KONGSBERG

Functional Design Specification

Ballast and Bilge Control System

KM-Drill 8

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1 About this document

1.1 Document history

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1.2 References

No	*Doc No*	*Description*
1	MB601.10	BALLAST SYSTEM
2	MB101.80(5/11)	BALLAST SYSTEM(NO.6 W.B.T & A.P TK)
3	MB601.20(1,2,3/3)	BILGE SYSTEM
4	MB101.80(7/11)	BILGE & G/S SYSTEM (PORT ENGIN ROOM)
5	MB101.80(8/11)	BILGE & G/S SYSTEM (CENT ENGIN ROOM)
6	MB101.80(9/11)	BILGE & G/S SYSTEM (STBD ENGIN ROOM)
7	MB101.80(10/11)	BILGE & G/S SYSTEM(FWD AUX. MACH. RM)
8	MB101.80(11/11)	BILGE & G/S SYSTEM(FWD AUX. MACH. RM)

1.3 Definitions / Abbreviations

AFT	Afterwards
AUX	Auxiliary
AVR	Automatic Voltage Regulation
CB	Circuit Breaker
DCU	Drive Control Unit
DG	Diesel Generator
DGPS	Differential Global Positioning System.
ECR	Engine Control Room
E/R	Engine Room
ESM	Engine Safety Module
FS	Field Station
FW	Fresh Water
FWG	Fresh Water Generator
FWD	Forward
DO	Diesel Oil
HT	High Temperature
HPR	Hydro acoustic Positioning System.
HPR-OS	Operator Station intended for the hydro acoustic system
HPU	Hydraulic Power Unit
HV	High voltage (11 kV systems)
IAS	Integrated Automation System
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 &S)	Main Switchboard Room, Port and Stbd
ODME	Oil Discharge Monitoring Equipment
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
K-Thrust OS	Kongsberg Maritime Thruster Control
K-Thrust-400	Operator Station intended for manual thruster control
K-Chief	KM Vessel Control (equal to IAS in SHI documents)
K-Chief OS	Operator Station for KM Vessel Control system
SW	Sea Water
T/R	Thruster Room
VDU	Video Display Unit
VFD	Variable Frequency Drive
VMS	Vessel Management System
VRU	Vertical Reference Unit

2 INTRODUCTION

2.1 Purpose

The aim of this functional analysis is to provide information and details required for implementing process and safety function and associated instrumentation for ballast system in this project.

It also gives enough information to allow the complete understanding for the control and operation of the related process unit.

3 Ballast Control System

Vessel ballast condition is remotely controlled from the IAS system. Control and monitoring is performed from the operator station in Wheel House. Operation responsibility is under some conditions required in Engine Control Room so ballast command control may be transferred to these locations.

The IAS system includes the following interface / control:

- Pump control
- Ballast Pump suction and discharge valve control
- Tank level monitoring
- Automatic emptying function (Auto stop when low pressure)
- Manually filling / emptying function
- Discharge valve control

1.1. Ballast system Aft

The water ballast tanks 6(P) and 6(S) along with Aft Peak Tank (P) and (S) are located afterwards of the vessel and these tanks are ballasted and de ballasted with the help of two pumps, located in Port Engine room and Starboard Engine room. These pumps are called Ballast, Bilge and GS pump for Port and Starboard Engine room (MIC-081204 and MIC-081208) based on the purpose they are used for. In this document the ballast service of these pumps will be described. The pumps can also be used for bilge and GS modes after manually aligning the valves.

3.1 Port E/R Bilge, Ballast and GS Pump

This pump is located in port engine room. The pump (MIC-081204) is a single speed Two- stage vertical centrifugal pump with a capacity of 500/240 m^3/hr at 40/100 Meters head. The pump is selected to be a two-stage pump for the higher head requirement. The pump suction is provided with a local pressure indication and a filter and isolation valve (manual). The pump discharge is also fitted with a local pressure indication.

The pump can draw suction from:

- Seawater crossover line through a remote manual controlled valve SOV-113001.
- This valve is a position control valve and operator can select the required opening.
- Any of these below stated tanks through Pump discharge valve BG204F.

The pump is connected to the tank valves for the water ballast tanks 6P (SOV-112002 and SOV-112004), 6S (SOV-112102 and SOV-112104), Aft Peak Tank (P) (SOV-112003) and Aft Peak Tank (S) (SOV-112103). Opening any of these valves will provide path for de-ballasting from that tank. For ballasting and de-ballasting starboard side tanks with this pump the interconnecting valve shall be local lined up. The valve is a position control valve with 4-20mA position feedback signal and operator can adjust the position of this valve and maintain the head of the pump.

The pump discharge can be delivered to any of the water ballast tanks 6 or APT through the pump discharge valve and a common tank-filling valve. Manually lining up the discharge valve and this valve together with any of the tank valves namely SOV-112001 OR SOV-112002 OR SOV-112003 OR SOV-112004 will make it possible to ballast the tanks taking water from the sea chest through the crossover line valve SOV-113001.

The tank valves on port and starboard water ballast tanks are interconnected with a cross over line valve SOV-112537. For ballasting and de-ballasting starboard side tanks the interconnecting valve shall be lined up.

The above valves can be remotely manually opened and closed from IAS screen.

The Bilge, ballast and GS pump can be started and stopped from the IAS screen manually (MC-081204A/B) when the pump is in remote (MI-081204B) and when no fault exists (MA-081204). Operator has to line up the correct valves before starting the pump. For this confirmation special soft switches are provided on the screens. Operator shall confirm that the valves are lined up and also confirm the type of operation if used for bilge.

Priming is applied for this pump. The pump starter unit handles the priming control.

1.1.1. 3.2.1 Controls

3.1.1.1 IAS Control

Remote manual start and stop of the pump and manually open and close of the remote on/off valves is possible.

The remote manual closing and opening of the position control valves is done by the operator from the IAS screen by selecting the position. The valve function-block in IAS then shall open/close the valve in increments based on the current position and the required position and will stop the valve when it reaches the required position.

Port Engine room Bilge Ballast and GS pump (MIC-081204)		
Function	**Description**	**Tag Number**
Remote Auto Start	Not applied	
Remote Auto stop	Not applied	
Remote Manual Start	From IAS Screen	MC-081204A
Remote Manual stop	From IAS Screen	MC-081204B

1.2. Stbd E/R Ballast, Bilge and GS Pump

This pump is located in Starboard engine room. The pump (MIC-081208) is a single speed two stage vertical centrifugal pump with a capacity of 500/240 M³/hr at 40/100 meters head. The pump suction is provided with a local pressure indication. The pump discharge is also fitted with a local pressure indication and a non-return valve.

The pump can draw suction from:

- Seawater crossover line through a remote manual controlled valve SOV-113210. This valve is a position control valve and operator can select the required opening.
- Any of these above stated tanks(6 & APT) through pump Suction valve BG109F

The pump suction valve is connected to the tank valves for the water ballast tanks6P (SOV-112002 and SOV-112004), 6S (SOV-112102 and SOV-112104), Aft Peak Tank (P) (SOV-112003) and Aft Peak Tank (S) (SOV-112103). Opening any of these valves together with the pump suction valve will provide path for de-ballasting from that tank. For ballasting and de-ballasting Port side tanks with this pump the interconnecting valve (SOV-112537) shall be lined up. Operator training and intervention is required.
This valve is a position control valve and operator can adjust the position of this valve and maintain the head of the pump.

The pump discharge can be delivered to any of the water ballast tanks 6 or APT through the pump discharge valve and a common tank-filling valve. Manually lining up the discharge valve and this valve together with any of the tank valves namely SOV-112101 OR SOV-112102 OR SOV-112103 OR SOV-112104 will make it possible to ballast the tanks taking water from the sea chest through the crossover line valve SOV-113210.

The tank valves on port and starboard water ballast tanks are interconnected with a cross over line valve SOV-112537. For ballasting and de-ballasting Port side tanks the interconnecting valve SOV-112537 shall be manually lined up

The above valves can be remotely manually opened and closed from IAS screen. Operator intervention and training is required for lining up the valves correctly for ballasting and de-ballasting the required tanks.

The Bilge and Ballast pump can be started and stopped from the IAS screen manually (MC-081208A and B) when the pump is in remote (MI-081208B) and when no fault exists (MA-081208).

Priming is applied for this pump. The pump starter unit handles the priming control.

1.2.1. Controls

3.1.1.2 IAS Control

Remote manual start and stop of the pump and manually open and close of the remote on/off valves is possible.

The remote manual closing and opening of the position control valves is done by the operator from the IAS screen by selecting the position and setting the valve to auto mode. The valve function-block in IAS then shall open/close the valve in increments based on the current position and the required position and will stop the valve when it reaches the required position. Refer section 9.3 Valve List, for more detail about remote control valves.

Stbd Engine room Bilge and Ballast pump (MIC-081204)		
Function	**Description**	**Tag Number**
Remote Auto Start	Not applied	
Remote Auto stop	Not applied	
Remote Manual	From IAS Screen	MIC-081208/Start

Stbd Engine room Bilge and Ballast pump (MIC-081204)		
Function	**Description**	**Tag Number**
Start		
Remote Manual stop	From IAS Screen	MIC-081208/Stop

4 engine room bilge and gs system

4.1 Bilge & GS System – Engine Room Port

The Port engine room Bilge and GS services are handled by the Bilge, Ballast and GS pump. This pump is located in port engine room. The pump (MIC-081204) is a single speed two stage vertical centrifugal pump with a capacity of 500/240 M^3/hr at 4/10 bar. The pump is selected to be a two-stage pump for the higher head requirement. The pump suction is provided with a local pressure indication and a filter and isolation valve (manual). The pump discharge is also fitted with a local pressure indication. The pump discharges bilges overboard.

In bilge service the pump draws suction from the port engine room bilge wells, the port stern thruster room bilge wells, and the port side clean area bilge wells. By lining up the manual valves the following bilge wells can be emptied by this pump when the respective high level alarm from that bilge well is received. This operation is completely manual. Only remote start and stop of the Bilge and GS pump (MIC-081204) is possible from IAS screen. Bilge can be discharged over board by manually lining up the valves.

Port engine room Bilge well 1, and 2:

(LACH-081111/LCL-081111A, LACH-081112/LCL-081112A)

Port Stern Thruster room Bilge well and sunken part Bilge hats:

(LACH-081116/LCL-081116A, LACH-081115)

Port side clean area bilge well:

(LACH-081127/LCL-081127A)

Port Purifier room bilge hats:

(LACH-081113,081114)

It is also possible to draw suction with this pump from the centre engine room and centre stern thruster room bilge wells (see section 4.2).

An air driven bilge pump is (Local manual operation) fitted in the Port Stern Thruster room. This pump can empty the Thruster room bilges to Bilge holding tank. Operator intervention and training is required for bilge operations.

The centre E/R sludge pump, when required, can be used to empty the Port Purifier room bilge hats and the Port E/R MDO purifier sludge tank. These bilges can be discharged to the incinerator waste oil tank. The Port purifier room Bilge hats are fitted with level alarms that are interfaced to IAS (LACH-081113 and 081114).

Water mist & Inergen sys. room is fitted with one bilge hat. With high level alarm LAH-081143. On receiving the high alarm operator has to manually drain the bilge hat.

The Bilge ballast and GS pump can be used for GS service. For this purpose a branch line is installed from the discharge of this pump to GS system in Hull.

1.2.2. Controls

4.1.1.1 IAS Control

There are no automatic controls for this system. The Bilge Ballast & GS can be started and stopped from the IAS screen manually (MC-081204A and B) when the pump is in remote (MI-081204B) and when no fault exists (MA-081204).

Port Engine room Bilge Ballast and GS pump (MIC-081204)		
Function	**Description**	**Tag Number**
Remote Auto Start	Not applied	
Remote Auto stop	Not applied	
Remote Manual Start	From IAS Screen	MIC-081204/Start
Remote Manual stop	From IAS Screen	MIC-081204/Stop

4.2 Bilge System- Engine Room Centre

The Centre engine room Bilges are handled by the port Bilge, Ballast and GS pump and/or stbd Bilge, Ballast and GS pump.

In bilge service the pump draws suction from the centre engine room bilge wells. By lining up the manual valves the following bilge wells can be emptied by these pumps when the respective high level alarm from that bilge well is received. This operation is completely manual. Only remote start and stop of the Bilge and GS pumps (MIC-081204/08) are possible from IAS screen.

Centre engine room Bilge well 1, and 2:

(LACH-081117/117A, LACH-081118/118A, 081129)

Centre Stern Thruster room and sunken part Bilge hats:

(LACH-081120/120A, LACH-081119, LACH- 081130)

Bilge can be discharged over board by manually lining up the valves

An air driven bilge pump is (Local manual operation) fitted in the Center Stern Thruster room. This pump can empty the Centre Thruster room bilges to Bilge holding tank.

Centre engine room also houses the Bilge holding tank, Separated Bilge oil tank, Center E/R Bilge pump, Centre E/R Sludge pump and Bilge water separator.

1.2.3. Bilge holding tank

The bilge holding tank (110.2 M^3 capacities) receives bilges from Thruster rooms, Bilge separator etc., and the tank is fitted with remote sounding system. The system measures the level and is interfaced to IAS. The level indication and high level are alarm (LIAHL-081127) in IAS. This tank is fitted with a low level switch that is directly connected to the unit control panel (Not true IAS) for the bilge separator to prevent the dry running of the separator unit bilge pump.

1.2.4. Separated Bilge Oil Tank

The oil that is separated from the bilge is transferred into the separated bilge oil tank (55.1 M^3 capacities). The tank is fitted with remote sounding system. The system measures the level and is interfaced to IAS. The level indication and high level are alarms (LIAH-081128).

1.2.5. E/R Bilge Pump

One (1) off electric motor driven piston type pump with capacity of 5 M3 that can pump at 3-bar pressure is installed in aft centre engine room (MIC-081207). This pump is called Centre E/R bilge pump. This pump is primed every time it starts. A freshwater line is connected to the pump through solenoid valve for this purpose. Upon receiving start command from IAS/Local the starter unit first open the priming solenoid valve and after 10 sec it starts the pump. The pump can draw its suction from either bilge holding tank or from bilge wells in engine rooms (P or C or S) depending on how the valves are lined up. The following bilge wells are fitted with level control switches and high and low level controls are interfaced to the IAS.

