

# **BESI Armaturen** **TANK MANAGEMENT SYSTEM**

## **Visualisation and Control of Valves and Tank Contents on Bord of Ocean Vessels**

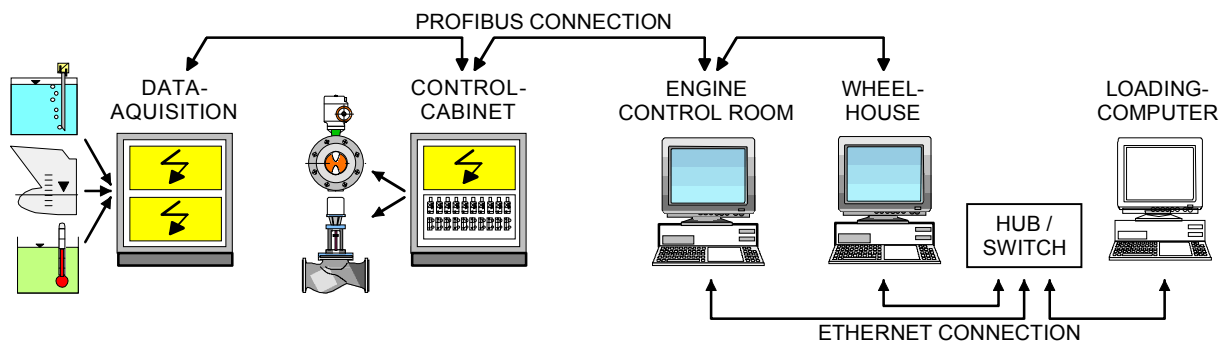
### Introduction

Handling of fluids on bord of ocean vessels is especially important as this has a large influence on the vessel's stability. Thus, for all components used the shipping company will usually require the authorisation of a classification society.

### Control System

#### a) Hardware

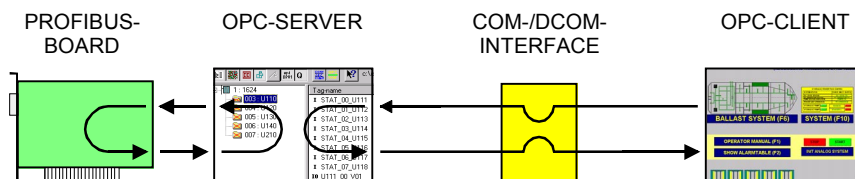
The central part of the system introduced below are personal computers authorised for the use on ships and each equipped with a ProfiBus-Board for the communication with the external hardware. Standard interfaces provide the data transfer with further systems.



*Illus.1 – Arrangement of the hardware*

#### b) Software

The operating system applied is MS-Windows™ NT4.0. The programme was developed with the automation software Lookout™ of National Instruments. The data link hardware/software is realised via the OPC<sup>1</sup>-server by means of a COM-/DCOM<sup>2</sup> interface.



*Illus.2 – Software interface*

<sup>1</sup> OPC = Object Linking and Embedding (OLE) for Process Control, the software „OPC Server“ belongs to the ProfiBus Card.  
<sup>2</sup> COM-/DCOM = (Distributed) Component Object Model, is component part of the Microsoft operating system Windows NT.

## Visualisation & Control

In order to have a better survey over the plant the layout of all functional modules is designed in the same way:

- > The upper half of the picture shows the piping system including all pipings, pumps and valves. Pipings not used will be displayed as a double line. When valves are opened and pipings thus switched free they are „filled“ and so specially marked. Operating errors and dangerous situations connected with these may thus be avoided.
- > The lower half of the picture displays analog input values such as tank contents, temperature and pump pressure in digital and analog (proportional) form.

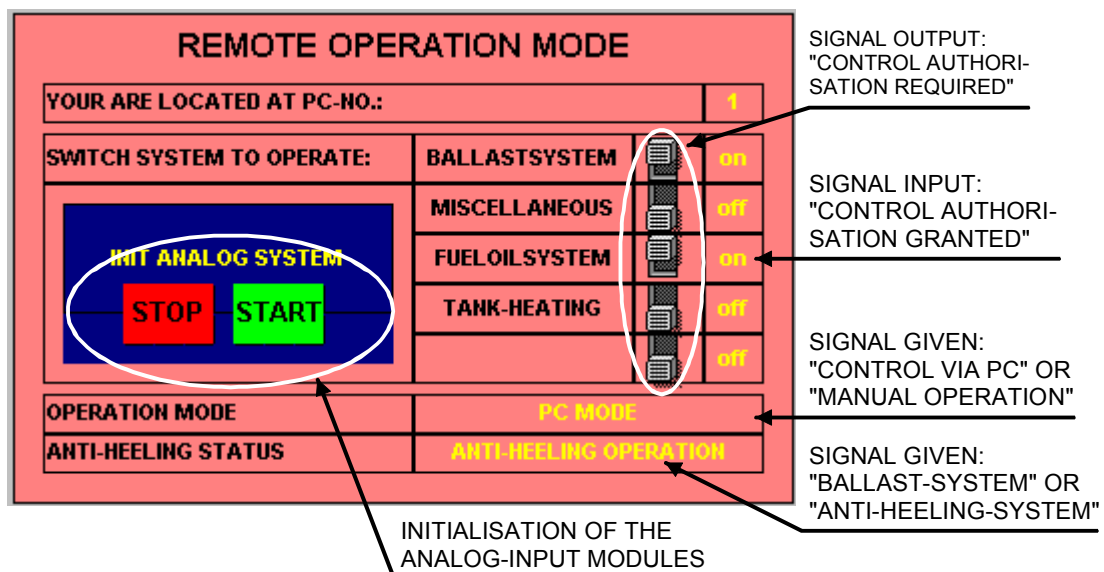
Pump control systems and other operating elements (as required in different situations) are arranged in terms of clarity.

Valves are controlled by clicking on the respective symbols which show their positions by changing colours (red = closed, green = open, yellow = intermediate position). Individual alarms in the valve control system or of the level indicator will either be optically displayed by means of blinking symbols or by active system signals and are listed in the functional module „Alarm Monitoring“.

## Operation from Different PCs

Working with several PCs in a network is the regular case: E.g. one PC is located in the machinery control room and used for the control of the fueloil system and another PC located on the bridge controls the ship's balance by means of the anti-heeling system or with the ballast system.

It is not allowed the actively control one system from two different locations at the same time, however, it must be possible to check all plant conditions from any point. The software will be established with validity for all PCs and authorisation rights on pre-defined parts of the system will be given by means of identification code numbers. In addition, it is thus guaranteed that when one PC is on failure the other units may take over its functions. If, in addition to this, the databus is also designed in double, redundancy will be available to a very high degree.



