Business Unit Naval Projects

Imtech Marine & Offshore B.V.
Sluisjesdijk 155
P.O. Box 5054
3008 AB Rotterdam
The Netherlands
Harbour number 2137
Tel. +31 (0)10 487 19 11
Fax. +31 (0)10 487 17 02

Integrated Platform Management System

Functional Specification

Volume -

Project:	TNI-AL Indonesia Corvette
Projectnumber:	190134
Main title:	Integrated Platform Management System
Sub title:	Functional Specification
Special remark:	
Issue:	1.1
Date:	4 April 2006
Total number of pages:	30
Registration code:	190134-4380-FSC

	Name	**Signature**
Author:	R. Langeveld	
Quality control:	E.J. Middeldorp	
Acknowledge:		
Approved:	R. van Treuren	
Certified:		

Table of contents

Figures

Tables

Appendices

References

[1] **Title:** **Technical Specification**
Description: Technical Specification between Schelde Naval Shipbuilding and IMTECH Marine & Offshore
Ref.: I 1005
From: Schelde Naval Shipbuilding
Issue: D
Date: 23 September 2004

[2] **Title:** **Documentation Plan**
Description: TNI-AL Documentation Plan
Ref.: 190134-DCL-001
From: R. v. Treuren
Issue: 1.1
Date: 31 January 2005

[3] **Title:** **IAS System Specification**
Description: Overall System specification of the Integrated Automation System
Ref.: 190134-4000-IAS-SSC
From: E.J. Middeldorp
Issue: V1.0
Date: 9 May 2005

[4] **Title:** **IPMS Functional Specification**
Description: Functional specification of the Integrated Platform Management System.
Ref.: 190134-4380-FSC
From: R. Langeveld
Issue: V1.0
Date: 9 May 2005

[5] **Title:** **IPMS Technical Specification HMI**
Description: Technical Specification of the Human Machine Interface of the IPMS
Ref.: 190134-4380-HMI-TSC
From: R. Langeveld
Issue: V1.0
Date: 9 May 2005

[6] **Title:** **IPMS Technical Specification ELP**
Description: Technical Specification of the Element Processing of the IPMS
Ref.: 190134-4380-ELP-TSC
From: R. Langeveld
Issue: V1.0
Date: <>

[7] **Title:** **PMS Functional Specification**
Description: Functional Specification of the Power Management System.
Ref.: 190134-3900-FSC
From: C. Schouten
Issue: V1.0
Date: <>

[8] **Title:** **PCS Functional Specification**
Description: Functional specification of the Propulsion Control System.
Ref.: 190134-2520-FSC
From: R. Bipat
Issue: V1.0
Date: <>

[9] **Title:** **Network Architecture CSN and PDN**
Description: Network architecture of the IAS, Client Server Network (CSN) and Platform Data Network (PDN)
Ref.: 190134-4000-CFS-001
From: A.H. de Groot
Issue: V2.0
Date: 9 May 2005

[10] **Title:** **Navigation System Interface Specification**
Description: Interface Specification for all external interfaces of the navigation functions
Ref.: 190134-ISC-001
From: H.J. Tigchelaar
Issue: 2.0
Date: 9 May 2005

[11] **Title:** **IO List**
Description: List with Input/Ouput signals of the IPMS
Ref.: 190134-4380-IOL
From: E.J. Middeldorp
Issue: V1.0
Date: <>

[12] **Title:** **Item Survey List**
Description: States the defined items and their characteristics, such as dimensions, weight, and allocation on board
Ref.: 190134-4000-ISL
From: E.J. Middeldorp
Issue: V1.0
Date: <>

[13] **Title:** **IPMS User Manual**
Description: An operator guide that describes the entire user scoped IPMS functions.
Ref.: 190134-4380-UM
From: R. Langeveld
Issue: V1.0
Date: <>

[14] **Title:** **GENSYS Technical documentation**
Description: All technical issues regarding the GENSYS modules.
Ref.: A40Z090004
From: DSF Technologies
Issue: h
Date: March 2003

[15] **Title:** **CCU2/C-MXMB**
Description: Installation and Configuration Manual
Ref.: CCU2/C-MXMB
From: Tyco Safety Product
Issue: Z
Date: 1 Feb 2004

[16] **Title:** **Local Control Panel Communication Modbus Definition**
Description: Modbus communication interface description with Pielstick main engines
Ref.: 17249S400372
From: SEMT Pielstick
Issue: A
Date: 31 Jan 2005

Abbreviations

ACS	Automatic Control Sequence
AIS	Automatic Identification System
ALP	Alarm presentation
C&M	Control & Monitoring
CAP	Component Assist Presentation
CCTV	Closed Circuit Television
CIP	Component Information Presentation
CFS	Network Diagram
COTS	Commercial Of The Shelf
CPM	Citadel Pressure Monitoring
CPP	Controllable Pitch Propeller
CSN	Client-Server Network
DE	Diesel Engine
DG	Diesel Generator
DTL	Data Logger
ECDIS	Electronic Chart Display & Information System
ELP	Element Processing
ESB	Emergency Switchboard
FAC	Function Allocation
FDC	Fire Detection Controller
FDS	Fire Detection System
FSC	Functional Specification
GAP	General Arrangement Plan
GCB	Generator circuit breaker
GCU	Generator Control Unit
HMI	Human Machine Interface
HMT	Health Monitoring
IMO	Imtech Marine & Offshore
IPMS	Integrated Monitoring & Control System
INFRA	Infrastructure
IO	Input/Output
IPMS	Integrated Platform Management System
LAN	Local Area Network
LPU	Local Processing Unit
MCR	Machinery Control Room
MCS	Master Clock System
ME	Main Engine
MIP	Mimic Presentation
MMI	Man Machine Interface
MJPEG	Motion-JPEG (video standard)
MSB	Main Switch Board
NBC	NBC Monitoring
NBCD	Nuclear, Biological, Chemical Damage
NSIU	Navigation System Interface Unit
PCM	Platform Control & Monitoring
PCS	Propulsion Control System
PDN	Platform Data Network