Port engine room Bilge well 1, 2, port aft thruster room and port purifier room.

(LACH-081111, LCL-081111A, LACH-081112, LCL-081112A,

LACH-081116, LCL-081116A, LACH-081127, LCL-081127A)

Centre engine room Bilge well 1, 2 and centre aft thruster room

(LACH-081117, LCL-081117A, LACH-081118, LCL-081118A,

LACH-081129, LCL-081129A, LACH-081120, LCL-081120A)

Stbd engine room Bilge well 1, 2, stbd aft thruster room and stbd purifier room.

(LACH-081121, LCL-081121A, LACH-081122, LCL-081122A,

LACH-081126, LCL-081126A, LACH-081128A, LCL-081128A)

The bilge wells are provided with remote operated valves on the suction lines that connect the bilge well and the E/R bilge pump. These valves are fail-close type. These valves are fitted with open/close position limit switches that are close on target type.

Port engine room Bilge well 1, 2, port aft thruster room and port purifier room.

(SOV-081303, 081304, 081312 & 081309)

Centre engine room Bilge well 1, 2,3 and centre aft thruster room.

(SOV-081305, 081306, 081311 & 081313)

Stbd engine room Bilge well 1, 2, stbd aft thruster room, stbd purofoer room.

(SOV-081307, 081308, 081314 & 081310)

The above valves are controlled from IAS. In the event of bilge level in the corresponding bilge well reaching high level the valve that connects the bilge well opens automatically. When IAS sees that the valve is opened then IAS starts the bilge pump to empty the well. When the level in the bilge well reaches a low level the valves closes. When IAS sees that the valve has left the open position the pump will be stopped.

As there are twelve wells and twelve valves and one pump, the pump is programmed to start when any of the valves is open and is programmed to stop when none of the valves is in open position.

The centre E/R bilge pump can also draw suction from the stern Thruster rooms (P or C or S) and the clean area bilge hat in centre engine room. This operation is completely manual.

4.2.1.1 Controls

4.2.1.1.1 IAS Control

The E/R Bilge pump can be started and stopped from the IAS screen manually (MC-081207A and B) when the pump is in remote (MI-081207B) and when no fault exists (MA-087207).

Engine room Bilge pump (MIC-081207)		
Function	**Description**	**Tag Number**
Remote Auto Start MIC-081207/Start	When any of the Bilge valves on lines connecting the E/R and thruster bilge wells and pump is open position;	VZO-081303, VZO-081304,VZO-081305,VZO-082306,VZO-081307,VZO-081308,VZO-081309,VZO-081310,VZO-081311,VZO-081312,VZO-081311,VZO-081313,VZO-081314 (when any one true)

Engine room Bilge pump (MIC-081207)		
Function	**Description**	**Tag Number**
Remote Auto stop MIC-081207/Stop	When none of the valves located on lines connecting the E/R and thruster bilge wells and pump are in open position;	VZC-081303, VZC - 081304,VZC-081305,VZC-082306,VZC-081307,VZC-081308, VZC-081309,VZC-081310, VZC-081311 VZC-081312,VZC-081311,VZC-081313, VZC-081314 (when any one true)
Remote Manual Start MIC-081207/Start	From IAS Screen	
Remote Manual stop MIC-081207/Stop	From IAS Screen	

1.2.6. Sludge pump

The Sludge pump located in the centre engine room is locally manually started and stopped. The pump draws suction from the Separated bilge oil tank, Port and Stbd purifier and LO purifier sludge tanks. This pump also empties purifier room bilge wells. The following High alarms will alert the operator to empty the bilge sells.

LAH-081113 – Port Purifier room Bilge Hat-1 High alarm

LAH-081114 – Port Purifier room Bilge Hat-2 High alarm

LAH-081123 – Stbd Purifier room Bilge Hat-1 High alarm

LAH-081124 – Stbd Purifier room Bilge Hat-2 High alarm

4.2.1.2 Controls

4.2.1.2.1 IAS Control

There are no interfaces to IAS from this pump unit.

1.2.7. Bilge Separator

A bilge separator is installed in centre engine room. The main purpose of bilge separator is to separate oil from the engine room bilges held in Bilge holding tank and send the separated oil to the separated bilge oil tank. The unit consists of a Pressure vessel, a bilge pump, Oil in water monitor unit, associated valves and instruments together with control system. A local panel is provided for controlling the separator. The separator unit and the controls can be started and stopped locally from the unit panel.

The control system logic reside in the separator unit controls the equipment to separate the oil from the bilges. The oil is intermittently drained to the separated oil tank. The clean bilge is either sent overboard or to the bilge holding tank by a 3-way valve. This valve is locally controlled based on the oil content in the bilge sampled and measured after the oil separation. If the oil content is less than 15 PPM the bilge valve is allowed to open to overboard and if the oil content is above 15 PPM the valve opens to the tank side and the bilge is returned to the holding tank. A level transmitter (LIAHL-081127) is fitted on the Bilge holding tank and interfaced to IAS. When the level in the tank is low, the IAS will give stop command (XC-082206) to bilge pump located in the unit to prevent the dry running of the pump.

The local panel is mounted on the unit and the front facia consists of Power On switch and lamp, Alarm lamp and the pump start stop switch. The unit is started and stopped manually from the local panel. The following alarms are interfaced to the IAS.

XA-082202	BILGE SEPAR ABNORMAL
XC-082206	BILGE SEPAR PUMP AUTO STOP

4.2.1.3 Controls

4.2.1.3.1 IAS Control

When the level in bilge holding tank is low, the IAS will give stop command to bilge pump in the bilge separator unit.

LIAHL-081127	LOW LEVEL	XC-082206 –ACTIVE (PUMP STOP)

4.3 Bilge System- Engine Room Stbd

The Stbd engine room Bilge and GS services are handled by the Stbd Bilge, Ballast and GS pump. This pump is located in stbd engine room. The pump (MIC-081208) is a single speed two stage vertical centrifugal pump with a capacity of 500/240 m³/hr at 4/10 bar. The pump is selected to be a two-stage pump for the higher head requirement. The pump suction is provided with a local pressure indication and a filter and isolation valve (manual). The pump discharge is also fitted with a local pressure indication. The pump discharge bilges overboard.

In bilge service the pump draws suction from the stbd engine room bilge wells, the stbd stern thruster room bilge wells, and the stbd side clean area bilge wells. By lining up the manual valves the following bilge wells can be emptied by this pump when the respective high level alarm from that bilge well is received. This operation is completely manual. Only remote start and stop of the Bilge and GS pump (MIC-081208) is possible from IAS screen. Bilge can be discharged over board by manually lining up the valves.

Stbd engine room Bilge well 1and 2:

(LACH-081121/121A, LACH-81122/122A).

Stbd Stern Thruster room Bilge well and sunken part Bilge hats:

(LACH-081126/126A, LACH-081125)

Stbd side clean area bilge well:

(LACH- 081128/128A)

Stbd Purifier room bilge hats:

(LACH-081123/123A,LACH-081124/124A)

It is also possible to draw suction with this pump from the centre engine room and centre stern thruster room bilge wells (see section 4.2).

An air driven bilge pump is (Only local manual operation) fitted in the Stbd Stern Thruster room. This pump can empty the Thruster room bilges to Bilge holding tank.

The centre E/R sludge pump, when required, can be used to empty the Stbd Purifier room bilge hats and the Stbd E/R MDO purifier sludge tank. These bilges can be discharged to the incinerator waste oil tank. The Stbd purifier room Bilge hats are fitted with level alarms that are interfaced to IAS (LACH-081123 and 081124).

The Bilge ballast and GS pump can be used for GS service. For this purpose a branch line is installed from the discharge of this pump to GS system in Hull.

1.2.7.1. Controls

1.2.7.1.1. IAS Control

There are no automatic controls for this system.

The Bilge & Ballast pump can be started and stopped from the IAS screen manually (MIC-081208) when the pump is in remote and when no fault exists.

Stbd Engine room Bilge and Ballast pump (MIC-081208)		
Function	**Description**	**Tag Number**
Remote Auto Start	Not applied	
Remote Auto stop	Not applied	
Remote Manual Start	From IAS Screen	MIC-081208/Start
Remote Manual stop	From IAS Screen	MIC-081208/Stop

4.4 Fwd Aux Machinery Room - Bilge System

1.2.8. Fwd Bilge Pump

One fwd Bilge pump is installed in the Fwd aux machinery room. This pump has capacity of 5 cubic meters at 3bar. This pump draws suction from the centre bow, port bow and stbd bow thruster rooms bilge wells, the Fwd aux machinery room bilge wells, and the Fwd aux machinery room clean area bilge hats. It discharges through the secondary port aft escape way into the port drain holding tank or the AFT bilge holding tank in centre engine room. The pump can also draw suction from the Fwd Aux Machine Room bilge holding tank and transfer the contents the same route as from the wells.

The fwd bilge holding tank is of capacity 53 cubic meters. The tank is fitted with remote sounding system and the tank level is transferred to IAS via the tank monitoring system (LIAH-081129). The tank is also fitted with high-level switch LAH-081103.

The following bilge wells are fitted with level control switches and high and low level controls are interfaced to the IAS.

Fwd Aux Mach room Bilge well-1 and 2	LACH-081101, 081102
Centre Bow Thruster Room Bilge Well	LACH-081104
Port Bow Thruster Room Bilge Hat Sunken part	LACH-081106
Port Bow Thruster Room Bilge Well	LACH-081107
Stbd Bow Thruster Room Bilge Hat Sunken part	LACH-081108
Stbd Bow Thruster Room Bilge Well	LACH-081109

The bilge wells are provided with remote operated valves on the suction lines that connect the bilge well and the Fwd bilge pump. These valves are fail-close type. These valves are fitted with open/close position limit switches that are close on target type.

Fwd Aux Mach room Bilge well-1 and 2 (SOV-081301 & 081302)

Centre Bow Thruster Room Bilge Well (SOV-081315)

Port Bow Thruster Bilge well (SOV-081316)

Stbd Bow Thruster Room Bilge Well (SOV-081317)

The above valves are controlled from IAS. In the event of bilge level in the corresponding bilge well reaching high level the valve that connects the bilge well will open automatically. When IAS sees that the valve is opened then IAS starts the bilge pump to empty the well. When the level in the bilge well reaches a low level the valves closes. When IAS sees that the valve has left the open position the pump will be stopped.

As there are five wells and five valves and one pump, the pump is programmed to start when any of the valves is open and is programmed to stop when none of the valves is in open position.

The fwd bilge pump is automatically started and stopped based on the bilge levels in the bilge hats in fwd aux mach room and bow thruster rooms. The fwd aux machinery and thruster room bilge wells are fitted with Bilge control level switches with both high and low level contacts (LACH-081101/101A, LACH-081102/102A, LACH-081104/104A, LACH-081106, LACH-081107/107A, LACH-081108 and LACH-081109/109A). The bilge line that connects the bilge well and the bilge pump are fitted with an air operated valve that is Fail close type (SOV-081301, SOV-081302, SOV-081315, SOV-081316 and SOV-081317). These valves are fitted with Open position limit switch (VZO-081301, VZO-081302, VZO-081315, VZO-081316 and VZO-081317)

When the bilge level in the bilge well reaches high level, IAS opens the corresponding bilge valve. When IAS senses that the bilge valve is opened IAS shall start the fwd bilge pump (MIC-081203). When the bilge level reaches the set low level as sensed by the bilge switch, the bilge valve will be closed. When IAS senses that neither of the bilge valves in open position, IAS stops the fwd bilge pump (MIC-081203).

An air driven bilge pump is (Local manual operation) fitted in the Bow Thruster rooms. This pump can empty the Thruster rooms bilges respectively to the Fwd Aux Machine Room Bilge holding tank.

4.4.1.1 IAS Control

The fwd Bilge pump can be started and stopped from the IAS screen manually (MC-081203) when the pump is in remote and when no fault exists.

Fwd Bilge pump (MIC-081203)		
Function	**Description**	**Tag Number**
Remote Auto Start MIC-081203/Start	When any of the Bilge valves on lines connecting to the fwd bilge wells and pump is open position;	VZO-081301, VZO-081302, VZO-081315, VZO-081316 or VZO-081317 (when any one true)
Remote Auto stop MIC-081203/Stop	When none of the valves located on lines connecting to the fwd bilge wells and pump are in open position;	VZO-081301, VZO-081302, VZO-081315, VZO-081316 or VZO-081317 (when any one true)
Remote Manual Start MIC-081203/Start	From IAS Screen	
Remote Manual stop MIC-081203/Stop	From IAS Screen	

4.5 Fwd Aux Machinery Room - GS System

The Fwd Aux machinery room bilge system consists of two numbers of Fwd Bilge and GS pumps (MIC-081201 and MIC-081202). These pumps have a capacity of 340 cubic meters at 6bar. These pumps are manually started and stopped from IAS screen. These pumps can be used for Bilge emptying purpose or for General Service purpose. These pumps are fitted with vacuum pump for priming. The pumps are primed every time they are started. The respective starter unit controls the priming.

GS operations:

In GS operation these Bilge & GS pumps (MIC-081201 and 02) draw suction from the seawater cross over line and pump to deck wash line. These pipes are routed through the port escape routes. The pumps can be used for this purpose by locally and manually lining up the manual valves. These operations are manual and operator intervention and training are required.

1.2.9. Controls

4.5.1.1 IAS Control

There are no automatic controls for this system.

Note: The different operations (*Bilge- and GS-operation*) are not an automatically function but has to be done manually be correct lining up the manual valves.

Fwd A/M Bilge GS Pump No.1 (MIC-081201)		
Function	**Description**	**Tag Number**
Remote Auto Start	Not applied	
Remote Auto stop	Not applied	
Remote Manual Start	From IAS Screen	MC-081201/Start
Remote Manual stop	From IAS Screen	MC-081201/Stop

Fwd A/M Bilge GS Pump No.2 (MIC-081202)		
Function	**Description**	**Tag Number**
Remote Auto Start	Not applied	
Remote Auto stop	Not applied	
Remote Manual Start	From IAS Screen	MC-081202/Start
Remote Manual stop	From IAS Screen	MC-081202/Stop

5 Main Water Ballast System

5.1 Ballast Tanks

The facility is provided with a total of fifteen (15) water ballast tanks and twelve (12) hold ballast tanks.

