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Propulsion Control System (PCS)

User Manual

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Preface

This document describes the basic functionality and operating functions of the Propulsion control system (PCS) as part of the Integrated Automation System (IAS) for the TNI-AL Sigma Class Corvette. This document is based on the references as mentioned in the list of references.
This document **does not** describe the operational procedures necessary to sail the ship.

References

A Propulsion Control System Functional Specification
Document no. 190134-2520-FSC
Revision: 1.1

Abbreviations

AI	Analogue Input
AO	Analogue Output
BOP	Bridge overhead panel
CSN	Client Server Network
CPP	Controllable pitch propeller
CPU	Central Processing Unit
DI	Digital Input
DO	Digital Output
ECS	Engine Control System
ELOP	Electric motor driven lube oil pump
ES	Emergency Stop
FSR	Fuel Stop Rating
GB	Gearbox
HMI	Human Machine interface
HPP	Hydraulic Power Pack
IAS	Integrated Automation system
IMO	Imtech Marine & Offshore
IO	Input/Output
IPMS	Integrated Platform Management System
LCP	Local Control Panel
LED	Light Emitting Diode
LO	Lubrication Oil
LPU	Local processing unit
MCR	Machine Control Room
MCR	Maximum Continuous Rating
MDC	Multi disc clutch
ME	Main engine
n.a.	Not applicable
NO	Normally Open
NC	Normally Closed
PCS	Propulsion control system
PDN	Platform Data Network
PLC	Programmable Logic Controller
PMS	Power Management System
PS	Portside
PSU	Power Supply Unit
PTI	Power Take In

PTO	Power Take Off
RFU	Ready For Use
RIO	Remote IO
SB	Starboard
TBD	To be defined

Updates

Underneath are the updates indicated of those parts, which have been changed related to the previous release.

Issue:	Date:	Change:	Reason:
1.0	13-06-2006	First Issue	

1. Introduction

1.1 Purpose of this document

This document describes the operator control and monitoring functions of the Propulsion Control System (PCS) as part of the Integrated Automation System (IAS) for the TNI-AL project Indonesia Navy Corvette program, Tentara Nasional Indonesia Angkatan Laut. This document is based on the functionality as described in the references.

1.2 Content of this document

Chapter 1 contains general information
Chapter 2 describes the Man Machine Interface (MMI). This will include a description of the PCS panels and the IPMS mimics.
Chapter 3 describes how the PCS operates.
Chapter 4 gives an overview of the PCS I/O and parameters.

1.3 Configuration of main propulsion plant

The main propulsion plant (see also Figure 1) consists of:

- Two (2) Pielstick diesel engines (8.1MW at 1050 rpm/8.9MW at 1084 rpm for 1 hour/6hours) each connected to a power take in (PTI) of their respective propulsion gearbox;
- Two RENK gearboxes (ratio 1:4.419) each with
  - one (1) power take in (PTI)
  - one (1) power take off (PTO)
  - one multi disc clutch (MDC) for the interconnection of each diesel engine to it's respective shaft; Several Hydraulic pumps, Lubrication oil pumps, Locking devices;
- Two (2) shafts, each with controllable pitch propellers (CPP) each connected to a power take off (PTO) of it's respective propulsion gearbox;

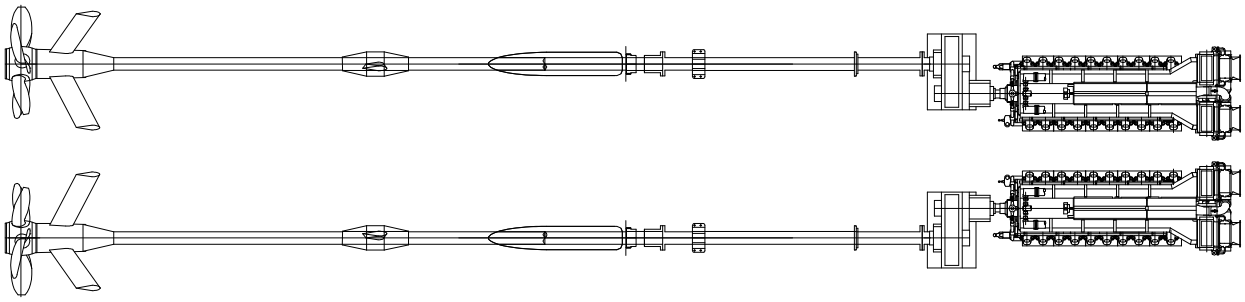

Figure 1: Propulsion plant overview

The propulsion plant has the following control levels:

- Local-Manual
  - Diesel engines controlled from local control panel (LCP);
  - Clutch in/out controlled from LCP;
  - Gearbox standby lub oil pump controlled from local starter panel;
  - CPP controlled by mechanical valve at hydraulic power pack.
- Remote-Manual
  - Start/stop ME from PCS panel in MCR;
  - Speed and pitch control from PCS panel in MCR or Bridge with pushbuttons;
  - Clutch control from PCS panel in MCR or Bridge with pushbuttons;
  - Automatic start/stop of gearbox standby lub oil pump.
- Remote-Auto
  - Speed and pitch control from PCS panel in MCR or Bridge with lever;
  - Automatic clutch control from PCS panel in MCR or Bridge;
  - Automatic start/stop of gearbox standby lub oil pump.

There are two (2) functional identical propulsion control units (PCS PS and PCS SB), one for each propulsion train, which contain the control, monitoring and protection functions for the propulsion plant.
For remote control of the propulsion plant there are two PCS control panels, one in the MCR and one on the bridge.

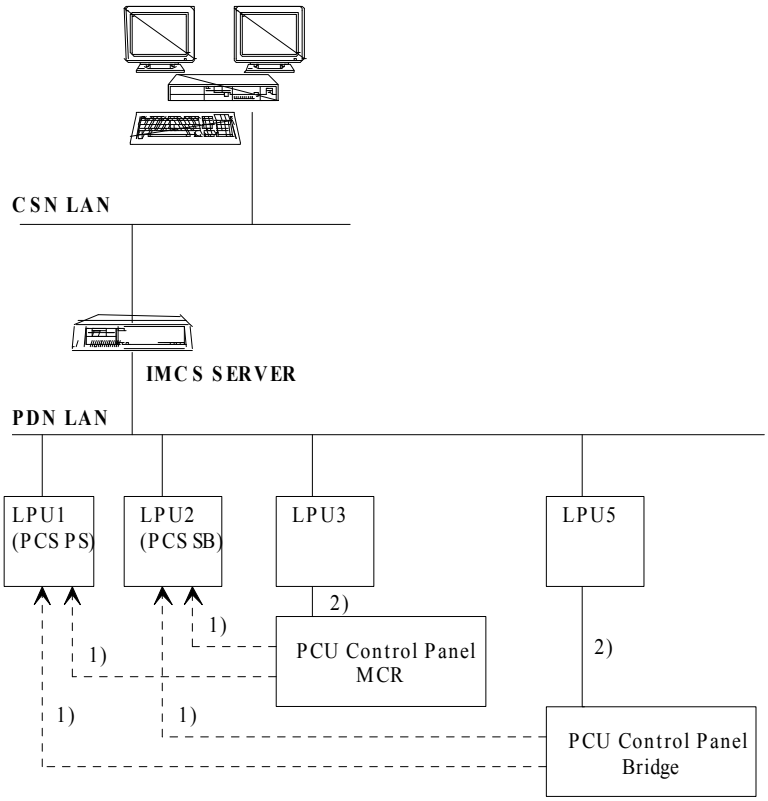

Figure 2: Automation context

1) Control lever signal (4-20mA)
2) Devicenet

The PCS PS is running in a Controllogix PLC placed in LPU1 (4381 E5012) in room 1071 (Main Engine Room).
The PCS SB is running in a Controllogix PLC placed in LPU2 (4381 E5013) in room 1071 (Main Engine Room).
The PCS Panel MCR handling is running in a Controllogix PLC placed in LPU3 (4381 E5014) placed near the MCR Console (6622 E5001) in room 3084 (Switchboard Room Aft/MCR).
The PCS Panel Bridge handling is running in a Controllogix PLC placed in LPU5 (4381 E5024) placed in Navigation Bridge Console (6621 E5001) in room 5041 (Bridge).

The two propulsion control units communicate with each other and with the PCS control panels via the PDN LAN.

2. Operator interface

2.1 Introduction

In this chapter an overview is given of the various control and monitoring elements of the PCS and the way they are distributed over the PCS control panels.

2.2 Panel overview

The PCS has the following control and monitoring panels:

- PCS control panel MCR;
- PCS control panel bridge.

2.3 Control philosophy

The PCS checks if a control command is valid on the basis of the following criteria:

- Control position. Only control commands from the actual control position are accepted (except control position selection commands)
- Control level. Some control commands are only possible in Remote-Auto.
- Specific conditions. Sometimes additional criteria apply, for example starting conditions. If these specific criteria are not met the command is blocked.

For status indications the following apply:

- Actual state is indicated with a continuous lit LED;
- A request and/or a transition is indicated with a flashing LED.

The PCS control panel's also incorporate failure indications. On activation of a failure the associated LED starts flashing and the buzzer is activated. Pressing the pushbutton STOP HORN or the pushbutton ALARM ACCEPT will silence the buzzer.
If the pushbutton STOP HORN is used the alarm indication remains flashing.
If the pushbutton ALARM ACCEPT is used the alarm indication will go to continuous lit in case the failure condition is still active, or to continuous off if the failure condition is lifted.

If there is a problem with a control panel all commands from this panel will be blocked. The indications will be blanked with the exception of the indication PCS ALARM. This indication will flash.

2.4 Description of PCS control panels

For the PCS there are two (2) control panels:

PCS Panel MCR

PCS Panel Bridge

The propulsion platform can also be monitored via mimics on the IPMS.

2.4.1 PCS Panel MCR

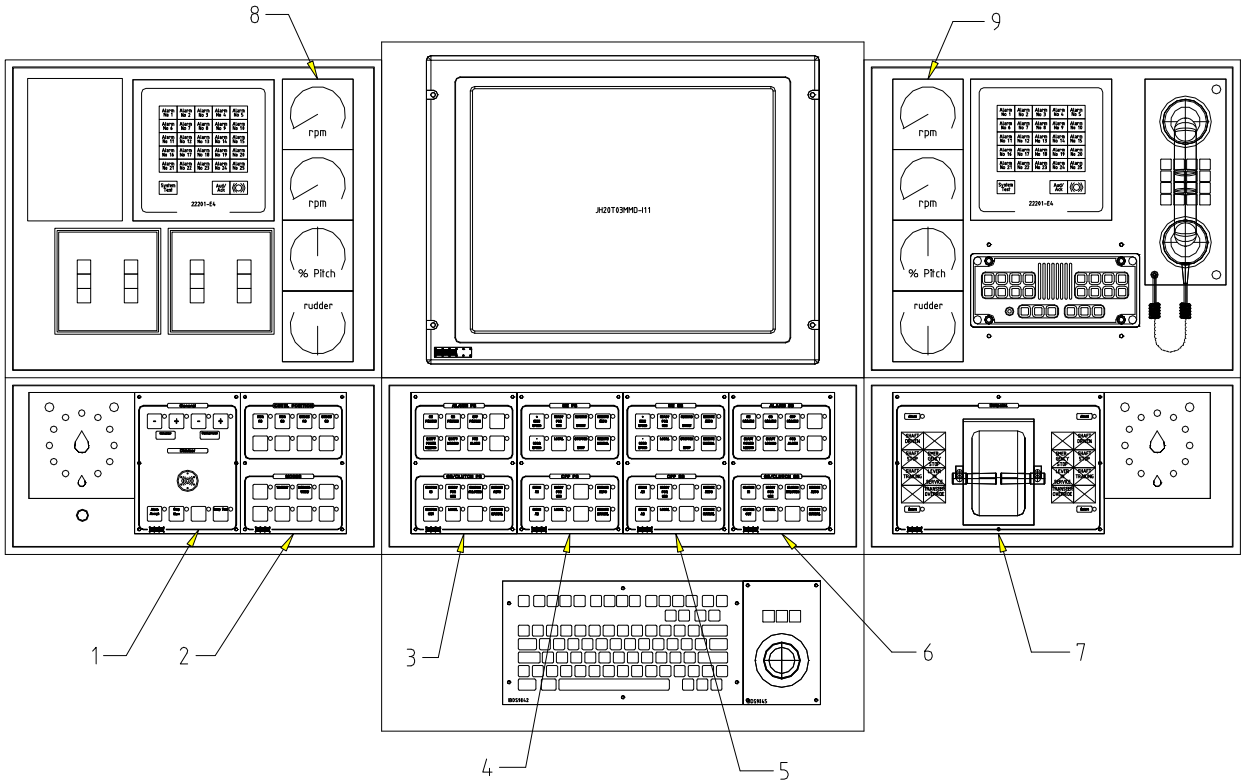

Figure 3: PCS panel MCR

The PCS panel MCR consist of 7 control units and 2 analogue indicator sections:

- Unit1: General control
- Unit2: Control position and Control mode selection
- Unit3: Alarm PS and GB/Clutch PS control
- Unit4: ME PS and CPP PS control
- Unit5: ME SB and CPP SB control
- Unit6: Alarm SB and GB/Clutch SB control
- Unit7: Control lever and shaft mode selection PS and SB
- Unit8: Analogue indicators PCS PS
- Unit9: Analogue indicators PCS SB

In the next paragraphs the panels will de described in detail.

2.4.1.1 Unit1

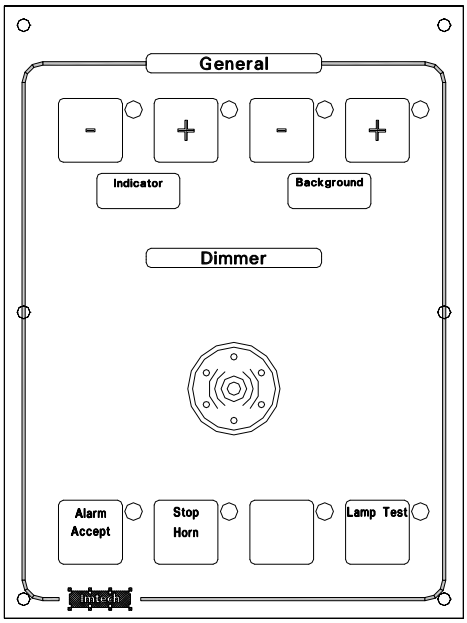

Figure 4: General control

Unit1 contains the following control and monitoring elements:

Dimmer Pushbutton INDICATIOR -	Used for decreasing the illumination intensity of the indications on Unit1 to Unit7
Dimmer Pushbutton INDICATIOR +	Used for increasing the illumination intensity of the indications on Unit1 to Unit7
Dimmer Pushbutton BACKGROUND -	Used for decreasing the background illumination intensity on Unit1 to Unit7
Dimmer Pushbutton BACKGROUND +	Used for increasing the background illumination intensity on Unit1 to Unit7
Pushbutton ALARM ACCEPT	Pushbutton for accepting the alarm that activated and to silence the buzzer.
Pushbutton STOP HORN	Pushbutton for silencing the buzzer without accepting the activated alarm.
Pushbutton LAMP TEST	Pushbutton for testing (**all**) the indication LED's and the buzzer (units 1 to 7).
Buzzer	Audible indication. Continuous tone = Alarm activated Intermitting tone = Control position transfer request.

2.4.1.2 Unit2

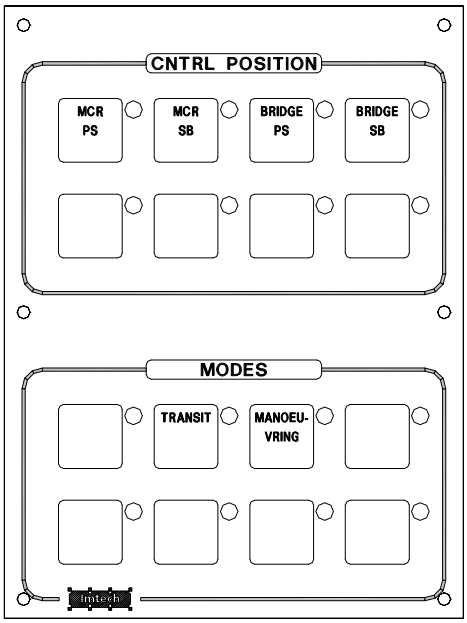

Figure 5: Control Position and Control Mode selection

Unit2 contains the following control and monitoring elements:

Control position pushbutton MCR PS	Pushbutton for requesting MCR control if bridge is in control, or accepting MCR control if bridge request for MCR control is present.
Control position indication MCR PS	Continuous lit = MCR in control Flashing = MCR Control request.
Control position pushbutton MCR SB	Pushbutton for requesting MCR control if bridge is in control, or accepting MCR control if bridge request for MCR control is present.
Control position indication MCR SB	Continuous lit = MCR in control Flashing = MCR Control request.
Control position pushbutton BRIDGE PS	Pushbutton for requesting bridge control if MCR is in control, or accepting bridge control if bridge request for bridge control is present.
Control position indication BRIDGE PS	Continuous lit = bridge in control Flashing= BRIDGE Control request.
Control position pushbutton BRIDGE SB	Pushbutton for requesting bridge control if MCR is in control, or accepting bridge control if bridge request for bridge control is present.
Control position indication BRIDGE SB	Continuous lit = bridge in control Flashing= BRIDGE Control request.
Mode pushbutton TRANSIT	Pushbutton for switching to transit mode
Mode indication TRANSIT	Continuous lit = transit mode.
Mode pushbutton MANOEUVRING	Pushbutton for switching to manoeuvring mode
Mode indication MANOEUVRING	Continuous lit = manoeuvring mode.

2.4.1.3 Unit3 and Unit6

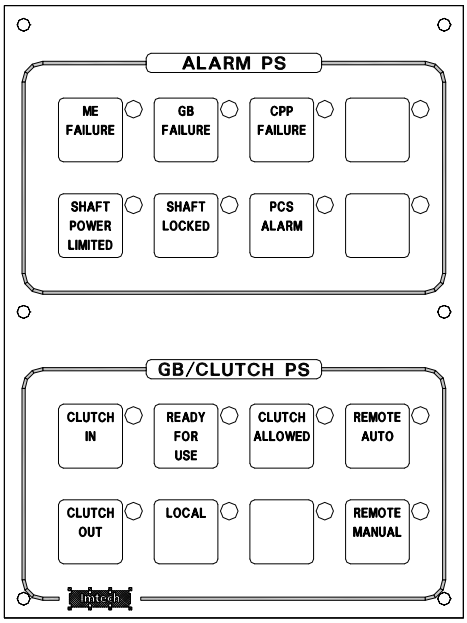

Figure 6: Alarm panel and GB/Clutch control

Unit3(6) contains the following control and monitoring elements:

Alarm indication ME FAILURE	Indicates that a failure is detected at the main engine. Flashing= Alarm activated and not yet accepted Continuous lit = Alarm active and accepted.
Alarm indication GB FAILURE	Indicates that a failure is detected at the gearbox or clutch. Flashing= Alarm activated and not yet accepted Continuous lit = Alarm active and accepted.
Alarm indication CPP FAILURE	Indicates that a failure is detected at the controllable pitch. Flashing= Alarm activated and not yet accepted Continuous lit = Alarm active and accepted.
Alarm indication PCS ALARM	Indicates that a failure is detected in the PCS system. Flashing= Alarm activated and not yet accepted or communication between panel and PCS has been lost. Continuous lit = Alarm active and accepted.