PLC	Programmable Logic Controller
PMS	Power Management System
PSS	Power Supply System
SCADA	Supervisory Control And Data Acquisition
SSC	System Specification
TBD	To Be Defined
TMS	Tank Monitoring System
TRE	Trending
UniMACS	Universal Monitoring And Control System
UPS	Uninterruptible Power Supply
WS	Workstation

Terms and definitions

Alarm	A state that indicates the occurrence of some undesirable event.
Platform	The underlying hardware architecture of the ship.
Typical	To be read as 'Example of'. I.e. the final implementation for this project may differ.

Updates

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

Issue:	Date:	Change:	Reason:
1.0	9-May-2005	-	Initial release
1.1	4-April-2006	Systems vs. installation group mapping. TBD items filled in. Appendix A: Mimic summary updated Typo's corrected	Update

1. Introduction

1.1 Purpose of this document

This document covers the Integrated Platform Management System's (IPMS) functional specification of the TNI-AL Indonesia Corvette. It is based on the IAS System Specification, ref. [3].

The Integrated Automation System (IAS) offers a integrated solution for ship management, control and automation. It complies with the notation: ✠ 100 A1 SCC MONO PATROL G5 LMC

For the Integrated Automation System, Imtech's UniMACS 3000 concept is used as a basis.

1.2 Relationship to other documents

This document is part of the documentation for the Integrated Automation System. The relation to other documents is illustrated by Figure 1-1

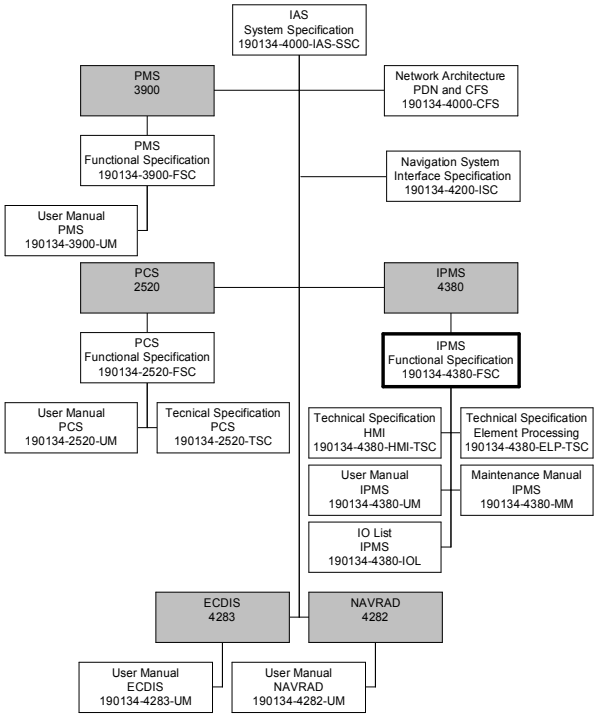


Figure 1-1 Overview of the documentation

2. System overview

2.1 Introduction

This chapter intends to point out all IPMS key items. First, consider the simplified IPMS block diagram (Figure 2-1) that shows the most important IPMS topics.

2.2 System layout and interfaces

The IPMS incorporates the following equipment:

Category	Console / Area	Description	ID	Abbreviation	Function
SERVERS/ WORK STATIONS	MCR CONSOLE	IPMS SERVER 1 & WORKSTATION 'E'	TNI-001	MCR_E	Data Processing / Monitoring & Control
		IPMS WORKSTATION 'PCS'	TNI-003	MCR_PCS	Monitoring & Control
		IPMS WORKSTATION 'AUX'	TNI-004	MCR_AUX	Monitoring & Control
	IBS WHEELHOUSE	IPMS SERVER 2 & WORKSTATION 'BRIDGE'	TNI-002	BRG_IPMS	Data Processing / Monitoring & Control
LOCAL PROCESSING UNITS (LPU)	MAIN ENGINE ROOM (MER)	LPU 1 (PCS-PS)	LPU 1	LPU 1	Data processing
		LPU 2 (PCS-SB)	LPU 2	LPU 2	Data processing
	SWITCHBOARD ROOM AFT (MCR)	LPU 3 (AUX / MSB AFT / DG 3+4)	LPU 3	LPU 3	Data processing
	SWITCHBOARD ROOM FWD	LPU 4 (AUX / MSB FWD / DG 1+2)	LPU 4	LPU 4	Data processing
	BRIDGE	LPU 5 (AUX)	LPU 5	LPU 5	Data processing
PDN	THROUGHOUT VESSEL. Repeater 'A' in LPU 3 cabinet. Repeater 'B' in LPU 4 cabinet.	CONTROLNET (REDUNDANT) COAXIAL (RG6) CABLE	PDN-A + PDN-B	PDN	Data transfer
PRINTERS	MCR	B&W LASER PRINTER	PMCR	PMCR	Data Printing
	OPERATION ROOM	B&W LASER PRINTER	PCIC	PCIC	Data Printing

Table 2-1 Overview IPMS system

2.2.1 IPMS Servers and workstations

The Human Machine Interface (HMI) is used to visualize platform statuses and to notify the operators about any undesirable platform status. Besides this operators are able to control the platform via the HMI provided they are granted to this.