Water Ballast tanks:

No	SERVICE DESCRIPTION	I/O TAG
1	NO.1 FWD D/B WBT (C)	LIAH-111415
2	NO.1 AFT W.B.T STBD	LIAH-111402
3	NO.1 AFT W.B.T PORT	LIAH-111401
4	NO.2 W.B.T STBD	LIAH-111417
5	NO.2 W.B.T PORT	LIAH-111406
6	NO.3 W.B.T STBD	LIAH-111418
7	NO.3 W.B.T PORT	LIAH-111407
8	NO.4 W.B.T STBD	LIAH-111419
9	NO.4 W.B.T PORT	LIAH-111408
10	NO.5 W.B.T PORT	LIAH-111409
11	NO.5 W.B.T STBD	LIAH-111420
12	AFT PEAK TK (P)	LIAH-111424
13	AFT PEAK TK (S)	LIAH-111425
14	NO.6 W.B.T PORT	LIAH-111410
15	NO.6 W.B.T STBD	LIAH-111421

Hold Ballast Tanks:

No	SERVICE DESCRIPTION	I/O TAG
1	NO.1 HOLD BALL.TK (C)	LIAH-111404

No	SERVICE DESCRIPTION	I/O TAG
2	NO.1 HOLD BALL.TK (P)	LIAH-111403
3	NO.1 HOLD BALL.TK (S)	LIAH-111405
4	NO.2 HOLD BALL. TK (P)	LIAH-111411
5	NO.2 HOLD BALL. TK (S)	LIAH-111422
6	NO.2 HOLD BALL.TK (C)	LIAH-111416
7	NO.3 HOLD BALL. TK (P)	LIAH-111412
8	NO.3 HOLD BALL. TK (S)	LIAH-111423
9	NO.4 HOLD BALL.TK (S)	LIAH-111414
10	NO.4 HOLD BALL.TK (P)	LIAH-111413
11	NO.5 HOLD BALL.TK (S)	LIAH-111434
12	NO.5 HOLD BALL.TK (P)	LIAH-111433

For ballasting and de-ballasting operations of WBT 6 and aft peak tanks see chapter 4.

The ballast tanks are provided with remote sounding system.

5.2 Ballast Pumps

The facility is provided with two (2) ballast pumps (MIC-111101 and MIC-111201). The ballast pumps are vertical, electric motor driven; centrifugal double suction pumps. MIC-111101 has a two speed motor that drive the pump. MIC-111201 is single speed. The pumps are rated for 2500 m^3/hr discharge rate at a head of 38 Meters. The pumps are made of Bronze casing and phosphor bronze impellers. The electric motors are located in the main engine room while the pumps are located in the ballast pump room. The pumps and motors are connected by a Cr-Mo steel intermediate shaft. The shaft passes through the deck. Stuffing box with gas tight gland packing is provided at each penetration of the shaft. The start and normal stop of the pump is done from IAS screen (MC-111101A&B and MC-111201 A&B). Manual emergency stop facility is provided at:

- Independent ES push buttons at Electric motor side in engine room (directly wired to the respective Pump unit relay box)
- Ballast pump room (Directly wired to the respective Pump unit relay box)

- Independent ES push buttons at Wheelhouse. Wired to the respective pump unit relay box.

The ballast pumps are supplied by SHINKO, Japan. The system is supplied complete with pressure and temperature sensors for the Pumps, Deck stuffing box and the eductor (500 m³/hr) Shinko also supplies the ballast pump trip and alarm control.

The control and trip system for each pump consists of Sensors, Emergency stop PB, IS Barrier boxes, Relay box and Junction box.

Ballast Pump No.1 (MIC-111101) is powered from Port LV switchboard and Ballast Pump No.2 (MIC-111201) is powered from Cent Switchboard. Normally the pumps are started and stopped from IAS. The ballast valves also can be opened and closed from IAS screen. In the event of emergency the pump can be started locally from the starter unit and the valves can be manually opened and closed from the SOV cabinet if the hydraulic unit driving the valves is operational.

The relay box for each pump unit is located in the engine room near the Motor.

The following sensors are provided 1 set for each pump:

Description	**Pump No.1**	**Pump No.2**
Suction pressure	PI-111102	PI-111202
Discharge pressure	PI-111103	PI-111203
Deck stuffing box temp.	TIAH-111104	TIAH-111204
Upper Bearing temperature	TIAH-111105	TIAH-111205
Lower Bearing temperature	TIAH-111107	TIAH-111207
Pump Casing temperature	TIAH-111106	TIAH-111206
Pump Current	IIAH-111101	IIAH-111201
Pump Power	JI-111101	JI-111201
Pump Emcy Stop Activated	XA-111108	XA-111208
Pump Abnormal Trip	XA-111109	XA-111209

Pump Master Trip	XA-111110	XA-111210
Pump Winding Temp.-R	TIAH-111111	TIAH-111211
Pump Winding Temp-S	TIAH-111112	TIAH-111212
Pump Winding Temp-T	TIAH-111113	TIAH-111213

The Emergency Stop activated alarm is transferred from the relay box to IAS for alarm. When this is received IAS will close the following valves:

For Ballast Pump 1 (Port side)

Suction valves: SOV-112538 (De-ballast), SOV-112542 (Ballast)

Sea chest isolation valve SOV-112546 (Port side), SOV-112547 (Stbd side)

Discharge valve SOV-112553

Overboard valve SOV-112558

For Ballast Pump 2 (Stbd side)

Suction valves: SOV-112539 (De-ballast), SOV-112543 (Ballast)

Sea chest isolation valve SOV-112546 (Port side), SOV-112547 (Stbd side)

Discharge valve SOV-112554

Overboard valve SOV-112558

One eductor unit is provided in the pump room which is driven by the ballast pump itself. The eductor unit is used for stripping the tanks. The suction and discharge pressures are measured and indicated in IAS. (PI-111301, PI-111302).

The trip circuit for the pumps can be reset from the Engine room relay box.

1.2.10. Controls

5.2.1.1 IAS Controls

There is a “Confirm Valve”-button for each ballast pump where the operator has to confirm that the valves are lined up correctly. Before this is confirmed the pumps are interlocked and not possible to start.

There is included a button for “ESD Ballast Shutdown” on the Ballast Main mimic. This is connected to the Ballast ESD shutdown from the ESD-Main mimic.

1.2.11.

5.3 Ballast Lines and Valves

The Ballast pumps No.1 (MIC-111101) and No.2 (MIC-111201) have suction through suction valves SOV-112542 and SOV-112543 respectively. These valves are connected to a cross over line, connecting the Port (SOV-112546) and Starboard (SOV-112547) sea chest valves. At each end on this cross over line one manually operated isolation valve is fitted to isolate the line from sea chest (port valves SOV-112544 and SOV-112546, Stbd valves SOV-112545 and SOV-112547). This is a manual valve with the control handles extended to upper deck for remote manual control. These valves are provided with open and closed position limit switches (VZC/VZO-112544/112545). The hydraulically operated remote manually controlled valves (SOV-112542 and 112543), port and starboard, can be closed or opened from IAS and have single acting actuators and shall close on power failure.

The ballast plant consists of two main tank lines for ballasting / de-ballasting, serving port and starboard tanks. Each line is connected to one of the main ballast pumps. Each water ballast tank is provided with main (300mm) and stripping (150mm) bell-mouths.

The ballast pump No. 1 and No. 2 draw suction from the Port and Stbd side ballast headers for de-ballasting operations through valves SOV-112538 and SOV-112539 respectively. A crossover header is provided with isolation valves SOV-112537. By manually lining up the valves it is possible to use the No. 1 pump to ballast and de-ballast the Stbd tanks and vice-versa.

The main suction valves for the pumps from the sea chest cross over line are located in the pump room. These are hydraulically operated valves (SOV-112542 for No.1 pump and SOV-112543 for No.2 pump). The pump suction is drawn through a filter unit.

The No.1 and No.2 pumps discharge the ballast water through a position control valve SOV-112553 and SOV-112554 respectively. Operator can set the position of the valve from IAS screen. The pumps discharge into a common header. An isolation valve SOV-112555 is fitted on the discharge header.

The pump discharge can be cross-transferred from port to starboard header. Two valves SOV-112541 and SOV-112557 are installed to connect the common discharge header back to port and starboard headers and make this cross transfer possible. For de-ballasting operations the pumps discharge ballast water through eductor by-pass valve SOV-112558 and overboard discharge valve SOV-112560.

The IAS operator can perform ballasting and de-ballasting operations and transfer operations manually by lining up the valves and starting ballast pumps. These operations require operator training and intervention. However IAS performs some important controls. These are listed below.

1.2.12. 5.3.1 Controls

5.3.1.1 IAS Control

There is a “Close All Valves” button on the IAS screen that makes it possible to close all the valves for ballasting and de-ballasting. To avoid damage on the pumps, this button is disabled when one or both the pumps are running.

To prevent the ballast pumps (MIC-111101 and MIC-111201) from running with no suction there is an interlock on the pumps that prevents the pumps from starting when there are no tank valves or sea chest valves open. From the sea chests there are one valve that is operated from IAS and one that is operated locally with monitoring in IAS. These valves are on the same line and therefore both these valves have to be open at the same time in order to remove the interlock.

5.3.1.1.1 Automatic De-Ballast Pump Control

Prior to starting the de-ballasting operation, the operator shall line up the required valves i.e. the operator selects the tanks to be emptied. Operator selects the ballast pump, the suction valves SOV-112538 for pump No.1 and SOV-112539 for pump No.2 and the discharge valves SOV-112553 for pump No.1 and SOV-112554 for pump No.2 into auto mode, by selecting an auto manual switch (one per pump) to Auto mode, if the operator wants automatic operation for that pump.

Upon a ballast pump start request from the operator, the IAS ballast control system will check that the discharge valve SOV-112553/554. SOV-112542 & SOV-112543 are closed prior to start. After pump start, the discharge valve will be opened automatically and water will enter to the pump.

When discharge valve is confirmed (SOV-112553 or SOV -112554 <15%) closed and line suction valve is confirmed open position (SOV-112538 / SOV -112539) the pump will be commanded to start.

After the pump starts IAS checks whether the discharge pressure is higher than the pre-set low value (PI-111103/ PI-111203), (hold time 20 sec). If the pressure is above the low-set the ballast pump will continue to run and the pump discharge valve (SOV-112553/SOV-112554) will be gradually opened to the pre-set maximum value. The preset minimum pressure and preset maximum discharge valve opening position are to be set by operator. The operator can adjust the pump discharge valve maximum position in order to adjust the pumping rate.

When the level in the ballast tank reaches the bottom area, the discharge pressure will start falling. At the pre-set low pressure (hold time 20 sec) the “Discharge Complete” alarm will be generated, and the ballast pump will be automatically stopped. Upon ballast pump stopped information the discharge valve and the line suction valve will automatically be closed. Ballasting from sea chest is purely a manual operation. The Auto On soft button on the operator menu on screen has to be unabled. Operator has to open the suction valve and close the discharge valve start the pump and then open-close the discharge valve based on the pumping rate required. Also operator shall stop the pump when required.

The following conditions will disable IAS remote start button or stop the running of the ballast pump:

Ballasting Mode:

Description	Tag	Limit	Remark
SUCTION VALVE CLOSED	SOV-112542/543	0% Open	When the valve-closed signal is active pump shall be blocked.
DISCHARGE VALVE POSITION	SOV-112553/554	>15% open = block	Set point for auto start = 15% open. However to accommodate minor errors the system checks if the valve is opened <15%. This is adjustable by the operator.
DISCHARGE PRESS	PI-111103/ PI-111203		Pressure < than the low set. Hold time 20sec after low pressure, then the pump stops.
VRCS Hyd. Oli Pressure	PIAHL-062403		Pressure < than the low set. Hold time 20 sec after pump start. Stop pump after 20 sec of start
VALVE LINE UP NOT CONFIRMED	SW Button		Valves not confirmed lined up for the purpose.
ANY SHUTDOWN PRESENT			Pump tripped on fault or tripped by external ESD

De ballasting Mode:

Description	Tag	Limit	Remark
SUCTION VALVE CLOSED	SOV-112538/539	0% Open	When the valve-closed signal is active pump shall be blocked.
DISCHARGE VALVE POSITION	SOV-112553/554	>15% open = block	Set point for auto start = 15% open. However to accommodate minor errors the system checks if the valve is opened <15%. This is adjustable by the operator.
DISCHARGE PRESS	PI-111103/ PI-111203		Pressure < than the low set. Hold time 20 sec after pump start. Stop pump after 20 sec of start
SUCTION PRESS	PI-111102 / PI-111202		Minimum head
VRCS Hyd. Oli Pressure	PIAHL-062403		Pressure < than the low set. Hold time 20 sec after pump start. Stop pump after 20 sec of start
VALVE LINE UP NOT CONFIRMED	SW Button		Valves not confirmed lined up for the purpose.
ANY SHUTDOWN PRESENT			Pump tripped on fault or tripped by external ESD

5.3.1.1.2 Stripping Eductor

Ballast tank stripping is a manual operation.

The ballast eductor (500 m³/hr capacities) is water driven and stripping by the eductor is performed by the following procedure:

Ballast tank stripping port side:

This operation is described as an example:

Operator shall open the pump suction valve (SOV-112542), close discharge valve (SOV-112553), close the tank side suction valve (SOV-112538), open the eductor driver valve (SOV-112535), close isolating valves SOV-112557 and SOV-112555, open suction and discharge valves (SOV-112533 and SOV-112536) and open overboard valve (SOV-112558 and SOV-112560), line up other valves for stripping and open the sea chest valve (SOV-112546) then start the pump (MIC- 111101). After the pump has started operator shall open the discharge valve (SOV-112553) and adjust the flow rate by checking the discharge pressure (PI-111103) and the discharge valve opening.

The operator observes the eductor suction (PI-111301) and discharge (PI-111302) pressures during this operation.

Ballast tank stripping Stbd side:

This is a similar operation as that of Port side. Operator shall line up the proper valves.

