A	PI-016705
Indication	Charge Air Cylinder Row B	PI-016706

9 TOPSIDE INTERFACE

There are two Profibus serial lines between IAS and topside in additional to the HW power available signals, one for the topside HVAC (THVAC) and one for the NOV Drilling Control System (DCS).

9.1 Topside HVAC Interface

Open/Close feedback signals for all the topside dampers and ventilation fan start, stop, failure and Remote signals are exchanged between IAS and topside HVAC system.

Note: *For a complete signal list see the signal interface document, IO list and makers System description.*

9.2 DCS Interface

9.2.1 Introduction

The following signals are interfaced between DCS and IAS by use of serial line:

RMS/RTS(BOP):

- Signals in order to monitor the BOP and Riser Tensioner system.

Mud/Pits:

- Mud/pits system monitoring.
- Bulk tank volume and weight monitoring.

For a complete signal list of the data items which will be displayed, alarmed and controlled in the IAS refer to the Profibus IO list between Kongsberg and NOV.

9.3 Brine and Base Oil system

The following signals are interfaced between IAS and DCS for the Mud control system (MCS) by use of serial line:

- Brine System
    - 2 pumps
- Base Oil System
    - 2 pumps

9.3.1 Function Description

There is a dual control for the brine and base oil systems, where the system can be controlled from either IAS or the MCS. The MCS is the master on the system and is used during normal operation. If the operator wants to control the equipment via IAS, normally during bunkering operations, they have to send a request bit to MCS. MCS will then transfer operation to IAS. Operation from MCS will then be disabled. When IAS is no longer in need for the control the request bit should be set to "0". When MCS is in control operation from IAS will be disabled.

9.3.2 Command Signals

The command signals must be pulsed (duration 5sec.). Applicable signals are start/stop for the pumps.

9.3.3 Status Signals

The serial link has a counter that checks the status on the link, if the link is going down the MCS automatically switch to MCS operation mode.

Note: *For a complete signal list see the signal interface document and IO list.*

10 HVAC AND MECHANICAL VENT. SYST.

10.1 Introduction

The Ventilation system is divided into four parts in this project.

(a) Accommodation HVAC system (HVAC)

(b) Mechanical ventilation for engine room (ERV)

(c) Hull spaces ventilation system (HSV)

(d) Topsides HVAC system(THVAC)

The Mechanical ventilation control system for ERV and HSV will form an integral part of the IAS and ESD/FGS system. The IAS and ESD/F&G Systems will contain the hardware and software necessary to perform continuous monitoring and control of ERV and HSV systems. The IAS/ESD/F&G will also contain monitoring, alarm handling reporting and self-checking. Temperature control will be via local controllers.

10.2 IAS Control and Monitoring

Control and monitoring of all ERV and HSV system fans will be through VDU mimics at the IAS workstations.

- Fans Start and Stop command and Running and Failure indication
- Dampers Open and Close indication and command

10.3 Emergency Shutdown

The marine ESD/F&G systems are independent monitoring & control systems. The Marine ESD/F&G systems perform logic shutdown of all fans and close of fire dampers in case of gas/smoke detection inside the protected area or gas/smoke detection in an air intake.

The ERV and HSV system will function independently as a part of the IAS, but the ESD/F&G will be capable of overriding any IAS command as determined by the ESD/F&G Cause & Effect Matrix. Reset of these signals will only be possible from the ESD/F&G system matrix.

After shutdown reset, the basic function for the ventilation system is that it has to be started up manually i.e. it will not start up in the same condition as it was before the shutdown occurs.

10.4 Blackout function

After a Power blackout/reconnection, the basic function for the ventilation system is that the fan(s) will return back to normal condition, i.e. the system will be in the same condition as it was before the blackout occurs.

For accommodation HVAC system; IAS will first send a reset pulse when blackout condition has been recovered, before start of any fans.

10.5 Operation for Fans

For Fan control, the IAS will give start/stop signal to the MCC. Motor status information is transferred to the IAS.

The marine ESD/F&G system will give shutdown(trip) signal to the fan motor starters. These signal shall prevent corresponding fans from being started either remotely (IAS) or locally (MCC). Reset of these signals will only be possible from the ESD system.

10.6 Ventilation System (ERV and HSV) Automatic Mode

For each Room there is a common auto/manual button in the mimic. When operating the Auto Software Button, the fans and dampers will be switched to auto mode, the dampers will open and the duty fan will automatically start. Operating the Manual Software Button will stop the running fan and switch the dampers and fans to manual mode. In manual mode the operator can start and stop fans as well as open and close the dampers independently.

Note that the start and stop sequences will differ from system to system. Commons for all systems are that each main fan has a dedicated damper and that the start and stop command signals will be pulsed signals (duration 5 sec.).

For each fan/damper the following always apply:

- When the Manual Software Button is pressed the dampers shall not close unless initiated by F&G system. This will always ensure natural ventilation and also combustion air for the engines.
- If the damper is closed while the fan is running, the fan shall stop.

For the ERV & HSV-system that has duty/standby fans, the operator may select which fan he wants to have in duty and standby by using the operator menu on the duty/standby module in the screen. To start up the system after these selections, the operator has to push "On" in the same operator menu. Should the duty fan be unavailable for some reason, the standby fan will automatically start up. This will produce a "Standby Unavailable" alarm.