Illus.3 – Authorisation rights

## Modules for the Operation of the System

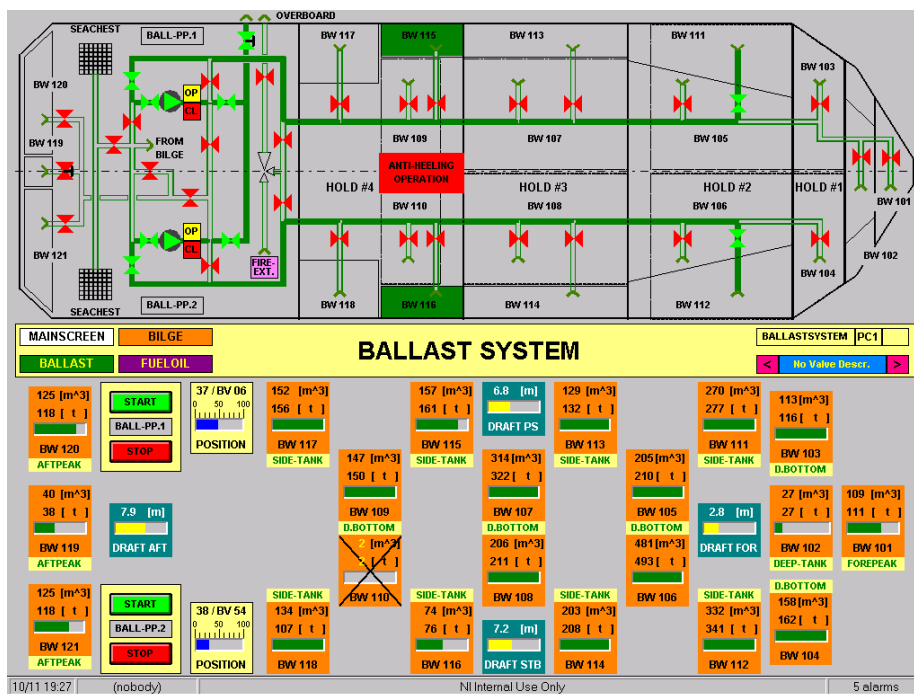
All systems may directly be activated via the functional keys F1 to F12. The hierarchy of the systems is in accordance with their application and importance. Functional modules may be released or locked according to request.

### Mainscreen (F5)

Main screen with a survey on the systems available, each may be selected via the functional keys (F1 - F12) or by clicking onto the symbols.

### Ballast System (F6)

- > Remote control of valves with position indicators
- > Levels of all relevant tanks including volumes and material mass
- > Pumps Start/Stop, pressure gauge for the overpressure and negative pressure sides.



*Illus.4 – Pumping of ballast water out of the tanks BW111&BW112 at similar operation of the anti-heeling system*

### Bilge System / Miscellaneous (F7)

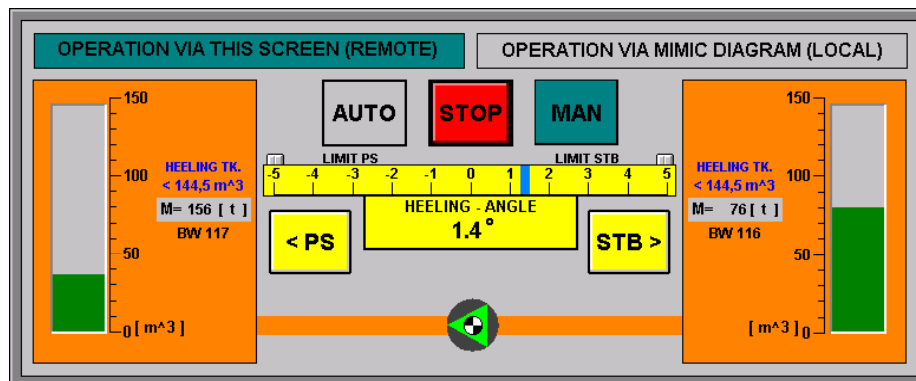
- > Remote control of valves with position indicators
- > Overflow display (binary) of bilge wells including alarms
- > Pumps Start/Stop, pressure gauge for discharge and suction pressure
- > Level indicators for fresh- and potable water tanks.

### Fueloil System (F8)

- > Remote control of valves with position indicators
- > Levels of all relevant tanks including volumes and fluid mass
- > Temperature displays of the fueloil tanks including alarm points.

## Anti-Heeling System (F9)

The anti-heeling system keeps a vessel in a horizontal position during loading and unloading procedures by means of pumping ballast water from portside to starboard (or vice versa). The virtual control panel contains all necessary displays and operation instruments for the functioning of this. Status indicators and status keys are arranged one upon the other and thus give the impression of illuminated pressure keys through this compact arrangement. Heeling angles and levels of the opposite tanks together with active pumps displays complete the picture.



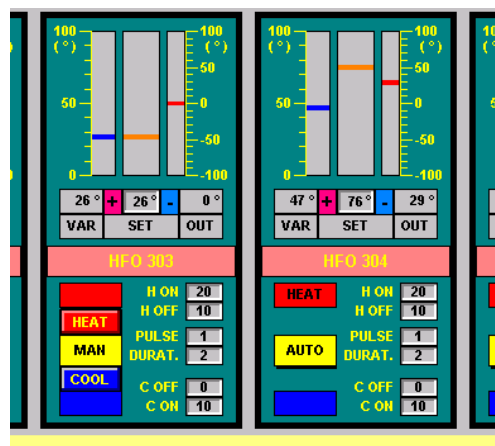
Illus.5 – Manual balancing of the heeling of approx. 1.4°

## System Control (F10)

- > Status of data acquisition system (hardware & software)
- > Pneumatic or hydraulic pressure and electric power control
- > Other components for the operation of the different systems

SYSTEM MODULES STATUS							
U111	U112	U113	U114	U115	U116	U117	U118
OK	OK	OK	OK	OK	OK	OK	OK
U121	U122	U123	U124	U125	U126	U127	U128
OK	OK	OK	OK	OK	OK	OK	OK
U131	U132	U133	U134	U135			
FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
U141	U142	U143	U144	U145	U146	U147	
OK	OK	OK	OK	OK	OK	OK	OK
STATUS OF ANALOG MODULES INITIALIZATION							
U211	U212	HYDRAULIC POWER PACK					
OK	OK						

Illus.6 – Data error in knot no. 3



Illus.7 – Detailed view of temperature regulator

## Temperatures (F11)

Arrangement of temperature regulators for the heating of the fueloil tanks with each

- > Input & display of process value, set value
- > Optional clock frequency for the operation of electrically controlled valves
- > Service operation selection „manual“ or „automatic“ with illuminated push buttons.