Indication SHAFT POWER LIMITED	Indicates that the load on the ME is larger than 100%
Indication SHAFT LOCKED	Indicated that the mechanical shaft brake is active.
GB/Clutch pushbutton CLUTCH IN	Pushbutton for initiating a clutch closing command.
GB/Clutch indication CLUTCH IN	Indicated the state of the clutch. Flashing= clutch is closing Continuous lit = clutch is closed
GB/Clutch pushbutton CLUTCH OUT	Pushbutton for initiating a clutch open command.
GB/Clutch indication CLUTCH OUT	Indicated the state of the clutch. Flashing= clutch is opening Continuous lit = clutch is open
GB/Clutch indication READY FOR USE	Indicates that the gearbox is ready for use
GB/Clutch indication CLUTCH ALLOWED	Indicates that the conditions for closing the clutch are met.
GB/Clutch indication LOCAL	Indicated the control position of the gearbox Continuous lit = gearbox in local control Flashing = alarm indication that gearbox has been taken to local control while MCR control is active. Remains flashing until pushbutton ALARM ACCEPT is operated.
GB/Clutch pushbutton REMOTE AUTO	Pushbutton for setting PCS to auto mode.
GB/Clutch indication REMOTE AUTO	Continuous lit = PCS in auto mode Flashing = Auto request active. Remains flashing until the conditions for the transfer to auto are met.
GB/Clutch pushbutton REMOTE MANUAL	Pushbutton for setting PCS to manual mode.
GB/Clutch indication REMOTE MANUAL	Indicates that the PCS in manual mode

2.4.1.4 Unit4 and Unit5

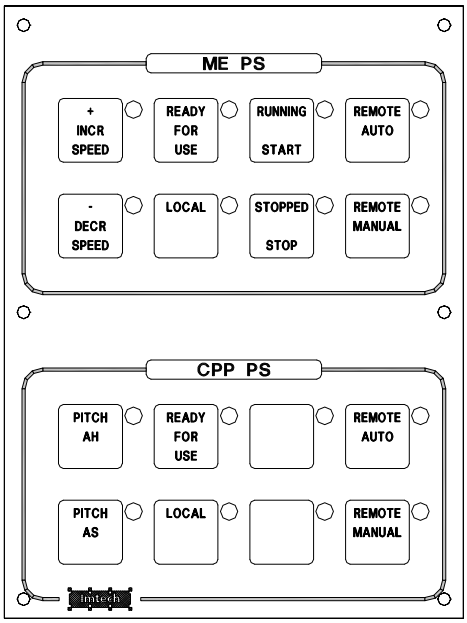

Figure 7: ME and CPP control

Unit4(5) contains the following control and monitoring elements:

ME pushbutton + INCR SPEED	Pushbutton for increasing the speed of the main engine
ME Indication + INCR SPEED	Indicates that for the transfer to REMOTE AUTO the ME speed needs to increased
ME pushbutton - DECR SPEED	Pushbutton for decreasing the speed of the main engine
ME Indication - DECR SPEED	Indicates that for the transfer to REMOTE AUTO the ME speed needs to decreased
ME indication READY FOR USE	Indicates that the ME is ready for start
ME indication LOCAL	Indicated the control position of the ME Continuous lit = ME in local control Flashing = alarm indication that ME has been taken to local control while MCR control is active. Remains flashing until pushbutton ALARM ACCEPT is operated
ME pushbutton START	Pushbutton for starting the main engine
ME indication RUNNING	Indicates the state of the main engine Continuous lit = ME is running Flashing = ME is starting
ME pushbutton STOP	Pushbutton for stopping the main engine
ME indication STOPPING	Indicates the state of the main engine Continuous lit = ME is stopped Flashing = ME is stopping or cooling down
ME pushbutton REMOTE AUTO	Pushbutton for setting PCS to auto mode.

ME indication REMOTE AUTO	Continuous lit = PCS in auto mode Flashing = Auto request active. Remains flashing until the conditions for the transfer to auto are met.
ME pushbutton REMOTE MANUAL	Pushbutton for setting PCS to manual mode.
ME indication REMOTE MANUAL	Indicates that the PCS in manual mode
CPP pushbutton PITCH AH	Pushbutton to increase the pitch
CPP indication PITCH AH	Indicates that for the transfer to REMOTE AUTO the pitch needs to increased
CPP pushbutton PITCH AS	Pushbutton to decrease the pitch
CPP indication PITCH AS	Indicates that for the transfer to REMOTE AUTO the pitch needs to decreased
CPP indication READY FOR USE	Indicates that the CPP is ready for start
CPP indication LOCAL	Indicated the control position of the CPP Continuous lit = CPP in local control Flashing = alarm indication that CPP has been taken to local control while MCR control is active. Remains flashing until pushbutton ALARM ACCEPT is operated
CPP pushbutton REMOTE AUTO	Pushbutton for setting PCS to auto mode.
CPP indication REMOTE AUTO	Continuous lit = PCS in auto mode Flashing = Auto request active. Remains flashing until the conditions for the transfer to auto are met.
CPP pushbutton REMOTE MANUAL	Pushbutton for setting PCS to manual mode.
CPP indication REMOTE MANUAL	Indicates that the PCS in manual mode

2.4.1.5 Unit7

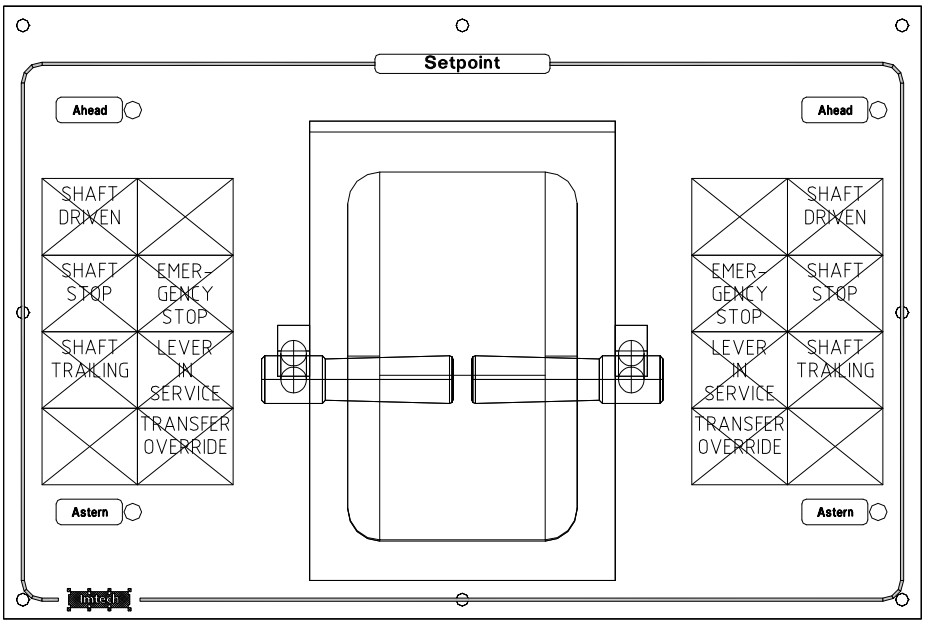

Figure 8: Control lever and shaft mode control

Unit4(5) contains the following control and monitoring elements:

Dual control lever	Control lever for speed and pitch control according active combinatory curve
PS shaft illuminated pushbutton SHAFT DRIVEN	Pushbutton to set the shaft mode to DRIVEN Continuous lit = Shaft mode is DRIVEN Flashing = SHAFT DRIVEN request is active
PS shaft illuminated pushbutton SHAFT STOP	Pushbutton to set the shaft mode to STOP Continuous lit = Shaft mode is STOP Flashing = SHAFT STOP request is active
PS shaft illuminated pushbutton SHAFT TRAIL	Pushbutton to set the shaft mode to TRAIL Continuous lit = Shaft mode is TRAIL Flashing = SHAFT TRAIL request is active
PS ME illuminated pushbutton EMERGENCY STOP	Emergency stop pushbutton switch for ME PS Continuous lit = emergency pushbutton switch activated
PS illuminated pushbutton TRANSFER OVERRIDE	Pushbutton for changing control position without synchronizing the control lever. Continuous lit = pushbutton activated.
PS indication LEVER IN SERVICE	Indication that the lever can be used for thrust control.
PS illumination AHEAD	Flashing = direction of synchronisation for control position transfer. Continuous = lever is synchronized at control position transfer, or thrust is ahead.

PS illumination ASTERN	Flashing = direction of synchronisation for control position transfer. Continuous = lever is synchronized at control position transfer, or thrust is astern.
SB shaft illuminated pushbutton SHAFT DRIVEN	Pushbutton to set the shaft mode to DRIVEN Continuous lit = Shaft mode is DRIVEN Flashing = SHAFT DRIVEN request is active
SB shaft illuminated pushbutton SHAFT STOP	Pushbutton to set the shaft mode to STOP Continuous lit = Shaft mode is STOP Flashing = SHAFT STOP request is active
SB shaft illuminated pushbutton SHAFT TRAIL	Pushbutton to set the shaft mode to TRAIL Continuous lit = Shaft mode is TRAIL Flashing = SHAFT TRAIL request is active
SB ME illuminated pushbutton EMERGENCY STOP	Emergency stop pushbutton switch for ME PS Continuous lit = emergency pushbutton switch activated
SB illuminated pushbutton TRANSFER OVERRIDE	Pushbutton for changing control position without synchronizing the control lever. Continuous lit = pushbutton activated.
SB indication LEVER IN SERVICE	Indication that the lever can be used for thrust control.
SB illumination AHEAD	Flashing = direction of synchronisation for control position transfer. Continuous = lever is synchronized at control position transfer, or thrust is ahead.
SB illumination ASTERN	Flashing = direction of synchronisation for control position transfer. Continuous = lever is synchronized at control position transfer, or thrust is astern.

2.4.1.6 Unit 8&9 Analogue indicators

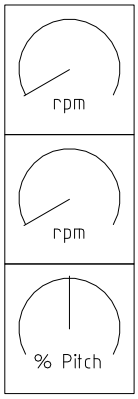

Figure 9: Analogue indicators

For the PCS the following analogue indications are available from top to bottem:

ME RPM	Indication actual ME speed
SHAFT RPM	Indication actual shaft speed
CPP PITCH	Indication actual pitch.

2.4.2 PCS panel Bridge

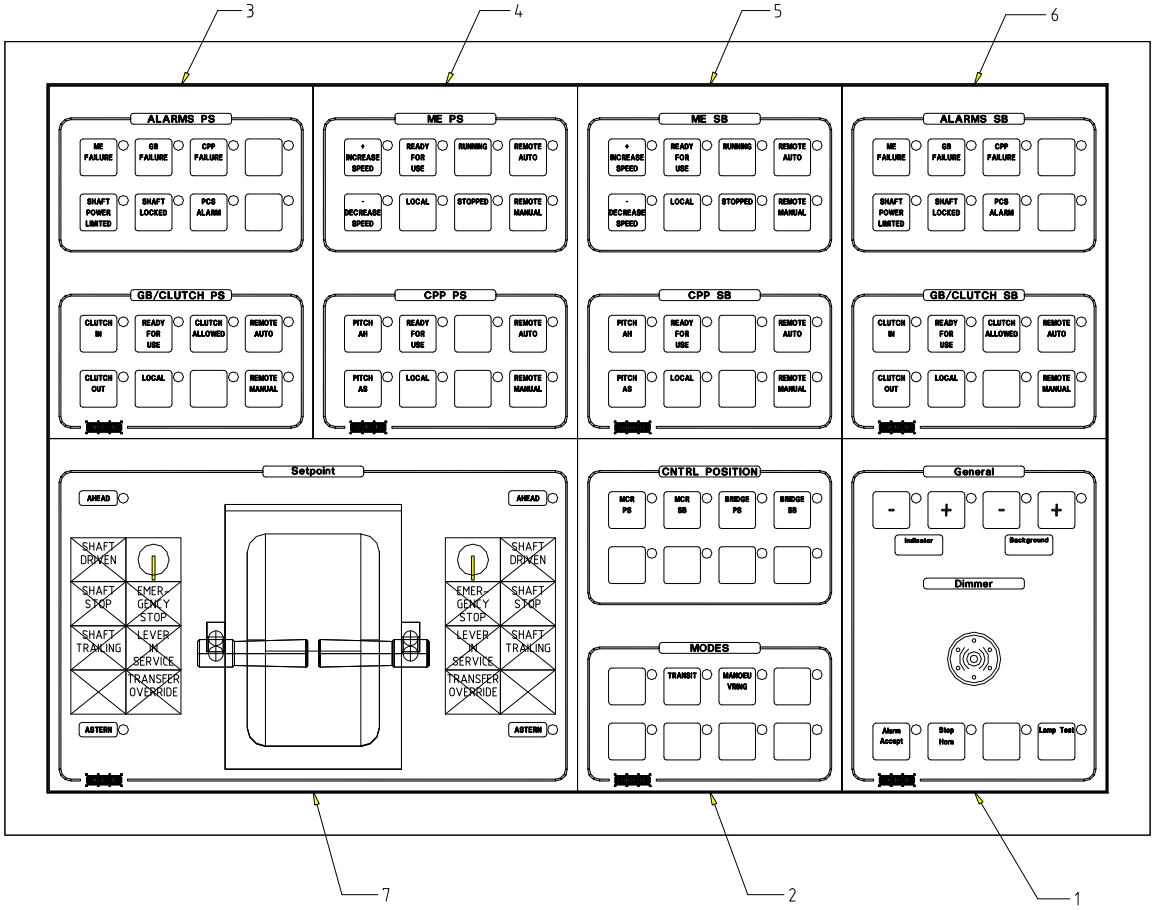

Figure 10: PCS panel Bridge

The PCS panel MCR consist of 7 control units and 2 analogue indicator fields:
- Unit1: General control
- Unit2: Control position and Control mode selection
- Unit3: Alarm PS and GB/Clutch PS control
- Unit4: ME PS and CPP PS control
- Unit5: ME SB and CPP SB control
- Unit6: Alarm SB and GB/Clutch SB control
- Unit7: Control lever and shaft mode selection PS and SB
- Unit8: Analogue indicators PCS PS
- Unit9: Analogue indicators PCS SB

In the next paragraphs the panels will de described in detail.

2.4.2.1 Unit1

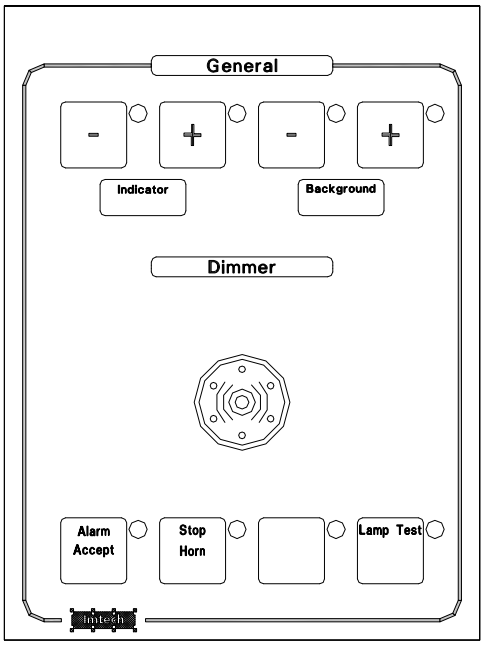

Figure 11: General control

Dimmer Pushbutton INDICATIOR -	Used for decreasing the illumination intensity of the indications on Unit1 to Unit7
Dimmer Pushbutton INDICATIOR +	Used for increasing the illumination intensity of the indications on Unit1 to Unit7
Dimmer Pushbutton BACKGROUND -	Used for decreasing the background illumination intensity on Unit1 to Unit7
Dimmer Pushbutton BACKGROUND +	Used for increasing the background illumination intensity on Unit1 to Unit7
Pushbutton ALARM ACCEPT	Pushbutton for accepting the alarm that activated and to silence the buzzer.
Pushbutton STOP HORN	Pushbutton for silencing the buzzer without accepting the activated alarm.
Pushbutton LAMPTEST	Pushbutton for testing (**all**) the indication LED's and the buzzer (unit 1 to 7).
Buzzer	Audible indication. Continuous tone = Alarm activated Intermitting tone = Control position transfer request.

2.4.2.2 Unit2

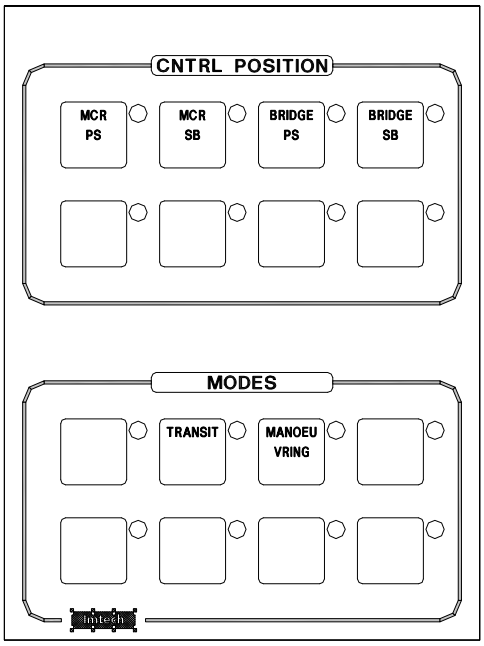

Figure 12: Control position and Control mode selection

Unit2 contains the following control and monitoring elements:

Control position pushbutton MCR PS	Pushbutton for requesting MCR control if bridge is in control.
Control position indication MCR PS	Continuous lit = MCR in control Flashing= MCR Control request.
Control position pushbutton MCR SB	Pushbutton for requesting MCR control if bridge is in control.
Control position indication MCR SB	Continuous lit = MCR in control Flashing= MCR Control request.
Control position pushbutton BRIDGE PS	Pushbutton for requesting bridge control if MCR is in control, or accepting bridge control if MCR request for bridge control is present.
Control position indication BRIDGE PS	Continuous lit = bridge in control Flashing= BRIDGE Control request.
Control position pushbutton BRIDGE SB	Pushbutton for requesting bridge control if MCR is in control, or accepting bridge control if MCR request for bridge control is present.
Control position indication BRIDGE SB	Continuous lit = bridge in control Flashing= BRIDGE Control request.
Mode pushbutton TRANSIT	Pushbutton for switching to transit mode
Mode indication TRANSIT	Continuous lit = transit mode.
Mode pushbutton MANOEUVRING	Pushbutton for switching to manoeuvring mode
Mode indication MANOEUVRING	Continuous lit = manoeuvring mode.