The change over from a duty fan to standby fan will automatically occur for the following conditions:

- When the duty fan trips (fails)
- Shut-off damper for duty fan fails or closed (on consequential stop of the duty fan). The shut off damper and fan stop logic is applied for fans where the shut off damper is installed. For accommodation AHU, this logic resides in the HVAC panel.

10.7 Ventilation Manual Mode

For service and/or maintenance, each and one of the units (e.g. fans and dampers) can be tested manually by selecting Auto/Manual directly on the fan or damper symbol it selves. However, this is recommended to be done when the system is stopped and can only be done if the Manual Software Button is active (room ventilation control in manual mode). The operator must be aware of unwanted situations (under/over pressure etc.) when operating in manual mode.

10.8 Control Typical

The Ventilation system controlled by IAS can be grouped into 3 Control Typical.

Common Functionality for these typical is:

- Selection of Automatic and Manual mode.
- Auto Start/Stop.
- Start interlock on fan fault or close indication on corresponding damper.

Control Typical 1

System type: ***Fans with Duty/Stby Configuration, Single Speed.***

Control Typical 2

System type: ***Fans without duty/stby configuration, dual speed.***

Control Typical 3

System type: ***Fans without duty/stby configuration, dual speed and reverse.***

10.9 System Description

All occupied spaces within the accommodation shall be air-conditioned. Specified Machinery spaces and Hull spaces have to be mechanically ventilated. This includes cabins, offices, public-spaces, working-spaces, control-spaces, switch rooms, workshops etc.

The HVAC system panels (both Accommodation and Topsides) are interfaced to the IAS system by serial line.

Brief individual system descriptions and control/indication interfaces to IAS are described below.

10.10 Accommodation HVAC

The system comprises of:

- Fire dampers
- Fans
- One air-conditioning unit with two (2) off compressors and two oil lubrication pumps
- HVAC control panels for Accommodation
- AC Unit control panel (Starter Panel)
- Electrics and Instrumentation

The fresh air intake is located on A-Deck on the aft side of accommodation. The galley air intake is also located on A-Deck but on the Port side. The air intakes are provided with fire dampers and gas detectors. The accommodation air intake is also fitted with smoke detectors. The fire dampers are remotely controlled from the F&G panel. The fire dampers can be operated manually from strategically located manual valves.

Air to the spaces is supplied by ductwork and cabinet heater units control the temperature of air to the cabins. A re-circulation system circulates part of the return air back into the air-handling units for mixing with the fresh air intake.

Separate extract system is used for galley. A separate Galley supply fan supplies air to Galley in the event of hi-speed extraction of smoke is required and the extract fan is turned on to high speed. Control of these fans are applied in HVAC panel an only running/failure indication is transmitted to IAS.

Note: *For a complete signal list, see the signal interface document, IO list and maker's system description.*

10.10.1 Accommodation AHU

There are three AHU units, two working and the one incold standby. Standby unit shall start automatically when one of the duty units fail. Each unit is divided onto the following sections:

- Intake and Mixing section
- Filter Section
- Heating section
- Cooling section
- Water eliminating section
- Humidifying section.
- Fan section
- Recirculation fan section

The fresh air is drawn from the air intake through a fire damper and passed through the mixing section. HVAC PLC controlled modulating damper is fitted at the entry of the section. The accommodation returns are re-circulated by a re-circulation fan. The fan delivers return air into the mixing section through a modulating damper. The return air and fresh air are mixed in the mixing section. Temperature of the mixed air is measured in this section for cooling control application. The mixed air is then passed through the filter section. The filtered air is then passed through the electrical heating section. The HVAC panel controls the electrical heaters. This section is operated when the outside ambient temperatures are very low and the incoming air temperature is to be raised.

The filtered/heated air is then drawn into the cooling section where the temperature of the air to accommodation spaces is controlled. R404A Freon is used for cooling the air outlet. The compressor and condensing units supply the Freon to the cooling section. WCCU control panel controls the cooling. The instrument signals are gathered by the junction boxes and are connected to the WCCU control panel. The WCCU control is enabled when the compressors are running. HVAC control panel sends the compressors running signals to the WCCU control panel.

The compressors are powered from the air-conditioning compressor control panel. Each compressor and associated lube oil pump are controlled by UNISAB controllers located in local panels and are interfaced to the A/C control panel by hardwired signals.

Humidifying section maintains suitable humidity of accommodation spaces by injecting freshwater. This is necessary because the humidity of heated outside air at winter season is very low. Humidifier is constructed with spray nozzles for freshwater. Water elimination section is placed after cooling section and prevents the condensed water from falling into fan section. Fan section supplies the conditioned air from heating or cooling coil to accommodation spaces and contains a centrifugal fan of double suction multi blade type and a V-belt driven motor. The fan unit is mounted on vibration

dampers. Distribution section distributes the conditioned air to the ducts and inside is insulated with sound absorbing material to reduce the noise emitting from the fan.

10.10.2 Galley AHU

Galley AHU sections are similar to the Accommodation AHU sections. The cooled air is sent to galley separately.

10.10.3 Recirculation Fan for Accommodation

The return air from the accommodation is re-circulated. Each AHU is fitted with a recirculation fan. The re-circulation fan draws the air from accommodation and discharges air into the intake section of the AHU.