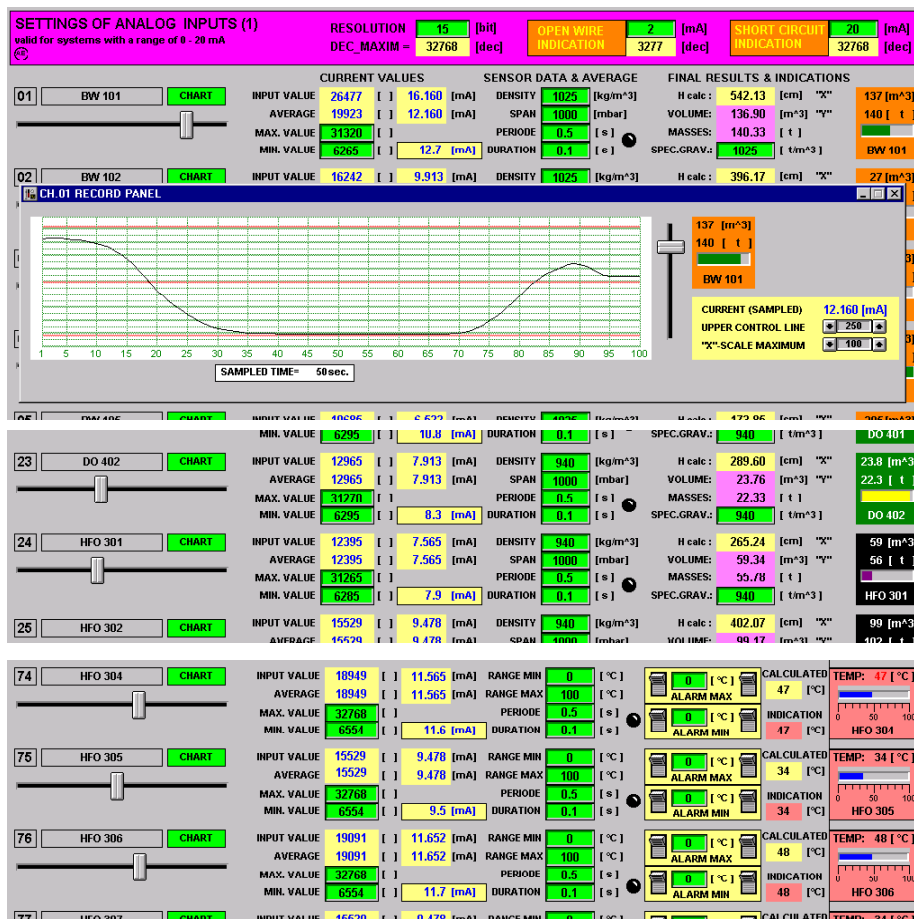
The above mentioned functional program parts enable the operation of the complete system. However, during a commissioning different parameters must be set: In order to have a correct display all analog inputs must be calibrated, binary signal inputs and switching outputs e.g. must be compared with running period alarms.

## Modules for the Calibration of Analog Inputs

### Settings of Analog Inputs (CTRL-& F1) to (CTRL-& F12)

Calibration of the analog data acquisition and the adjustment of sensors on the selected screen.

- > Push button „CHART“ with linewriter function for each single channel.
- > The potentiometer reflects the collected analog value; the Pots are able to be hold with the left mouse key and moved it into the desired direction so you can simulate analog values and check displays and selected alarms.
- > Free selection of specific weight for tank contents
- > Free setting of values for min. alarm & max. alarm.



Illus.8 – Calibration of analog inputs

## Modules for the Definition of Operating Elements and Displays

### Definition of Binary Signals (SHIFT-& F1) to (SHIFT -& F12)

- > Definition of all binary input and output signals
- > Standard setting of switch reactions (bistable/ monostable)
- > Display of valve positions
- > Setting of runtime alarms for valves
- > Allocation of identifications for PCs and components

NO	NAME BESI YARD	OPERATION		OFF	POS	ALARM	ALARM-TIMER			INDICATIONS								
		SET INP	DEL DEL	AHS SYS	IND op		IND cl	IND opt	IND tbi	IND DEL	IND ON	IND OPEN	IND DEL	IND ON	IND CLOSED	IND HOR	IND BESI	IND YARD
1	BV 03	off	OP	1	1		S	off										
2	BV 04	on	OP	1	1		S	on	A									
3	BV 05	on	OP	1	1		S	off										
4	BV 07	off	OP	1	1		S	on	A									
11	BV 15	on	OP	1	1		S	on	A									
12	BV 16	off	OP	1	1		S	off										
13	BV 17	off	OP	1	1		S	on	A									
14	BV 18	off	OP	1	1		S	on	A									

Illus.9 – Definition of the valve control including runtime alarms

HYDRAULIC POWER PACK CONTROL																			
U212-03	LOW OIL LEVEL INDICATION																		
U212-04	LOW OIL PRESSURE INDICATION																		
U212-05	PRESSURE PRESENT INDICATION																		
U212-06	PUMP STATUS INDICATION																		
U212-07	LOCAL/MANUAL OPERATION																		
U212-08	REMOTE/PC OPERATION																		
U212-09	PUMP1 STANDBY																		
U212-10	PUMP2 STANDBY																		
U212-11	SUPPLY FLOW INDICATION																		
U212-12	RETURN FLOW INDICATION																		
<table border="1"> <thead> <tr> <th>SYSTEM STATUS</th> <th>SYSTEM RUNNING</th> </tr> </thead> <tbody> <tr> <td>OIL LEVEL STATUS</td> <td>OIL LEVEL OK</td> </tr> <tr> <td>OIL PRESSURE STATUS</td> <td>OIL PRESSURE OK</td> </tr> <tr> <td>SUPPLY FLOW INDICATION</td> <td></td> </tr> <tr> <td>RETURN FLOW INDICATION</td> <td>RETURN FLOW</td> </tr> <tr> <td>PUMP STATUS INDICATION</td> <td>PUMPS OK</td> </tr> <tr> <td>POWER UNIT OPERATION</td> <td>PC OPERATION</td> </tr> <tr> <td>HYDRAULIC PUMP 1</td> <td>START RUNNING STOP</td> </tr> <tr> <td>HYDRAULIC PUMP 2</td> <td>START STANDBY STOP</td> </tr> </tbody> </table>		SYSTEM STATUS	SYSTEM RUNNING	OIL LEVEL STATUS	OIL LEVEL OK	OIL PRESSURE STATUS	OIL PRESSURE OK	SUPPLY FLOW INDICATION		RETURN FLOW INDICATION	RETURN FLOW	PUMP STATUS INDICATION	PUMPS OK	POWER UNIT OPERATION	PC OPERATION	HYDRAULIC PUMP 1	START RUNNING STOP	HYDRAULIC PUMP 2	START STANDBY STOP
SYSTEM STATUS	SYSTEM RUNNING																		
OIL LEVEL STATUS	OIL LEVEL OK																		
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POWER UNIT OPERATION	PC OPERATION																		
HYDRAULIC PUMP 1	START RUNNING STOP																		
HYDRAULIC PUMP 2	START STANDBY STOP																		

Illus.10 – TAG allocation of system signals

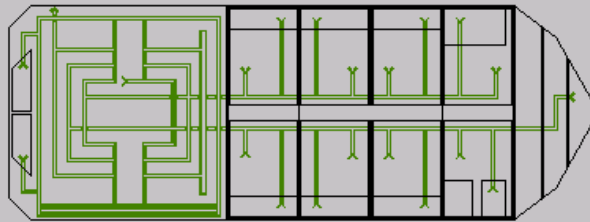
## Conclusion

The software TANK MANAGEMENT SYSTEM is a system for the visualisation and control of plants for fluid operations on board of ocean vessels.

All functions are graphically displayed in separate programm parts and may be called directly via shortcuts. A large number of system components may freely be adapted even under operation conditions.