5.3.1.1.3 Manual Ballast Pump Control

In manual mode starting/stopping of pumps and opening/closing of valves is performed manually by the operator from the OS. However, starting of the pumps is blocked, if the start prevention conditions are not full-filled.

5.3.1.1.4 Trip system

The safety system of the ballast pumps is incorporated with the local indication and trip panel supplied with the pumps. The shutdown conditions are monitored by the IAS control system and the local control panel performs shutdown of the actual pump and trip information is transmitted to IAS (XA-111110).

Description	Tag	Remark
BALLAST PP 1 UPPER BRNG TMP	TIAH-111105	
BALLAST PP 1 LOWER BRNG TMP	TIAH-111107	
BALLAST PP 1 STUFFING BOX TMP	TIAH-111104	
BALLAST PP 1 CASING TMP	TIAH-111106	

The respective starter unit for the ballast pump checks overload and trips the pump. When the pump is tripped on overload the motor fault and abnormal trip signal is given to IAS and alarm is raised (MA-111101/ MA-111201) & (XA-111110/XA-111210). The overload trip-inhibit time settings are internal in the starter unit.

5.3.1.1.5 Ballast Pump Discharge valve

Maximum output command for the discharge valve can be limited by the operator by software pushbuttons.

When the discharge valve (SOV-112553 (P) or SOV-112554 (S)) is selected to manual mode the operator can give fully open or fully close command and stop the output signals whenever required as the operator reads the position feedback. Or the operator can give an “open” or “close” pulsed output command.

When in automatic mode the discharge valve shall open/close based on the ballast pump running/stopped information.

The open command will always be limited to the maximum value defined by the operator from the mimic.

5.3.1.1.6 Ballast pump Suction Valve

Automatic control of the ballast suction valves is performed whenever the valves are in auto mode.

Automatic opening of the valve when:

-Ballast pump start request is performed.

Automatic closing of the valve when:

-Ballast pump stopped or emergency stopped.

Ballast Alarm

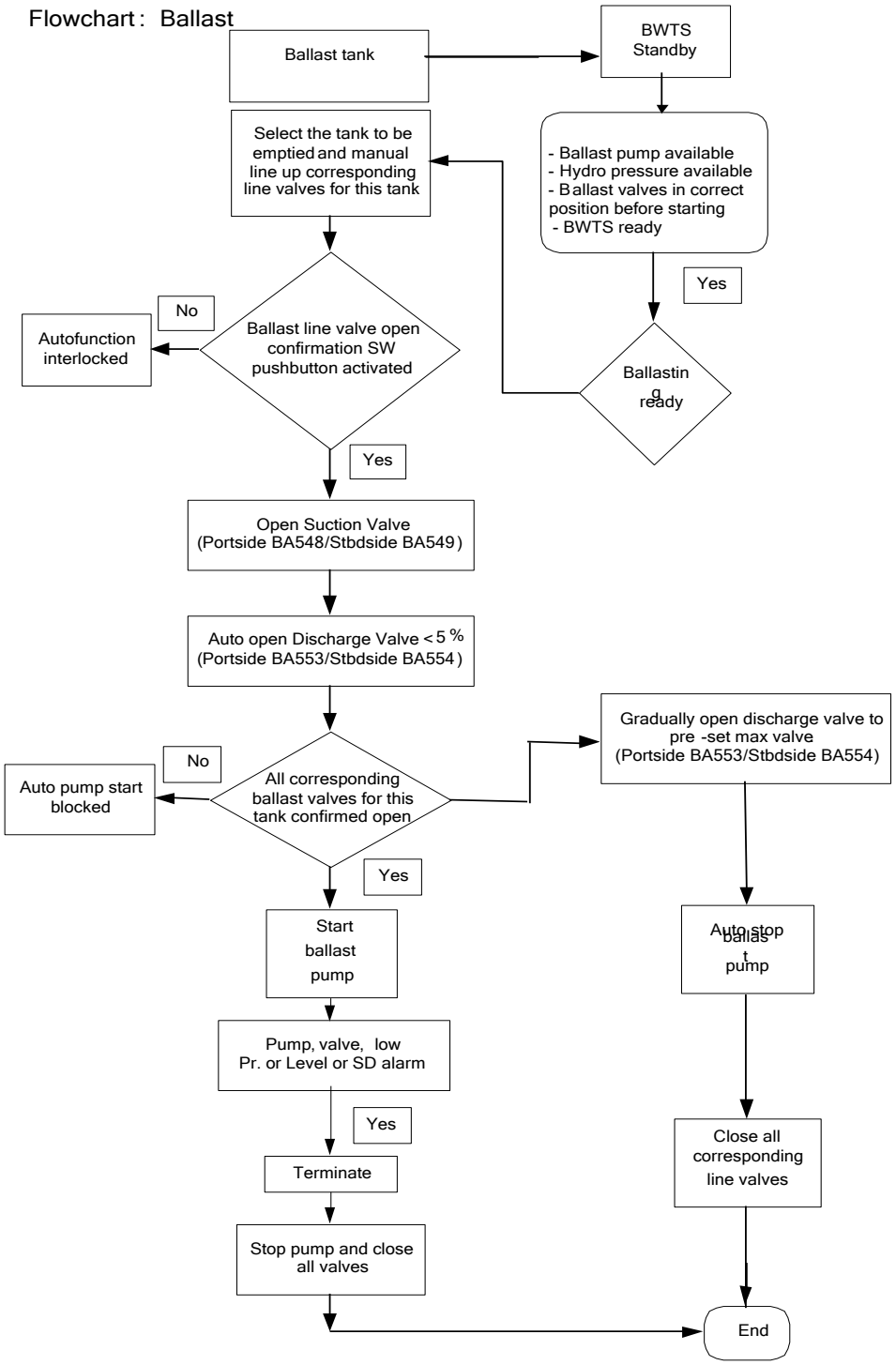
The “Discharge pressure low” when ballast pump running and low-low limit exceeds.

The “Discharge completed” alarm corresponds with ballast pump run and then stop after 20sec low discharge pressure..

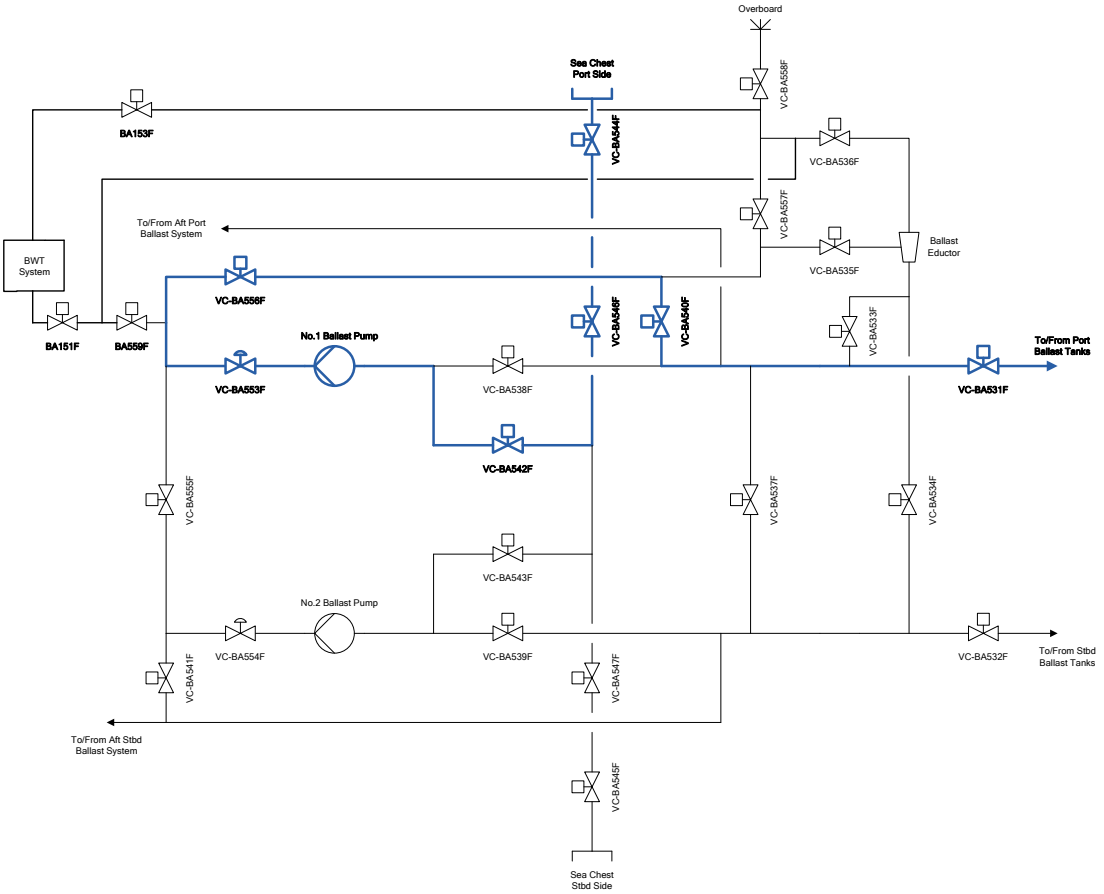
Ballast Pump No.1 (MIC-111101)		
Function	**Description**	**Tag Number**
Remote Auto Start	Not applied	
Remote Auto stop MC-111101B	For Low discharge pressure, valves closed or SD conditions	
Remote Manual Start MC-111101A	From IAS Screen when in Manual mode	
Remote Manual stop MC-111101B	From IAS Screen when in Manual mode	

Ballast Pump No.2 (MIC-111201)		
Function	**Description**	**Tag Number**
Remote Auto Start	Not applied	
Remote Auto stop MC-111201B	For Low discharge pressure, valves closed or SD conditions	
Remote Manual Start MC-111201A	From IAS Screen when in Manual mode	
Remote Manual stop MC-111201B	From IAS Screen when in Manual mode	