The recirculation fan is fitted with manual shutoff dampers in the suction and a volume control damper in the discharge side. In the event of fire in any accommodation deck and after the fire is extinguished the smoke from the deck can be extracted by the recirculation fan. The recirculation fan can be used as the extract fan.

10.10.4 Galley Supply and Extract Fans

The galley supply and extract fans are located on B-deck and are driven by electric motors. These fans are only controlled by the local control panel.

10.10.5 Accommodation Fire Dampers

Fire dampers are located in each deck such that the decks are isolatable in the event of a fire. The accommodation is divided into various fire zones and the fire dampers are shutdown based on the fire in the respective zones. Refer to the cause and effect diagrams for the shutdown causes of the fire dampers.

Note: *For a complete signal list see the signal interface document, IO list and makers System description.*

10.10.6 Accommodation Fans

The fans installed in the Accommodation are interfaced by use of Profibus serial line. These fans can be started and stopped from the IAS mimics. Fan start is possible if the fan is available and if the damper in front of the fan is opened. Interlocks is checked in local panel as well as in IAS. Exhaust fans can only be started if one of the main AHU supply fans is running. If the Auto Software Button is active then the exhaust fan(s) will automatically start when main AHU supply fan is started.

Note: *For a complete signal list see the signal interface document, IO list and makers System description.*

10.10.7 Acc. Room Over-Pressure switches

HVAC system maintains a positive pressure of 50 Pa to avoid ingress of gas and smoke into accommodation areas. Refer to the serial line interface document for details.

10.10.8 Accommodation Unit Coolers

Wheelhouse and heli-deck reception room are provided with package air conditioning units. The package air conditioning units are automatically controlled by the room temperature by thermostats. The units are powered by 3-phase AC 440V supply. The cooling capacity of the units is 10.4 kW and the heating capacity is 9kW. Abnormal alarm is interfaced to IAS.

There are package air conditioning units in Wheelhouse, DP Back-up Room and General Electric Room. On main HVAC system stopped signal, IAS shall automatically start these three units.

Note: *For a complete signal list see the signal interface document, IO list and makers System description.*

10.10.9 Controls

10.10.9.1.1 IAS Control

The accommodation HVAC local panel does the complete accommodation HVAC system control i.e. all the logic for automatic control is in the Allen Bradley PLC installed in the Accommodation HVAC panel and the panel internal logic checks the required interlocks and controls the AHU fans and extract fans. The control panel is supplied with an UPS power. The following signals are transferred on the serial link between the Accommodation HVAC panel and F&G cabinet. For complete serial line signals see separate serial line IO-list.

- Fan start and stop signals.
- Fan status signals
- Accommodation dampers close status.
- Fire zone status signals.
- Etc.

Fan and damper logic is implemented in HVAC local panel. If damper is not open, fan cannot be started. If damper closes accidentally while fan is running, the fan shall be stopped/start blocked.

F&G system will provide trip signals to HVAC panel for tripping the fans on F&G situations and ESD situations. The signal is active till the ESD and/or F&G are reset. The fans cannot be started again unless the ESD/F&G is reset.

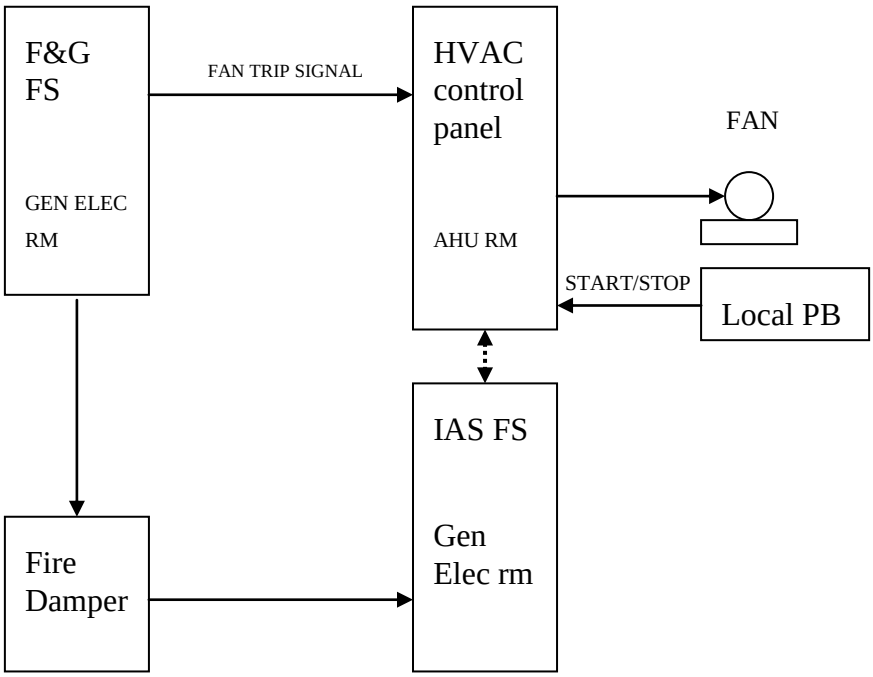
Fan start/stop from IAS:

LOC/REM IN HVAC	AUTO/MANUAL IN HVAC MIMIC	IAS START/STOP	LOCAL START/STOP	REMARKS
REMOTE	AUTO	ENABLE	DISABLE	AUTOMATIC CONTROL OF FANS
REMOTE	MANUAL	ENABLE	DISABLE	INDIVIDUAL START/STOP FROM IAS
LOCAL	AUTO	DISABLE	ENABLE	AUTOMATIC CONTROL OF FANS
LOCAL	MANUAL	DISABLE	ENABLE	INDIVIDUAL FAN START/STOP FROM LOCAL

The operator can start and stop the fans from IAS when the selector switch on the HVAC panel is remote mode except the galley exhaust and supply fans. If the fan is selected in auto mode in the HVAC panel then the corresponding fans will function as duty/stby mode upon receiving the start command from IAS. In manual mode, operator can individually start/stop the fans from IAS.

If the fan is not started within 10 seconds then the IAS returns fan start fail alarm. The start and stop command signals will be pulsed signals (5 seconds pulse)

All the vent fans in accommodation are single speed except galley exhaust fan. The galley exhaust fan is 2-speed fans but it is only controlled from local control panel, and not from IAS.


F&G
FS
GEN ELEC
RM
FAN TRIP SIGNAL
HVAC
control
panel
AHU RM
FAN
START/STOP
Local PB
IAS FS
Gen
Elec rm
Fire
Damper

10.11 Machinery Part Ventilation

The engine rooms and thruster rooms and other machinery spaces are provided with mechanical ventilation. Each ventilated space is fitted with ventilation fans and dampers. The fans are controlled from IAS and tripped from F&G system. The dampers are controlled from the fire and gas system. Each dampers status is wired to IAS for damper fan logic application. Fan damper logic is implemented in IAS. If damper is not open fan cannot be started. If damper closes accidentally while fan is running, the fan shall be stopped/start blocked. If the fan stops the damper shall close unless being activated by F&G system.

F&G controller controls the dampers by energizing the group solenoid valves. The open/close limit switches from the dampers are wired to the IAS process cabinets where the respective Fan is controlled. This is to facilitate the Fan damper control logic. The dampers can be closed from the Forward Emergency Head Quarters. For this purpose switches are provided on the fire damper control panel located in Forward Emergency Head Quarters. The switch contact is normally open. Closing the switch closes the damper. The switch contacts are wired to F&G field station and are line monitored.

10.11.1 Group Solenoid Valve

The group solenoid valves, controls that rooms dampers. It is possible to open/close the dampers from IAS, FGS operator station or manually from the local mounted panels.

10.11.2 Machinery Spaces Fans

The Fans installed in the Machinery spaces can be started and stopped from the IAS mimics. Interlocks apply. The fan start is possible if the Fan is available and if the associated damper is opened. If the room is set to auto mode by the respective Auto Software Button in IAS, the dampers will open and the fans will start automatically.

10.11.3 Machinery space Unit Coolers

MSBD rooms, Engine Control Room and thrusters rooms are provided with package air conditioning units (unit coolers).

The package air condition units are automatically controlled by the room temperature by thermostats. The units are powered by 3-phase AC 440V supply. The cooling capacity of the units is 10.4 kW and the heating capacity is 9kW. Abnormal alarm is interfaced to IAS. IAS can also send a start pulse to the unit by manual operation.

10.11.3.1 Controls

No.2 supply fan in each engine room, No.2 supply fan in Forward Auxiliary Machine Room and all thrusters room fans are two speed/reversible fans. The reversing operation is an operator-attended operation.

Each engine rooms supply fans are operated in duty/stby mode. The duty fan will normally run in low speed, but in high speed when both main generator engines are running. The fan can be started from IAS if all the following conditions are satisfy

- The fan is in remote
- There is no fault on the fan
- The damper associated with the fan is open

Closure of damper when the fan is running will stop that fan. However fan stop will not close the damper unless triggered by the F&G logic. The dampers for engine rooms shall not close on wire break. Hence these SOV's are normally de-energized and line monitored. The damper closes when energized. The SOV's are supplied with manual reset.

Forward Auxiliary Machine Room fans are also operated in duty/stby mode. The fan can be started from IAS if all the following conditions satisfy

- The fan is in remote
- There is no fault on the fan
- The damper associated with the fan is open

Purifier room exhaust fans can be started only if at least one of the supply fans in that engine room is running.

Auto operation from IAS:

The operator can start and stop the fans from IAS when the fan is in remote mode. When operating the Auto Software Button, the fans and dampers will be switched to auto mode, the dampers will open and the duty fans will automatically start. Operating the Manual Software Button will stop the running fan and fans and dampers will switch to manual mode.

If the fan is not started within 10 seconds then the IAS returns fan start fail alarm..

Manual operation from IAS:

By pushing the Manual Software Button the manual mode will be activated. In this mode the operator can individually start/stop fans and open/close dampers. This mode is basically meant for service and maintenance

Remote position in MCC	Auto (Control in IAS)	Automatic control of fans and dampers
Remote position in MCC	Manual (Control in IAS)	Fans and dampers can be operated individually
Local position in MCC		Fan can be individually started/stopped either from MCC or local push button.