# BESI Armaturen Tankmanagement System

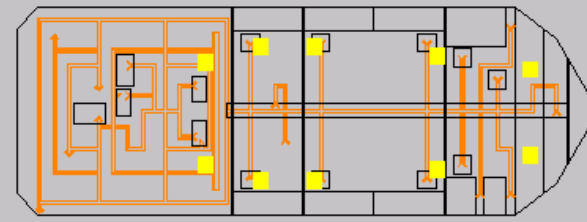
(NEWBUILDINGS NEW CENTURY SY NB JS99-014/015)



**BALLAST SYSTEM (F6)**

HYDRAULIC POWER PACK CONTROL	
SYSTEM STATUS	CHECK EMERGENCY SWITCH
OIL LEVEL STATUS	OIL LEVEL OK
OIL PRESSURE STATUS	
PUMP STATUS INDICATION	PUMPS OK
POWER UNIT OPERATION	
HYDRAULIC PUMP 1	STANDBY
HYDRAULIC PUMP 2	STANDBY

**SYSTEM (F10)**



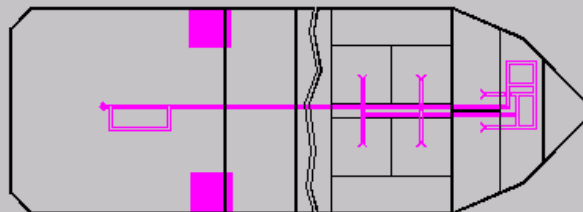
**BILGE SYSTEM (F7)**

**SHOW ALARMTABLE (F2)**

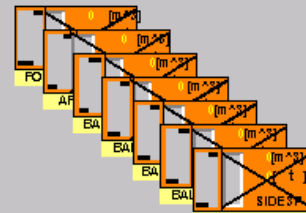
**ALARM ACKNOWLEDGE (F3)**

**CLOSE ALARMTABLE (F4)**

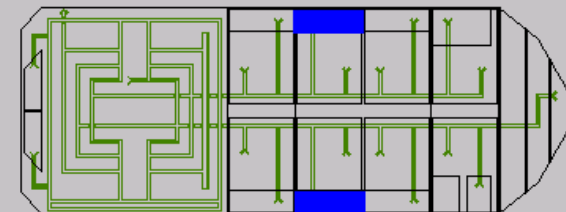
**BUNKER ALARM (F11)**



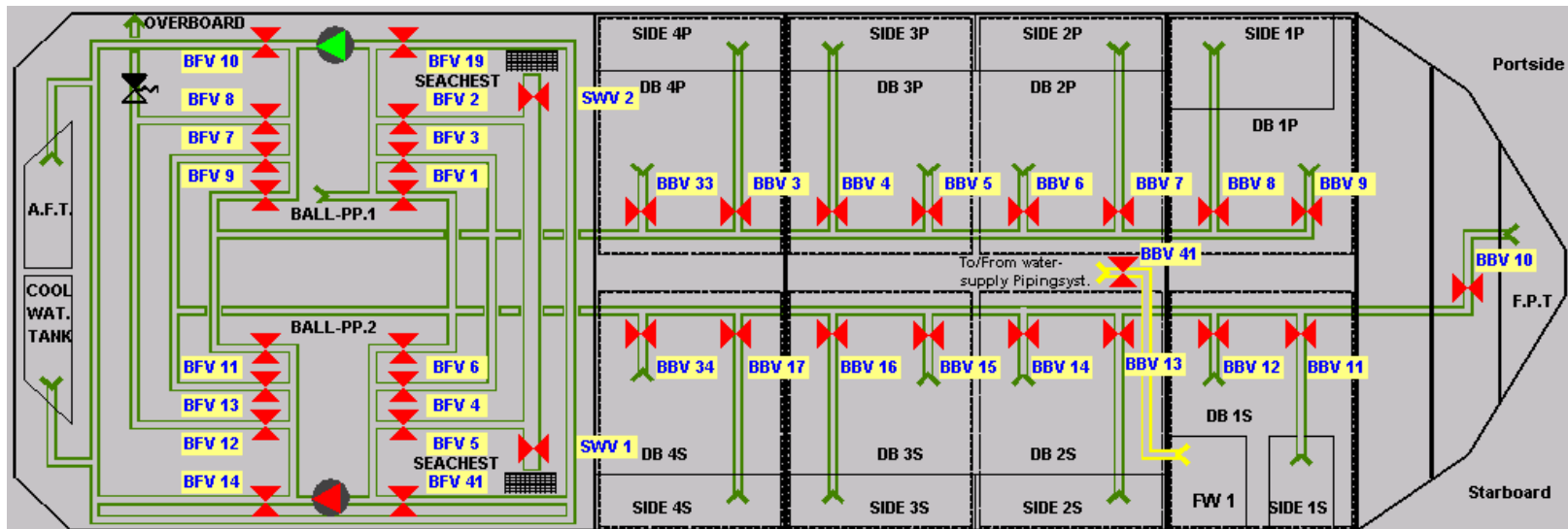
**FUEL OIL SYSTEM (F8)**



**TANKS**



**AHS & STABI-TEST (F9)**



**BALLAST SYSTEM**

MAINSCREEN | BILGE | BALLAST- & AHS-SYSTEM PC1

FUELOIL | ANTIHEELING | ANTI-HEELING

Yard's Valve No.