HMI is based on client-server related SCADA software that runs on IPMS servers and IPMS workstations (=clients). IPMS servers obtain platform data from the LPUs via the PDN. This data is stored in server-sited point database. Whenever a client needs certain data to visualize installation statuses it will request the IPMS server for this data. Subsequently the IPMS server will broadcast this data via the CSN.

A secondary IPMS server is able to take over the all master server roles automatically in case the primary IPMS server fails provided that is was running as a backup.

Whenever a remote operator issues any platform control by his workstation then this command will be send to the master IPMS server. The master IPMS server will forward the command to the applicable LPU that processes the platform element concerned.

Each IPMS workstation will be equipped with a 19 " rack computer, a TFT screen (20"/ Resolution: 1280 x 1024 pixels), a keyboard and a track-ball. The operating system to be used for an IPMS workstation is 'Windows 2000 Professional Workstation' whilst both IPMS servers, due to performance needs, will have the Windows 2003 Server Edition Operating System installed.

Computer hardware reserved for running both IPMS server and IPMS workstation tasks will differ from those just functioning as an IPMS workstation as data processing and server redundancy functions being executed by both IPMS servers require extra computer performance.

The IPMS WORKSTATION 'AUX' workstation (TNI-004) is not dedicated to IPMS usage. That is, besides functioning as an IPMS client workstation it will also be used by the UniMACS-CCTV application. The operator is able to focus either one of these tasks by a simple left-click on the relevant icon from the Application Manager bar. This bar will slide into the visible screen area whenever the mouse pointer is moved to the far left (or right) side of the screen.

IPMS workstations will interface the master IPMS server by the Client Server Network (See system specification of the Integrated Automation System ref. [3] for a description of the CSN). This is illustrated by Figure 2-1

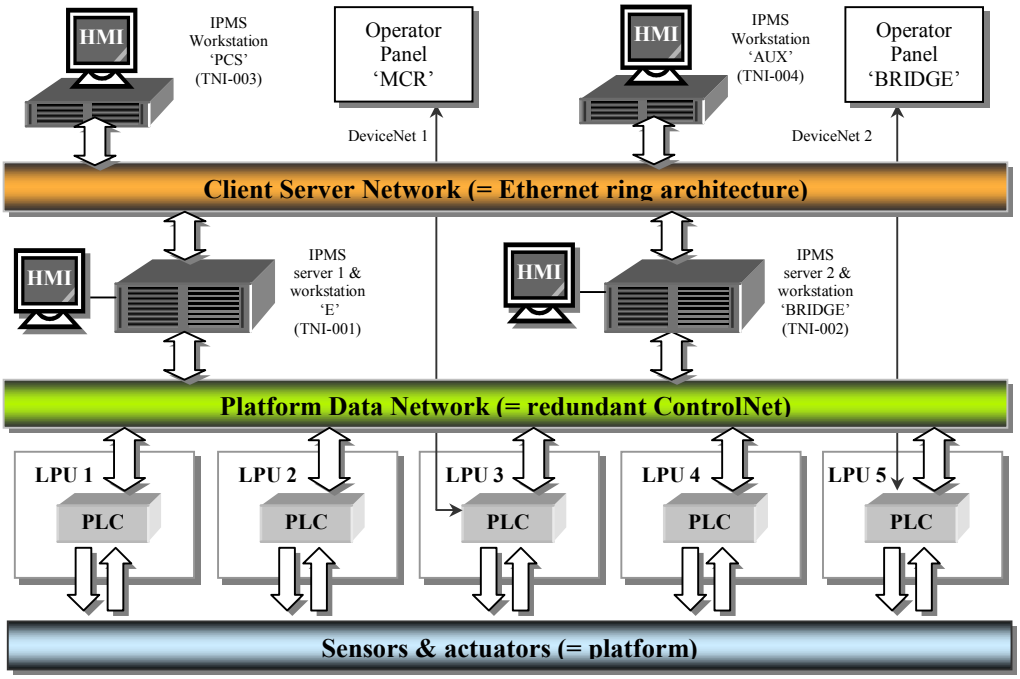


Figure 2-1 Simplified block diagram of IPMS

2.2.2 Local Processing Units

Five Local Processing Units (LPUs) are used to interface the platform (by its sensors and actuators) by means of Programmable Logic Controllers, type ControlLogix , make Allen Bradley. The ControlLogix series PLCs offer a fast and flexible way to interface the platform in a deterministic way. No matter where processor modules and relevant IO-modules reside the redundant platform data network (PDN) will take care of all scheduled data transfers to achieve a deterministic communication link in-between.

Each PLC controller module polls its applicable input module data, runs its IPMS application-software and accesses the appropriate output modules to achieve platform control. Besides this, each PLC controller is able to interface both IPMS servers to support the HMI. That is, each PLC processor will periodically transmit its platform alarm and status information to both IPMS servers in the unscheduled ControlNet time slice. Moreover, the master IPMS server will forward operator commands on event to the applicable PLC processor.
Every LPU cabinet will be equipped with at least one PLC rack. Besides this, additional IO racks might be installed to extend LPU IO count. These extra racks do not necessarily need a PLC controller module since they are accessible as remote-IO.