10.12 Hull Spaces Ventilation System

The hull spaces are provided with mechanical ventilation. The ventilated spaces is fitted with ventilation fans and fire dampers. The fans are controlled from IAS and tripped from F&G system. The dampers are controlled from the fire and gas system. Each dampers status is wired to IAS for damper fan logic application. Fan damper logic is implemented in IAS. If damper is not open fan cannot be started. If damper closes accidentally while fan is running, the fan shall be stopped/start blocked.

F&G controller controls the dampers by energizing the group solenoid valves. The open/close limit switches from the dampers are wired to the IAS process cabinets where the respective fan is controlled. This is to facilitate the fan damper control logic.

The group solenoid valves control that room’s dampers. It is possible to close the dampers manually from the local mounted panels.

10.12.1 Hull Spaces Fans

The fans installed in the hull spaces can be started and stopped from the IAS mimics. Damper interlocks apply in IAS. The fan start is possible if the fan is available and if the damper in front of the fan is opened.

10.12.1.1 Controls

The exhaust fans (MIC-062619 and MIC-062630) in ballast pump room shall work as duty/standby and these are the only duty/standby fans in the Hull Spaces Ventilation System. The duty fan can be started from IAS if:

- Fan is in remote
- Fan has not failed/tripped
- The dampers in front of the fan is open

All other fans than the exhaust fan in ballast pump room are duty fans. Fans can be started from IAS if all the following conditions are satisfied:

- Fan is in remote
- Fan has no failure
- The damper in front of the fan is open

Fan damper logic shall apply. Running fan shall stop if the damper is closed and fan cannot be started again unless the damper is opened. Fan stop does not close the damper unless activated by F&G trip signal.

When gas is detected in the Ballast Pump Room exhaust duct or inside the room the standby exhaust fan shall be started. When fire is detected inside the room both the fans shall be stopped.

Auto operation from IAS:

The operator can start and stop the fans from IAS when the fan is in remote mode. When operating the Auto Software Button, the fans and dampers will be switched to auto mode, the dampers will open and the duty fan will automatically start. Operating the Manual Software Button will stop the running fan and switch dampers and fan to manual mode.

If the fan is not started within 10 seconds after start command the IAS returns a fan start failure alarm. The operator can stop the fans if the Manual Software Button is active.

Manual operation from IAS:

By pushing the Manual Software Button the manual mode will be activated. In this mode the operator can individually start/stop fans and open/close dampers for the selected system. This mode is basically meant for service and maintenance.

10.13 Topsides Ventilation

The topsides HVAC system comprises of the following sub systems:

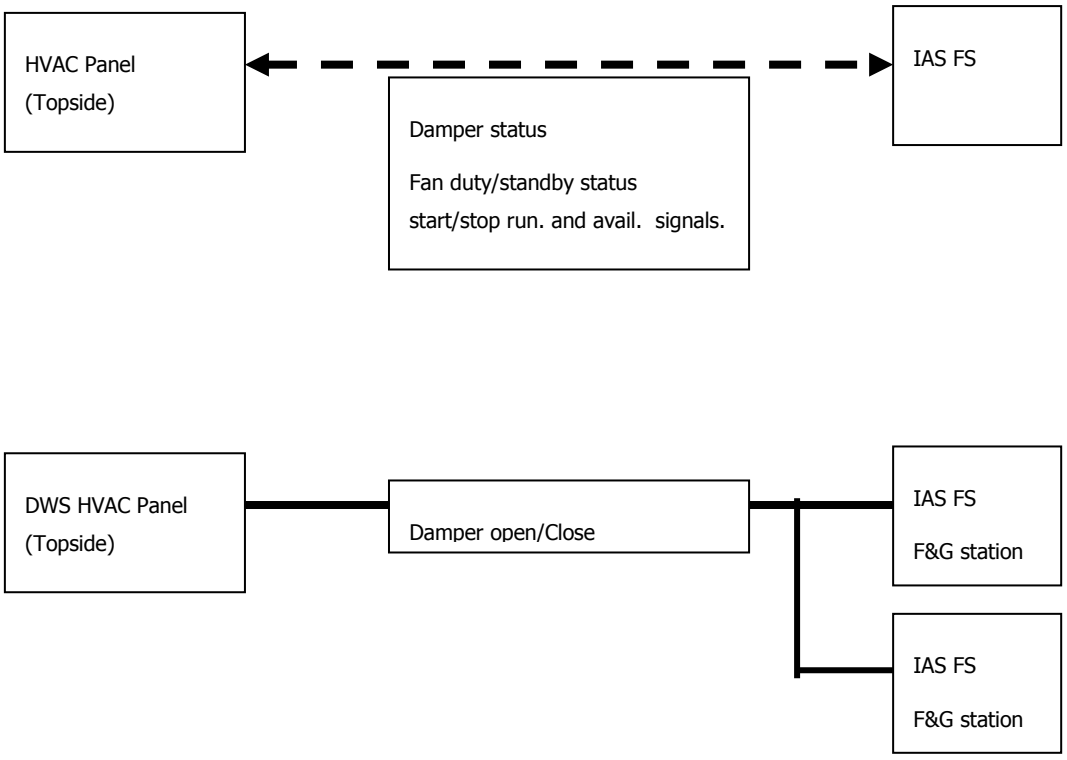
- Switchgear room and transformer room –MM31
- Sack store and cementing room
- Mud pit tank top area
- Mud Pump Room
- Drilling welding workshop
- Shale shaker area
- Mud proc., Mod., Cut and tans.
- Sub Control Module
- Sub Control Module General Areas
- DC, LER and TDCR

The Topside HVAC is controlled by the Topside HVAC panel. The Topside HVAC panel has serial and hardwired interfaces to Hull IAS for limited control.