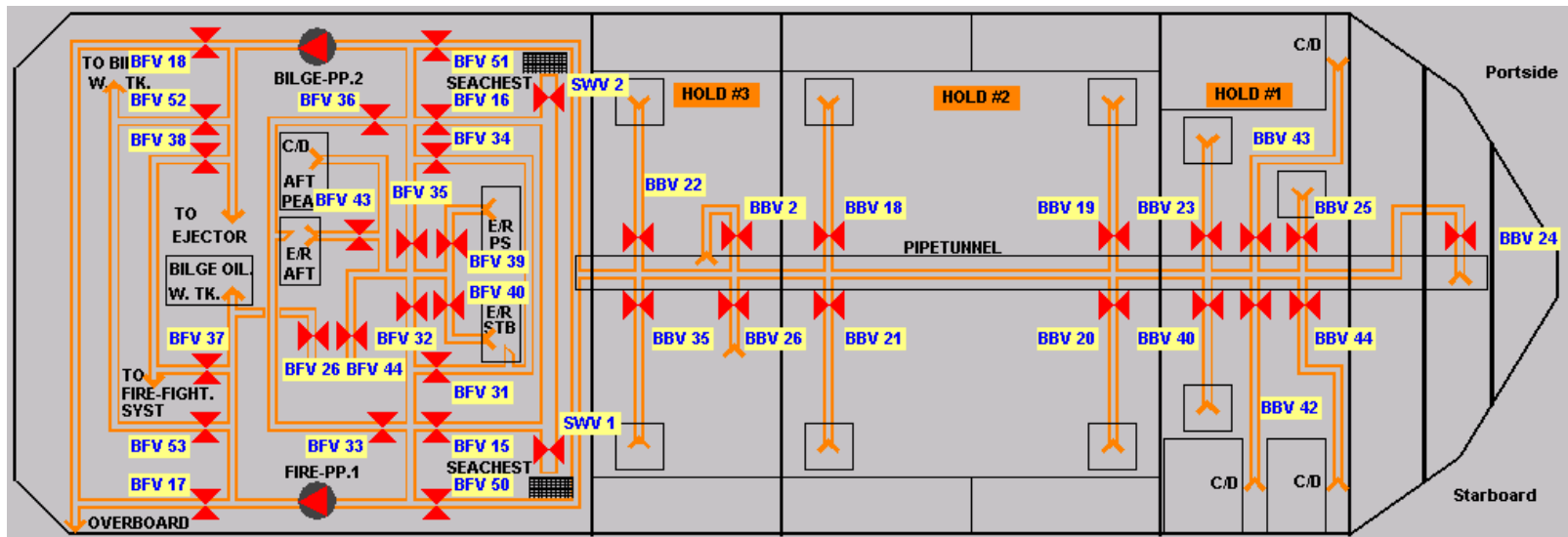
<p>58 [m<sup>3</sup>] / 58 [t]</p> <p>FW 1</p> <p>FRESHWATER TANK</p> <p>START</p> <p>BALL-PP.1</p> <p>STOP</p>	<p>4.3 [m]</p> <p>DRAFT PS</p>	<p>96 [m<sup>3</sup>] / 99 [t]</p> <p>SIDE 4P</p> <p>BALLASTWATER</p>	<p>184 [m<sup>3</sup>] / 189 [t]</p> <p>SIDE 3P</p> <p>BALLASTWATER</p>	<p>231 [m<sup>3</sup>] / 236 [t]</p> <p>SIDE 2P</p> <p>BALLASTWATER</p>	<p>254 [m<sup>3</sup>] / 260 [t]</p> <p>SIDE 1P</p> <p>BALLASTWATER</p>
<p>118 [m<sup>3</sup>] / 121 [t]</p> <p>A.F.T.</p> <p>AFTPEAK TANK</p>	<p>4.1 [m]</p> <p>DRAFT AFT</p>	<p>316 [m<sup>3</sup>] / 324 [t]</p> <p>DB 4P</p> <p>DOUBLE BOTTOM BW</p>	<p>290 [m<sup>3</sup>] / 297 [t]</p> <p>DB 3P</p> <p>DOUBLE BOTTOM BW</p>	<p>278 [m<sup>3</sup>] / 285 [t]</p> <p>DB 2P</p> <p>DOUBLE BOTTOM BW</p>	<p>118 [m<sup>3</sup>] / 121 [t]</p> <p>DB 1P</p> <p>DOUBLE BOTTOM BW</p>
<p>7 [m<sup>3</sup>] / 7 [t]</p> <p>FW 2</p> <p>FRESHWATER TANK</p> <p>START</p> <p>BALL-PP.2</p> <p>STOP</p>	<p>5.7 [m]</p> <p>DRAFT STB</p>	<p>316 [m<sup>3</sup>] / 324 [t]</p> <p>DB 4S</p> <p>DOUBLE BOTTOM BW</p>	<p>290 [m<sup>3</sup>] / 297 [t]</p> <p>DB 3S</p> <p>DOUBLE BOTTOM BW</p>	<p>278 [m<sup>3</sup>] / 285 [t]</p> <p>DB 2S</p> <p>DOUBLE BOTTOM BW</p>	<p>116 [m<sup>3</sup>] / 119 [t]</p> <p>DB 1S</p> <p>DOUBLE BOTTOM BW</p>
		<p>151 [m<sup>3</sup>] / 155 [t]</p> <p>SIDE 4S</p> <p>BALLASTWATER</p>	<p>177 [m<sup>3</sup>] / 181 [t]</p> <p>SIDE 3S</p> <p>BALLASTWATER</p>	<p>159 [m<sup>3</sup>] / 163 [t]</p> <p>SIDE 2S</p> <p>BALLASTWATER</p>	<p>73 [m<sup>3</sup>] / 74 [t]</p> <p>SIDE 1S</p> <p>BALLASTWATER</p>