2.4.2.3 Unit3 and Unit6

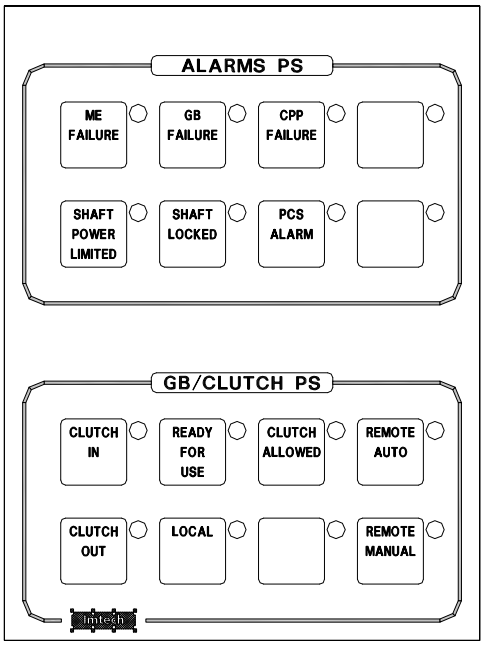

Figure 13: Alarm panel and GB/Clutch control

Unit3(6) contains the following control and monitoring elements:

Alarm indication ME FAILURE	Indicates that a failure is detected at the main engine. Flashing= Alarm activated and not yet accepted Continuous lit = Alarm active and accepted.
Alarm indication GB FAILURE	Indicates that a failure is detected at the gearbox or clutch. Flashing= Alarm activated and not yet accepted Continuous lit = Alarm active and accepted.
Alarm indication CPP FAILURE	Indicates that a failure is detected at the controllable pitch. Flashing= Alarm activated and not yet accepted Continuous lit = Alarm active and accepted.
Alarm indication PCS ALARM	Indicates that a failure is detected in the PCS system. Flashing= Alarm activated and not yet accepted or communication between panel and PCS has been lost. Continuous lit = Alarm active and accepted.
Indication SHAFT POWER LIMITED	Indicates that the load on the ME is larger than 100%

Indication SHAFT LOCKED	Indicated that the mechanical shaft brake is active.
GB/Clutch pushbutton CLUTCH IN	Pushbutton for initiating a clutch closing command.
GB/Clutch indication CLUTCH IN	Indicated the state of the clutch. Flashing= clutch is closing Continuous lit = clutch is closed
GB/Clutch pushbutton CLUTCH OUT	Pushbutton for initiating a clutch open command.
GB/Clutch indication CLUTCH OUT	Indicated the state of the clutch. Flashing= clutch is opening Continuous lit = clutch is open
GB/Clutch indication READY FOR USE	Indicates that the gearbox is ready for use
GB/Clutch indication CLUTCH ALLOWED	Indicates that the conditions for closing the clutch are met.
GB/Clutch indication LOCAL	Indicated the control position of the gearbox Continuous lit = gearbox in local control Flashing = alarm indication that gearbox has been taken to local control while MCR control is active. Remains flashing until pushbutton ALARM ACCEPT is operated.
GB/Clutch pushbutton REMOTE AUTO	Pushbutton for setting PCS to auto mode.
GB/Clutch indication REMOTE AUTO	Continuous lit = PCS in auto mode Flashing = Auto request active. Remains flashing until the conditions for the transfer to auto are met.
GB/Clutch pushbutton REMOTE MANUAL	Pushbutton for setting PCS to manual mode.
GB/Clutch indication REMOTE MANUAL	Indicates that the PCS in manual mode

2.4.2.4 Unit4 and Unit5

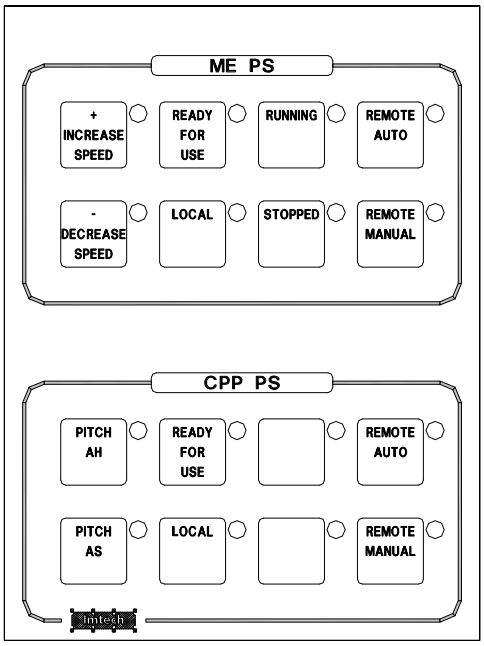

Figure 14: ME and CPP control

Unit4(5) contains the following control and monitoring elements:

ME pushbutton + INCR SPEED	Pushbutton for increasing the speed of the main engine
ME Indication + INCR SPEED	Indicates that for the transfer to REMOTE AUTO the ME speed needs to increased
ME pushbutton - DECR SPEED	Pushbutton for decreasing the speed of the main engine
ME Indication - DECR SPEED	Indicates that for the transfer to REMOTE AUTO the ME speed needs to decreased
ME indication READY FOR USE	Indicates that the ME is ready for start
ME indication LOCAL	Indicated the control position of the ME Continuous lit = ME in local control Flashing = alarm indication that ME has been taken to local control while MCR control is active. Remains flashing until pushbutton ALARM ACCEPT is operated
ME indication RUNNING	Indicates the state of the main engine Continuous lit = ME is running Flashing = ME is starting
ME indication STOPPING	Indicates the state of the main engine Continuous lit = ME is stopped Flashing = ME is stopping or cooling down
ME pushbutton REMOTE AUTO	Pushbutton for setting PCS to auto mode.
ME indication REMOTE AUTO	Continuous lit = PCS in auto mode Flashing = Auto request active. Remains

	flashing until the conditions for the transfer to auto are met.
ME pushbutton REMOTE MANUAL	Pushbutton for setting PCS to manual mode.
ME indication REMOTE MANUAL	Indicates that the PCS in manual mode
CPP pushbutton PITCH AH	Pushbutton to increase the pitch
CPP indication PITCH AH	Indicates that for the transfer to REMOTE AUTO the pitch needs to increased
CPP pushbutton PITCH AS	Pushbutton to decrease the pitch
CPP indication PITCH AS	Indicates that for the transfer to REMOTE AUTO the pitch needs to decreased
CPP indication READY FOR USE	Indicates that the CPP is ready for start
CPP indication LOCAL	Indicated the control position of the CPP Continuous lit = CPP in local control Flashing = alarm indication that CPP has been taken to local control while MCR control is active. Remains flashing until pushbutton ALARM ACCEPT is operated
CPP pushbutton REMOTE AUTO	Pushbutton for setting PCS to auto mode.
CPP indication REMOTE AUTO	Continuous lit = PCS in auto mode Flashing = Auto request active. Remains flashing until the conditions for the transfer to auto are met.
CPP pushbutton REMOTE MANUAL	Pushbutton for setting PCS to manual mode.
CPP indication REMOTE MANUAL	Indicates that the PCS in manual mode

2.4.2.5 Unit7

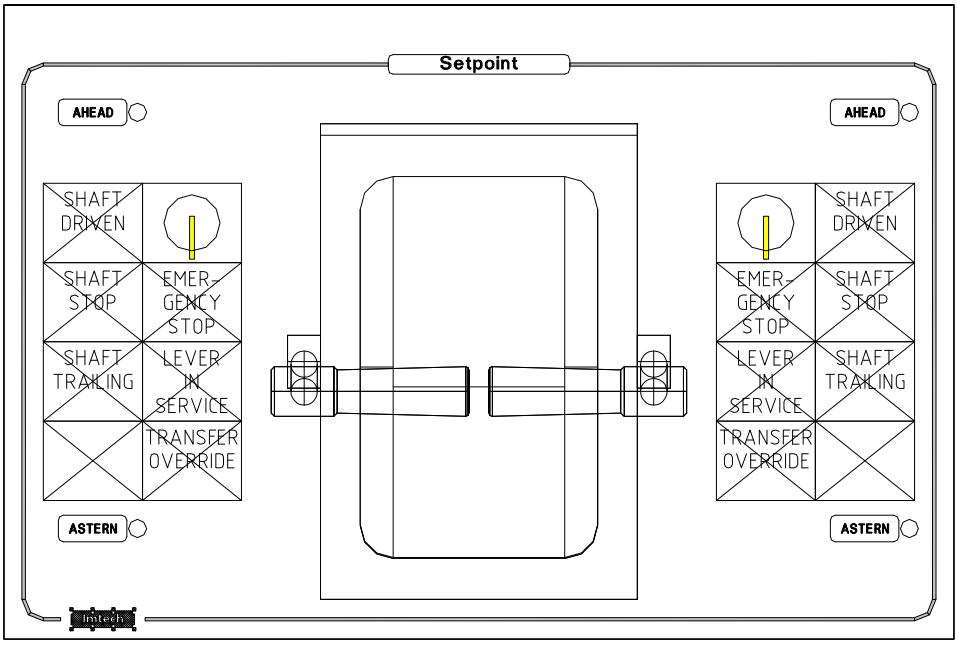

Figure 15: Control lever and shaft mode control

Unit4(5) contains the following control and monitoring elements:

Dual control lever	Control lever for speed and pitch control according active combinatory curve
PS shaft illuminated pushbutton SHAFT DRIVEN	Pushbutton to set the shaft mode to DRIVEN Continuous lit = Shaft mode is DRIVEN Flashing = SHAFT DRIVEN request is active
PS shaft illuminated pushbutton SHAFT STOP	Pushbutton to set the shaft mode to STOP Continuous lit = Shaft mode is STOP Flashing = SHAFT STOP request is active
PS shaft illuminated pushbutton SHAFT TRAIL	Pushbutton to set the shaft mode to TRAIL Continuous lit = Shaft mode is TRAIL Flashing = SHAFT TRAIL request is active
PS key switch 110% MCR	Key switch for enabling 110% MCR of the main engine
PS ME illuminated pushbutton EMERGENCY STOP	Emergency stop pushbutton switch for ME PS Continuous lit = emergency pushbutton switch activated
PS illuminated pushbutton TRANSFER OVERRIDE	Pushbutton for changing control position without synchronizing the control lever. Continuous lit = pushbutton activated.
PS indication LEVER IN SERVICE	Indication that the lever can be used for thrust control.
PS illumination AHEAD	Flashing = direction of synchronisation for control position transfer. Continuous = lever is synchronized at control position transfer, or thrust is ahead.
PS illumination ASTERN	Flashing = direction of synchronisation for control position transfer. Continuous = lever is synchronized at control position transfer, or thrust is astern.
SB shaft illuminated pushbutton SHAFT DRIVEN	Pushbutton to set the shaft mode to DRIVEN Continuous lit = Shaft mode is DRIVEN Flashing = SHAFT DRIVEN request is active
SB shaft illuminated pushbutton SHAFT STOP	Pushbutton to set the shaft mode to STOP Continuous lit = Shaft mode is STOP Flashing = SHAFT STOP request is active
SB shaft illuminated pushbutton SHAFT TRAIL	Pushbutton to set the shaft mode to TRAIL Continuous lit = Shaft mode is TRAIL Flashing = SHAFT TRAIL request is active
SB key switch 110% MCR	Key switch for enabling 110% MCR of the main engine
SB ME illuminated pushbutton EMERGENCY STOP	Emergency stop pushbutton switch for ME PS Continuous lit = emergency pushbutton switch activated
SB illuminated pushbutton TRANSFER OVERRIDE	Pushbutton for changing control position without synchronizing the control lever. Continuous lit = pushbutton activated.

SB indication LEVER IN SERVICE	Indication that the lever can be used for thrust control.
SB illumination AHEAD	Flashing = direction of synchronisation for control position transfer. Continuous = lever is synchronized at control position transfer, or thrust is ahead.
SB illumination ASTERN	Flashing = direction of synchronisation for control position transfer. Continuous = lever is synchronized at control position transfer, or thrust is astern.

2.4.2.6 Unit 8&9 Analogue indicators

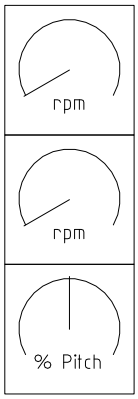

Figure 16: Analogue indicators

For the PCS the following analogue indications are available from top to bottem:

ME RPM	Indication actual ME speed
SHAFT RPM	Indication actual shaft speed
CPP PITCH	Indication actual pitch.

2.4.3 IPMS mimics

2.4.3.1 Mimic 30

p.m.

2.4.3.2 Mimic 36

p.m.

3. Functional description

3.1 Control configuration

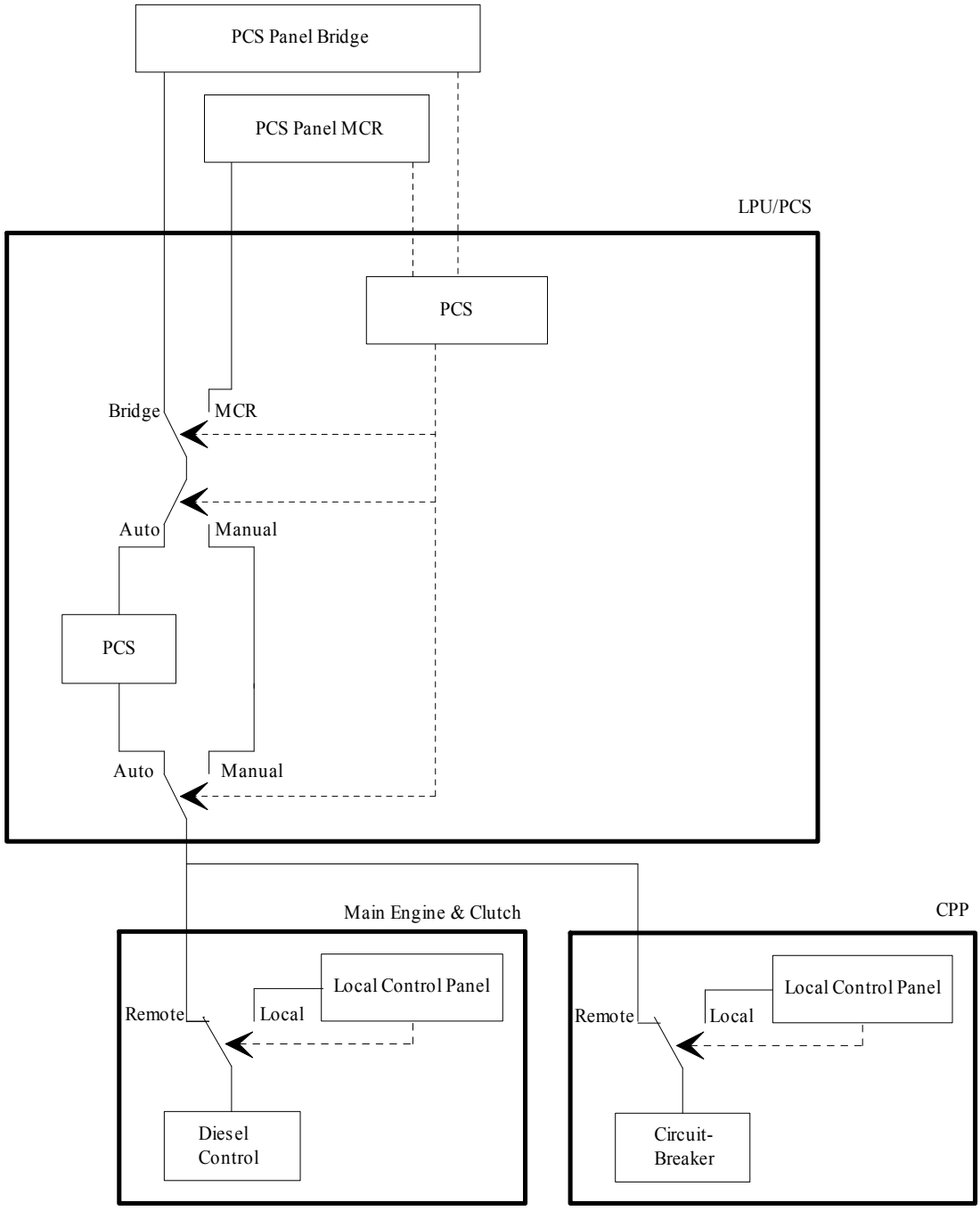

Figure 17: Control configuration PCS

3.2 Control position

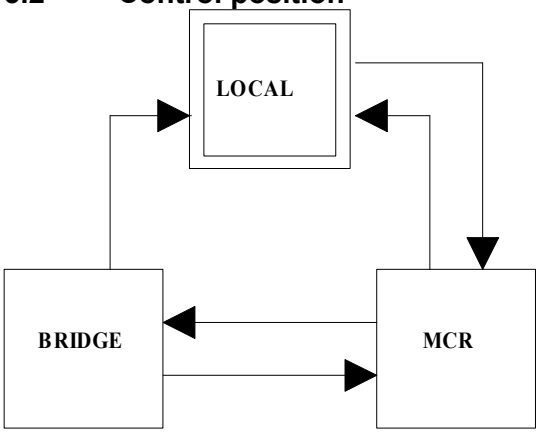

Figure 18: State diagram control position

For the PCS the following control positions apply:

- LOCAL
  Local control is selected (= control on component in engine room). The PCS has no control over the installation.
  The indications “LOCAL” are lit on the PCS Panel MCR and PCS Panel Bridge.
- LOCAL-MCR
  PCS Panel MCR is partially in control. As soon as the first component (ME, GB or CPP) is switched to remote control the PCS control position changes to MCR.
- MCR
  PCS Panel MCR is in control. All components are switched to remote control.
  The indications “LOCAL” are off, and the indication MCR is lit on the PCS Panel MCR and PCS Panel Bridge.
  The following controls are possible:
  • Selection control level Manual/Auto
  • The controls associated with the control level.
- MCR-BRIDGE
  Transition from MCR to bridge. PCS waits for acceptance of the control position by the PCS Panel Bridge operator. All controls of the PCS Panel MCR remain active until the bridge control is accepted.
  The transition request can be initiated by:
  • The operator in the MCR by activating the pushbutton CNTRL POS BRIDGE
  • The operator on the bridge by activating the pushbutton CNTRL POS BRIDGE.
  The indication MCR is lit, and the indication BRIDGE is flashing on the PCS Panel MCR and PCS Panel Bridge.
- BRIDGE-MCR
  Transition from bridge to MCR. There are two possible transitions possible:
  • Forced transfer.
    The operator in the MCR selects MCR control. The control is transferred directly and an alarm is initiated on the bridge.
  • Transfer by ask/accept. The operator on the bridge can initiate this by activating the pushbutton CNTRL POS MCR.
  The indication BRIDGE is lit, and the indication MCR is flashing on the PCS Panel MCR and PCS Panel Bridge.
- BRIDGE
  PCS Panel Bridge is in control.
  The following controls are possible:
  • Selection control level Manual/Auto
  • The controls associated with the control level (with the exception of ME START/STOP which is only possible in the MCR).
  The indication BRIDGE is lit on the PCS Panel MCR and PCS Panel Bridge.
- BRIDGE-LOCAL
  Transition from bridge to LOCAL. This transition takes place if:
  • All components are taken to LOCAL.
- MCR-LOCAL
  Transition from MCR to LOCAL. This transition takes place if:
  • All components are taken to LOCAL.