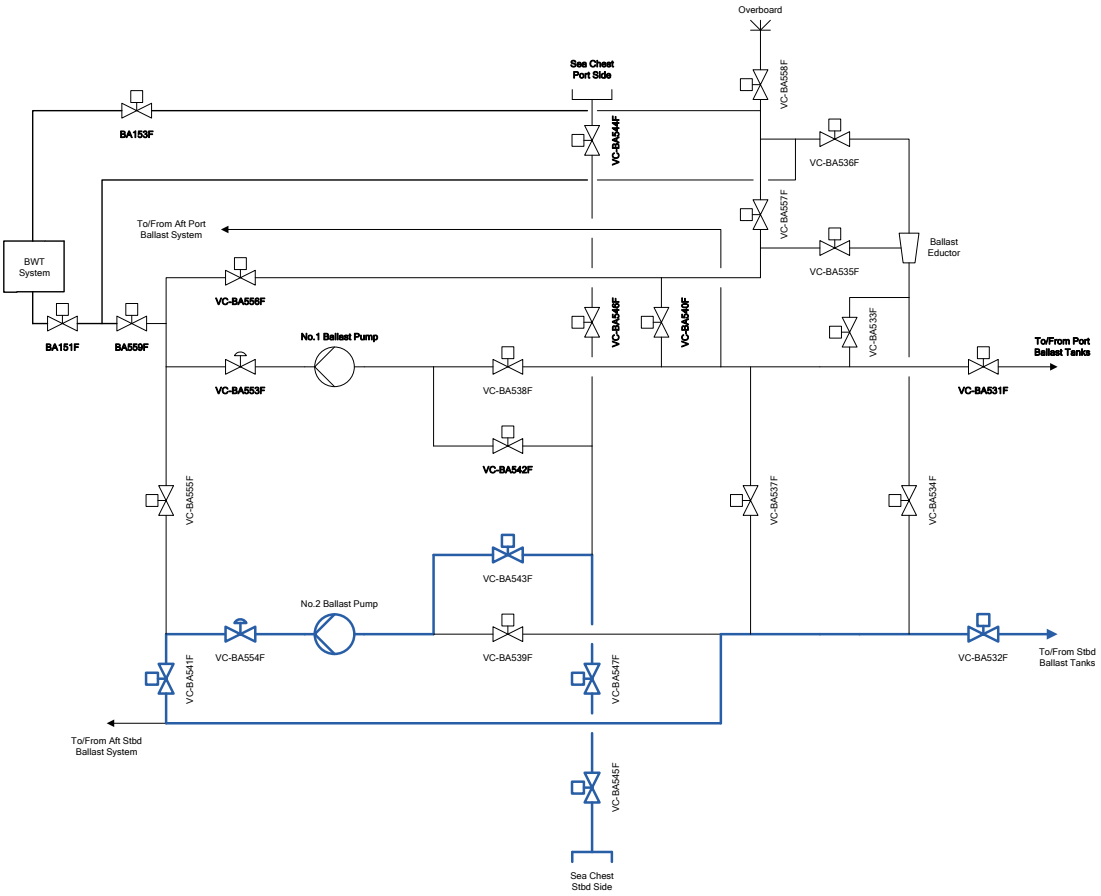
5.4 Flowchart Ballasting



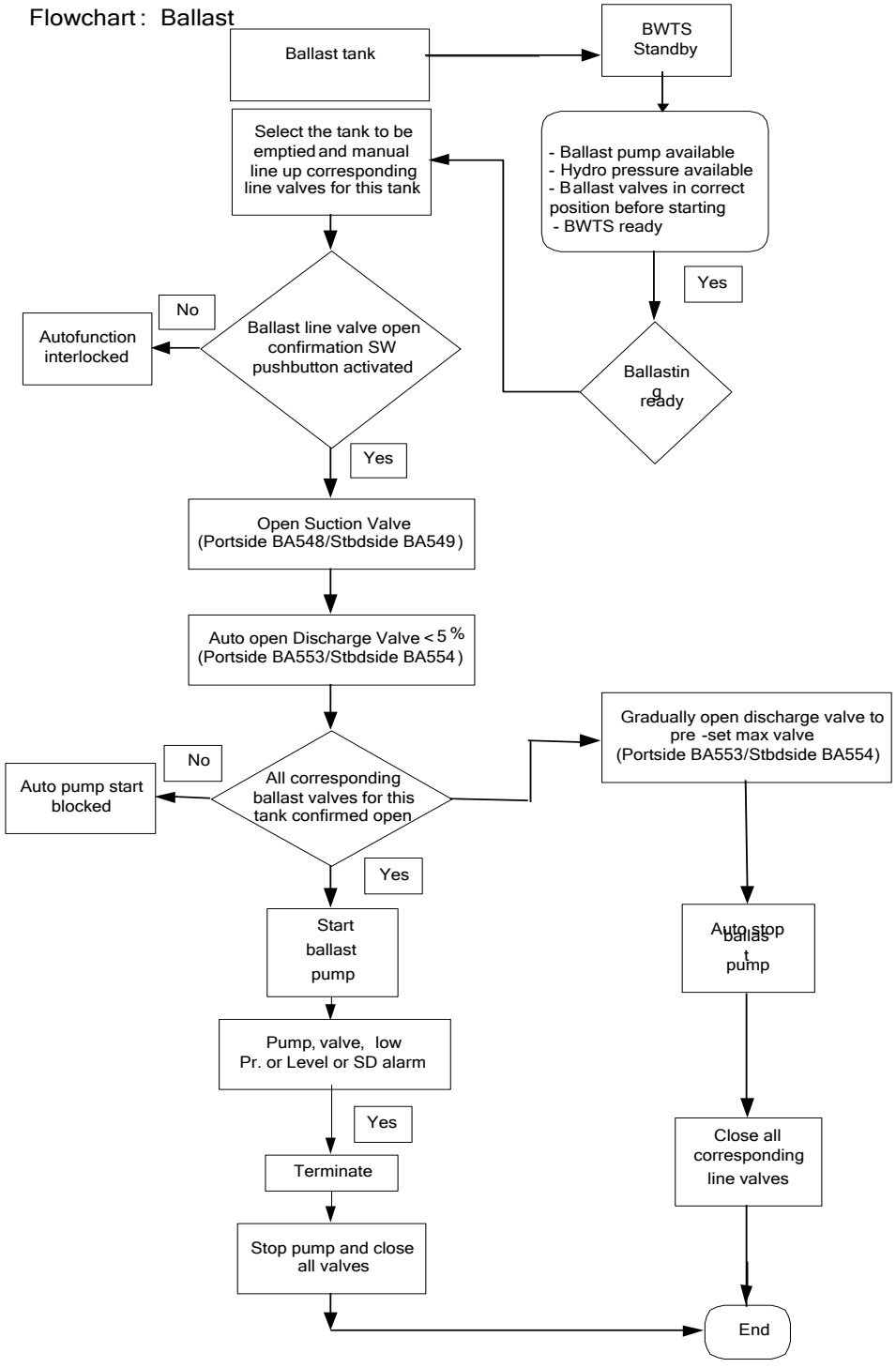
1.2.13. 5.4.1 Ballasting tank Port side:



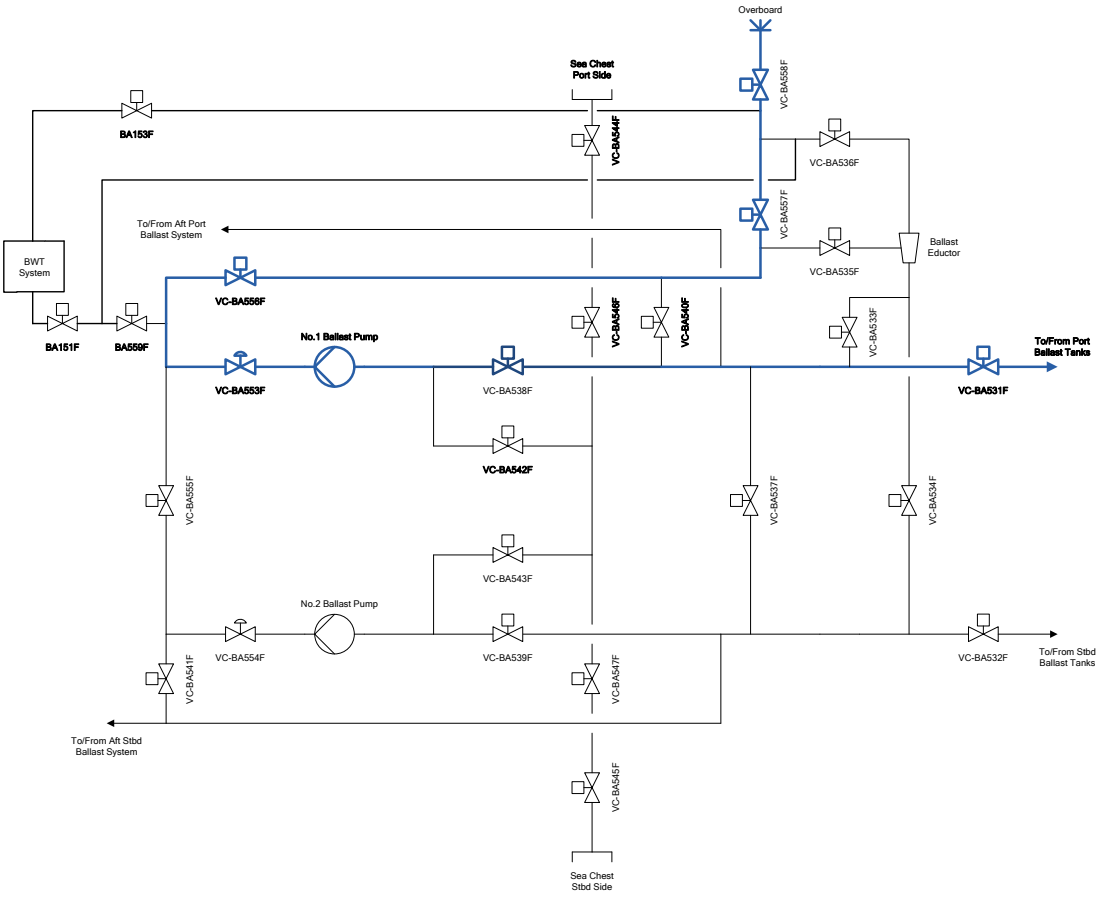
1.2.14. 5.4.2 Ballasting tank STBD side:



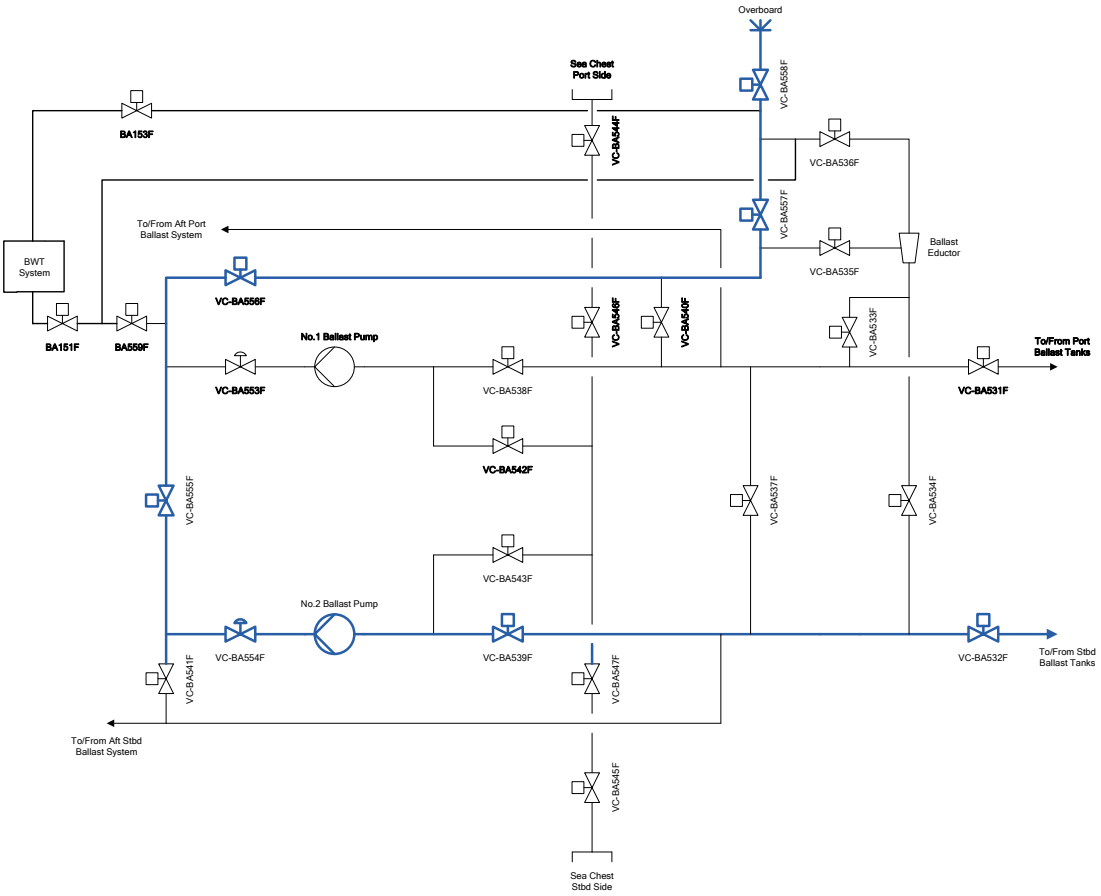
5.5 FlowChart De-Ballasting



1.2.15. 5.5.1 De-ballasting Port side:



1.2.16. 5.5.2 De-ballasting STBD side:



5.6 Pure Ballast Treatment

IMO requires that the ballast water be filtered, disinfected before taking into the ballast tanks. While de-ballasting the de-ballast water shall be neutralized for any excess disinfectant.

Transporting species of both flora and fauna belonging to one environment and by accident planting it in a new environment may thus knock out the local species or causing damage to them by transferring diseases. Therefore international conventions put demands on all commercial ships that they have to be equipped with systems for cleaning ballast water.

For treating ballast water in ships, it is thus very important that no water is leaving the ship untreated in connection with the de-ballasting. The system should be controlled and monitored so that a safe and optimal function is obtained.

Accordingly one Ballast water treatment unit is fitted in this vessel. This system is located in Centre engine room aft. The ballast pumps pump water to the tank through this system while ballasting and pump the water overboard through this system while de-ballasting.

This system consists of one Filter unit, 10 off UV sterilizing units also called reactors 10 UV lamp units and one CIP (Cleaning in Place unit).

The stripped water from the ballast tanks or the seawater to the ballast tanks is first filtered in an auto filter unit. This filter unit is isolatable with air operated isolating valves. The filter can be bypassed when required. An air operated By-pass valve is in position for this purpose.

The main principle of PureBallast treatment is filtration followed by an advanced oxidation technology (AOT). In the process PureBallast uses a patented AOT component: Wallenius AOT™, which is the main stage of treatment during ballasting and deballasting.

A PureBallast system consists of one to ten AOTs, which can be connected in parallel to achieve flow rates between 250 and 2500 m3/h. The capacity of one AOT module is 250 m3/h.

The filter unit is fitted with a Diff. pressure indicator. The filter is an auto filter and hence back flushing is done automatically. The back flush water is sent overboard

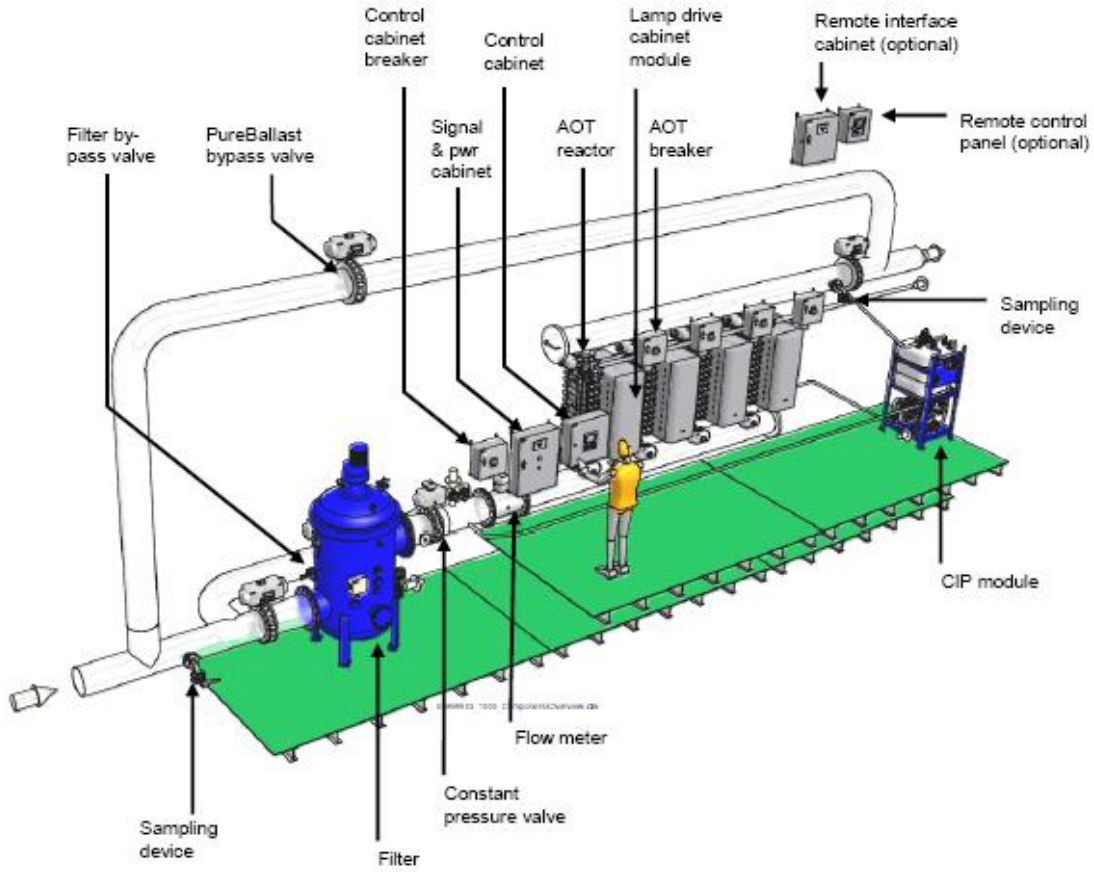
The ballast water is then routed to individual reactors through air operated control valves. Flow rate and pressure are measured on the common header.