2.2.3 Redundant Platform Data Network (PDN)

The Redundant Platform Date network interconnects the LPU's and both IPMS servers by means of a coaxial ControlNet network. The ControlNet is a redundant state-of-the-art coaxial control network that meets the demands of real-time, high-throughput applications. It offers deterministic, repeatable transfers of all mission-critical control data in addition to supporting transfers of non-time-critical data. The ControlNet network transfers data at 5 Mbit/s.

The ControlNet comprises the following components:

- Coaxial cables
- Taps
- Nodes
- Terminators

The trunk cable is the bus, or ControlNet backbone. The trunk cable is composed of multiple sections of cable. The cable needed to assemble a trunk-cable section is a quad shielded RG-6 type coaxial cable. Taps (T) connect each ControlNet node (N) on a network to the coaxial cable system via an integral 1 m drop cable. A 75-Ω termination resistor must be installed on each end tap. (See Figure 2-2)

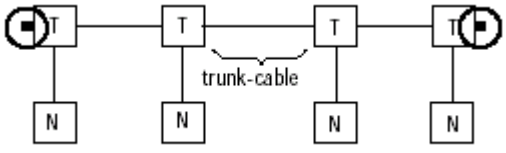


Figure 2-2 ControlNet coax cable system

ControlNet redundancy is achieved by installing two identical ControlNet coaxial cable systems (i.e. twice the system shown in Figure 2-2). Each ControlNet node will be provided with a redundant ControlNet interface module that supports connections for both ControlNet (A and B) taps.

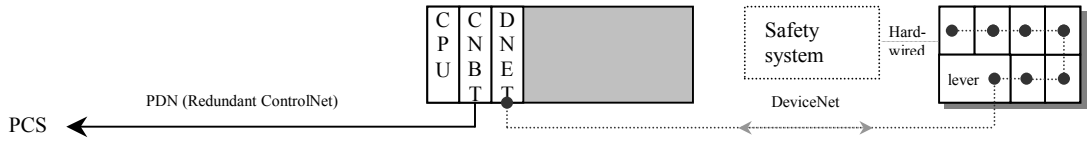
On behalf of maximized redundancy functions both ControlNet backbones (A and B) are preferably to be routed along different paths to reduce the chance of both cables being damaged at the same time. Besides this the following guidelines are to be observed:

- Both cable system routes have the same number of nodes, taps and repeaters;
- Both cable system routes follow the same relative node sequence;
- The total difference in length between the two trunk cables shall be less than 800 meters.

To increase PDN robustness a ControlNet repeater module will be installed for each 'A' and 'B' ControlNet.

2.2.4 PCS operator panels

Operator panels are provided in the MCR and on the bridge to support PCS functions. Buttons and indicators on each operator panel sub-section interface a PLC controller module (CPU) via a DeviceNet link cable and a DeviceNet module (DNET). If safety rules (e.g. "emergency stop") are involved with some of the keys/indicators then these keys/indicators are to be hardwired. As the PCS operator panel interface supports digital inputs/outputs only the analogue lever signal is to be hardwired as well.



Whenever a button is pressed, its status will be sent to either one of both DeviceNet bridge modules (DNET) that reside in both LPU3 and LPU5. Subsequently the CPU will forward this data to the relevant PCS application via the PDN. Likewise, relevant PCS statuses will be transferred back to the PLC controller that hosts the operator panel indicators. See Functional Specification PCS, ref. [8] for more details concerning these operator panels.

2.2.5 Printers

Each workstation can print screen dumps and alarm histories on either one of both black and white laser printers. One is to be installed in the MCR. The other one will be installed in the CIC.

2.2.6 IPMS Interfaces

The IPMS interfaces the following systems:

- Fire Detection System (FDS)
- Generator Management Systems (GENSYS 1,2,3,4);
- Main Engines (PS and SB).
- INFRA system;

See section 4 of this document for more details concerning these interfaces.

2.3 IPMS monitoring & control architecture

The IPMS system comprises several hierarchical monitoring and control levels applicable to the various platform systems:

- Supervisory control level (management facilities)
  Management facilities are provided for configuration of the IPMS in terms of operator task assignments, availability of platform components etc.

- Remote control and monitoring level (operators)
  On this level the operator is able to monitor the platform from remote via his workstation. Platform controllability and alarm management however will be limited to objects/alarms being classified for installation groups allocated

to his workstation.

- Remote monitoring level (operators)
  If no installation groups are allocated by the current workstation then remote platform monitoring is the only IPMS function available.

- Local control and monitoring level
  By using this level an operator is able to monitor and control platform components mostly by means of local control panels. Local controls are overruling the operator commands given from remote by the IPMS.

2.4 System components and states

The IPMS comprises a number of computerized equipment. Regarding this the following states can be distinguished:

- Unavailable (=offline)
  Condition of the system component in which the component is not available for normal operation.
  Causes for the 'Unavailable' condition can be:
  - The system component has no power supply;
  - The system component has no communication with other system components;
  - A fatal error has occurred within the system component;

- Online
  Condition of the system component in which the component executes IPMS functions.

Most IPMS components on which IPMS software resides can execute their tasks independently. However since functional links in between IPMS components exist some of those functions might be disturbed if one of the components gets unavailable. To overcome IPMS key roles, such as 'IPMS server' and the 'ControlNet network' redundant configurations concerning these functions are installed. In case of a failure in one of the redundantly installed functions, the Health Monitoring Task (HMT) will generate an IPMS alarm. Besides this, almost all redundant installed functions will switchover automatically to their relevant backup without system operator intervention.