In control level AUTO (see 3.3) the transitions MCR-BRIDGE and BRIDGE-MCR are only accepted by the PCS if the control levers are synchronized. The operator has to synchronize the levers manually. The flashing indication AHEAD or ASTERN indicates the direction the lever has to be moved. if the indication(s) are lit continuously the levers are synchronized.
In case the synchronization is not possible the transition can be forced by pressing the pushbutton TRANSFER OVERRIDE while accepting the control position.

If an operator on a lower control position forces the control to his/her control position the following sequence of events will apply:

Situation 1: Actual control position is BRIDGE. The operator in the MCR takes the control to the MCR. Then the alarm buzzer on the bridge will be activated and the indication CNTRL POS MCR starts flashing. The indication CNTRL POS BRIDGE remains continuous lit. After operating the pushbutton ALARM ACCEPT the indication CNTRL POS MCR changes to continuous lit and the indication CNTRL POS BRIDGE extinguishes.
Note: Although the indication CNTRL POS BRIDGE remains continuous lit while the alarm buzzer is sounding the actual control is already at the control position MCR.

Situation 2: Actual control position is MCR or BRIDGE. The operator on local level takes a component (ME, gearbox or CPP) to local control. Then the alarm buzzer on the actual control position will be activated and the indication LOCAL of the component starts flashing. The indication of the actual control position remains continuous lit. After operating the pushbutton ALARM ACCEPT the indication LOCAL changes to continuous lit. The indication of the actual control position only extinguishes if all components are switched to local control.

The control position of the PCS after starting up of the PLC depends on the control position of the components. If one of them is in remote control the control position automatically becomes MCR.
If the communication between the actual control position and the PCS is lost, the PCS shall file a request for the other control position, which has to be accepted by the operator. The control lever will remain active (when selected) until the operator has accepted the other control position.

3.3 Control level

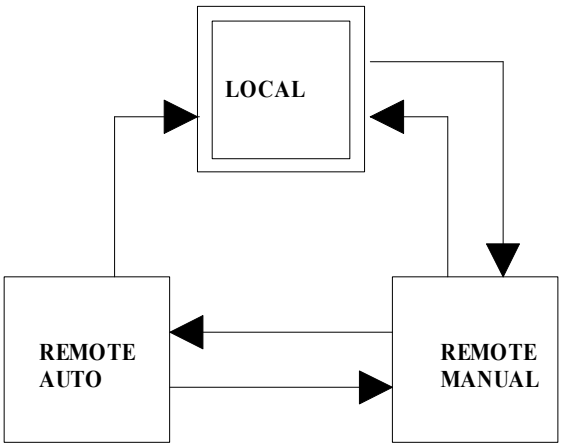

Figure 19: State diagram control level

For the PCS the following control levels apply:

- LOCAL
  The PCS is in control position LOCAL.
- MANUAL
  At MANUAL the propulsion plant is controlled by the pushbuttons in the control field of the component (Units3 to 6). The PCS is automatically switched to control level MANUAL at the transition LOCAL-MCR. In MANUAL the following pushbutton controls are possible:
  - ME start/stop (PCS panel MCR only);
  - ME Increase/decrease speed;
  - Clutch in/out;
  - CPP pitch ahead/astern.
- MANUAL-AUTO
  Transition from MANUAL to AUTO. The PCS waits with the acceptance of the control level AUTO until the control lever is synchronised with the actual state of the propulsion plant. Flashing indications at the pushbuttons ME INCR/DECR and PITCH AH/AS indicate the required direction of synchronisation. (note: if the indication ME INCR is flashing synchronisation can be achieved by increasing the ME speed or by moving the lever down) The MANUAL control elements remain active until the PCS accepted the transition to AUTO.
- AUTO-MANUAL
  Transition from AUTO to MANUAL. This transition takes place if:
  - The operator gives an REMOTE MANUAL command;
  - One of the components is taken to LOCAL
  - The state of the ME changes to STOPPED.
  - After a safety declutch command.
- AUTO
  At AUTO the propulsion plant is controlled by the control elements on Unit7 (see 2.4.1.5 and 2.4.2.5). In AUTO the following controls are possible:
  - Speed and pitch control by control lever according a pre-programmed combinatory curve (see 3.8).
  - Shaft mode DRIVE/STOP/TRAIL (see 3.5).
  - Control Mode TRANSIT/MANOEUVRING (see 3.4)
  - 110% MCR (PCS Panel Bridge only) (see 3.6)
- AUTO-LOCAL
  Transition from AUTO to LOCAL. This transition takes place if:
  - All components are taken to LOCAL.
- MANUAL-LOCAL
  Transition from MANUAL to LOCAL. This transition takes place if:
  - All components are taken to LOCAL.

The control level of the PCS after starting up of the PLC depends on the control position of the components. If one of them is in remote control the control level automatically becomes MANUAL.

3.4 Control Mode

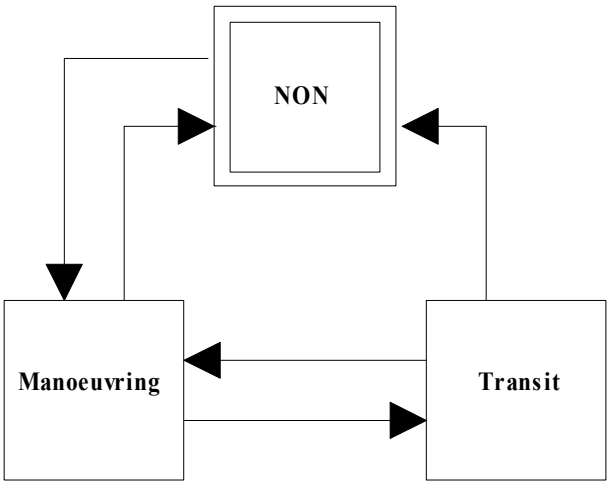

Figure 20: State diagram control mode

With the selected control mode the PCS controls the dynamic response of the installation on a change in lever setpoint. The control modes only apply at control level AUTO.
The following control modes apply:

- NON
  The PCS is in control position LOCAL
- MANOEUVRING
  Fast responding combinatory control of propeller pitch and main engine speed. Active in ahead and astern direction.
  MANOEUVRING is the default control mode after the transition MANUAL-AUTO.
- TRANSIT
  Slow responding combinatory control of propeller pitch and main engine speed. Only active in the ahead direction. When the control lever is moved from AHEAD to ASTERN position the control mode automatically changes over to MANOEUVRING.
  In TRANSIT the 110% MCR key switch can be operated (see 3.6).
- TRANSIT-MANOEUVRING
  Transition from TRANSIT to MANEOUVRING. This transition takes place if one of the following conditions is true:
  - The operator operates the pushbutton MODE MANOEUVRING;
  - The control lever is set to ASTERN;
  - The control mode of the other PCS changes to MANOEUVRING.
- MANOEUVRING-TRANSIT
  Transition from MANOEUVRING to TRANSIT. This transition takes place if the conditions for TRANSIT-MANOEUVRING are not met and the operator operates the pushbutton MODE TRANSIT.

3.5 Shaft Mode

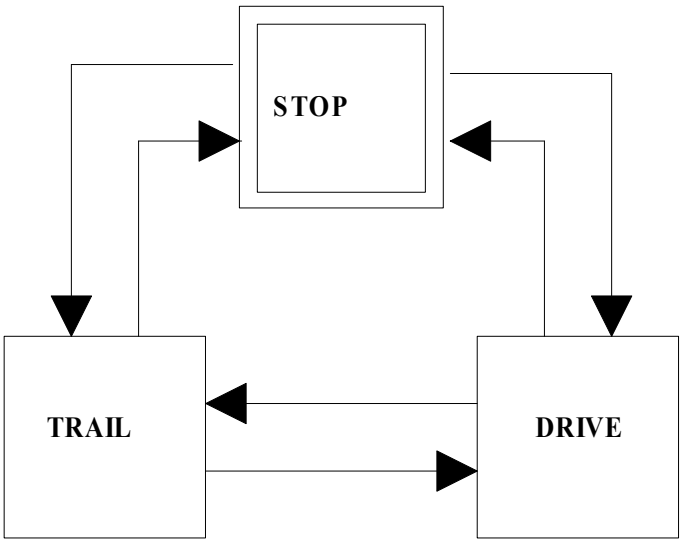

Figure 21: State diagram shaft mode

With the selected shaft mode the PCS determines the required control of the shaft. For PCS control the shaft modes only apply at control level AUTO. The following shaft modes apply:

- DRIVE
  The clutch is engaged and the shaft is driving the ship (delivers thrust). The shaft speed and propeller pitch are set on basis combinatory curve (see 3.8).
- STOP
  The clutch is disengaged and the propeller is set to “zero thrust”.
- TRAIL

The clutch is disengaged and the propeller pitch is controlled to maintain a shaft speed between 45 and 50 rpm.

Note: the shaft mode TRAIL is only allowed if the other shaft is in DRIVE with foreward thrust and the ship has a foreward speed.

- DRIVE-STOP
  Transition from DRIVE to STOP. The PCS waits with the acceptance of the shaft mode until the ME speed and propeller pitch settings are low enough to open the clutch. The ME speed and propeller pitch will be set automatically by the PCS if the control lever deviates from the "zero" position.
- DRIVE-TRAIL
  Transition from DRIVE to TRAIL. The PCS waits with the acceptance of the shaft mode until the ME speed and propeller pitch settings are low enough to open the clutch. The ME speed and propeller pitch will be set automatically by the PCS if the control lever deviates from the "zero" position.
- STOP-DRIVE
  Transition from DRIVE to STOP. The PCS waits with the acceptance of the shaft mode until the ME speed and propeller pitch match the clutch close allowance conditions, and then automatically closes the clutch.
- STOP-TRAIL
  Transition from STOP to TRAIL. This transition is direct.
- TRAIL-STOP
  Transition from TRAIL to STOP. The PCS waits with the acceptance of the shaft mode until the propeller pitch is "zero". This transition take place at the following conditions:
  - The operator operates the pushbutton Shaft Mode STOP;
  - The control lever other PCS is set to ASTERN.
- TRAIL-DRIVE
  Transition from TRAIL to DRIVE. The PCS waits with the acceptance of the shaft mode until the ME speed and propeller pitch match the clutch close allowance conditions, and then automatically closes the clutch.

In MANUAL the indications DRIVE/STOP/TRAIL indicate what the shaft mode would be in AUTO.

3.6 110% MCR

The PCS has the option to overload the ME to 110%. This option is only allowed for (cumulative) one (1) hour every six (6) hours. 110% MCR can only be used at control position BRIDGE in mode TRANSIT. To activate 110% MCR the operator must turn the key-switch "110% MCR" to ON.

3.7 Independent controls

Independent controls are:
- Emergency stop pushbutton switches on PCS Panel MCR and PCS Panel Bridge.
- Emergency telegraph system.

3.8 Combinatory curves

For the control lever(s) the PCS has pre-programmed combinatory curves which translate the control lever setting to ME speed setting and propeller pitch setting. The following combinatory curves are available:

- CC MAN
  Combinatory curve active in mode MANOEUVRING.
- CC TRANSIT
  Combinatory curve active in mode TRANSIT
- CC MAX FSR
  Combinatory curve active in mode TRANSIT and 110% MCR is active.
- CC TRAIL
  Combinatory curve active if the shaft mode of the other shaft is TRAIL.