PureBallast incorporates Advanced Oxidation Technology. AOT units contain titanium dioxide catalysts, which generate radicals when hit by light. The radicals, whose lifetime is only a few milliseconds, break down the cell membrane of microorganisms without the use of chemicals or the creation of harmful residuals. During ballasting, water passes through a 50 um pre filter to remove larger particles and organisms and to prevent sediment build-up in the ballast tanks. The water then continues to the AOT units where smaller organisms that pass the filter are broken down by the radicals produced here. During de ballasting, water again passes the AOT units to destroy any organisms that might have re-grown in the tanks during the voyage.

The number of AOT units that are required is determined by the flow rate. The reactors are flushed initially be freshwater. The Lamp drive cabinets are also continuously cooled by the freshwater.

The treated Ballast water is then routed either to the tanks or to the sea.

The PureBallast system is an integral part of the vessel's ballast water system, on the discharge side of the vessel's ballast water pumps. It is equipped with a bypass valve that is controlled from the K-Chief. PureBallast is also equipped with two sampling devices, one before treatment and one after treatment. This makes it possible to take samples of the ballast water according to IMO requirements.
The operation of PureBallast are done locally or remotely. It is operated either from the local control panel or from K-Chief mimic. The main operations for this system are ballasting and deballasting.



1.2.17. 5.6.1 Cleaning in Place unit (CIP):

The CIP unit circulates a biodegradable solution (CIP liquid cleaning media) through the treatment unit to remove ballast water scaling. As the ballast water is salt containing sea water it is important to take measures against corrosion in the system. Thus the cleaning process also comprises flushing the filter and reactor with fresh water before and after the cleaning with the CIP cleaning media and draining the treatment unit of the different liquids after each step.

The flushing of the filter also has the effect that the ballast water in the filter is diluted to prevent that organisms survive in the filter and multiply to block the filter. Fresh water is connected to the CIP unit.

1.2.18.

1.2.19. 5.6.2 Controls

5.6.2.1 IAS Control

The PureBallast system is integrated with the K-Chief. This will allow the

operator to perform the basic operations, ballasting, deballasting and CIP cleaning from the K-Chief. Full operation and settings can still be performed in the PureBallast control system main panel.
The PureBallast is based on manual operated, meaning the system don't start automatic when start of ballast pump.

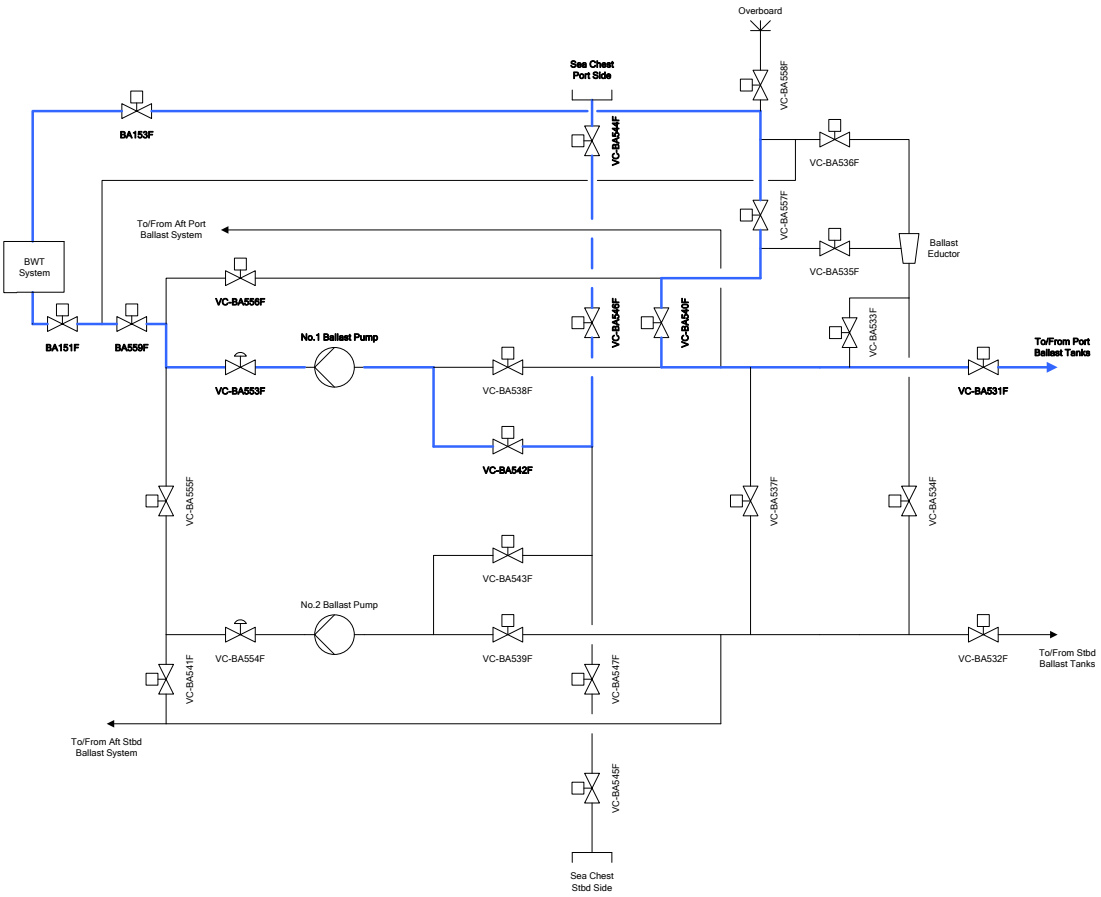
Following signal are interfaced with the Pure Ballast system:

Tag Number	Description
XC-111601	START BALLAST
XC-111602	START DEBALLAST
XC-111603	START CIP
XC-111604	STOP BWTS
XC-111605	BWTS MANUAL BACK FLUSH
XC-111607	ACKNOWLEDGE ALL ALARMS
XC-111635	SELECTED FLOW
XC-111636	BWTS AOT 1 SELECTED
XC-111637	BWTS AOT 2 SELECTED
XC-111638	BWTS AOT 3 SELECTED
XC-111639	BWTS AOT 4 SELECTED
XC-111640	BWTS AOT 5 SELECTED
XC-111641	BWTS AOT 6 SELECTED
XC-111642	BWTS AOT 7 SELECTED
XC-111643	BWTS AOT 8 SELECTED
XC-111644	BWTS AOT 9 SELECTED
XC-111645	BWTS AOT 10 SELECTED
XC-111651	BWTS AOT SELESTION ENABLED
XC-111652	BWTS FLOW SELESTION ENABLED
XI-111608	BWTS PROCESS MODE
XI-111608	BWTS STANDBY

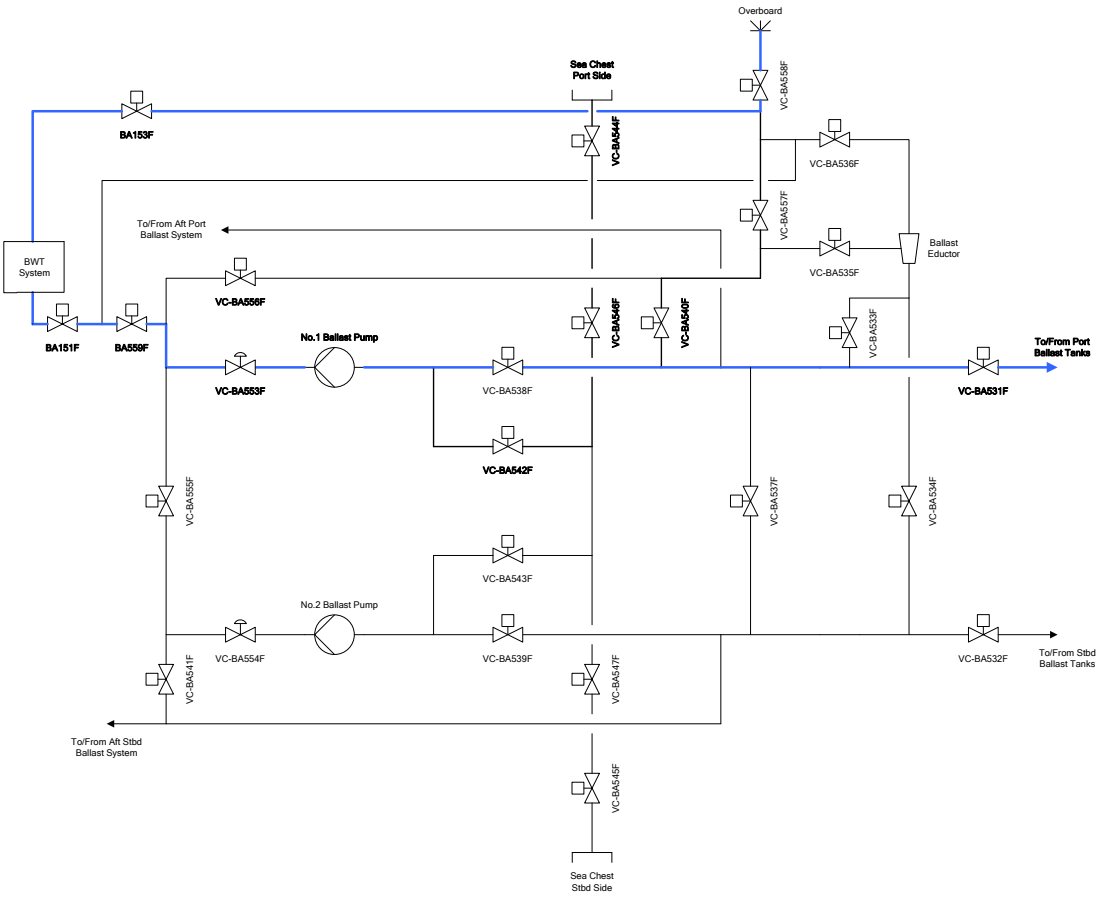
XI-111608	BWTS BALLAST BWTS CIP
XI-111608	BWTS EMERGENCY STOP
XI-111613	BWTS MANUAL/REMOTE
XI-111614	BWTS SUBPROCESS MODE
XI-111614	BWTS HEELING MODE
XI-111614	BWTS STOP
XI-111614	BWTS BACK FLUSH
XI-111617	BWTS AOT 1 ACTIVATED/RUNNING
XI-111618	BWTS AOT 2 ACTIVATED/RUNNING
XI-111619	BWTS AOT 3 ACTIVATED/RUNNING
XI-111620	BWTS AOT 4 ACTIVATED/RUNNING
XI-111621	BWTS AOT 5 ACTIVATED/RUNNING
XI-111622	BWTS AOT 6 ACTIVATED/RUNNING
XI-111623	BWTS AOT 7 ACTIVATED/RUNNING
XI-111624	BWTS AOT 8 ACTIVATED/RUNNING
XI-111625	BWTS AOT 9 ACTIVATED/RUNNING
XI-111626	BWTS AOT 10 ACTIVATED/RUNNING
XI-111646	COOLING WATER REACTOR VALVE V403-35
XI-111647	MAIN INLET VALVE IN DEBALLAST V201-9
XI-111648	MAIN INLET VALVE IN BALLAST V201-3
XI-111649	MAIN LINE IN VALVE CONTROL V201-8
XI-111650	FILTER OUTLET VALVE V201-32
XI-111627	FLOW INDICATION
XI-111633	SYSTEM LINE PRESURE
XI-111628	DIFF. PRESSURE OVER FILTER

XI-111629	BWTS REQUEST TO START BALLAST PUMP
XI-111630	BWTS REQUEST TO OPEN OVERBAORD VALVE
XC-111631	BALLST PUMP RUNNING FEEDBACK TO BWTS
XC-111632	OVERBAORD ACTIVATION OF NEW FLOW SELECTED
XC-111653	CONFIRM ACTIVATION OF NEW FLOW SELECTED

1.2.20. 5.5.2 Ballasting PORT side:



1.2.21. 5.5.2 De-Ballasting PORT side:



6 hull bilge system

6.1 Bosun Store Bilge

Bosun store is provided with two (2) bilge hats. These hats are fitted with level switches for high-level alarm. The high level alarm is interfaced to IAS. The bilge hats in Bosun store can be drained to the centre bow thruster room bilge well by gravity flow. Operator on receiving the high alarm from the level switches shall drain the bilge overboard by operating the manual valves in the drain line.

Bosun stores Bilge well (S) (LAH-081132)

Bosun stores Bilge well (P) (LAH-081131)

1.2.22. 6.1.1 Controls

6.1.1.1 IAS Control

The bilge emptying operation is a manual.

6.2 Dry Bulk Tank Room Bilge

There are (2) bilge wells in dry bulk tank room. These wells are fitted with level switches and level alarms are interfaced to IAS and based on the level alarm operator can empty the bilge into FWD or AFT drain holding tank, or the stbd waste mud tank, by manually starting the bilge pump. This bilge pump has a capacity to empty 40 m^3/Hr at 4 bar. This pump is driven by service air.

Dry Bulk Tank Area (P) Bilge well (LAH-081138)

Dry Bulk Tank Area (S) Bilge well (LAH-081139)

6.3 HPR Compartment (AFT) and (FWD) Bilges

Each compartment has two bilge eductors, one port side and one stbd side, for emptying the bilge wells overboard. The bilge wells are fitted with level switches and high level is alarmed in IAS. Based on the alarm, operator can empty the bilge overboard by locally manually starting the bilge eductor fitted for the purpose. The suction in these eductors is generated by any of the GS service pumps onboard.

HPR Compartment AFT (P) Bilge-well (LAH-081155)

HPR Compartment AFT (S) Bilge-well (LAH-081156)

HPR Compartment FWD (P) Bilge-well (LAH-081136)

HPR Compartment FWD (S) Bilge-well (LAH-081137)

6.4 Pump room Bilge

There are three (3) bilge hats in pump room. These are fitted with level switches and level alarms are interfaced to IAS and based on the level alarm operator can empty the bilges into AFT Drain holding tank by opening the manual valves and then starting one of the drain pumps either from IAS or locally. The manual valve for port bilge hat has the opening handles extended to upper deck for remote manual opening.