3. IPMS Functions

Several IPMS functions can be distinguished each of them performing a certain IPMS task.

1. Element processing (ELP)
2. Platform Control and Monitoring (PCM)
3. Mimic Presentation (MIP)
4. Alarm presentation (ALP)
5. Function Allocation (FAC)
6. Data Logging (DTL)
7. Signal trending (TRE)
8. Health Monitoring (HMT)
9. Tank Monitoring System (TMS)

3.1 Element Processing (ELP)

The function 'Element Processing' actually controls and monitors the ship's platform. This is all based on the data transferred from/to the I/O modules being connected to the platform and the operator commands given via the HMI system or by automatic functions.

3.1.1 Functional description

The ELP function is based on a number of generic software modules, one for each platform element type. Platform element types can be distinguished by means of their electrical interface and their functional behaviour. Regarding this, almost all platform objects can be classified among one of the element types currently defined. Once classified, each platform object can be processed just by calling the applicable software instance along with its relevant settings.

The following element types are available:

Element type acronym	Element type description
AAE	Analogue Application Element
CBA	Circuit Breaker Element for Applications
CBE	Circuit Breaker Element
CTR	Control-element
DAE	Digital Application Element
MCD	Motor Control element with Double speed function
MCE	Motor Control Element
MCS	Motor Control element with Standby function
RHE	Running Hours counter Element
SAE	Serial Application Element. Dual logical alarm inputs
SEE	Switching Event Element
SPE	Setpoint element
SSE	Sensor Element with alarm low/high support
SS1	Sensor Element with alarm high / highhigh / too high support
SS2	Application Element with alarm high / highhigh / too high support
SSL	Sensor element with tank content measurement support
SWB	Switch-element Basic functions only
SWE	Switch-element with alarm function
SWN	Switch element used for NBCD related objects

Element type acronym	Element type description
VCE	Valve Control Element
VCH	Valve Control Element for hydraulically controlled valves
VCP	Valve Control Element for proportionally controlled valves

Table 3-1 List of element types

Besides interfacing the platform and element type specific processing, ELP includes other functions as well:

- HMI interfacing;
- Parameter Change support;
- Alarm inhibits;
- Element disable.

3.1.1.1 HMI interfacing

The HMI interface function enables the HMI to visualize the actual state of a physical platform object by colour and/or shape animation. Moreover as soon as an undesirable platform state is detected an operator will be notified by means of an audible alarm signal. Messages concerning the alarm will be displayed by the alarm presentation. The HMI interface also supports remote platform management signals in case operators control the platform by their workstation.

3.1.1.2 Parameter Change Support

Considering the element type, parameters are defined in order to configure element operation. Most of these parameters apply to alarm features such as alarm thresholds; alarm delay times etc. Authorized remote operators can alter most of these parameters from remote by using the HMI Component Assist Page. (See also: IPMS Technical Specification HMI. Ref. [5])

3.1.1.3 Alarm inhibits

Certain platform events may cause irrelevant platform alarms. For instance a pressure sensor installed near a lubrication oil pump outlet will cause an alarm as soon as the pump is switched off. Since these spurious alarms will cloud the alarm list and so the operator view on the platform state, ELP supports alarm inhibits. Whenever alarms are inhibited they won't spuriously appear anymore.

3.1.1.4 Element disable

Platform components that are out of order or that are in repair may transmit signals that are wrong or that are not significant for the operator. It is possible to suppress these signals and to prohibit operations by disabling the applicable element. Element disable/enable commands need authorized operator access.

As a result of element disable the concerning alarm notifications are rectified on the alarm screen while the element's actual status is no longer reflected by its animated symbol. Regarding this, the HMI will show the 'Disabled'/'Unavailable' animation instead. Furthermore most of the operator commands for this element are disabled.

When an element has been repaired or when the maintenance has been finished, the concerning element can be enabled again. For the IPMS this means that the element is included (again) into the installation. So, then element states are generated, all operator commands are permitted (if they were enabled before) and current alarm notifications are presented on the alarm screen.

3.2 Platform Control and Monitoring

Although some operators may not have sufficient rights to control the platform they still are able to monitor all IPMS related platform systems including their alarm statuses by calling the relevant mimics on their workstation. A left-click on one of the symbols will cause all relevant object information along with its remote control functions to be visualized by the Component Information Presentation (CIP) window.

The CIP window is shown at the bottom of each IPMS screen. To control a platform object the operator must first left-click its representative symbol. As a result the CIP will show all applicable object information. The installation group involved with the platform object 'in focus' must be assigned to the workstation. Once this has been achieved the operator is able to control all objects classified for that installation group. Only supervised users having management abilities can alter the 'installation group to workstation assignment' by using the Function Allocation Control mechanism. (See also section 3.5)

Besides function allocation it is necessary that the control mode of the platform object in concern to be set to 'REMOTE'. If the control mode is 'LOCAL' then the remote operator still won't be able to control the component as local operator controls override commands given from remote. The control mode currently applicable to a platform object is shown by the CIP as well. Control buttons (F1-F8) will be enabled (i.e. not in a greyed-out state) once remote control has been granted to the operator.

However, to prevent from accidental controls a control time gate mechanism will disable all control buttons even if all control requirements have been met. If operator control is required then, a button, either a physical one or the one shown by the CIP, must be pressed within a certain time after the symbol click. This event will extend the control time by another time slice. Once the timer has been expired all function keys will be disabled (i.e. in a greyed-out state). The operator must left-click the representative symbol again to regain control accessibility

See document: 'Technical Specification IPMS HMI' , ref.: [5] for a detailed specification regarding the CIP window.