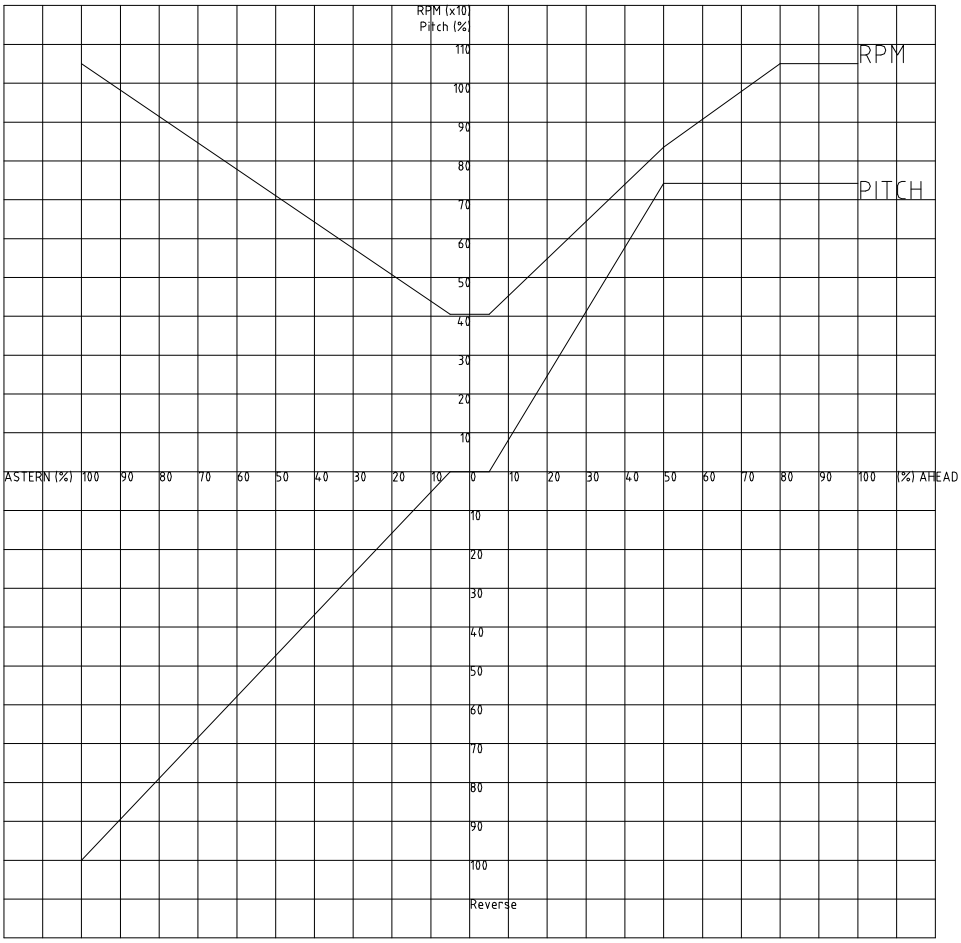

Figure 22: CC MAN

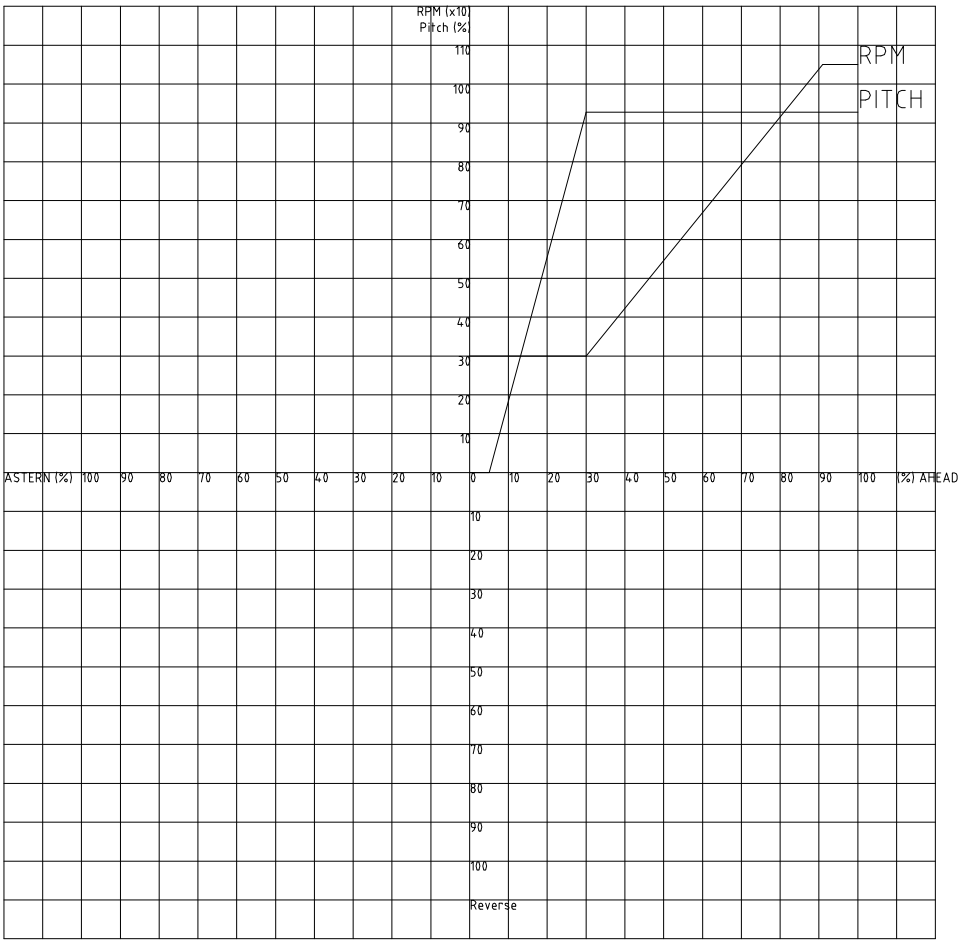

Figure 23: CC TRANSIT

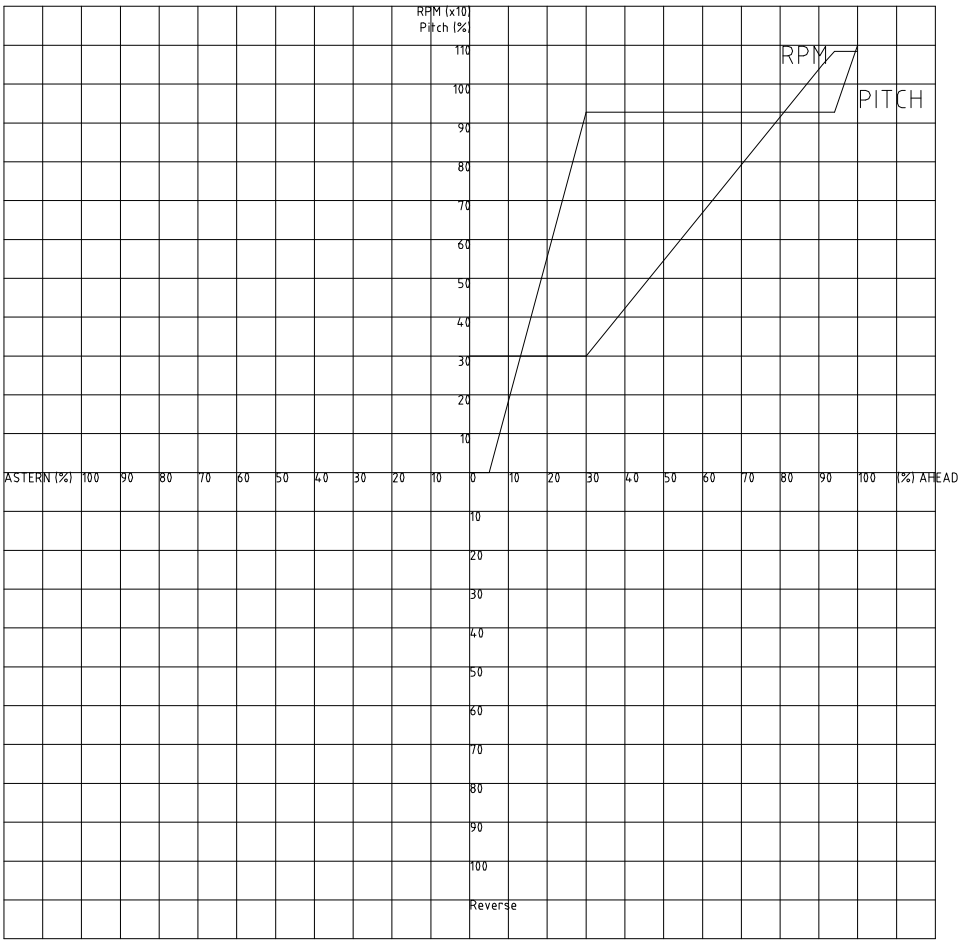

Figure 24: CC MAX FSR

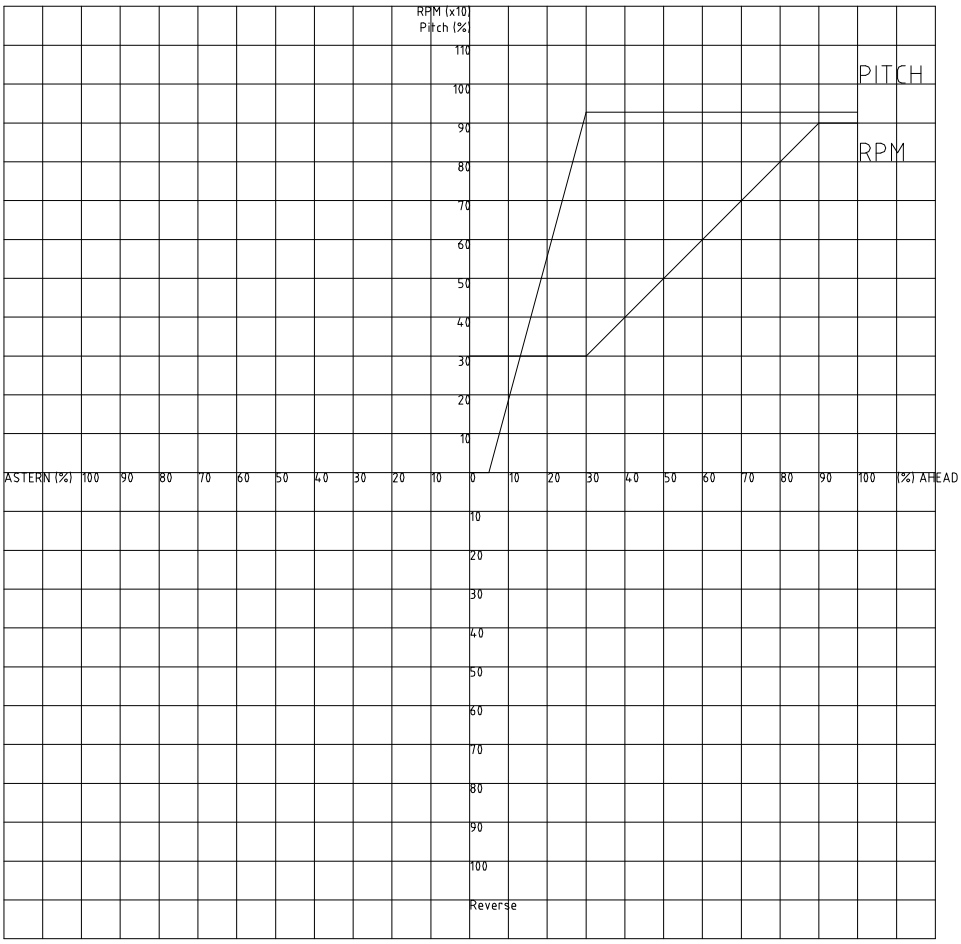

Figure 25: CC TRAIL

3.9 ME control

Starting and stopping of the main engine can only be done at control position MCR in MANUAL mode, or at control position LOCAL on the local control panel of the main engine.
For the ME the following states can be distinguished:

- Stopped, the indication ME STOPPED is continuous lit.
- Starting, at a valid start command the ME is set to “Starting”. If the ME does not indicate “Running” within tStart seconds the state is reversed to “Stopped” and a ME FAILURE (time-out alarm) is initiated. During starting the indication ME RUNNING is flashing.
- Running, the ME indicates running.
- Stopping, this state is initiated if a valid stop command is given. After a normal stop command the ME enters a cooling down cycle. During stopping the indication ME STOPPED is flashing.

A valid start command is given if the start conditions are met and the operator in the MCR gives a ME START command.
A valid stop command is given if the stop conditions are met and the operator in the MCR gives a ME STOP command, or ME protection is activated.

3.9.1 Start conditions

The ME can only be started if the following starting conditions are met:

- Control position is MCR;
- Control level is MANUAL;
- ME indicate “Ready for start” or is in cooling down cycle;
- ME protection is not active;
- Clutch is OUT;
- Gearbox is “Ready for use”.

3.9.2 Stop conditions

The ME can only be stopped if the following starting conditions are met:

- Control position is MCR;
- Control level is MANUAL;

3.9.3 ME protection

The ME protection is active if one of the following conditions is true:

- ME indicate a “Shutdown”;
- A start failure is present;
- A Clutch failure is active.

3.9.4 ME alarms

The PCS generates alarms to the IPMS if the ME is operated outside its design parameters for a prolonged time.

3.9.4.1 Low load alarm

The PCS starts a counter as soon as the shaft torque reaches 14% or less and remains in this range. An alarm to the IPMS is generated if this counter reaches 48 hour to indicate that the load must be increased on the ME. If the load increases above 60% for more than 20 minutes the counter will be reset.

3.9.4.2 Very low load alarm

The PCS starts a counter as soon as the shaft torque reaches 7% or less and remains in this range. An alarm to the IPMS is generated if this counter reaches 12 hour to indicate that the load must be increased on the ME. If the load increases above 60% for more than 20 minutes the counter will be reset.

3.9.4.3 Max FSR alarm

The PCS starts a counter as soon as the ME power goes over 100% MCR and remains in this range. An alarm to the IPMS is generated if this counter reaches 1 hour to indicate that the load must be decreased below a predefined value for the following 5 hours. If within the hour the load decreases below a predefined level for a predefined time the counter will be reset.

3.10 Gearbox control

The actual clutch IN/OUT command to the gearbox is a function of the local control panel (LCP) of the main engine. The PCS sends its clutch in/out command to the LCP and assumes that the LCP will execute the command. The electrical lubrication pump of the gearbox is controlled by the PCS on basis ME speed and oil pressure.
For the clutch the following states can be distinguished:

- Disengaged, the indication CLUTCH OUT is continuous lit.
- Closing, at a valid clutch in command the clutch is set to “Closing”. If the clutch does not indicate “Engaged” within tClutch seconds the state is reversed to “Disengaged” and a GB FAILURE (time-out alarm) is initiated. During closing the indication CLUTCH IN is flashing.
- Engaged, the clutch indicates IN. The indication CLUTCH IN is continuous lit.
- Opening, this state is initiated if a valid clutch out command is given. During opening the indication CLUTCH OUT is flashing.

A valid clutch in command is given if the closing conditions are met and the operator in the MCR, bridge or the PCS gives a CLUTCH IN command.
A valid clutch out command is given if the opening conditions are met and the operator in the MCR, bridge or the PCS gives a CLUTCH OUT command, or GB protection is activated.

3.10.1 Closing conditions

The clutch can only be closed if the following closing conditions are met:

- Propeller pitch in zero position;
- Shaft not locked;
- The electrical lubrication pump of the gearbox is running;
- GB Lub oil sensor standby start (105) measures a pressure > 0.5 bar;
- GB Lub oil sensor emergency stop (103) measures a pressure > 0.3 bar.
- Clutch allowance indication from LCP is present.

3.10.2 Opening conditions

In MANUAL there are no specific opening conditions. In AUTO the following opening conditions apply:

- ME speed < 415 rpm;
- Propeller pitch in zero thrust.

3.10.3 Start lub oil pump

The electrical lubrication pump of the gearbox is started if:

- Lub oil pump control unit in remote control;
- Lub oil pump control unit indication “ready for use” is present;
- One of the following conditions is true:
  - Shaft speed < 92 rpm;
  - Shaft speed > 92 rpm and GB Lub oil sensor standby start (105) measures a pressure < 0.0025 x ME Speed – 0.6356 bar;
  - Clutch is engaged and the control oil pressure sensor (93) indicates “Pressure too low”.

3.10.4 Stop lub oil pump

The electrical lubrication pump of the gearbox is stopped if:

- Lub oil pump control unit in remote control;
- Shaft speed > 113 rpm;
- Non of the start conditions above apply.

3.10.5 GB protection

3.10.5.1 GB Emergency Stop

On a GB Emergency Stop a CLUTCH OUT command and an emergency stop of the ME is generated by the LCP. A GB Emergency Stop is generated if one of the following conditions applies:

- ME speed < 450 rpm and GB Lub oil sensor emergency stop (103) measures a pressure < 0.3 bar;
- Shaft speed > 102 rpm and GB Lub oil sensor emergency stop (103) measures a pressure < 0.0022 x ME Speed – 0.6937 bar.

The conditions above are time delayed during closing of the clutch.

3.10.5.2 GB Safety Declutch

On a GB Safety Declutch a CLUTCH OUT command is generated by the LCP. The ME remain running. A GB Safety Declutch is generated if one of the following conditions applies:

- The clutch is engaged and the GB control oil sensor emergency stop (104) measures a pressure <13 bar.

3.11 CPP control

The pitch of the propeller is controlled by the operator in MANUAL with the pushbuttons CPP PITCH AH (ahead) and CPP PITCH AS (astern), and in AUTO by the PCS. Pitch control is only possible if the CPP installation is “ready for use”.
The CPP installation is ready for use if:

- CPP control unit in remote control;
- At least one of the hydraulic pumps is running;
- CPP control pressure (sensor PT2) > 0.8 MPa;
- No control failure indication present in AUTO;
- Backup control confirmation present in MANUAL.

3.11.1 CPP Failure

A CPP Failure is generated if:

- Both hydraulic pumps indicate OVERLOAD;
- First hydraulic pump indicates OVERLOAD and the second (standby) pump fails to auto start;
- CPP Control unit indicate “Control Failure”;
- CPP Control unit indicate “Follow-up Failure”;
- CPP Control unit indicate “Backup supply Failure”.

3.12 CPP warnings

3.12.1 Trail alarm

The PCS starts a counter as soon as the shaft rpm of the trailing shaft reaches 45 rpm or less and remains in this range. An alarm to the IPMS is generated if this counter reaches 30s (default value, adjustable) to indicate that the operator must take action. If the shaft rpm increases above 45 rpm the counter will be reset.

3.13 Internal functions

In this chapter a short description is given of the control loops used by the PCS in AUTO to familiarise the operator with the response of the propulsion plant after an operator command.

3.13.1 Control loops

The PCS contains the following control loops:

- Drive Control. This control loop is active in shaft mode DRIVE.
- Trail Control. This control loop is active in shaft mode TRAIL.
- Stop Control. This control loop is active in shaft mode STOP.

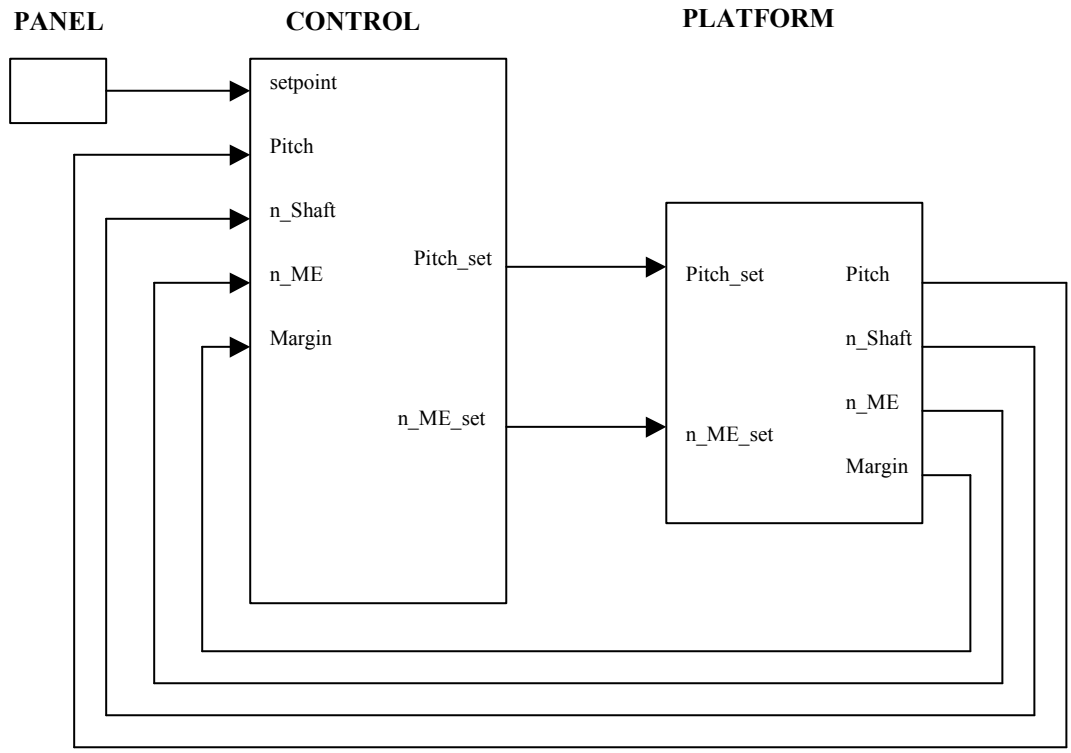

Figure 26: General overview of AUTO propulsion control

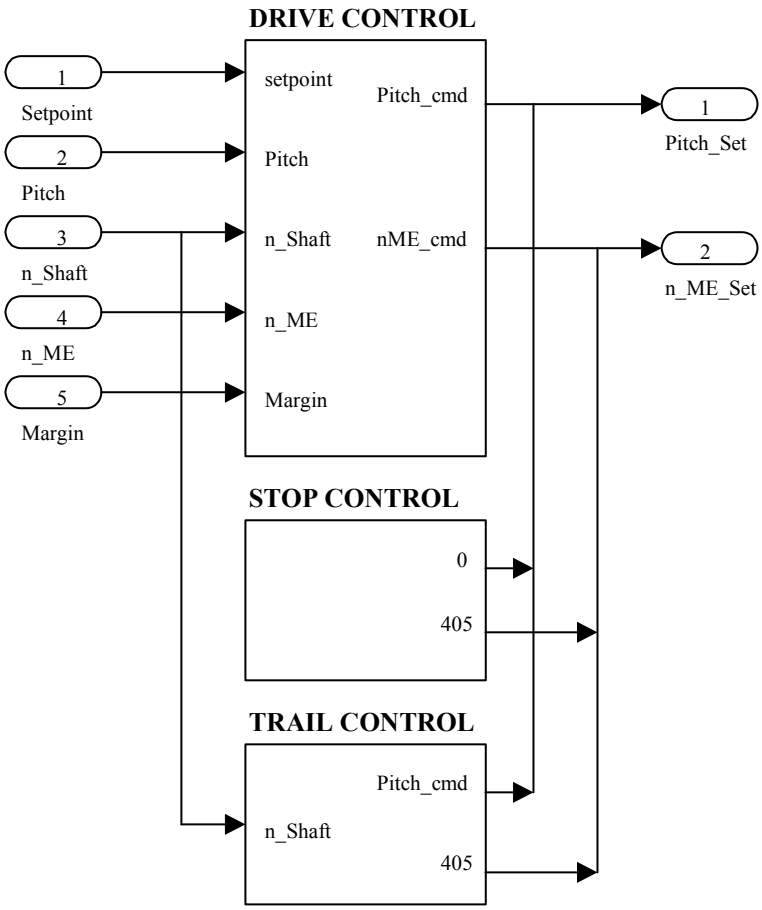

Figure 27: Overview control loops

3.13.1.1 Drive Control

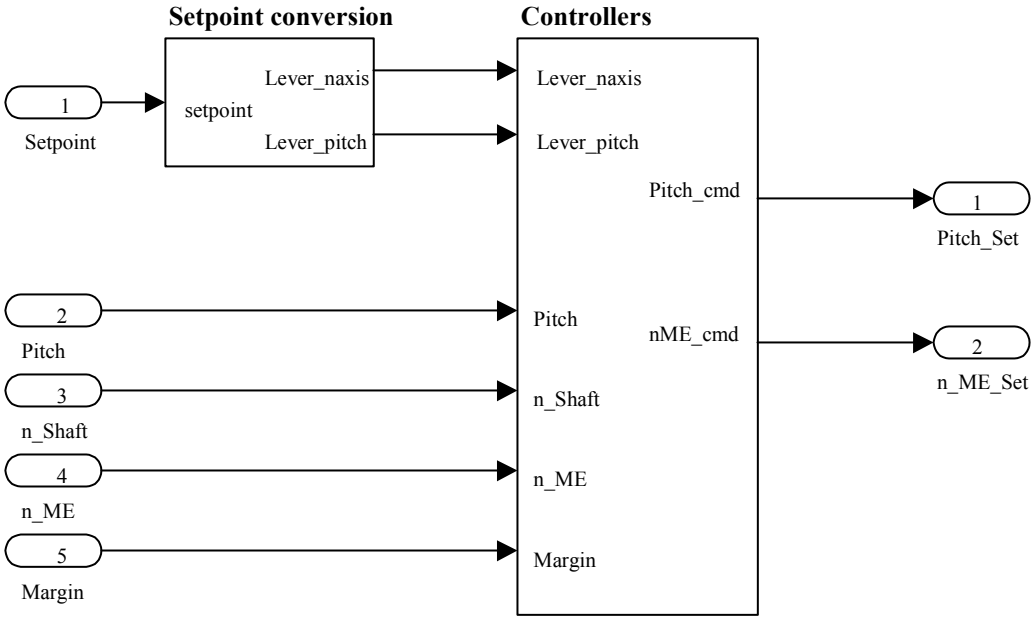

Figure 28: Overview Drive control

In drive control the (active) lever setpoint is converted via the active combinatory curve (see 3.8) in a speed setpoint (Lever_naxis) and a pitch setpoint (Lever_pitch). These setpoints are used generate the ME Speed setpoint for the LCP and the Pitch Command for the CPP Control unit.
If the lever setpoint is increased first the pitch setpoint command will be set before the ME speed setpoint is increased. At higher settings the ME speed setpoint will be reduced first, then the pitch is increased followed by the increase of the ME speed setpoint.
If the lever setpoint is decreased first the ME speed setpoint will be decreased and then the pitch command will be reduced.
The same applies if the pitch has to change direction (for instance at crash stop). First the ME speed is reduced to approx. 750 rpm and then the pitch is reversed. When the pitch reached the desired value the ME speed is increased to the desired value.