Pump room Bilge Hat-P (LAH-081140)

Pump room Bilge Hat-C (LAH-081141)

Pump room Bilge Hat-S (LAH-081142)

6.5 Drain Pumps

Two drain pumps (MIC-081225 & 081235) are fitted in ballast pump room for emptying the ballast pump room bilge hats into drain tank (P) and also for discharging the drain tanks (P&S) bilges to overboard. These pumps are electric driven with a capacity of 100 M3/Hr and a head of 90 meters. The electric motors are located in the main engine room while the pumps are located in the ballast pump room. The pumps and motors are connected by a carbon steel intermediate shaft. The shaft passes through the deck. Stuffing box with gas tight gland packing is provided at each penetration of the shaft. The start and normal stop of the pump is done from IAS screen (MC-081225A&B and MC-081235A&B). Manual emergency stop facility is provided at:

- Independent ES push buttons at Electric motor side in engine room (directly wired to the respective Pump unit relay box)
- Ballast pump room and shore connection side (P), wired to respective relay panel.

- Independent ES push buttons at Wheelhouse. Wired to the respective pump unit relay box.

The drain pumps are supplied by SHINKO, Japan. The system is supplied complete with pressure and temperature sensors for the Pumps, Deck stuffing box .Shinko also supplies the drain pump trip and alarm control panels.

The control and trip system for each pump consists of Sensors, Emergency stop PB, IS Barrier boxes, Relay box and Junction box.

Drain Pump No.1 (MIC-081225) is powered from Port LV switchboard and Pump No.2 (MIC-081235) is powered from Stbd Switchboard. Normally the pumps are started and stopped from IAS. In the emergency event the pump can be started locally from the starter unit, the valves manually opened and closed from the SOV cabinet if the hydraulic unit driving the valves is operational.

The relay box for each pump unit is located in the engine room near the Motor.

The following points are interfaced with IAS for each pump:

Description	**Pump No.1**	**Pump No.2**
Suction pressure	PI-081226	PI-081236
Discharge pressure	PI-081227	PI-081237
Deck stuffing box temp.	TIAH-081228	TIAH-081238
Upper Bearing temperature	TIAH-081229	TIAH-081239
Lower Bearing temperature	TIAH-081231	TIAH-081241
Pump Casing temperature	TIAH-081230	TIAH-081240
Pump Emcy Stop Activated	XA-081232	XA-081242
Pump Abnormal Trip Alarm	XA-081233	XA-081243
Pump Master Trip Alarm	XA-081234	XA-081244

These drain pumps can be lined up to have its suction from either ballast pump room bilge hats by opening the remote handle manual valves or from the drain tanks by opening the remote valves SOV-081807/081808 together with tank suction valves. These valves can be opened from IAS screen. The pumps discharges are routed through a pumps discharge valves SOV-081818/081817. These valves are position control valves. Operator from IAS screen can adjust the opening of these valves by selecting the required opening. The pump is fitted with suction and discharge local pressure gauges and pressure transmitters (PI-081226/081227 & PI-081236/081237) for remote indication in IAS. The drain pumps are used to pump the drain tank bilges to the Oil discharge monitoring system. Oil discharge monitoring equipment analyses the oil content in the bilge water. If the oil content is below 15 PPM then the drains are routed overboard through remotely operable valves SOV-081822. If the content is above 15 PPM the drains are routed back into the AFT Drain Holding Tank.

The No.1 drain pump is connected with drain holding tank (P) and No.2 drain pump is connected with drain holding tank (S). No.1 pump can be used for emptying stbd side drain holding tank by opening interconnecting valve SOV-081809 along with suction valves. Similarly no.2 pump can be used for port side drain holding tank.

6.5.1 Controls

6.5.1.1 IAS Control

The drain pumps can be started and stopped manually from IAS screen (MC-081225A/B and MC-081235A/B) if the pump is in remote (MI-081225B/081235B) and if there is no fault (MA-081225/081235).

NO.1 Drain Pump (MIC-081225)		
Function	Description	Tag Number
Remote Auto Start	Not applied	
Remote Auto stop	From IAS Screen Pressure < than the low set. Hold time 20 sec after pump start. Stop pump after 20 sec of start	PIAHL-062403
Remote Manual Start	From IAS Screen	MC-081225A
Remote Manual stop	From IAS Screen	MC-081225B

NO.2 Drain Pump (MIC-081235)		
Function	Description	Tag Number
Remote Auto Start	Not applied	
Remote Auto stop	From IAS Screen Pressure < than the low set. Hold time 20 sec after pump start. Stop pump after 20 sec of start	PIAHL-062403
Remote Manual Start	From IAS Screen	MC-081235A
Remote Manual stop	From IAS Screen	MC-081235B

Drain Pump Interlock

Drain Pumps start will be interlocked if no possible suction is available,
and Discharge valve >15%

Remove tables

NO.1 Drain Pump Interlock (MIC-081225)								
	RESULT	BG802F	BG803F	BG804F	BG805F	BG807F	BG808F	BG817F
1	Interlock					Open	Close	
2	Interlock			Open			Close	
3	Interlock				Open		Close	
4	Interlock	Close	Close				Close	
5	Interlock	Close	Close	Close	Close	Close		
6	Interlock							Close (15% and Below)

NO.2 Drain Pump Interlock (MIC-081235)								
	RESULT	BG802F	BG803F	BG804F	BG805F	BG807F	BG808F	BG818F
1	Interlock	Open					Close	
2	Interlock		Open				Close	
3	Interlock						Close	To Be Deleted
4	Interlock			Close	Close	Close	Close	

5	Interlock	Close	Close	Close	Close	Close		
6	Interlock							Close (15% and Below)

6.6 Oil Discharge Monitoring Equipment (Pump Room)

The vessel is fitted with two slop tanks, one port side and the other Stbd side. The port slop tank holds dirty slops while the starboard slop tank holds the clean slops. The tanks are connected with a hydraulic valve that, when operated, transfers the decanted slops from Stbd to the port slop tank. The slops in port tank are discharged over board through Oil Discharge Monitoring system.

This unit consists of hydraulic panel unit with sampling device located in pump room, the measuring oil content meter and the motor starter in engine room and the controller unit in CBC in wheelhouse. This unit is a vendor package unit. The unit has one electric driven hydraulic pump with pressure switch and sample flow transmitter. The pressure switch and the flow transmitter are located in hazardous area and hence the signals are routed through IS barriers located in oil content meter.

The starter unit is fitted with an auto/manual switch. In manual mode the unit is started as soon as the switch is turned to manual mode. When the switch is kept in auto mode the unit can be started from IAS (VC-082103) (Contact open monitoring start). When the unit is started the unit checks that the overboard discharge valve SOV-081822 is closed before starting the unit. IAS provides this signal to the unit (VC-082104) (ODME over board valve status. The signal contact is closed when the valve is closed.). The unit then analyses the slops. If the oil content in bilge is less than 15PPM the unit provides a signal (XI-082102) to IAS (Closed= OB discharge permitted). If the unit is not functioning then the unit sends an abnormal signal (XA-082101) to IAS. IAS after checking that there is no abnormal signal from the unit and that the unit has permitted the discharge would then permit the overboard valve to be opened. In the event of the oil content more than 15 ppm, the slops are discharged back to slop tank (p) via SOV-081819.

IAS will open the valve SOV-081819 when starting the ODME. When the overboard valve is opened the open position limit switch contact ZSO-081822 shall close the slop tank valve SOV-081819 automatically. As long as the overboard valve is opened this tank valve shall be interlocked from opening in IAS. When the overboard valve leaves the open position, the interlock is removed. However operator can override this interlock and shall be able to open the tank valve if required. This facility is provided in the IAS screen.

1.2.23. 6.6.1 Controls

6.6.1.1 IAS Control

Overboard valve SOV-081822		
Function	**Description**	**Tag Number**
Remote Auto Open	When the SOV-081819 is closed. And XA-082101is not active	
Remote Auto Close	When the SOV-081819 is open. OR when XA-082101is open.	
Remote Manual Open	Permitted when XI-082102 is active AND XA-082101 not active.	
Remote Manual Close	Possible from IAS screen.	

Slop Tank Valve SOV-081819		
Function	**Description**	**Tag Number**
Remote Auto Open	When the overboard valve SOV-081822 is Closed	SOV-081822
Remote Auto Close	When the overboard valve is open.	SOV-081822

Slop Tank Valve SOV-081819		
Function	**Description**	**Tag Number**
Remote Manual Open	Possible from IAS screen. But when the overboard valve is opened the tank will be closed by interlock.	Operator can override
Remote Manual Close	Possible from IAS screen.	

6.7 Void Moon Pool & Void Space (C)

One cofferdam is provided in aft of moon pool area. One bilge hat in this cofferdam. The high level in these hats is interfaced to IAS. Operator can empty these bilge hats into slop tank upon receiving the high level alarm on IAS, by manually operating the air driven bilge pumps.

Coffer Dam bilge hat (Aft) LAH-081134

One bilge hat is provided in the void space. One high level switch is and interfaced to IAS. T bilge hat is interconnected and empty by one air driven pump having the capacity of 40m^3/h & 4.0 Bar. Operator can empty this bilge hat into slop tank upon receiving the high level alarm on IAS, by manually operating the air driven bilge pumps. The manual valve for cent bilge hat has the opening handles extended to upper deck for remote manual opening.

Void space bilge hat (Cent) LAH-081146

6.8 Agitator Room

Two bilge hats are provided in agitator room, one in port side and another in stbd side. Each hat has fitted with high level switch and interfaced to IAS. Operator can empty these bilge hats into the FWD drain holding tank or the stbd waste mud tank upon receiving the high level alarm on IAS, by manually operating the air driven bilge pump located in agitator room.

Agitator room bilge hat (Port) LAH-081148

Agitator room bilge hat (Stbd) LAH-081149

6.9 FWD DRAIN HOLDING TANK AND OILY WATER SEPARATOR

This drain system consists of

- Drain holding tank
- Oily bilge pump
- Oily water separator unit
- Recovered oil tank
- Recovered oil transfer pump

1.2.24. 6.9.1 Drain Holding Tank

The capacity of drain holding tank is 98 Cubic meters. The tank is located in dry bulk tank area. The tank is fitted with three (3) drain points for suction; First one (L1) is at 7.0m), second one (L2) is at 4m level and third one (L3) is at 1m level. These suction points connect to a common suction line of the oily bilge pump.

The drain holding tank receives drains from topside Deck drains through an air driven pump, sand trip, active mud tank, mud pump area and mud mixing area, external floor drains rotary table, shale shaker room, moon pool drains, non hazardous drains, external floor drains , setback drains and subsea area drains.

Drain holding tank is fitted with remote sounding system and the level is interfaced to IAS (LIAHL-081157).

This tank is fitted with three outlets each has its suction points at different elevations. The first one (L1) is at 7 meters from the bottom, the second one (L2) is at 4 meters and the third one (L3) is at 1 meters from the bottom. The outlets are fitted with isolating valves. These isolating valves are fitted with open position limit switches and these signals are interfaced to IAS (SOV-082303, 082304, 082305). All these three lines are connected common after the isolating valves and the common line provides suction for the oily water separator.

1.2.25. 6.9.2 Oily Bilge Pump

The oily bilge pump is driven by an electric motor and is manually started and stopped from the oily water separator local control panel. Operator shall manually start this pump-based on the level in drain holding tank (LIAHL-081157) and the oily water separator discharge the bilges overboard.

1.2.26. 6.9.3 Oily Water Separator

One (1) number of oily water separator equipment is installed in the hull on this facility. The oily water separator units consists of a separator unit, emulsion treatment unit and overboard discharge valve. A local control panel controls the oily water separator unit. The oily water separator's main function is to separate the oil from the drain holding tank bilges and then discharge clean bilge (<15PPM oil content) overboard and return the oily bilge to the drain holding tank. The separated oil is periodically drained into the separated bilge oil tank.

The oily water separator is gravity –coalescence separator. The oil from bilge is removed by using the difference in density and the surface tension between oil and water as well as coalescing process. This equipment is a two (2)-stage separator. The oil water mixture is pumped into the pre-separation stage where virtually all the oil is retained. The oil separation, the removal of small and finest oil drops takes place in the high efficiency coalescing unit. The water with low oil content will be passed to a separate housing. The oil droplets with finest diameters will be separated in this housing. The treated water leaves the housing via sea bilge valve and the 15PPM-measuring unit measures the oil content of the discharged water. Package vendor supplies the complete unit with the measuring equipment.

The unit supplied with power for operation of the oily water pump. The pump unit is provided with a heater.

Starting the oily water separator unit starts the oily bilge pump also. The pump has its suction from the drain holding tank. The unit can be started and stopped manually from local panel. The unit will automatically stop when the level in the daily holding tank is very low as measured by the remote sounding system. For this purpose IAS will provide one digital output to the oily water separator unit (XC-082306). When this signal is active the oily water separator unit shall be stopped and the oily bilge pump shall be stopped by the oily water separator control panel.

The unit is also fitted with a 3-way valve. This valves discharges the clean bilge overboard when the oil content in the discharged water from the separator is <15PPM. If the oil content is >15PPM the bilge water is discharged back into the topsides drain tank. The Unit's local panel controls this 3-way valve. A manual valve is installed in the outlet line from the 3-way valve that leads overboard. Operator can divert the bilge back into the topsides drain tank by operating this manual valve. The overboard line is fitted with another manual valve at the end of the line.

The following alarms are interfaced from the oily water separator to the IAS.

- 15PPM alarm XA-082302
- Abnormal alarm XA-082301
- Pump auto stop XC-082306

The oily water separator pump can be set to discharge into a recovered oil tank by manually lining up the valves. The recovered oil tank is fitted with remote sounding system level detection (LIAHL-073104). The contents of the recovered oil tank can be emptied into a drain holding tank (p) through an electric driven recovered oil transfer pump. This pump has a capacity of 5 cubic meters at 4 bar. The pump can be started and stopped locally manually.

7 tank monitoring system

7.1 Tank Remote Sounding System

Electric type Tank level-measuring system is applied and fitted for the following tanks in this vessel.