3.3 Mimic Presentation (MIP)

The system function 'Mimic Presentation' is able to show graphical pictures (mimics). Each of them represents (part of) an installation such that platform functions and platform status are unambiguously shown to the operators. As soon as a platform status change is detected by the IPMS this will be shown by the applicable mimic(s). Appendix A shows a summary of mimics to be implemented.

See document: 'Technical Specification IPMS HMI', ref.: [5] for a detailed specification regarding mimic presentation issues.

3.4 Alarm presentation (ALP)

Alarm handling and presentation is one of the major IPMS functions. Machinery, safety and control system faults are to be indicated at the workstations currently in control of the installation group(s) being involved with the alarm(s). Besides this, an audible signal must be activated on those workstations as soon as the IPMS detects the alarm to draw operator attention.

Furthermore, the IPMS will store each alarm event along with a set of attributes such as 'timestamp', 'alarm message', 'alarm final state' etc. for logging purposes.

There are three different types of alarm notifications available from the IPMS:

- Alarm Presentation
  The Alarm Presentation shows a list of alarms, applicable to the installation groups currently allocated by the workstation. It will be shown on operator request. (function key F9 on CIP) All the alarms shown by the

alarm presentation should have the attention of the operator who is controlling the IPMS station. If no installation groups are assigned to the workstation or, if no alarms exist within the installation groups currently attached then consequently the Alarm Presentation list will be empty.

- Alarm Group Bar
  The Alarm Group Bar is always visible on top of each IPMS screen. It provides a set of buttons and installation group allocation indicators one for each installation group being defined for the project. (Max. number of groups: 16). Buttons and allocation indicators are animated according to the alarm existence within the installation groups and according to the function allocation map settings being applied.

  - Button animation:
    - Black abbreviated text relevant to the installation group in concern on a grey coloured button face means that no alarms are active in that installation group. Pressing such a button displays an alarm summary applicable to that group but the list will be empty.
    - Black abbreviated text relevant to the installation group in concern on a red flashing button face means that unacknowledged alarms are active in that installation group. Pressing such a button displays an alarm summary applicable to that group showing the unacknowledged alarm(s) on top of the list.
    - Black abbreviated text relevant to the installation group in concern on a solid red button face means that alarms are active in that installation group but all of them have been acknowledged. Pressing such a button displays an alarm summary applicable to that group showing the latest alarm generation events on top of the list.
  - Allocation indicator animation:
    - The allocation indicator is located below each installation group button. Its colour is yellow whenever the workstation is in control for that group. Otherwise the allocation indicator will be grey.

- Slave Alarm Summaries
  Slave Alarm Summaries are available at all IPMS workstations for each installation group that has been defined for the project. By pressing a button (one button for each installation group is shown) on the alarm group bar (shown at the top of the screen) each operator is able to view a filtered alarm list applicable to that installation group only, even if the operator has no control access for that group. Acknowledgement of alarms however is not possible using the slave alarm summaries even if control access for these groups is granted. The operator should use the alarm presentation (available from function key F9) instead.

Table 3-2 shows the differences between the available alarm presentations.

	Alarm Presentation	Alarm group bar	Slave Alarm Summaries
Available at	All IPMS operators with control facilities (stations-in-control)	All IPMS workstations	All IPMS workstations
Presentation	On operator demand	Always on top of the IPMS display	On operator demand
Visual alarm information	At workstation-in-control: All alarms involved with installation groups that are allocated to the station are shown.	Alarms status indication by colour animation of button face. A tool tip that appears while hovering the mouse pointer over the button shows alarm counts.	All alarms that exists in all installation groups
Audible signal	An audible alarm sounds at the workstation –in-control when an unacknowledged alarm is detected by the system in one of the allocated installation groups	Not applicable	An audible alarm sounds at the workstation when the audible slave alarm feature is enabled for the installation group involved with the unacknowledged alarm.
Silence audible signal	The audible alarm will cease when the alarm is acknowledged on the system OR when a silence horn command is given.	Not applicable	The audible alarm will cease when a silence horn command is given.
Order	Presentation in descending order of 1. Unacknowledged state 2. Occurrence/detection	Not applicable	Presentation in descending order of 1. Unacknowledged state 2. Occurrence/detection
Filtering	Filtering on installation groups currently allocated by the workstation.	Not applicable	Filtering on installation groups per installation group

Table 3-2 Alarm presentations

3.4.1 Alarm presentation features

Four alarm states, each of them shown by a unique colour animation, can be distinguished:

Non-rectified and unacknowledged alarms are shown by a white text on a red background.
Rectified and unacknowledged alarm are shown by a white text on a grey background.
Non-rectified and acknowledged alarm are shown by a red text on a black background.
Unavailable alarm states are shown by white text on a pink background

Non-rectified alarm states apply to alarm conditions that currently exist.
Rectified alarm notifications apply to alarms that were detected in the past but have been reset now. An alarm message applicable to a rectified alarm is shown as long as the operator hasn't acknowledged the alarm generation event. Once a rectified alarm notification is acknowledged it will automatically disappear from the list.

Alarms have to be acknowledged by the operator at the station-in-control. As long as the alarm notification is unacknowledged it may toggle between a non-rectified and a rectified state. When this is happening the colour animation of the alarm message will change. Besides this, the alarm occurrence timestamp will be reinitialised when the alarm is regenerated.