The pitch and ME speed normally are set to the desired values Lever_naxis and Lever_pitch unless a restriction applies. The main restriction is the MCR of the main engine. If the ME reaches MCR the increase of pitch and ME speed is halted until the load has decreased sufficient for further increase of pitch and/or ME speed. The control loop uses the power margin signal from the LCP for limiting the pitch and/or ME speed. If 110% MCR is set the PCS will allow a 10% overload of the main engine.

The rate of increase/decrease of the pitch and ME speed depends on:
- Actual control mode (see 3.4);
- Actual power margin.

3.13.1.2 Trail Control

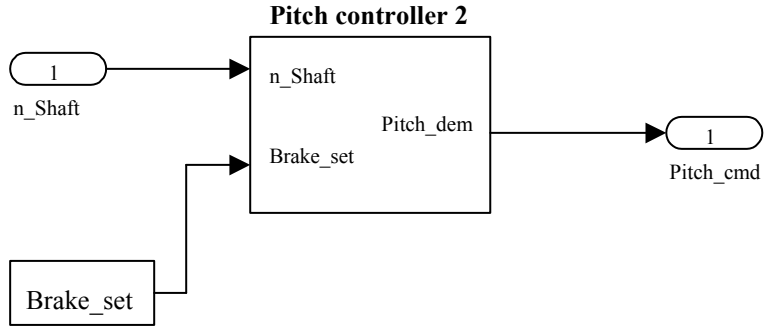

Figure 29: Overview Trail control

In trail control the pitch is increased or decreased depending on the actual shaft speed. The control loop will start to increase the pitch to maximum pitch and then decrease the pitch as the shaft build up momentum. If the shaft is locked the pitch will be set to zero.

3.13.1.3 Stop Control

Stop control is not really a control loop. In shaft mode STOP a fixed setpoint is used.

3.14 PCS alarms

The functions of the PCS itself are also monitored, and in case of a failure an alarm will be send to the PCS Panels and to the IMCS. A PCS Alarm will be generated if one of the following conditions applies:
- Communication failure detected with other PCS PLC;
- Communication failure detected with PCS Panel MCR;
- Communication failure detected with PCS Panel Bridge;
- MCR lever setpoint signal out of range;
- Bridge lever setpoint signal out of range;
- ME Speed sensor out of range;
- Fuel rack position sensor out of range;
- Power margin sensor out of range;
- Shaft speed sensor out of range;
- Propeller pitch sensor out of range;
- GB Lub oil sensor emergency stop (103) out of range;
- GB control oil sensor emergency stop (104) out of range;
- GB Lub oil sensor standby start (105) out of range;
- CPP Control oil pressure sensor (PT2) out of range.

In case of a communication failure the PCS will assume a safe state of the communication partner.
If an out of range is detected for an analogue input the sensor value is set to zero.

4. Maintenance

4.1 Parameters

Name	Description	Value
C1	Parameter for pitch ramp rate correction	0.24568
C2	Parameter for pitch ramp rate correction	0.39298
C3	Parameter for pitch ramp rate correction	0.00558968
C4	Parameter for pitch ramp rate correction	0.53208
CLLDrive	Constant low load alarm 2 driving shafts	366
CLLTrail	Constant low load alarm 1 driving shaft	306
CVLLdrive	Constant very low load alarm 2 driving shafts	269
CVLLtrail	Constant very low load alarm 1 driving shafts	243
degproc	Conversion factor angle → percentage	2.7778
DeltaPitch	Maximum deviation between actual pitch and lever setting for control transfer	2%
DeltaRpm	Maximum deviation between actual speed and lever setting for control transfer	5 rpm
Delta SP	Maximum deviation between MCR lever and Bridge lever setting for control transfer	2%
dmaxnasm	Maximum ramp rpm setpoint in “manoeuvring”	14 rpm/s
dmaxnast	Maximum ramp rpm setpoint in “transit”	5 rpm/s
dmaxpf	Maximum ramp pitch setpoint in “transit” > 80%	0.3%/s
dmaxpm	Maximum ramp pitch setpoint in “manoeuvring”	5%/s
dmaxpt	Maximum ramp pitch setpoint in “transit” < 80%	3.6%/s
Exp	Normal log	2.7182817
FRP1	Reset value ME power	80% (26mm)
Fuel Rack EngVal20	High engineering value fuel rack	35 mm
Fuel Rack EngVal4	Low engineering value fuel rack	0 mm
H1	Gain factor first order lag	-1
H2	Gain factor first order lag	1
H3	Gain factor first order lag	1
H4	Gain factor first order lag	1
H6	Gain factor first order lag	0.1
Lever EngVal20	High engineering value control lever	+100%
Lever EngVal4	Low engineering value control lever	-100%
ME Speed EngVal20	High engineering value speed main engine	1250 rpm
ME Speed EngVal20	Low engineering value speed main engine	0 rpm
MELimit1 High	Parameter for pitch ramp rate correction	60
MELimit1 Low	Parameter for pitch ramp rate correction	50
MELimit2 High	Parameter for pitch ramp rate correction	42
MELimit2 Low	Parameter for pitch ramp rate correction	27
MELimit3 High	Parameter for pitch ramp rate correction	90
MELimit3 Low	Parameter for pitch ramp rate correction	10
multiplier1	Multiplier	2
multiplier2	Multiplier	0.05

Name	Description	Value
n1	Parameter for nME dem correction	50
n2	Parameter for nME dem correction	750
n3	Parameter for nME dem correction	750
n5	Parameter for nME dem correction	750
naxis_trail	Shaft speed trail setpoint	47 rpm
nclutch	ME speed clutch setpoint	410 rpm
nmaxn	Maximum speed ME in “normal”	1050 rpm
nmaxf	Maximum speed ME in “max FSR”	1084 rpm
NRev	Lever setpoint for determining reverse speed	5 %
p error1	Maximum pitch error	3 %
P60	Reset value for low load and very low load alarm	60% (19mm)
pdem3 max	Maximum pitch demand factor trail control	100
pdem3 min	Minimum pitch demand factor trail control	0
pdem4 max	Maximum pitch demand factor trail control	100
pdem4 min	Minimum pitch demand factor trail control	0
pmaxf	Maximum pitch at Max FSR	110%
pmaxm	Maximum pitch at manoeuvring	80%
pmaxn	Maximum pitch normal	100%
pminm	Minimum pitch at manoeuvring	-100%
Power Margin EngVal20	High engineering value power margin main engine	+10%
Power Margin EngVal4	Low engineering value power margin main engine	-10%
pRate down	Rate limitation pitch adjust	-0.3 %/s
pRate up	Rate limitation pitch adjust	3 %/s
Pressure sensor 103 EngVal20	High engineering value pressure sensor 103	6 bar
Pressure sensor 103 EngVal4	Low engineering value pressure sensor 103	0 bar
Pressure sensor 104 EngVal20	High engineering value pressure sensor 104	25 bar
Pressure sensor 104 EngVal4	Low engineering value pressure sensor 104	0 bar
Pressure sensor 105 EngVal20	High engineering value pressure sensor 105	6 bar
Pressure sensor 105 EngVal20	High engineering value pressure sensor 105	0 bar
Pressure sensor PT2 EngVal20	High engineering value pressure sensor PT2	16 bar
Pressure sensor PT2 EngVal20	Low engineering value pressure sensor PT2	0 bar
Prop Pitch EngVal20	High engineering value propeller pitch	100%
Prop Pitch EngVal4	Low engineering value propeller pitch	-100%
pset1	Threshold parameter	80%
pzero	Threshold parameter	0%
rpmrad	Conversion factor rpm → rad/s	0.1047

Name	Description	Value
Shaft Speed EngVal20	High engineering value shaft speed	283 rpm
Shaft Speed EngVal4	Low engineering value shaft speed	0 rpm
SpRed1	Correction parameter pitch dem	14
SpRed2	Correction parameter pitch dem	14
SpRedMin	Correction parameter pitch dem	41
t3	Max duration time Max FSR	1 hour
t2	Reset time Max FSR	30 minutes
table1 high	Parameter for pitch demand correction	90
table1 Low	Parameter for pitch demand correction	10
table2 high	Parameter for pitch demand correction	60
table2 Low	Parameter for pitch demand correction	40
table3 high	Parameter for pitch demand correction	60
table3 Low	Parameter for pitch demand correction	40
table4 high	Parameter for pitch demand correction	600
table4 Low	Parameter for pitch demand correction	550
table5 high	Parameter for nME demand correction	56
table5 Low	Parameter for nME demand correction	42
table6 high	Parameter for nME demand correction	28
table6 Low	Parameter for nME demand correction	14
table6 high	Parameter for nME demand correction	8
table6 Low	Parameter for nME demand correction	3
TauP1	Time constant first order lag	0.5
TauP2	Time constant first order lag	10
TauP3	Time constant first order lag	0.2
TauP4	Time constant first order lag	0.5
tclose	Time delay clutch close failure	30s
tLL	Time delay low load alarm	172800 s
tMaxBlocking	Time Max FSR is blocked	5 hour
tOpen	Time delay clutch open failure	10s
tReset	Time delay reset low load and very low load alarm	1200 s
tStart	Time delay start failure	60s
tStop	Time delay stop failure	180s
tTrail	Time delay trail alarm	30s
tVLL	Time delay very low load alarm	43200 s
Windmill High	Parameter for nME rate correction	900 rpm
Windmill Low	Parameter for nME rate correction	800 rpm
XrLimit1 High	Parameter for nME rate correction	80 rpm
XrLimit1 Low	Parameter for nME rate correction	40 rpm
XrLimit2 High	Parameter for nME rate correction	5 rpm
XrLimit2 Low	Parameter for nME rate correction	2 rpm
XrLimit3 High	Parameter for nME rate correction	80 rpm
XrLimit3 Low	Parameter for nME rate correction	40 rpm
XrLimit4 High	Parameter for nME rate correction	75 rpm
XrLimit4 Low	Parameter for nME rate correction	40 rpm

Table 1: List of parameters

4.2 PCS I/O

4.2.1 I/O specification

Remark: Spare means that this I/O point is not used for the PCS application. This does not mean that there is no sensor or actuator connected to it.

4.2.2 Digital inputs

APL_DI_01	(Local:2:I.Data)	Hardware inputs card 02
APL_DI_01.0	Spare	
APL_DI_01.1	Pin code bit 0	
APL_DI_01.2	Pin code bit 1	
APL_DI_01.3	Pin code bit 2	
APL_DI_01.4	Pin code bit 3	
APL_DI_01.5	ME Clutched	True = Clutched
APL_DI_01.6	ME De-Clutched	True = de-clutched
APL_DI_01.7	ME Remote Control	True = Remote control
APL_DI_01.8	ME Remote Control Request	True = Remote Control Request
APL_DI_01.9	ME decrease pitch	True = decrease pitch
APL_DI_01.10	ME stop pitch increase	True = stop pitch increase
APL_DI_01.11	ME Emergency stop local	False = Emergency stop
APL_DI_01.12	ME Manual handle to stop position	False = Stop position
APL_DI_01.13	ME Overspeed	False = overspeed
APL_DI_01.14	ME Started	True = Started
APL_DI_01.15	ME Ready to start	True = Ready to start
APL_DI_01.16	Spare	p.m.
APL_DI_01.17	Spare	
APL_DI_01.18	ME Protection override active	True = Override active
APL_DI_01.19	ME Shutdown	False = Shutdown
APL_DI_01.20	ME Start Failure	False = Start failure
APL_DI_01.21	ME Start in progress	True = Start in progress
APL_DI_01.22	Spare	
APL_DI_01.23	Spare	
APL_DI_01.24	ME Clutch allowed	True = Clutch allowed
APL_DI_01.25	GB Lo pump Failure	False = Failure
APL_DI_01.26	GB Lo pump Remote	True = Remote
APL_DI_01.27	GB Lo pump ready for use	True = Ready for use
APL_DI_01.28	GB Lo pump running	True = Running
APL_DI_01.29	GB Control oil PTL (93)	True = PTL
APL_DI_01.30	Spare	
APL_DI_01.31	Spare	

APL_DI_02	(Local:3:I.Data)	Hardware inputs card 03
APL_DI_02.0	Spare	
APL_DI_02.1	Spare	
APL_DI_02.2	Spare	
APL_DI_02.3	Spare	
APL_DI_02.4	CPP CLS Control failure	False = Failure
APL_DI_02.5	CPP CLS Backup power on	True = Backup power on
APL_DI_02.6	CPP CLS Follow-up failure	False = Failure
APL_DI_02.7	CPP CLS Backup supply failure	False = Failure
APL_DI_02.8	CPP HPP Local Control	True = local control
APL_DI_02.9	Spare	
APL_DI_02.10	Spare	
APL_DI_02.11	Spare	
APL_DI_02.12	CPP Pitch in zero position	True = Pitch in zero position
APL_DI_02.13	CPP HPP Pump 1 running	True = pump running
APL_DI_02.14	CPP HPP pump 1 overload	True = overload
APL_DI_02.16	Spare	
APL_DI_02.17		
APL_DI_02.18		
APL_DI_02.19		
APL_DI_02.20		
APL_DI_02.21	CPP HPP Pump 1 standby started	True = started
APL_DI_02.22	CPP HPP Pump 2 running	True = running
APL_DI_02.23	CPP HPP Pump 2 overload	True = overload
APL_DI_02.24	CPP HPP Pump 2 standby started	True = started
APL_DI_02.25	CPP HPP Pump 3 running	True = running
APL_DI_02.26	CPP HPP Pump 3 overload	True = overload
APL_DI_02.27		
APL_DI_02.28		
APL_DI_02.29		
APL_DI_02.30	CPP Shaft not Locked	True = not locked
APL_DI_02.31		

4.2.3 Digital outputs

APL_DO_01	(Local:7:O.Data)	Hardware outputs card 07
APL_DO_01.0	ME Clutching interlock	False = Interlock
APL_DO_01.1	Spare	
APL_DO_01.2	ME Analogue speed setpoint selection	True = Analogue speed setpoint
APL_DO_01.3	ME Decrease speed	True (pulse) = decrease
APL_DO_01.4	ME Increase speed	True (pulse) = increase
APL_DO_01.5	ME Remote control accepted	True = Accepted
APL_DO_01.6	Spare	
APL_DO_01.7	ME Start Command	True (pulse) = start
APL_DO_01.8	ME Stop Command	True (pulse) = stop
APL_DO_01.9	ME Gearbox emergency stop	False = emergency stop
APL_DO_01.10	Clutch Safety de-clutch	False = De-clutch
APL_DO_01.11	ME Clutch command	True (pulse) = clutch
APL_DO_01.12	ME De-clutch Command	True (pulse) = de-clutch
APL_DO_01.13	Spare	
APL_DO_01.14	Spare	
APL_DO_01.15	ME Emergency stop	False = emergency stop
APL_DO_01.16	Spare	
APL_DO_01.17	GB Lo pump Start command	True (pulse) = start
APL_DO_01.18	GB Lo pump Stop command	True (pulse) = stop
APL_DO_01.19	CPP Back-up Request	True = Main
APL_DO_01.20	CPP Pitch Ahead Command	True = Ahead
APL_DO_01.21	CPP Pitch Astern Command	True = Astern
APL_DO_01.22	Spare	
APL_DO_01.23	Spare	
APL_DO_01.24	Spare	
APL_DO_01.25	Spare	
APL_DO_01.26	Spare	
APL_DO_01.27	Spare	
APL_DO_01.28	Spare	
APL_DO_01.29	Spare	
APL_DO_01.30	Spare	
APL_DO_01.31	Spare	

4.2.4 Analogue inputs

APL_AI_01	(Local:5:I.Ch1Data)	ME Power Margin Limit Range: 0-50-100% equals: -10% - 0 - +10%
APL_AI_02	(Local:5:I.Ch2Data)	ME Speed Range: 0-100% equals: 0-1250 rpm
APL_AI_03	(Local:5:I.Ch5Data)	Shaft speed Range: 0-100% equals: 0-284rpm
APL_AI_04	(Local:5:I.Ch15Data)	Propeller Pitch Range: 0-50-100% equals: -100% - 0 +100%
APL_AI_05	(Local:6:I.Ch3Data)	ME Fuel rack position Range: 0-100% equals: 0-35mm
APL_AI_06	(Local:6:I.Ch14Data)	MCR Lever Range: 0-50-100% equals: -100% - 0 - +100%
APL_AI_07	(Local:6:I.Ch15Data)	Bridge Lever Range: 0-50-100% equals: -100% - 0 - +100%
APL_AI_08	(Local:6:I.Ch0Data)	CPP Servo Oil pressure Range: 0-100% equals: 0-16MPa
APL_AI_10	(Local:5:I.Ch4Data)	GB Lu Oil pressure stby start (105) Range: 0-100% equals: 0-6bar
APL_AI_11	(Local:5:I.Ch13Data)	GB Lu Oil pressure em stop (103) Range: 0-100% equals: 0-6bar
APL_AI_14	(Local:5:I.Ch14Data)	GB Control Oil pressure em stop (104) Range: 0-100% equals: 0-25bar

4.2.5 Analogue outputs

APL_AO_01	**(**Local:8:O.Ch0Data)	Speed setpoint to ME Range: 0 - 100% equals: 0 rpm - 1250 rpm
APL_AO_02	(Local:8:O.Ch1Data)	Pitch setpoint to CPP Range: 0 – 50 - 100% equals: -100% - 0 - +100%