DC, LER and TDCR Air Conditioning System is a separate system from NOV and is interfaced via the NOV Profibus serial line to IAS.

10.13.1 General Concept

The communication between the IAS and topsides HVAC panel is by Profibus. This is decided to be a single link.



The fire damper status signals are wired to topsides IAS for controlling the fan damper logic. Topsides have only one “Damper Closed” contact interfaced to IAS. Hence IAS will recognize the signal as described below:

Signal status “0”= Damper opened

Signal status “1” = Damper closed

All fans have the following signals interfaced to IAS. Start and Stop command as well as Running, Available (no fault), remote/local, duty and standby status. Two-speed fans speed selection is done in IAS.

All fire dampers control is done from the F&G system. The fire damper status switches are connected to the IAS. This will help IAS to perform the fan damper logic.

Whenever a fan is start commanded and if the fan running signal is not received by the IAS within a specified time say 10 seconds IAS generates a "Fan failed to start" alarm.

10.13.2 System-1, Switchgear Transformer Room (MM31/MM32)

Air Handling units are located in HVAC plant room (MM21)

The system has 3 AHU fans. Two fans work as duty and one as standby. The duty standby selection and control is done in HVAC local panel or from IAS if in remote mode The standby fan starts whenever the running duty fan is stopped by an abnormal condition.

The AHU is fitted with inlet filters and each inlet filter is fitted with PDI.

The AHU fans supply air to the switchgear/transformer/UPS room. The return from this room is collected and mixed into the fresh air supply. Fresh air is drawn from outside through a non-return damper. Both the supply and the return line for the room is fitted with a fire damper.

The fans can be started and stopped from Topside HVAC panel. The AHU fans can be started if the supply and return dampers are in open condition. Also the fans can be started and stopped from IAS when the Topsides HVAC panel is in remote mode and the AHU fans are available. IAS can control duty standby selection and operation. However all interlocks are checked in HVAC panel.

This area has one extract fan. The fan exhausts air through a fire damper. This fan is permitted to start if at least one AHU fan is running and if the fire damper is opened. The fan is stopped or start-blocked when none of the AHU's is running OR when the fire damper is closed. This interlock is achieved in IAS.

Inergen System is applied to this room. The fans and dampers and the engine have to be shut down before inergen is released into this compartment. This is achieved by the Fire & Gas System.

This area also consists of the following rooms.

- Technical Office room-MM22
- ET room –MM23
- Drilling Elect workshop- MM24
- Coffee shop (smoking) –MM25
- Drill Mechanical workshop –MM12
- Store keeper's house –MM13
- Warehouse –MM14

One package air conditioning unit is fitted in HVAC Plant room. This unit supplies conditioned air to all the rooms above including HVAC plant room but except the Warehouse. This unit receives fresh air from outside through a non-return damper. The unit supplies cooled air to the rooms through the fire dampers. The return line from the rooms to the air conditioning unit is fitted with fire dampers.

Duct heaters are fitted in Technical Office, Coffee Shop, ET Shop. Drill Electrical Workshop, Storekeepers House and Drill Mechanical Workshop. Thyrister controllers located in these rooms control the heaters based on the room/duct temperatures. These controllers are interlocked with the air conditioning unit's running signal. The heaters will be stopped on high-high temperature or when the air conditioning unit is not running. This control is applied in the local units.

Closed status of the fire dampers will be checked by HVAC logic before the start of the air conditioning unit is executed. The unit is started and stopped from IAS or Topside HVAC Panel and all interlocks are checked in Topside HVAC panel.

There are three compressor/condenser units located in this room, which provide coolant to the AHU respectively. The return air temperature in the AHU return ducts is measured and input to a sequential controller that controls the coolant flow. The HVAC panel handles the start/stop of compressors and the associated interlocks between compressors and the AHU. Running indication is interfaced to IAS.

Freshwater cooling is applied to the condensers and the package air conditioning units. The unit's return air temperature is measured and connected to a sequential controller that controls the coolant to the unit.

Start/stop commands, running indication and abnormal alarm from the air conditioning unit are interfaced to IAS.

The warehouses is fitted with supply and extract fans. This room has only non-return dampers and no fire dampers. The supply fan shall be running before the extract fan can be started. This interlock is applied in IAS. However for local start from Topside HVAC Panel this interlock is not applied. Operator intervention and training would be required.

The HVAC Plant Room has also one extract fan. The room is fitted with non-return dampers for fresh air inlet and exhaust for the room as well as for the fresh air inlet duct to the AHU. The extract fan can be started and stopped from IAS when the HVAC panel is in remote mode and if the fan is available.

These non-return dampers do not have any control or indication in IAS/F&G.

10.13.3 System-2, Sack Storage Area (MM33) & Cementer Room (MM35)

Sack Storage Area is fitted with two supply and two extract fans. All fans are fitted with non-return dampers. Control and indication of these dampers is not interfaced to IAS.