No	I/O TAG	SERVICE DESCRIPTION
1	LIAH-081129	BILGE HOLDING TANK IN FWD
2	LIAH-081127	AFT E/R BILGE HOLDING TK
3	LIAH-081128	AFT E/R SEP BILGE OIL TK
4	LIAHL-072120	NO.1 D.O. STORAGE TANK (P)
5	LIAH-072123	NO.1 D.O. STORAGE TANK (S)
6	LIAH-072108	NO.2 D.O. STORAGE TANK (P)
7	LIAH-072110	NO.2 D.O. STORAGE TANK (S)
8	LIAHL-072107	D.O. SERVICE TK (P)
9	LIAL-072109	D.O. SERVICE TK (S)
10	LIAH-072112	D.O. OVERFLOW / DRAIN TK (P)
11	LIAH-042126	F.W.T 1 (P) POTABLE FWD
12	LIAH-042125	F.W.T 1 (S) POTABLE FWD
13	LIAH-042127	NO.2 F.W.T (S) AFT.
14	LIAL-072204	MGE L.O STOR. TK (P)
15	LIAL-072205	MGE L.O STOR. TK (S)
16	LIAH-042404	DRILLING W.T (P)
17	LIAH-042405	DRILLING W.T (S)
18	LIAH-111401	W.B.T 1 (P)
19	LIAH-111402	W.B.T 1 (S)

No	I/O TAG	SERVICE DESCRIPTION
20	LIAH-111403	H.B.T 1 (P)
21	LIAH-111404	H.B.T 1 (C)
22	LIAH-111405	H.B.T 1 (S)
23	LIAH-111406	W.B.T 2 (P)
24	LIAH-111407	W.B.T 3 (P)
25	LIAH-111408	W.B.T 4 (P)
26	LIAH-111409	W.B.T 5 (P)
27	LIAH-111410	W.B.T 6 (P)
28	LIAH-111411	H.B.T 2 (P)
29	LIAH-111412	H.B.T 3 (P)
30	LIAH-111413	H.B.T 4 (P)
31	LIAH-111414	H.B.T 4 (S)
32	LIAH-111415	NO.1 FWD D/B W.B.T (C)
33	LIAH-111416	H.B.T 2 (C)
34	LIAH-111417	W.B.T 2 (S)
35	LIAH-111418	W.B.T 3 (S)
36	LIAH-111419	W.B.T 4 (S)
37	LIAH-111420	W.B.T 5 (S)
38	LIAH-111421	W.B.T 6 (S)
39	LIAH-111422	H.B.T 2 (S)
40	LIAH-111423	H.B.T 3 (S)
41	LIAH-111424	AFT PEAK TK (P)
42	LIAH-111425	AFT PEAK TK (S)
43	LI-073101	BRINE TK 1 (P)
44	LI-073102	BRINE TK 2 (P)
45	LI-073104	BRINE TK 3 (P)

No	I/O TAG	SERVICE DESCRIPTION
46	LI-073103	BASE OIL TK (P)
47	LIAHL-073104	RECOVERED OIL TK
48	LIAH-081158	DRAIN HOLDING TK(P)
49	LIAH-081159	DRAIN HOLDING TK(S)
50	LIAHL-081157	DRAIN HOLDING TK(FWD)
51	LIAH-042128	NO.2 F.W.T (P) AFT.
52	LIAH-072114	D.O. OVERFLOW / DRAIN TK (P)
53	LIAH-111433	H.B.T 5 (P)
54	LIAH-111434	H.B.T 5 (S)
55	LIAHL-072113	EMCY GEN D.O. SERV TK LVL

The Tank remote sounding system (level monitoring system) operates based on electric pressure transducer principle.

The system consists of:

- Level sensors
- Remote sounding System cabinet-1
- Remote sounding System cabinet-2

The sensors are connected to the remote sounding system cabinets and the cabinets are interconnected. All the level signals from above tanks are interfaced to IAS via serial interface.

All the above 73 signals (4-20mA) are sent to Tank monitoring system cabinet for further transmission to IAS. IAS calculates level based on density and sensor pressure. Then transmit these values over LAN to the Load calculator, which in turn calculates tank volumes. The volume of each tank is transmitted back for displaying on IAS. IAS can also, based on the tank table data, calculate volumes.

1.2.27. 7.1.1 Controls

7.1.1.1 IAS Control

There are no IAS controls for this unit. The tank level signals are interfaced to IAS via a serial link. The alarms are assigned in the IAS.

8 Hydraulic powerpack unit (hPU)

8.1 VALVE REMOTE CONTROL- HPU

The Hydraulic Power pack unit for providing the driving power to the remotely operated hydraulic control valves for Ballast and Bilge operations is located in the Hyd Power pack room. This unit supplies hydraulic power to the solenoid valve cabinets (No.1 and No. 2) that are located in Hydraulic Power pack room.

This unit consists of an oil reservoir of capacity 1100 litres. Two electric motor driven pumps pump oil into two (2) bladder accumulators. The bladder accumulators have a capacity of 50 litres each. The unit is supplied with Pressure sensing device, level switches and temperature sensor.

The pumps operate on lead / lag mode. The unit is supplied with a starter cum control panel. The panel is located in HPP room. No.1 Hyd pump is supplied with normal power and No.2 pump is supplied with emergency power. The hydraulic unit normal / emergency power fail alarm is interfaced to IAS (XA-062401/062402).

Both pumps start when there is no pressure in the accumulators and charge the accumulators. On falling pressure the lead pump shall start at 145 bar and the lag pump shall start at 140 bar. Both pumps stop at 165 bar. This control is affected in the starter cum control cabinet. A mechanical pressure relief valve is provided for bleeding the excess pressure and is set at 135 bar. The accumulator pre charge N2 pressure is 125 bar.

Lead/lag pump control done by the unit control panel logic	
Lead Auto Start	145 +/- 0.1 bar
Lag Auto Start	140+/- 0.1 bar
Lag Auto Stop	165+/- 0.1 bar
Lead Auto stop	165+/- 0.1 bar

The above logic is built into the unit control panel. The unit control panel has the following controls on the front facia:

- Main power switch
- Power On Lamp
- Start stop control for pumps. This control will be active only if the control switch for that pump is set to “Local” mode.
- Selection of pump1 or pump 2 to lead mode. The other pump is automatically designated as in lag mode provided that the control switch for that pump is set to either “Auto” mode or to “Remote” mode.
- Lamp and buzzer test button
- Buzzer
- Alarm indication unit.

The pumps can be started and stopped from the local control panel if the control switch for that pump is set to “local” mode. This is possible only if there is no Low-Low level alarm in the tank

The reservoir unit is fitted with two level switches. The first switch is for low-level alarm 50% level. The second switch is for low-low level alarm25% level. The pumps cannot be started in any mode if there is low-low alarm.

The pumps can also be set to “LEAD/LAG” mode in the local control panel. Each pump can separately be set to auto lead lag mode. In auto lead lag mode the pumps start and stop based on the accumulator pressure as long as there is no low-low level in the tank. The temperature of the oil in the reservoir is monitored and high temperature alarm.

The Unit panel also monitors the accumulator pressure and the repeat signal is interfaced to the IAS (PIAHL-062403) for alarm signal is interfaced to IAS.

The pumps are normally set to remote mode in the Unit control panel. When set to the remote mode (MI-062404B and 062405B) the pumps can be started and stopped from IAS (MIC-062404 and 061405). When start command is given the pumps start and automatically stop based on the pressure of the reservoir. The pumps work either in lead mode or lag mode based on the setting in the unit local control panel.

Normally the operator sets the unit control panel settings selecting both pumps to remote mode and selecting one pump to lead mode, the pumps start and work in lead lag mode. Running of the pumps are interfaced to IAS. (MI-062404A and 062405A)

1.2.28. 8.1.1 Controls

8.1.1.1 IAS Control

The Hyd. Power Pack Pumps (MIC-062404 and 062405) can be manually started and stopped from IAS screen (MC-062404A and B and 062405A and B) when the pumps are in remote (MI-062404B and MI-062405B) and there is no LOW level alarm.

The pumps can be started and stopped automatically from IAS based on pressure.

Lead pump start when pressure drops below 130bar, and stop when pressure increases above 145bar. Lag pump start when pressure drops below 125bar, and stop when pressure increases above 140bar.

Selection of lead/lag pump is done in the local panel.

Hyd. Pwr. Pack Pump No.1 (MIC-062404)		
Function	Description	Tag Number
Remote Auto Start	Lead mode 130bar Lag mode 125bar	MC-062404A
Remote Auto stop	Lead mode 145 bar Lag mode 140bar	MC-062404B
Remote Manual Start	From IAS Screen	MC-062404A
Remote Manual stop	From IAS Screen	MC-062404B

Hyd. Pwr. Pack Pump No.2 (MIC-062405)		
Function	Description	Tag Number
Remote Auto Start	Lead mode 130bar Lag mode 125bar	MC-062405A
Remote Auto stop	Lead mode 145 bar Lag mode 140bar	MC-062405B
Remote Manual Start	From IAS Screen	MC-062405A
Remote Manual stop	From IAS Screen	MC-062405B

The following Signals are interfaced from the local starter / control panel to IAS.

- Hydraulic Oil pressure PIAHL-062403; HI-170 Bar / Lo-130 Bar

8.2 Remote valves

Three types of remotely operated Hydraulic valves are used in this project. These valves are a) Double acting position control valves (VCC/VCO-xxxxxx / ZI-xxxxxx); b) Double acting ON /OFF valves (VCC/VCO-xxxxxx / ZSC/ZSO-xxxxxx) and c) Single acting on/off valves (VC-xxxxxx / ZSC/ZSO-xxxxxx).

(a) Position control valves: These valves position can be selected from the operator station and the valve can be set to Auto mode. Then the valve function block checks the current valve position and the required valve position and opens or closes the valve accordingly. IAS sends consecutive pulses to the valve closing or opening SOV till both the positions is equal. The position of the valve is interfaced to IAS

(b) Double acting open/close valves: These valves have two SOV, one for opening the valve and the other for closing the valve. These valves have two positions only either open or close position. IAS sends a pulse to the valve with a minimum pulse width of 20 seconds to either open or close the valve. The valves take different times to open and close based on the size. (See table below). IAS shall generate a discrepancy alarm after the time delay if the opened OR closed feedback is not received. The open and close position of these valves is interfaced to the IAS.

(c) Single acting valves: Single acting valves are always open when energized and closed when de-energized. IAS shall keep the output to SOV held for keeping the valve open. Discrepancy alarm is generated as above. The open and close position of these valves is interfaced to the IAS.

1.2.29. 8.2.1 Valve opening and closing times:

Valve size	Required time for Valve open/shut
100A and below	Up to 10 sec
125 A	5 to 15 sec
150A	6-18 Sec
200A	8-24 Sec
250A	10-30 Sec
300A	12-36 Sec

Valve size	Required time for Valve open/shut
350A	14-42 Sec
400A	16 –48 Sec
450A	18-54 Sec
500A	20-60 sec
550A	22 to 66 sec
600A	24 to 72 sec
650A	26 to 78 sec
700A	28 to 84 sec
750A	30 to 90 sec
800A	32 to 96 sec
850A	34 to 102 sec
900A	36 to 108 sec
1000A	40 to 120 sec
> 1000A	> 120 sec

8.3 HPU for Deck Machinery

Two (2) hydraulic power pack units, one located in Bosun stores and the other located in Rope store provide the hydraulic power required for deck machinery.

The HPU in Bosun stores supply power for forward area mooring winches. The rope store HPU provide power to aft area powers mooring winches and the burner boom swivelling system of the vessel. The Fwd and Aft deck machinery HPU abnormal alarms are interfaced to IAS (XA-062408/062409).

8.4 Base oil and Brine system

Ref : Hullside P&ID : MB 101.25

NOV Doc. : T8479-Z-SA-001 Mud control system Functional description

T8479-Z-KA-001 FAT for mud control system

The facility is fitted with 2 off Base oil transfer pumps (324G1G1 , 324G1G2) and 2 off Brine transfer pumps (324G2G1, 324G2G2). These systems are fitted for Topside use.

The pumps can be started and stopped from both the IAS and topside MCS (Mud control system) . Only one part can operate the equipment at a time. If the communication between MCS and IAS fail, MCS automatically receive the control. Pumps start/stop command and running status are transferred on serial link from topsides MCS through DCI-IAS Serial link. No automatic transfers are performed by MCS. One mimic diagram is provided for the Base oil and brine pumps in the IAS.

The Base oil Pump draw suction from Base oil tank(P). The pumps are fitted with remotely operable suction (OB514F) and discharge valves (OB508F / OB509F)

No.1 Brine pumps can withdraw suction from No.1 Brine tanks(P) through remotely operated valve WB501F and No.2 draw suction from No.2 Brine tanks(P) through remotely operated valve WB502F . Pumps discharge are passed WB511F& WB512F.

Pumps controls are hardwired to topside MCS (Mud control system) from Topside MCC. MCC Starters are controlled by MCS system via remote I/O in Topside MCC (3D89101).

All remotely operated valves are wired directly to Mud control system (3D24708).

No.1 Base Oil Pump (324G1G1)		
Function	**Description**	**Tag Number**
Remote Auto Start	Not applied.	
Remote Auto stop	Not applied.	
Remote Manual Start	From IAS Screen	MC-073205A

No.1 Base Oil Pump (324G1G1)		
Function	**Description**	**Tag Number**
Remote Manual stop	From IAS Screen	MC-073205B

No.2 Base Oil Pump (324G1G2)		
Function	**Description**	**Tag Number**
Remote Auto Start	Not applied.	
Remote Auto stop	Not applied.	
Remote Manual Start	From IAS Screen	MC-073206A
Remote Manual stop	From IAS Screen	MC-073206B

No.1 Brine Pump (324G2G1)		
Function	**Description**	**Tag Number**
Remote Auto Start	Not applied.	
Remote Auto stop	Not applied.	
Remote Manual Start	From IAS Screen	MC-073203A
Remote Manual stop	From IAS Screen	MC-073203B

No.2 Brine Pump (324G2G2)		
Function	**Description**	**Tag Number**
Remote Auto Start	Not applied.	
Remote Auto stop	Not applied.	
Remote Manual Start	From IAS Screen	MC-073204A
Remote Manual stop	From IAS Screen	MC-073204B