4.2.6 Serial inputs

4.2.6.1 APL_SI_01: Input from MCR Control Panel

APL_SI_01[0].12	MCR PB Alarm Acknowledged
APL_SI_01[0].13	MCR PB Stop Horn
APL_SI_01[0].15	MCR PB Lamptest
APL_SI_01[1].0	MCR PB MCR Control PS
APL_SI_01[1].1	MCR PB MCR Control SB
APL_SI_01[1].2	MCR PB Bridge Control PS
APL_SI_01[1].3	MCR PB Bridge Control SB
APL_SI_01[1].9	MCR PB Transit
APL_SI_01[1].10	MCR PB Manoeuvring
APL_SI_01[2].8	MCR PB Clutch in SB
APL_SI_01[2].11	MCR PB GB Remote Auto SB
APL_SI_01[2].12	MCR PB Clutch out SB
APL_SI_01[2].15	MCR PB GB Remote Manual SB
APL_SI_01[3].0	MCR PB Increase speed SB
APL_SI_01[3].2	MCR PB Start SB
APL_SI_01[3].3	MCR PB ME Remote Auto SB
APL_SI_01[3].4	MCR PB Decrease speed SB
APL_SI_01[3].6	MCR PB Stop SB
APL_SI_01[3].7	MCR PB ME Remote Manual SB
APL_SI_01[3].8	MCR PB Pitch Ahead SB
APL_SI_01[3].11	MCR PB CPP Remote Auto SB
APL_SI_01[3].12	MCR PB Pitch Astern SB
APL_SI_01[3].15	MCR PB CPP Remote Manual SB
APL_SI_01[4].0	MCR PB Increase speed PS
APL_SI_01[4].2	MCR PB Start PS
APL_SI_01[4].3	MCR PB ME Remote Auto PS
APL_SI_01[4].4	MCR PB Decrease speed PS
APL_SI_01[4].6	MCR PB Stop PS
APL_SI_01[4].7	MCR PB ME Remote Manual PS
APL_SI_01[4].8	MCR PB Pitch Ahead PS
APL_SI_01[4].11	MCR PB CPP Remote Auto PS
APL_SI_01[4].12	MCR PB Pitch Astern PS
APL_SI_01[4].15	MCR PB CPP Remote Manual PS
APL_SI_01[5].8	MCR PB Clutch in PS
APL_SI_01[5].11	MCR PB GB Remote Auto PS
APL_SI_01[5].12	MCR PB Clutch out PS
APL_SI_01[5].15	MCR PB GB Remote Manual PS
APL_SI_01[6].0	MCR PB Max FSR PS
APL_SI_01[6].1	MCR PB Shaft Driven PS
APL_SI_01[6].2	MCR PB Shaft Stop PS
APL_SI_01[6].4	MCR PB Shaft Trail PS
APL_SI_01[6].5	MCR PB Transfer Override PS
APL_SI_01[6].6	MCR PB Max FSR SB
APL_SI_01[6].7	MCR PB Shaft Driven SB
APL_SI_01[6].8	MCR PB Shaft Stop SB
APL_SI_01[6].10	MCR PB Shaft Trail SB
APL_SI_01[6].11	MCR PB Transfer Override SB

4.2.6.2 APL_SI_02: Input from Bridge Control Panel

APL_SI_02[0].12	BRIDGE PB Alarm Acknowledged
APL_SI_02[0].13	BRIDGE PB Stop Horn
APL_SI_02[0].15	BRIDGE PB Lamptest
APL_SI_02[1].0	BRIDGE PB MCR Control PS
APL_SI_02[1].1	BRIDGE PB MCR Control SB
APL_SI_02[1].2	BRIDGE PB Bridge Control PS
APL_SI_02[1].3	BRIDGE PB Bridge Control SB
APL_SI_02[1].9	BRIDGE PB Transit
APL_SI_02[1].10	BRIDGE PB Manoeuvring
APL_SI_02[2].8	BRIDGE PB Clutch in SB
APL_SI_02[2].11	BRIDGE PB GB Remote Auto SB
APL_SI_02[2].12	BRIDGE PB Clutch out SB
APL_SI_02[2].15	BRIDGE PB GB Remote Manual SB
APL_SI_02[3].0	BRIDGE PB Increase speed SB
APL_SI_02[3].2	BRIDGE PB Start SB
APL_SI_02[3].3	BRIDGE PB ME Remote Auto SB
APL_SI_02[3].4	BRIDGE PB Decrease speed SB
APL_SI_02[3].6	BRIDGE PB Stop SB
APL_SI_02[3].7	BRIDGE PB ME Remote Manual SB
APL_SI_02[3].8	BRIDGE PB Pitch Ahead SB
APL_SI_02[3].11	BRIDGE PB CPP Remote Auto SB
APL_SI_02[3].12	BRIDGE PB Pitch Astern SB
APL_SI_02[3].15	BRIDGE PB CPP Remote Manual SB
APL_SI_02[4].0	BRIDGE PB Increase speed PS
APL_SI_02[4].2	BRIDGE PB Start PS
APL_SI_02[4].3	BRIDGE PB ME Remote Auto PS
APL_SI_02[4].4	BRIDGE PB Decrease speed PS
APL_SI_02[4].6	BRIDGE PB Stop PS
APL_SI_02[4].7	BRIDGE PB ME Remote Manual PS
APL_SI_02[4].8	BRIDGE PB Pitch Ahead PS
APL_SI_02[4].11	BRIDGE PB CPP Remote Auto PS
APL_SI_02[4].12	BRIDGE PB Pitch Astern PS
APL_SI_02[4].15	BRIDGE PB CPP Remote Manual PS
APL_SI_02[5].8	BRIDGE PB Clutch in PS
APL_SI_02[5].11	BRIDGE PB GB Remote Auto PS
APL_SI_02[5].12	BRIDGE PB Clutch out PS
APL_SI_02[5].15	BRIDGE PB GB Remote Manual PS
APL_SI_02[6].0	BRIDGE PB Max FSR PS
APL_SI_02[6].1	BRIDGE PB Shaft Driven PS
APL_SI_02[6].2	BRIDGE PB Shaft Stop PS
APL_SI_02[6].4	BRIDGE PB Shaft Trail PS
APL_SI_02[6].5	BRIDGE PB Transfer Override PS
APL_SI_02[6].6	BRIDGE PB Max FSR SB
APL_SI_02[6].7	BRIDGE PB Shaft Driven SB
APL_SI_02[6].8	BRIDGE PB Shaft Stop SB
APL_SI_02[6].10	BRIDGE PB Shaft Trail SB
APL_SI_02[6].11	BRIDGE PB Transfer Override SB

4.2.6.3 APL_SI_03: Input from other PCS

APL_SI_03[0]	Heartbeat
APL_SI_03[1]	STATE ME
APL_SI_03[2]	STATE CLUTCH
APL_SI_03[3]	SHAFT MODE
APL_SI_03[4]	CONTROL POSITION
APL_SI_03[5]	CONTROL MODE
APL_SI_03[6]	CONTROL LEVEL
APL_SI_03[7]	Shaft Speed
APL_SI_03[8]	Propeller Pitch
APL_SI_03[9].0	VRTA

4.2.7 Serial outputs

4.2.7.1 APL_SO_01: Serial output to MCR Control Panel

APL_SO_01[0,1].0	MCR Ind MCR Control Flashing PS
APL_SO_01[0,1].1	MCR Ind MCR Control Flashing SB
APL_SO_01[0,1].2	MCR Ind Bridge Control Flashing PS
APL_SO_01[0,1].3	MCR Ind Bridge Control Flashing SB
APL_SO_01[0,1].9	MCR Ind Transit Flashing
APL_SO_01[0,1].10	MCR Ind Manoeuvring Flashing
APL_SO_01[0,2].0	MCR Ind ME Failure Flashing SB
APL_SO_01[0,2].1	MCR Ind GB Failure Flashing SB
APL_SO_01[0,2].2	MCR Ind CPP Failure Flashing SB
APL_SO_01[0,2].4	MCR Ind Shaft power limited Flashing SB
APL_SO_01[0,2].5	MCR Ind Shaft not Locked Flashing SB
APL_SO_01[0,2].6	MCR Ind PCS Alarm Flashing SB
APL_SO_01[0,2].8	MCR Ind Clutch engaged Flashing SB
APL_SO_01[0,2].9	MCR Ind GB Ready for use Flashing SB
APL_SO_01[0,2].11	MCR Ind GB Remote Auto Flashing SB
APL_SO_01[0,2].12	MCR Ind Clutch disengaged Flashing SB
APL_SO_01[0,2].13	MCR Ind GB Local Flashing SB
APL_SO_01[0,2].15	MCR Ind GB Remote Manual Flashing SB
APL_SO_01[0,3].0	MCR Ind Increase Flashing SB
APL_SO_01[0,3].1	MCR Ind ME Ready for use Flashing SB
APL_SO_01[0,3].2	MCR Ind Running Flashing SB
APL_SO_01[0,3].3	MCR Ind ME Remote Auto Flashing SB
APL_SO_01[0,3].4	MCR Ind Decrease Flashing SB
APL_SO_01[0,3].5	MCR Ind ME Local Flashing SB
APL_SO_01[0,3].6	MCR Ind Stopped Flashing SB
APL_SO_01[0,3].7	MCR Ind ME Remote Manual Flashing SB
APL_SO_01[0,3].8	MCR Ind CPP Ahead Flashing SB
APL_SO_01[0,3].9	MCR Ind CPP Ready for use Flashing SB
APL_SO_01[0,3].11	MCR Ind CPP Remote Auto Flashing SB
APL_SO_01[0,3].12	MCR Ind CPP Astern Flashing SB
APL_SO_01[0,3].13	MCR Ind CPP Local Flashing SB
APL_SO_01[0,3].15	MCR Ind CPP Remote Manual Flashing SB
APL_SO_01[0,4].0	MCR Ind Increase Flashing PS
APL_SO_01[0,4].1	MCR Ind ME Ready for use Flashing PS
APL_SO_01[0,4].2	MCR Ind Running Flashing PS
APL_SO_01[0,4].3	MCR Ind ME Remote Auto Flashing PS
APL_SO_01[0,4].4	MCR Ind Decrease Flashing PS
APL_SO_01[0,4].5	MCR Ind ME Local Flashing PS
APL_SO_01[0,4].6	MCR Ind Stopped Flashing PS
APL_SO_01[0,4].7	MCR Ind ME Remote Manual Flashing PS
APL_SO_01[0,4].8	MCR Ind CPP Ahead Flashing PS
APL_SO_01[0,4].9	MCR Ind CPP Ready for use Flashing PS
APL_SO_01[0,4].11	MCR Ind CPP Remote Auto Flashing PS
APL_SO_01[0,4].12	MCR Ind CPP Astern Flashing PS
APL_SO_01[0,4].13	MCR Ind CPP Local Flashing PS
APL_SO_01[0,4].15	MCR Ind CPP Remote Manual Flashing PS
APL_SO_01[0,5].0	MCR Ind ME Failure Flashing PS

APL_SO_01[0,5].1	MCR Ind GB Failure Flashing PS
APL_SO_01[0,5].2	MCR Ind CPP Failure Flashing PS
APL_SO_01[0,5].4	MCR Ind Shaft power limited Flashing PS
APL_SO_01[0,5].5	MCR Ind Shaft not Locked Flashing PS
APL_SO_01[0,5].6	MCR Ind PCS Alarm Flashing PS
APL_SO_01[0,5].8	MCR Ind Clutch engaged Flashing PS
APL_SO_01[0,5].9	MCR Ind GB Ready for use Flashing PS
APL_SO_01[0,5].11	MCR Ind GB Remote Auto Flashing PS
APL_SO_01[0,5].12	MCR Ind Clutch disengaged Flashing PS
APL_SO_01[0,5].13	MCR Ind GB Local Flashing PS
APL_SO_01[0,5].15	MCR Ind GB Remote Manual Flashing PS
APL_SO_01[0,6].0	MCR Ind Ahead Flashing PS
APL_SO_01[0,6].1	MCR Ind Shaft Driven Flashing PS
APL_SO_01[0,6].2	MCR Ind Shaft Stop Flashing PS
APL_SO_01[0,6].3	MCR Ind Lever in service Flashing PS
APL_SO_01[0,6].4	MCR Ind Shaft Trail Flashing PS
APL_SO_01[0,6].5	MCR Ind Transfer Override Flashing PS
APL_SO_01[0,6].6	MCR Ind Ahead Flashing SB
APL_SO_01[0,6].7	MCR Ind Shaft Driven Flashing SB
APL_SO_01[0,6].8	MCR Ind Shaft Stop Flashing SB
APL_SO_01[0,6].9	MCR Ind Lever in service Flashing SB
APL_SO_01[0,6].10	MCR Ind Shaft Trail Flashing SB
APL_SO_01[0,6].11	MCR Ind Transfer Override Flashing SB
APL_SO_01[0,6].13	MCR Ind Astern Flashing PS
APL_SO_01[0,6].14	MCR Ind Astern Flashing SB
APL_SO_01[1,1].0	MCR Ind MCR Control On PS
APL_SO_01[1,1].1	MCR Ind MCR Control On SB
APL_SO_01[1,1].2	MCR Ind Bridge Control On PS
APL_SO_01[1,1].3	MCR Ind Bridge Control On SB
APL_SO_01[1,1].9	MCR Ind Transit On
APL_SO_01[1,1].10	MCR Ind Manoeuvring On
APL_SO_01[1,2].0	MCR Ind ME Failure On SB
APL_SO_01[1,2].1	MCR Ind GB Failure On SB
APL_SO_01[1,2].2	MCR Ind CPP Failure On SB
APL_SO_01[1,2].4	MCR Ind Shaft power limited On SB
APL_SO_01[1,2].5	MCR Ind Shaft not Locked On SB
APL_SO_01[1,2].6	MCR Ind PCS Alarm On PS
APL_SO_01[1,2].8	MCR Ind Clutch engaged On SB
APL_SO_01[1,2].9	MCR Ind GB Ready for use On SB
APL_SO_01[1,2].11	MCR Ind GB Remote Auto On SB
APL_SO_01[1,2].12	MCR Ind Clutch disengaged On SB
APL_SO_01[1,2].13	MCR Ind GB Local On SB
APL_SO_01[1,2].15	MCR Ind GB Remote Manual On SB
APL_SO_01[1,3].0	MCR Ind Increase On SB
APL_SO_01[1,3].1	MCR Ind ME Ready for use On SB
APL_SO_01[1,3].2	MCR Ind Running On SB
APL_SO_01[1,3].3	MCR Ind ME Remote Auto On SB
APL_SO_01[1,3].4	MCR Ind Decrease On SB
APL_SO_01[1,3].5	MCR Ind ME Local On SB
APL_SO_01[1,3].6	MCR Ind Stopped On SB
APL_SO_01[1,3].7	MCR Ind ME Remote Manual On SB
APL_SO_01[1,3].8	MCR Ind CPP Ahead On SB

APL_SO_01[1,3].9	MCR Ind CPP Ready for use On SB
APL_SO_01[1,3].11	MCR Ind CPP Remote Auto On SB
APL_SO_01[1,3].12	MCR Ind CPP Astern On SB
APL_SO_01[1,3].13	MCR Ind CPP Local On SB
APL_SO_01[1,3].15	MCR Ind CPP Remote Manual On SB
APL_SO_01[1,4].0	MCR Ind Increase On PS
APL_SO_01[1,4].1	MCR Ind ME Ready for use On PS
APL_SO_01[1,4].2	MCR Ind Running On PS
APL_SO_01[1,4].3	MCR Ind ME Remote Auto On PS
APL_SO_01[1,4].4	MCR Ind Decrease On PS
APL_SO_01[1,4].5	MCR Ind ME Local On PS
APL_SO_01[1,4].6	MCR Ind Stopped On PS
APL_SO_01[1,4].7	MCR Ind ME Remote Manual On PS
APL_SO_01[1,4].8	MCR Ind CPP Ahead On PS
APL_SO_01[1,4].9	MCR Ind CPP Ready for use On PS
APL_SO_01[1,4].11	MCR Ind CPP Remote Auto On PS
APL_SO_01[1,4].12	MCR Ind CPP Astern On PS
APL_SO_01[1,4].13	MCR Ind CPP Local On PS
APL_SO_01[1,4].15	MCR Ind CPP Remote Manual On PS
APL_SO_01[1,5].0	MCR Ind ME Failure On PS
APL_SO_01[1,5].1	MCR Ind GB Failure On PS
APL_SO_01[1,5].2	MCR Ind CPP Failure On PS
APL_SO_01[1,5].4	MCR Ind Shaft power limited On PS
APL_SO_01[1,5].5	MCR Ind Shaft not Locked On PS
APL_SO_01[1,5].6	MCR Ind PCS Alarm On PS
APL_SO_01[1,5].8	MCR Ind Clutch engaged On PS
APL_SO_01[1,5].9	MCR Ind GB Ready for use On PS
APL_SO_01[1,5].11	MCR Ind GB Remote Auto On PS
APL_SO_01[1,5].12	MCR Ind Clutch disengaged On PS
APL_SO_01[1,5].13	MCR Ind GB Local On PS
APL_SO_01[1,5].15	MCR Ind GB Remote Manual On PS
APL_SO_01[1,6].0	MCR Ind Ahead On PS
APL_SO_01[1,6].1	MCR Ind Shaft Driven On PS
APL_SO_01[1,6].2	MCR Ind Shaft Stop On PS
APL_SO_01[1,6].3	MCR Ind Lever in service On PS
APL_SO_01[1,6].4	MCR Ind Shaft Trail On PS
APL_SO_01[1,6].5	MCR Ind Transfer Override On PS
APL_SO_01[1,6].6	MCR Ind Ahead On SB
APL_SO_01[1,6].7	MCR Ind Shaft Driven On SB
APL_SO_01[1,6].8	MCR Ind Shaft Stop On SB
APL_SO_01[1,6].9	MCR Ind Lever in service On SB
APL_SO_01[1,6].10	MCR Ind Shaft Trail On SB
APL_SO_01[1,6].11	MCR Ind Transfer Override On SB
APL_SO_01[1,6].13	MCR Ind Astern On PS
APL_SO_01[1,6].14	MCR Ind Astern On SB
APL_SO_01[2,0].12	MCR PB Alarm Acknowledged Acknowledge PS
APL_SO_01[2,0].13	MCR PB Stop Horn Acknowledge PS
APL_SO_01[2,0].15	MCR PB Lamptest Acknowledge PS
APL_SO_01[2,1].0	MCR PB MCR Control Acknowledge PS
APL_SO_01[2,1].1	MCR PB MCR Control Acknowledge SB
APL_SO_01[2,1].2	MCR PB Bridge Control Acknowledge PS
APL_SO_01[2,1].3	MCR PB Bridge Control Acknowledge SB