In case the alarm state (TRUE or FALSE) is unavailable the HMI will show the applicable message indicating the operator that it can't determine the current alarm state. This state might apply whenever the HMI <> LPU link is lost.

It is possible to mute the audible alarm signal without acknowledging the alarm by pressing a 'Stop Horn' button. If the alarm sound has been silenced alarm state toggles between 'rectified' and 'non-rectified' do not cause an audible signal again. Once new alarms are being added to the alarm list audible and visual alarms are again to operate.

Because it is impossible to display all the alarm notifications simultaneously the following viewing mechanisms are provided:

- Scroll mechanism (up and down scroll through the alarm list);
- The operator may request an alarm summary showing a filtered alarm list of a selected installation by pressing the applicable button on the alarm group bar.

3.4.2 Special alarms

Once the Health Monitoring (HMT) feature detects a failing IAS function then a relevant alarm will be issued on the IPMS alarm presentation. As the IAS group includes alarms that apply to workstations as well as Ethernet statuses, requirements arise regarding the notification of those alarms. After all, if the IPMS workstation itself - currently in control of the IAS - would be involved with the IAS alarm then as a result the IAS alarm wouldn't be notified.

Therefore the IAS group will be assigned to all IPMS stations that have control potentials. Whenever an IAS alarm occurs, each applicable workstation will be notified about this. Though the handling of IAS alarms does not differ from the others, IAS alarms are to be acknowledged just once on any IPMS workstation in control of the IAS.

3.4.3 Human Machine Interface

Both the alarm presentation and the alarm summaries can be displayed by all workstation VDUs. Left clicking at an installation group button in the "Alarm Group Bar" will display an alarm summary showing the alarms for that installation group only.

Any alarm notification shown on the alarm presentation or the alarm summary displays the following fields:

- UTC-time of alarm detection (Resolution 1 second);
- Alarm Installation Group (abbreviated)
- Main mimic reference (a link to the mimic being involved with the alarm is provided to identify the alarm)
- Element ID-code;
- Alarm description (element description and alarm state description);
- Alarm acknowledged indicator (by a 'Y' or a 'N' and by row colour animation)
- Alarm rectified indication (by row colour animation);

The layout of the available presentations is defined by document: Technical Specification IPMS HMI. Ref. [5]

3.5 Function Allocation Control (FAC)

The purpose of this system function is to assign the technical supervision (control and monitoring) of installation groups to the available operators at their workstations.

3.5.1 Functional description

Each platform object has been grouped into one of the distinguished system numbers. (See Table 3-3). The IPMS converges this classification into maximum 16 installation groups. This relationship is predefined and cannot be changed at run-time. Since installation groups can be assigned to one operator (except for IAS related objects) only one operator can control his scope of platform objects. On the other hand each operator is able to monitor the whole ship's platform since all platform data is available to all workstations.

As a rule, the supervision of an installation group should always be assigned to at least one of the manned workstations that provide control facilities. At run-time, operators that have control potentials can alter the current assignment such that they will become the supervisor concerning certain installation groups. It is not possible to give

up some or all of the installation groups from the IPMS station in order to prevent group assignments to unmanned stations.

To support one-man control all installation groups can be assigned to a single workstation. Within seconds the assignment can be altered in accordance with the operational readiness state. Function allocation can be done via the Function allocation mimic (Authorization is needed to alter the current settings).

Whenever installation group settings must be reassigned then this will not only cause control supervisions to be altered but alarm presentations relevant to the change will be altered as well. Mind that if alarms apply to the reallocated installation group(s) then alarm responsibility will be reallocated as well. So, moving installation group controllability from one operator to the other will move the alarm notifications along with their alarm sounds also. To point out additional alarm statuses on the relevant operator he has to confirm a list of alarms that apply to the reallocated groups, as he will be responsible for them after the reassignment has been achieved. The transfer of installation groups will be annulled if the operator cancels the confirmation or when the installation group reassignment procedure times out. Of course, the alarm transfer action will have no consequence for the alarm state(s) involved.

The following systems and installation groups are to be defined:

System nr.	System Description	Alarm group
3122	EMERGENCY GENERATOR - AUT	DGSETS
3120	EMERGENCY GENERATOR	DGSETS
3241	440V AC 60Hz POWER SUPPLY SYSTEM	DGSETS
3121	EMERGENCY GENERATOR - C&M	DGSETS
3110	SHIPS SERVICE POWER GENERATION	DGSETS
4365	AUDIO VISUAL ALARMS ENGINE ROOM	DGSETS
3141	POWER CONVERSION EQUIPMENT - TRANSFORMERS	Distribution
3243	230V 60Hz DISTRIBUTION	Distribution
3242	24V DC POWER SUPPLY SYSTEM	Distribution
3245	115V 400Hz POWER DISTRIBUTION SYSTEM	Distribution
3901	POWER MANAGEMENT SYSTEM - C&M	Distribution
3244	115V 60Hz POWER DISTRIBUTION SYSTEM	Distribution
3142	POWER CONVERSION EQUIPMENT - CONVERTERS	Distribution
3900	POWER MANAGEMENT SYSTEM	Distribution
3000	POWER CONV AND DISTR - ELEC PLANT GENERAL	Distribution
3001	SUPPLY VOLTAGES	Distribution
3040	ELECTRIC CABLES	Distribution
3240	SWITCHGEAR AND PANELS	Distribution
3133	BATT & SERV FACILITIES - (UPS)	Distribution
3020	MOTORS AND ASSOCIATED EQUIPMENT	Distribution
3140	POWER CONVERSION EQUIPMENT	Distribution
2432	PROP SHAFT - COUPLINGS	Propulsion
2452	CONTROLLABLE PITCH PROPELLERS - C&M	Propulsion
2431	PROP SHAFTING	Propulsion
5612	STEERING GEAR - C&M	Propulsion
2430	PROP SHAFTING	Propulsion
2520	PROPULSION CONTROL SYSTEM (PCS)	Propulsion
2411	PROP RED GEAR - GENERAL	Propulsion
2412	PROP RED GEAR - MAIN EQUIPMENT SPEC.	Propulsion
2413	PROP RED GEAR - C&M	Propulsion
2414	PROP RED GEAR - AUT.	Propulsion
2330	PROP INT COMB ENGINES	Propulsion
2332	PROP INT COMB ENGINES - C&M	Propulsion
2450	CONTROLLABLE PITCH PROPELLERS	Propulsion
2410	PROP RED GEAR	Propulsion
2433	PROP SHAFT - SEALS	Propulsion
5610	STEERING GEAR	Propulsion