498 [m<sup>3</sup>] / 510 [t] F.P.T. FOREPEAK TANK

6.7 [m] DRAFT FOR

26/06 15:35 (nobody) BESİ ARMATUREN GmbH 5 alarms





MAINSCREEN
FUELOIL
BALLAST
BILGE SYSTEM
BILGESYSTEM PC1
Yard's Valve No.
5

10 [m<sup>3</sup>]  
10 [ t ]  
BILGE W

BILGE WATER TANK

7 [m<sup>3</sup>]  
7 [ t ]  
BILGE OIL W

BILGE OILY WATER

START

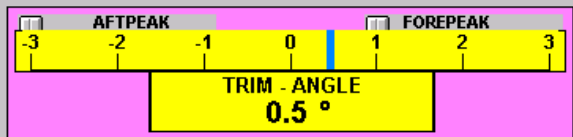
BILGE-PP.2

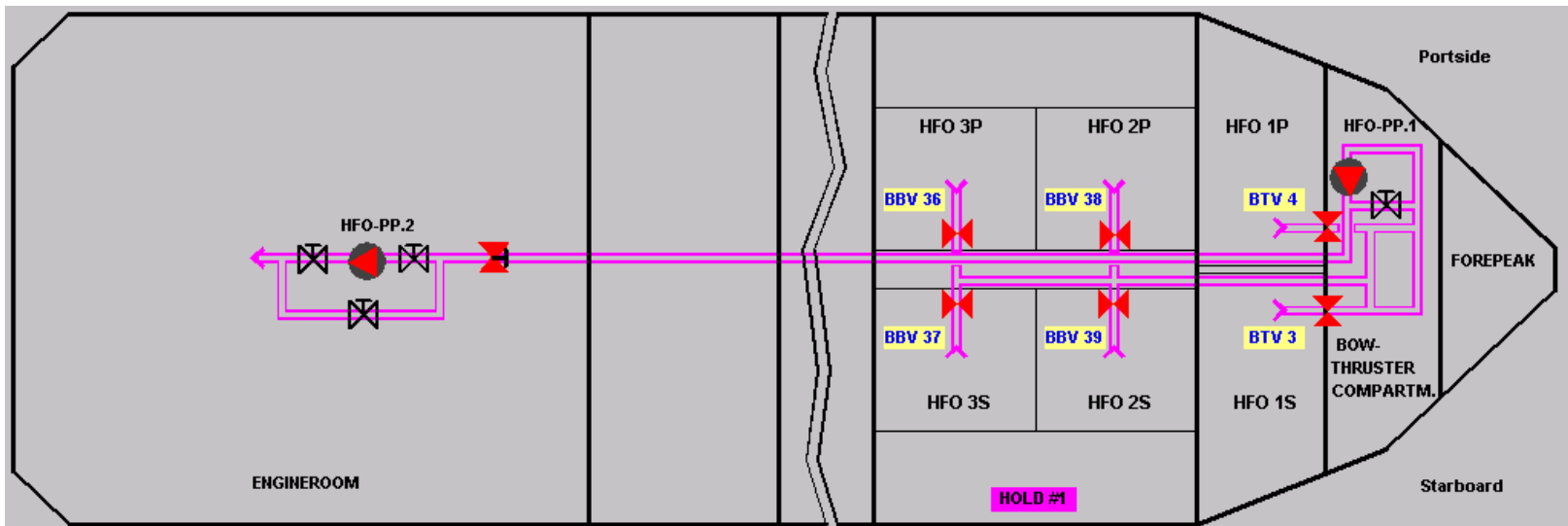
STOP

START

FIRE-PP.1

STOP





**FUEL OIL SYSTEM**

<p>33 [m<sup>3</sup>] 32 [ t ] SETTLING HFO STORAGE TANK</p> <p>46 [m<sup>3</sup>] 38 [ t ] MDO STOR MDO STORAGE TANK</p> <p>5 [m<sup>3</sup>] 5 [ t ] OVERFLOW HFO STORAGE TANK</p> <p>26 [m<sup>3</sup>] 26 [ t ] DIRTY OIL DIRTY OIL TANK</p>	<p>8 [m<sup>3</sup>] 8 [ t ] CYL. STOR CYL.O.STORAGE TK</p> <p>19 [m<sup>3</sup>] 17 [ t ] M/E STOR M/E L.O. STORAGE TK</p> <p>9 [m<sup>3</sup>] 9 [ t ] LO DRAIN LUB.OIL TANK</p>	<p>27 [m<sup>3</sup>] 26 [ t ] SERV 1 SERVICE TANK 1</p> <p>27 [m<sup>3</sup>] 26 [ t ] SERV 2 SERVICE TANK 2</p> <p>6 [m<sup>3</sup>] 5 [ t ] SERV MDO SERVICE TANK</p>	<p><input type="button" value="START"/> <input type="button" value="HFO-PP.2"/> <input type="button" value="STOP"/></p> <p>39 [m<sup>3</sup>] 40 [ t ] HFO 4 HFO STORAGE TANK</p> <p><input type="button" value="START"/> <input type="button" value="HFO-PP.1"/> <input type="button" value="STOP"/></p>	<p>147 [m<sup>3</sup>] 141 [ t ] HFO 3P HFO STORAGE TANK</p> <p>84 [m<sup>3</sup>] 81 [ t ] HFO 2P HFO STORAGE TANK</p> <p>160 [m<sup>3</sup>] 154 [ t ] HFO 1P HFO STORAGE TANK</p> <p>201 [m<sup>3</sup>] 193 [ t ] HFO 3S HFO STORAGE TANK</p> <p>102 [m<sup>3</sup>] 98 [ t ] HFO 2S HFO STORAGE TANK</p> <p>135 [m<sup>3</sup>] 129 [ t ] HFO 1S HFO STORAGE TANK</p>
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26/06 15:41 (nobody) BESİ ARMATUREN GmbH 2 alarms

### DATA AKQUISITION SYSTEM

DATA CONNECTION (1) ANALOG	CHECK DATA-COMM!
DATA CONNECTION (2) BINARY	CHECK DATA-COMM!
DATA CONNECTION (3) HEELING	COMMUNICATION OK
OPC-SERVER CONN. (1) ANALOG	SERVER NOT UPDATING
OPC-SERVER CONN. (1) BINARY	SERVER NOT UPDATING
OPC-SERVER CONN. (1) HEELING	OPC-SERVER UPDATING
DEADMAN INDICATION PC(1)	NOT PRESENT
DEADMAN INDICATION PC(2)	NOT PRESENT

### REMOTE OPERATION MODE

YOUR ARE LOCATED AT PC-NO.: 1

RESET CONTROL SYSTEM  
RESET AHS SYSTEM

SWITCH SYSTEM TO OPERATE:	BALLAST- & AHS-SYSTEM		PC1
	BILGESYSTEM		PC1
	FUELOILSYSTEM		PC1

ANTI-HEELING STATUS: ANTI-HEELING OPERATION


MAINSCREEN	BILGE
BALLASTSYSTEM	FUELOIL











## SYSTEM CONTROL



### HYDRAULIC POWER PACK CONTROL

SYSTEM STATUS	CHECK EM.CY SWITCH
OIL LEVEL STATUS	OIL LEVEL OK
OIL PRESSURE STATUS	
PUMP STATUS INDICATION	PUMPS OK
POWER UNIT OPERATION	
HYDRAULIC PUMP 1	<span style="border: 1px solid black; padding: 2px;">START</span> <span style="border: 1px solid black; padding: 2px;">STANDSTILL</span> <span style="border: 1px solid black; padding: 2px;">STOP</span>
HYDRAULIC PUMP 2	<span style="border: 1px solid black; padding: 2px;">START</span> <span style="border: 1px solid black; padding: 2px;">STANDSTILL</span> <span style="border: 1px solid black; padding: 2px;">STOP</span>

MAINSCREEN **FUELOIL** **BUNKERSTATION - ALARMS** 

NO	NAME	ALARM		INDICATIONS	NO	NAME	ALARM		INDICATIONS
		opt	tbl				opt	tbl	
1	<b>HFO 1P</b>	Alarms by	85 %	206 [m <sup>3</sup> ]	6	<b>HFO 3S</b>	Alarms by	95 %	218 [m <sup>3</sup> ]
 TAB. ON OPT. ON					 TAB. ON OPT. ON				
160 [m <sup>3</sup> ] 154 [ t ] <b>HFO 1P</b> HFO STORAGE TANK					201 [m <sup>3</sup> ] 193 [ t ] <b>HFO 3S</b> HFO STORAGE TANK				
2	<b>HFO 1S</b>	Alarms by	95 %	230 [m <sup>3</sup> ]	7	<b>HFO 4</b>	Alarms by	95 %	81 [m <sup>3</sup> ]
 TAB. ON OPT. ON					 TAB. ON OPT. ON				
135 [m <sup>3</sup> ] 129 [ t ] <b>HFO 1S</b> HFO STORAGE TANK					39 [m <sup>3</sup> ] 40 [ t ] <b>HFO 4</b> HFO STORAGE TANK				
3	<b>HFO 2P</b>	Alarms by	95 %	173 [m <sup>3</sup> ]	8	<b>MDO STOR</b>	Alarms by	95 %	128 [m <sup>3</sup> ]
 TAB. ON OPT. ON					 TAB. ON OPT. ON				
84 [m <sup>3</sup> ] 81 [ t ] <b>HFO 2P</b> HFO STORAGE TANK					46 [m <sup>3</sup> ] 38 [ t ] <b>MDO STOR</b> MDO STORAGE TANK				
4	<b>HFO 2S</b>	Alarms by	95 %	218 [m <sup>3</sup> ]	9	<b>CYL. STOR</b>	Alarms by	95 %	25 [m <sup>3</sup> ]
 TAB. ON OPT. ON					 TAB. ON OPT. ON				
102 [m <sup>3</sup> ] 98 [ t ] <b>HFO 2S</b> HFO STORAGE TANK					8 [m <sup>3</sup> ] 8 [ t ] <b>CYL. STOR</b> CYL.O.STORAGE TK				
5	<b>HFO 3P</b>	Alarms by	95 %	181 [m <sup>3</sup> ]	10	<b>M/E STOR</b>	Alarms by	95 %	22 [m <sup>3</sup> ]
 TAB. ON OPT. ON					 TAB. ON OPT. ON				
147 [m <sup>3</sup> ] 141 [ t ] <b>HFO 3P</b> HFO STORAGE TANK					19 [m <sup>3</sup> ] 17 [ t ] <b>M/E STOR</b> M/E L.O. STORAGE TK				