APL_SO_01[2,1].9	MCR PB Transit Acknowledge PS
APL_SO_01[2,1].10	MCR PB Manoeuvring Acknowledge PS
APL_SO_01[2,2].8	MCR PB Clutch in Acknowledge SB
APL_SO_01[2,2].11	MCR PB GB Remote Auto Acknowledge SB
APL_SO_01[2,2].12	MCR PB Clutch out Acknowledge SB
APL_SO_01[2,2].15	MCR PB GB Remote Manual Acknowledge SB
APL_SO_01[2,3].0	MCR PB Increase speed Acknowledge SB
APL_SO_01[2,3].2	MCR PB Start Acknowledge SB
APL_SO_01[2,3].3	MCR PB ME Remote Auto Acknowledge SB
APL_SO_01[2,3].4	MCR PB Decrease speed Acknowledge SB
APL_SO_01[2,3].6	MCR PB Stop Acknowledge SB
APL_SO_01[2,3].7	MCR PB ME Remote Manual Acknowledge SB
APL_SO_01[2,3].8	MCR PB Pitch Ahead Acknowledge Sb
APL_SO_01[2,3].11	MCR PB CPP Remote Auto Acknowledge SB
APL_SO_01[2,3].12	MCR PB Pitch Astern Acknowledge SB
APL_SO_01[2,3].15	MCR PB CPP Remote Manual Acknowledge SB
APL_SO_01[2,4].0	MCR PB Increase speed Acknowledge PS
APL_SO_01[2,4].2	MCR PB Start Acknowledge PS
APL_SO_01[2,4].3	MCR PB ME Remote Auto Acknowledge PS
APL_SO_01[2,4].4	MCR PB Decrease speed Acknowledge PS
APL_SO_01[2,4].6	MCR PB Stop Acknowledge PS
APL_SO_01[2,4].7	MCR PB ME Remote Manual Acknowledge PS
APL_SO_01[2,4].8	MCR PB Pitch Ahead Acknowledge PS
APL_SO_01[2,4].11	MCR PB CPP Remote Auto Acknowledge PS
APL_SO_01[2,4].12	MCR PB Pitch Astern Acknowledge PS
APL_SO_01[2,4].15	MCR PB CPP Remote Manual Acknowledge PS
APL_SO_01[2,5].8	MCR PB Clutch in Acknowledge PS
APL_SO_01[2,5].11	MCR PB GB Remote Auto Acknowledge PS
APL_SO_01[2,5].12	MCR PB Clutch out Acknowledge PS
APL_SO_01[2,5].15	MCR PB GB Remote Manual Acknowledge PS
APL_SO_01[2,6].0	MCR PB Max FSR Acknowledge PS
APL_SO_01[2,6].1	MCR PB Shaft Driven Acknowledge PS
APL_SO_01[2,6].2	MCR PB Shaft Stop Acknowledge PS
APL_SO_01[2,6].4	MCR PB Shaft Trail Acknowledge PS
APL_SO_01[2,6].5	MCR PB Transfer Override Acknowledge PS
APL_SO_01[2,6].6	MCR PB Max FSR Acknowledge SB
APL_SO_01[2,6].7	MCR PB Shaft Driven Acknowledge SB
APL_SO_01[2,6].8	MCR PB Shaft Stop Acknowledge SB
APL_SO_01[2,6].10	MCR PB Shaft Trail Acknowledge SB
APL_SO_01[2,6].11	MCR PB Transfer Override Acknowledge SB

4.2.7.2 APL_SO_02: Serial output to Bridge Control Panel

APL_SO_02[0,1].0	Bridge Ind MCR Control Flashing PS
APL_SO_02[0,1].1	Bridge Ind MCR Control Flashing SB
APL_SO_02[0,1].2	Bridge Ind Bridge Control Flashing PS
APL_SO_02[0,1].3	Bridge Ind Bridge Control Flashing SB
APL_SO_02[0,1].9	Bridge Ind Transit Flashing
APL_SO_02[0,1].10	Bridge Ind Manoeuvring Flashing
APL_SO_02[0,2].0	Bridge Ind ME Failure Flashing SB
APL_SO_02[0,2].1	Bridge Ind GB Failure Flashing SB
APL_SO_02[0,2].2	Bridge Ind CPP Failure Flashing SB
APL_SO_02[0,2].4	Bridge Ind Shaft power limited Flashing SB
APL_SO_02[0,2].5	Bridge Ind Shaft not Locked Flashing SB
APL_SO_02[0,2].6	Bridge Ind PCS Alarm Flashing SB
APL_SO_02[0,2].8	Bridge Ind Clutch engaged Flashing SB
APL_SO_02[0,2].9	Bridge Ind GB Ready for use Flashing SB
APL_SO_02[0,2].11	Bridge Ind GB Remote Auto Flashing SB
APL_SO_02[0,2].12	Bridge Ind Clutch disengaged Flashing SB
APL_SO_02[0,2].13	Bridge Ind GB Local Flashing SB
APL_SO_02[0,2].15	Bridge Ind GB Remote Manual Flashing SB
APL_SO_02[0,3].0	Bridge Ind Increase Flashing SB
APL_SO_02[0,3].1	Bridge Ind ME Ready for use Flashing SB
APL_SO_02[0,3].2	Bridge Ind Running Flashing SB
APL_SO_02[0,3].3	Bridge Ind ME Remote Auto Flashing SB
APL_SO_02[0,3].4	Bridge Ind Decrease Flashing SB
APL_SO_02[0,3].5	Bridge Ind ME Local Flashing SB
APL_SO_02[0,3].6	Bridge Ind Stopped Flashing SB
APL_SO_02[0,3].7	Bridge Ind ME Remote Manual Flashing SB
APL_SO_02[0,3].8	Bridge Ind CPP Ahead Flashing SB
APL_SO_02[0,3].9	Bridge Ind CPP Ready for use Flashing SB
APL_SO_02[0,3].11	Bridge Ind CPP Remote Auto Flashing SB
APL_SO_02[0,3].12	Bridge Ind CPP Astern Flashing SB
APL_SO_02[0,3].13	Bridge Ind CPP Local Flashing SB
APL_SO_02[0,3].15	Bridge Ind CPP Remote Manual Flashing SB
APL_SO_02[0,4].0	Bridge Ind Increase Flashing PS
APL_SO_02[0,4].1	Bridge Ind ME Ready for use Flashing PS
APL_SO_02[0,4].2	Bridge Ind Running Flashing PS
APL_SO_02[0,4].3	Bridge Ind ME Remote Auto Flashing PS
APL_SO_02[0,4].4	Bridge Ind Decrease Flashing PS
APL_SO_02[0,4].5	Bridge Ind ME Local Flashing PS
APL_SO_02[0,4].6	Bridge Ind Stopped Flashing PS
APL_SO_02[0,4].7	Bridge Ind ME Remote Manual Flashing PS
APL_SO_02[0,4].8	Bridge Ind CPP Ahead Flashing PS
APL_SO_02[0,4].9	Bridge Ind CPP Ready for use Flashing PS
APL_SO_02[0,4].11	Bridge Ind CPP Remote Auto Flashing PS
APL_SO_02[0,4].12	Bridge Ind CPP Astern Flashing PS
APL_SO_02[0,4].13	Bridge Ind CPP Local Flashing PS
APL_SO_02[0,4].15	Bridge Ind CPP Remote Manual Flashing PS
APL_SO_02[0,5].0	Bridge Ind ME Failure Flashing PS
APL_SO_02[0,5].1	Bridge Ind GB Failure Flashing PS
APL_SO_02[0,5].2	Bridge Ind CPP Failure Flashing PS
APL_SO_02[0,5].4	Bridge Ind Shaft power limited Flashing PS

APL_SO_02[0,5].5	Bridge Ind Shaft not Locked Flashing PS
APL_SO_02[0,5].6	Bridge Ind PCS Alarm Flashing PS
APL_SO_02[0,5].8	Bridge Ind Clutch engaged Flashing PS
APL_SO_02[0,5].9	Bridge Ind GB Ready for use Flashing PS
APL_SO_02[0,5].11	Bridge Ind GB Remote Auto Flashing PS
APL_SO_02[0,5].12	Bridge Ind Clutch disengaged Flashing PS
APL_SO_02[0,5].13	Bridge Ind GB Local Flashing PS
APL_SO_02[0,5].15	Bridge Ind GB Remote Manual Flashing PS
APL_SO_02[0,6].0	Bridge Ind Ahead Flashing PS
APL_SO_02[0,6].1	Bridge Ind Shaft Driven Flashing PS
APL_SO_02[0,6].2	Bridge Ind Shaft Stop Flashing PS
APL_SO_02[0,6].3	Bridge Ind Lever in service Flashing PS
APL_SO_02[0,6].4	Bridge Ind Shaft Trail Flashing PS
APL_SO_02[0,6].5	Bridge Ind Transfer Override Flashing PS
APL_SO_02[0,6].6	Bridge Ind Ahead Flashing SB
APL_SO_02[0,6].7	Bridge Ind Shaft Driven Flashing SB
APL_SO_02[0,6].8	Bridge Ind Shaft Stop Flashing SB
APL_SO_02[0,6].9	Bridge Ind Lever in service Flashing SB
APL_SO_02[0,6].10	Bridge Ind Shaft Trail Flashing SB
APL_SO_02[0,6].11	Bridge Ind Transfer Override Flashing SB
APL_SO_02[0,6].13	Bridge Ind Astern Flashing PS
APL_SO_02[0,6].14	Bridge Ind Astern Flashing SB
APL_SO_02[1,1].0	Bridge Ind MCR Control On PS
APL_SO_02[1,1].1	Bridge Ind MCR Control On SB
APL_SO_02[1,1].2	Bridge Ind Bridge Control On PS
APL_SO_02[1,1].3	Bridge Ind Bridge Control On SB
APL_SO_02[1,1].9	Bridge Ind Transit On
APL_SO_02[1,1].10	Bridge Ind Manoeuvring On
APL_SO_02[1,2].0	Bridge Ind ME Failure On SB
APL_SO_02[1,2].1	Bridge Ind GB Failure On SB
APL_SO_02[1,2].2	Bridge Ind CPP Failure On SB
APL_SO_02[1,2].4	Bridge Ind Shaft power limited On SB
APL_SO_02[1,2].5	Bridge Ind Shaft not Locked On SB
APL_SO_02[1,2].6	Bridge Ind PCS Alarm On PS
APL_SO_02[1,2].8	Bridge Ind Clutch engaged On SB
APL_SO_02[1,2].9	Bridge Ind GB Ready for use On SB
APL_SO_02[1,2].11	Bridge Ind GB Remote Auto On SB
APL_SO_02[1,2].12	Bridge Ind Clutch disengaged On SB
APL_SO_02[1,2].13	Bridge Ind GB Local On SB
APL_SO_02[1,2].15	Bridge Ind GB Remote Manual On SB
APL_SO_02[1,3].0	Bridge Ind Increase On SB
APL_SO_02[1,3].1	Bridge Ind ME Ready for use On SB
APL_SO_02[1,3].2	Bridge Ind Running On SB
APL_SO_02[1,3].3	Bridge Ind ME Remote Auto On SB
APL_SO_02[1,3].4	Bridge Ind Decrease On SB
APL_SO_02[1,3].5	Bridge Ind ME Local On SB
APL_SO_02[1,3].6	Bridge Ind Stopped On SB
APL_SO_02[1,3].7	Bridge Ind ME Remote Manual On SB
APL_SO_02[1,3].8	Bridge Ind CPP Ahead On SB
APL_SO_02[1,3].9	Bridge Ind CPP Ready for use On SB
APL_SO_02[1,3].11	Bridge Ind CPP Remote Auto On SB
APL_SO_02[1,3].12	Bridge Ind CPP Astern On SB

APL_SO_02[1,3].13	Bridge Ind CPP Local On SB
APL_SO_02[1,3].15	Bridge Ind CPP Remote Manual On SB
APL_SO_02[1,4].0	Bridge Ind Increase On PS
APL_SO_02[1,4].1	Bridge Ind ME Ready for use On PS
APL_SO_02[1,4].2	Bridge Ind Running On PS
APL_SO_02[1,4].3	Bridge Ind ME Remote Auto On PS
APL_SO_02[1,4].4	Bridge Ind Decrease On PS
APL_SO_02[1,4].5	Bridge Ind ME Local On PS
APL_SO_02[1,4].6	Bridge Ind Stopped On PS
APL_SO_02[1,4].7	Bridge Ind ME Remote Manual On PS
APL_SO_02[1,4].8	Bridge Ind CPP Ahead On PS
APL_SO_02[1,4].9	Bridge Ind CPP Ready for use On PS
APL_SO_02[1,4].11	Bridge Ind CPP Remote Auto On PS
APL_SO_02[1,4].12	Bridge Ind CPP Astern On PS
APL_SO_02[1,4].13	Bridge Ind CPP Local On PS
APL_SO_02[1,4].15	Bridge Ind CPP Remote Manual On PS
APL_SO_02[1,5].0	Bridge Ind ME Failure On PS
APL_SO_02[1,5].1	Bridge Ind GB Failure On PS
APL_SO_02[1,5].2	Bridge Ind CPP Failure On PS
APL_SO_02[1,5].4	Bridge Ind Shaft power limited On PS
APL_SO_02[1,5].5	Bridge Ind Shaft not Locked On PS
APL_SO_02[1,5].6	Bridge Ind PCS Alarm On PS
APL_SO_02[1,5].8	Bridge Ind Clutch engaged On PS
APL_SO_02[1,5].9	Bridge Ind GB Ready for use On PS
APL_SO_02[1,5].11	Bridge Ind GB Remote Auto On PS
APL_SO_02[1,5].12	Bridge Ind Clutch disengaged On PS
APL_SO_02[1,5].13	Bridge Ind GB Local On PS
APL_SO_02[1,5].15	Bridge Ind GB Remote Manual On PS
APL_SO_02[1,6].0	Bridge Ind Ahead On PS
APL_SO_02[1,6].1	Bridge Ind Shaft Driven On PS
APL_SO_02[1,6].2	Bridge Ind Shaft Stop On PS
APL_SO_02[1,6].3	Bridge Ind Lever in service On PS
APL_SO_02[1,6].4	Bridge Ind Shaft Trail On PS
APL_SO_02[1,6].5	Bridge Ind Transfer Override On PS
APL_SO_02[1,6].6	Bridge Ind Ahead On SB
APL_SO_02[1,6].7	Bridge Ind Shaft Driven On SB
APL_SO_02[1,6].8	Bridge Ind Shaft Stop On SB
APL_SO_02[1,6].9	Bridge Ind Lever in service On SB
APL_SO_02[1,6].10	Bridge Ind Shaft Trail On SB
APL_SO_02[1,6].11	Bridge Ind Transfer Override On SB
APL_SO_02[1,6].13	Bridge Ind Astern On PS
APL_SO_02[1,6].14	Bridge Ind Astern On SB
APL_SO_02[2,0].12	BRIDGE PB Alarm Acknowledged Acknowledge PS
APL_SO_02[2,0].13	BRIDGE PB Stop Horn Acknowledge PS
APL_SO_02[2,0].15	BRIDGE PB Lamptest Acknowledge PS
APL_SO_02[2,1].0	BRIDGE PB MCR Control Acknowledge PS
APL_SO_02[2,1].1	BRIDGE PB MCR Control Acknowledge SB
APL_SO_02[2,1].2	BRIDGE PB Bridge Control Acknowledge PS
APL_SO_02[2,1].3	BRIDGE PB Bridge Control Acknowledge SB
APL_SO_02[2,1].9	BRIDGE PB Transit Acknowledge PS
APL_SO_02[2,1].10	BRIDGE PB Manoeuvring Acknowledge PS

APL_SO_02[2,2].8	BRIDGE PB Clutch in Acknowledge SB
APL_SO_02[2,2].11	BRIDGE PB GB Remote Auto Acknowledge SB
APL_SO_02[2,2].12	BRIDGE PB Clutch out Acknowledge SB
APL_SO_02[2,2].15	BRIDGE PB GB Remote Manual Acknowledge SB
APL_SO_02[2,3].0	BRIDGE PB Increase speed Acknowledge SB
APL_SO_02[2,3].2	BRIDGE PB Start Acknowledge SB
APL_SO_02[2,3].3	BRIDGE PB ME Remote Auto Acknowledge SB
APL_SO_02[2,3].4	BRIDGE PB Decrease speed Acknowledge SB
APL_SO_02[2,3].6	BRIDGE PB Stop Acknowledge SB
APL_SO_02[2,3].7	BRIDGE PB ME Remote Manual Acknowledge SB
APL_SO_02[2,3].8	BRIDGE PB Pitch Ahead Acknowledge Sb
APL_SO_02[2,3].11	BRIDGE PB CPP Remote Auto Acknowledge SB
APL_SO_02[2,3].12	BRIDGE PB Pitch Astern Acknowledge SB
APL_SO_02[2,3].15	BRIDGE PB CPP Remote Manual Acknowledge SB
APL_SO_02[2,4].0	BRIDGE PB Increase speed Acknowledge PS
APL_SO_02[2,4].2	BRIDGE PB Start Acknowledge PS
APL_SO_02[2,4].3	BRIDGE PB ME Remote Auto Acknowledge PS
APL_SO_02[2,4].4	BRIDGE PB Decrease speed Acknowledge PS
APL_SO_02[2,4].6	BRIDGE PB Stop Acknowledge PS
APL_SO_02[2,4].7	BRIDGE PB ME Remote Manual Acknowledge PS
APL_SO_02[2,4].8	BRIDGE PB Pitch Ahead Acknowledge PS
APL_SO_02[2,4].11	BRIDGE PB CPP Remote Auto Acknowledge PS
APL_SO_02[2,4].12	BRIDGE PB Pitch Astern Acknowledge PS
APL_SO_02[2,4].15	BRIDGE PB CPP Remote Manual Acknowledge PS
APL_SO_02[2,5].8	BRIDGE PB Clutch in Acknowledge PS
APL_SO_02[2,5].11	BRIDGE PB GB Remote Auto Acknowledge PS
APL_SO_02[2,5].12	BRIDGE PB Clutch out Acknowledge PS
APL_SO_02[2,5].15	BRIDGE PB GB Remote Manual Acknowledge PS
APL_SO_02[2,6].0	BRIDGE PB Max FSR Acknowledge PS
APL_SO_02[2,6].1	BRIDGE PB Shaft Driven Acknowledge PS
APL_SO_02[2,6].2	BRIDGE PB Shaft Stop Acknowledge PS
APL_SO_02[2,6].4	BRIDGE PB Shaft Trail Acknowledge PS
APL_SO_02[2,6].5	BRIDGE PB Transfer Override Acknowledge PS
APL_SO_02[2,6].6	BRIDGE PB Max FSR Acknowledge SB
APL_SO_02[2,6].7	BRIDGE PB Shaft Driven Acknowledge SB
APL_SO_02[2,6].8	BRIDGE PB Shaft Stop Acknowledge SB
APL_SO_02[2,6].10	BRIDGE PB Shaft Trail Acknowledge SB
APL_SO_02[2,6].11	BRIDGE PB Transfer Override Acknowledge SB

4.2.7.3 APL_SO_03: Serial output to other PCS

APL_SO_03[0]	Heartbeat PLC
APL_SO_03[1]	STATE ME
APL_SO_03[2]	STATE CLUTCH
APL_SO_03[3]	SHAFT MODE
APL_SO_03[4]	CONTROL POSITION
APL_SO_03[5]	CONTROL MODE
APL_SO_03[6]	CONTROL LEVEL
APL_SO_03[7]	Shaft Speed
APL_SO_03[8]	Propeller Pitch
APL_SO_03[9].0	VTRA

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