The fans are designed 2 x 50% and both supply and both extract fans shall always be running. Any Extract fan can be started only if at least one supply fan is running. Supply fans shall start first followed by extract fans. Both fans are interlocked. If any supply fan is stopped when both the extract fans are running then an alarm is generated in IAS. Operator action and intervention is required to assess the situation and to stop the running extract fans. These interlocks are applied in IAS.

Cementer Room is fitted with one supply and one extract fan in addition to a natural exhaust outlet. The inlet and outlets are fitted with fire dampers. The supply fan and extract fan can be started from IAS. The fans can be started when the respective dampers are in open condition. Also the extract fan can be started only when the supply fan is running. The extract fan shall be stopped when the supply fan is stopped. The fans shall be stopped if the respective dampers are closed. These interlocks are applied in IAS. Inergen system is applied to this room. The fans and dampers and the engine have to be shut down before inergen is released into this compartment.

Cementer engine is housed in Cementer Room, but is not interfaced to IAS. This engine is installed in an acoustic enclosure. The combustion air is supplied through a duct. The supply duct is fitted with a fire damper. The cooling of radiator is a forced cooling and the cooling fan forces the air out through a duct and the duct is fitted with a fire damper.

Mud Lab Room is fitted with one extract fan. This outlet is fitted with fire dampers. The extract fan can be started from IAS. The extract fans can be started when the respective dampers are in open condition. The fans shall be stopped if the respective dampers are closed. These interlocks are applied in IAS.

One package air conditioning unit is fitted in Sack Storage Area. This unit supplies conditioned air to Mud Lab Room and Mud Control Room. This unit receives fresh air from outside through a non-return damper. The unit supplies cooled air to the rooms through the fire dampers. Running, remote and failure status signals is interfaced to IAS as well as start and stop command.

10.13.4 System-3, Mud Pit Tank Top (MM16)

The Mud Pit Tank Top is fitted with two supply fans and two extract fans. These fans are designed 2 x 100%. The inlet and outlet are fitted with non-return dampers. These dampers' control and indication is however not interfaced to IAS. Extract fans shall start first followed by supply fans. Both fans are interlocked by adjacent dampers. All interlocks are applied in IAS.

Two extract fans are installed in this room to provide ventilation for the Mud Pits. The fans are 2x 100% and operate on duty/standby configuration. The duty/standby selection and control is done in IAS. If high gas level is detected in the Mud Pits both exhaust fans shall automatically start and run simultaneously, if the dampers are open.

The differential pressure between this room and the mud pump room is measured and the signal is interfaced to Topside HVAC Panel and also to IAS via a serial line. The loss of pressure is alarmed in IAS.

10.13.5 System-4, Mud Pumps Room (MM15) & Warehouse (MM14)

Mud Pumps Room is fitted with two supply fans and two extract fans. The room inlets are fitted with non-return dampers. These dampers' control and indication are not interfaced to IAS. The fans are designed to 2 x 50% operation. The fans are two speed fans. The fans need to be operated in high speed during summer and low speed during winter. Operator selects the speed required by commanding high or low auto mode, or independently for each fan in manual mode. The fans can be started from IAS when the fans are in remote mode. Extract fans shall start first followed by Supply fans. This interlock is applied in IAS. The number of extract fans running in high or low speed shall be equal to the number of supply fans running at high/low speed, if not IAS will generate an alarm with 30 seconds time delay. Operator intervention and training will be required.

Warehouse room is fitted with one supply fan and one extract fan. The room inlets are fitted with non-return dampers. These dampers' control and indication are not interfaced to IAS. The fans are designed to 100% operation and are single speed fans. The fans can be started from IAS when the fans are in remote mode. Extract fans shall start first followed by Supply fans. This interlock is applied in IAS.

10.13.6 System-5, Drilling Welding Workshop (MM11)

This room is fitted with two extract fans. The inlet and outlets are fitted with non-return dampers and these dampers' control and indication are not interfaced to IAS.

The fans can be started and stopped from IAS when the fans are in remote mode.

10.13.7 System-6, Shale Shaker Area (MP21)

This area is fitted with 2 supply fans and two exhaust fans. The air inlets to these fans are fitted with non-return dampers. These dampers' control and indication is not interfaced to IAS.

Both the supply and exhaust fans are designed as 2x100% and shall operate in duty/standby mode. The duty/standby selection and control is done in IAS. The fans can be started and stopped from IAS when the fans are in remote mode. Extract fans shall start first followed by Supply fans.

The exhaust fans are also used for ventilating the shale shaker tops and for the room extract. The shale shaker unit tops are fitted with a volume control dampers (manual). The outlet of the fans is a connected common and one non-return damper is fitted in the line. If high gas level is detected both exhaust fans shall automatically start and run simultaneously, if the dampers are open.

A differential pressure transmitter measures the room pressure and the signal is interfaced to Topside HVAC Panel and then to IAS via serial line for alarm.

10.13.8 Sys-7, Mud Process & Cutting Transport MP11

This area is fitted with two supply and two extract fans. The fans are designed 2x50% and both the fans in supply and extract shall normally always be running. The room inlet and outlets are fitted with non-return dampers and these dampers' control and indication are not interfaced to IAS. The fans can be started and stopped from IAS when the fan is in remote mode. Any supply fan can be started only if at least one extract fan is running. Extract fan shall start first followed by supply fans. Both fans are interlocked. If any extract fan is stopped when both the supply fans are running then an alarm is generated in IAS. All interlocks are applied in IAS.