26/06 15:57 (nobody) BESI ARMATUREN GmbH 2 alarms

# AHS - MAINSCREEN



SELECTION OF:  
AUTOMATIC ANTIHEELING SYSTEM WITH STABILITY TEST UNIT  
OR MANUAL ANTIHEELING SYSTEM

STEP 1 : SWITCH "ON" PROFIBUS CONNECTION



PROFIBUS CONNECTED

STEP 2 : START THE ANTIHEELINGSYSTEM



ANTI-HEELING OPERATION

STEP 3 : START THE PUMP TO OPERATE WITH

START  
BALL-PP.1   
STOP

START  
BALL-PP.2   
STOP

STEP 4 : CHOOSE MANUAL- OR AUTOMATICMODE



AUTOMATIC - MODE SELECTED

STEP 5 : CHOOSE YOUR WAY TO CONTINUE  
AND START AHS WITH AUTO-MODE

START AUTO-MODE

6

2 = CHOOSE SYSTEM

4 = RESET

MAINSCREEN

BALLASTSYSTEM

BALLAST- & AHS-SYSTEM

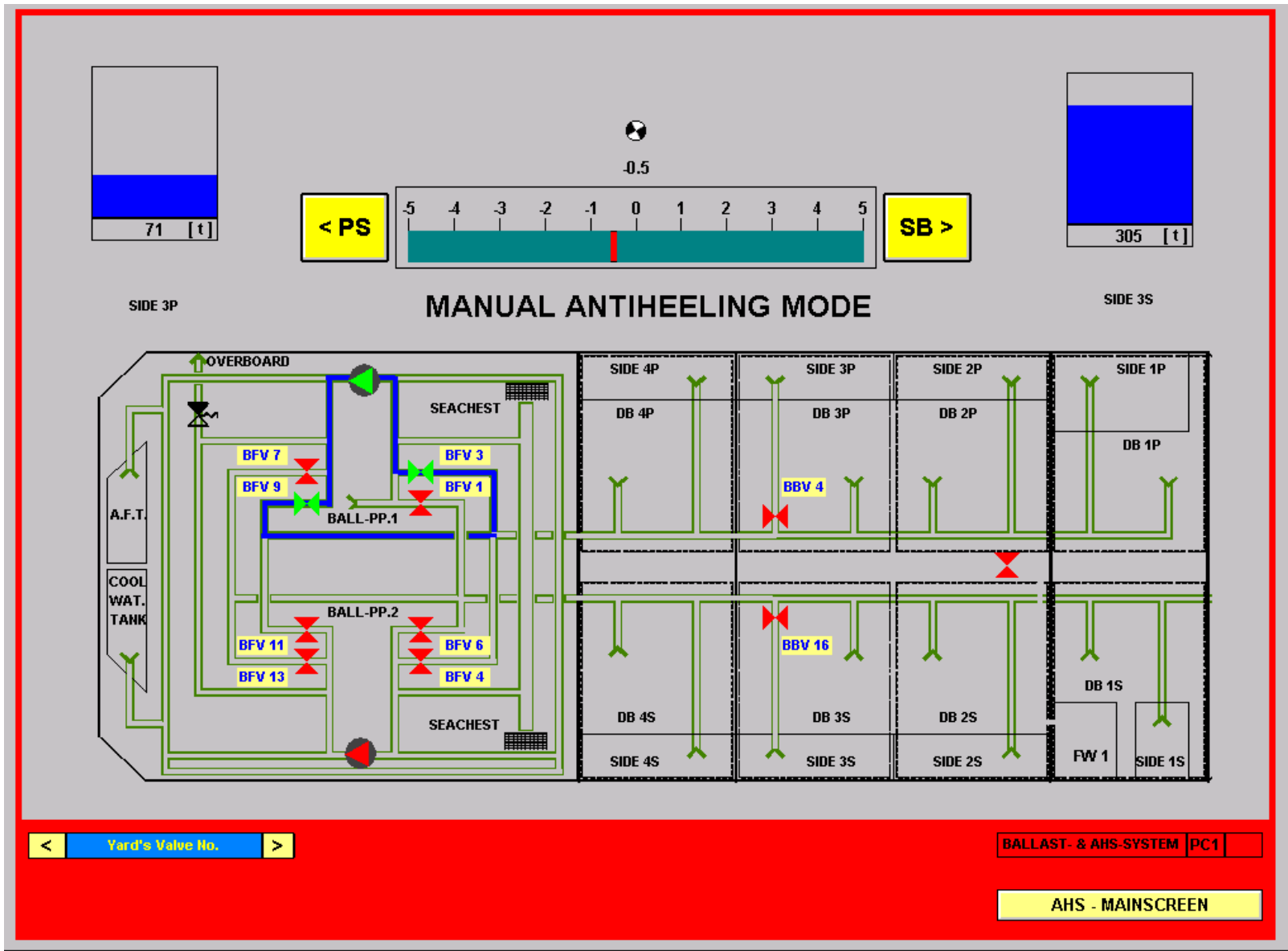
PC1

26/06 15:59

(nobody)