The room is fitted with a differential pressure transmitter and the signal is interfaced to HVAC panel and then to IAS via serial line for alarm.

10.13.9 System-8, Subsea Control Module

This area consists of the following rooms

- Subsea Workshop
- Subsea Office
- UPS Room (A)
- UPS Room (B)
- Rubber Goods Store

The areas are supplied with cooled air from a package air conditioning unit. The package air conditioning unit is located in Subsea Workshop. The fresh inlet to the air conditioning unit is fitted with a non-return damper. This damper is not controlled from or interfaced to IAS. The air conditioned air flows into the rooms via ducts with manually operated volume control dampers. The return air is sent back to the air conditioning unit through the manually operated volume control dampers. The room exhaust is through the door grills. The ducts that flow air into the Subsea Office and Rubber Goods Store are fitted with duct heaters. The duct heaters are controlled locally (not in IAS) based on the temperature measured in the duct. The duct heaters are start blocked and will stop when the package air conditioning unit fan is not running. This interlock is applied in Topside HVAC Panel.

The air conditioning unit can be started and stopped from the Topside HVAC Panel and also from IAS. Running indication and abnormal alarm are also interfaced to IAS. All interlocks are checked in Topside HVAC Panel.

The return air temperature is measured in the return duct and is interfaced to the sequential controller that controls the freshwater coolant to the air conditioning units. IAS has no control over the coolant and temperature control.

There is also installed a redundant air conditioning unit for the two UPS rooms and this can be started and stopped from the Topside HVAC Panel as well as from IAS. Running indication and abnormal alarm are also interfaced to IAS. This air conditioning unit has a fresh air inlet and a supply outlet to each UPS room. The inlet and outlets are fitted with fire dampers. All interlocks are checked in Topside HVAC Panel.

10.13.10 System-9, Subsea Control Module - General areas

The following are the general areas in the Subsea Control Module:

- HPU room (SC11)
- APV room (SC21)
- BOP Equipment room (SC12).

Each of the above rooms is fitted with one extract fan and one supply fan except the HPU Room which has only a supply fan (naturally ventilated exhaust outlet). The inlets and outlets are fitted with non-return dampers. These dampers do not have control and indication from IAS.

These fans can be started and stopped from the IAS. The extract fan in any room cannot be started if the supply fan in that room is not running. Also the extract fan shall be start-blocked or stopped when the supply fan is not running. This interlock is applied in IAS.

10.13.11 Drillers Cabin Room (DCR), Local Equipment Room (LER) and Total Drilling Control Room (TDCR) ventilation

These rooms ventilation is controlled by a local HVAC panel supplied by NOV, the drilling system vendor.

The system consists of 2 off ventilation fans supplying air to the above rooms. The fan control is affected in the local HVAC panel located in the LIR. The duct is fitted with a fire and gas damper at the exit of the fans. This damper control is from F&G system (IAS) and the damper closed position limit switch is interfaced to IAS and the open position limit switch is interfaced to the black start unit in the local HVAC panel.

The air duct is then branched off to two lines and one line supplies the Drillers Cabin Room through a sound attenuator and heater. The heater has temperature alarm and high temperature trip with manual reset. The air is then flown into the false ceiling of the Drillers Cabin Room where the air is mixed with the cooled air coming from the package air conditioning unit.

The Drillers Cabin Room is fitted with a differential pressure transmitter that is interfaced to the local HVAC panel. The Drillers Cabin Room exhaust outlet is fitted with a fire and gas damper. This damper is also controlled from F&G system. The closed position limit switch is connected to IAS and the open position limit switch is connected to the black start unit of the local HVAC panel. The air temperature and flow are measured in the line to the Drillers Cabin Room.

The second branch flows air to Local Equipment Room through sound attenuator and heater. The heater has temperature alarm and high temperature trip with manual reset. An air conditioning unit is installed for the room. The air temperature and flow measured in the line to the Local Equipment Room. The Local Equipment Room is fitted with room temperature and room differential pressure transmitters. The room exhaust outlet is fitted with a damper and the control is from the Fire & Gas System. The open limit switch is connected to the black start unit and the closed limit switch is connected to IAS.

A branch line from Local Equipment Room is taken to Total Drilling Control Room through sound attenuator and heater. The heater has temperature alarm and high temperature trip with manual reset. An air conditioning unit is installed for the room and located in the Local Equipment Room. The air temperature and flow measured in the line to the Total Drilling Control Room. The Total Drilling Control Room is fitted with room differential pressure transmitter. The room exhaust outlet is fitted with a damper and the control is from F&G system. The open limit switch is connected to the black start unit and the closed limit switch is connected to IAS.

This ventilation trip signal from the Fire & Gas System is interfaced to the local HVAC panel and the panel does further shut down of fans and air conditioning units etc.

10.13.12 Black Start Unit

The black start unit is fitted in the local HVAC cabinet. This unit is provided with a switch for black start. This switch is interfaced to the F&G system.

11 ESD/F&G TRIP

For ESD and F&G trips of equipment, refer to the ESD & F&G Cause and effect diagram.