BESI ARMATUREN GmbH

2 alarms

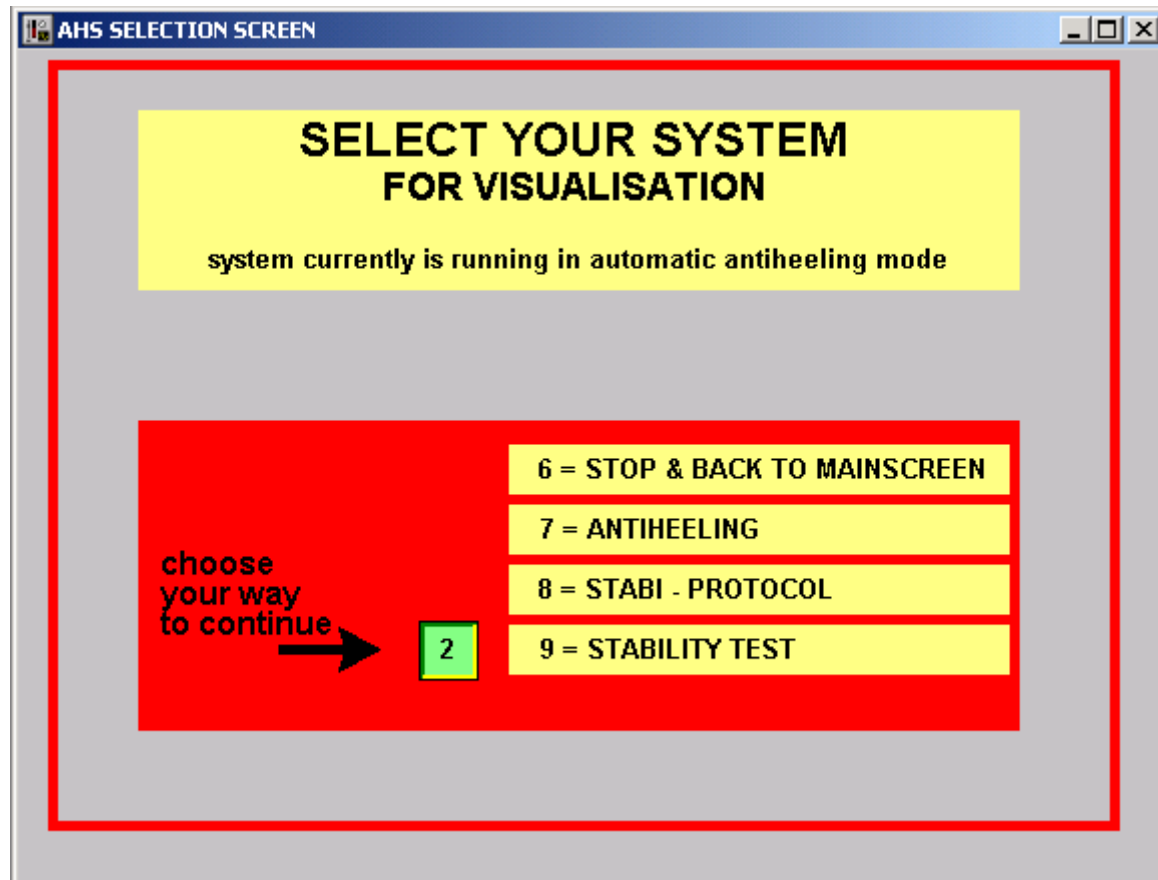



26/06 16:04

(nobody)

BESI ARMATUREN GmbH


2 alarms



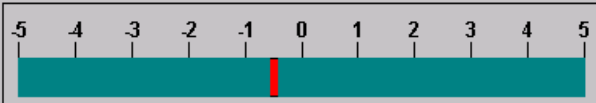



71 [t]  
SIDE 3P

PUMP TO STARBOARD



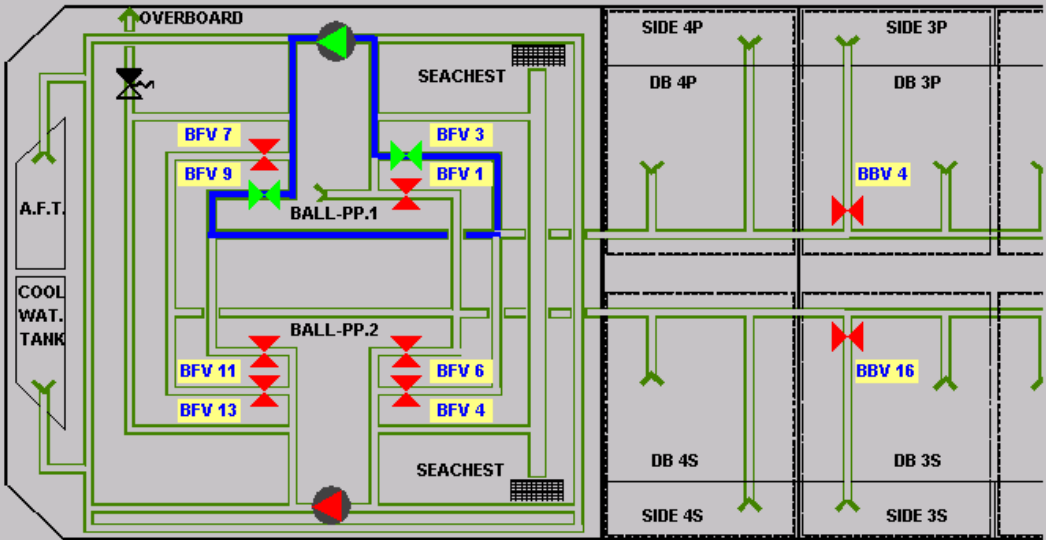
-0.5





305 [t]  
SIDE 3S

### AUTOMATIC ANTIHEELING IN PROGRESS



choose your way to continue →

2 = SELECTION SCREEN

6 = STOP AUTOMATIC OPERATION

BALLAST- & AHS-SYSTEM PC1

7

Yard's Valve Ho.

26/06 16:16
(nobody)
BESI ARMATUREN GmbH
2 alarms



**AHS INPUT SCREEN**

## STABILITY-TEST INPUT

YOU ARE REQUESTED FOR DATA INPUT  
system currently is running in automatic antiheeling mode

STEP 1 : ENTER SHIP's NAME	Shipname		
STEP 2 : ENTER DENSITY	1025	[kg/m <sup>3</sup> ]	ENTER
STEP 3 : ENTER DISPLACEMENT	123456	[t]	ENTER
STEP 4 : CHECK YOUR VALUES	YOUR INPUT		PLC's RESPONSE

**AUTOMATIC ANTIHEELING STATUS INDICATION**

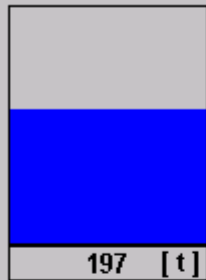
The diagram shows a horizontal scale from -5 to 5. A red vertical line is positioned at 0. To the right of the scale, there is a green indicator light and the text 'PUMP TO STARBOARD'. The scale is flanked by two vertical bars, one on the left and one on the right, both containing blue liquid levels.

choose your way to continue →

9

1 = PROCESS

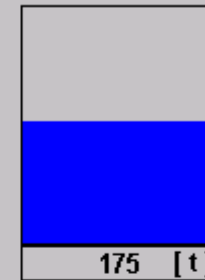
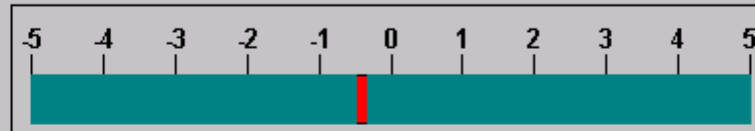
3 = EXIT



SIDE 3P



-0.4



SIDE 3S

## STABILITY TEST RESULTS

STEP	ANGLE [°]	M_PS [t]	Y_PS [m]	M_SB [t]	Y_SB [t]	GM [m]
0	-0.4	56.9	10.35	317.1	10.35	
1	-2.7	220.6	10.35	140.9	10.35	0.63
2	-0.2	161.9	10.35	209.8	10.35	0.21
3	2.0	126.9	10.35	249.1	10.35	0.14
4	-0.4	196.6	10.35	175.4	10.35	0.26
CALCULATED GM:						0.14

choose  
your way  
to continue



1

3 = EXIT

PRINT RESULTS

SHIP's NAME:

Shipname

SYSTEMTIME:

2002-06-27 10:48:00