System nr.	System Description	Alarm group
2420	PROPCOUPLINGS	Propulsion
2590	EXHAUST GAS LINES	Propulsion
2331	PROP INT COMB ENGINES - GENERAL	Propulsion
2442	PROP SHAFT BEARINGS -C&M	Propulsion
2441	PROP SHAFT BEARINGS - GENERAL	Propulsion
2440	PROP SHAFT BEARINGS	Propulsion
2436	PROP SHAFTING - C&M	Propulsion
2435	PROP.SHAFTING - SHAFT EARTHING DEVICE	Propulsion
2434	PROP SHAFTING - SHAFT LOCKING DEVICE	Propulsion
2451	CONTROLLABLE PITCH PROPELLERS - GEN.	Propulsion
4364	MEDICAL TREATMENT ROOM CALL SYSTEM	Auxiliary
7010	76MM GUN	Auxiliary
7100	AMUNITION STORES	Auxiliary
2622	LUB SYSTEMS - DIRTY OIL COLL & TRANS	Auxiliary
2620	LUB SYSTEMS	Auxiliary
2560	MACH SW, CIRC WATER & COOLING SYSTEMS	Auxiliary
5511	COMPRESSED AIR SYSTEMS - MAIN EQUIP SPEC	Auxiliary
5520	WORKING AIR SYSTEM	Auxiliary
5513	COMPRESSED AIR SYSTEMS - AUT	Auxiliary
5512	COMPRESSED AIR SYSTEMS - C&M	Auxiliary
5930	POLLUTION CONT SYST	Auxiliary
2621	LUB SYSTEMS - LUBE OIL FILLING & TRANSF.	Auxiliary
5510	COMPRESSED AIR SYSTEMS	Auxiliary
6234	ACCOMODATION LADDER	Auxiliary
5932	POLLUTION CONT SYST - OILY BILGE WATER SEP	Auxiliary
5210	SW COOLING SYSTEM	Auxiliary
4750	DEGAUSSING	Auxiliary
4551	AUTOMATIC IDENTIFICATION SYSTEM (AIS)	Auxiliary
5282	GREY WATER SYSTEM	Auxiliary
5281	SEWAGE VACUUM SYSTEM	Auxiliary
5220	FRESH WATER COOLING SYSTEM	Auxiliary
5212	SW COOLING SYSTEM - C&M	Auxiliary
5211	SW COOLING SYSTEM - MAIN EQUIPMENT SPEC	Auxiliary
2623	LUB OIL SERVICE SYSTEM	Auxiliary
2610	FUEL SERVICE SYSTEM	Fuel
5411	FO FILLING AND TRANSFER SYSTEM	Fuel
5412	FO FILLING AND TRANSFER SYSTEM - C&M	Fuel
5420	AVIATION FUEL SYSTEM	Fuel
5421	AVIATION FUEL SYSTEM - MAIN EQUIP SPEC	Fuel
5422	AVIATION FUEL SYSTEM - C&M	Fuel
5410	FO FILLING AND TRANSFER SYSTEM	Fuel
5311	DESALINATION PLANT - CO&M	Domest
4363	LOCK IN ALARM COLD AND FREEZE STORE ROOMS	Domest
5160	REFRIDGERATION SYSTEM	Domest
5161	CHILLED WATER SYSTEM	Domest
5162	PROVISIONS REFRIDGERATION SYSTEM	Domest
5310	DESALINATION PLANT	Domest
5312	DESALINATION PLANT - AUT	Domest
5321	C&H WATER PRESS SYSTEM	Domest
5322	C&H WATER PRESS SYSTEM - MAIN EQUIP SPEC	Domest
5324	C&H WATER PRESS SYSTEM - C&M	Domest
5325	C&H WATER PRESS - AUT	Domest
6331	CATHODIC PROTECTION ACTIVE	Domest
5320	FRESH WATER SERVICE SYSTEMS	Domest
5300	FRESH WATER SYSTEMS	Domest
5134	MACHINERY SPACE VENT SYSTEMS - LOUVERS	HVAC
5131	MACHINERY SPACE VENT SYSTEMS - ER	HVAC
5141	AC INSTALLATION	HVAC
5135	MACHINERY SPACE VENT SYSTEMS - C&M	HVAC

System nr.	System Description	Alarm group
5130	MACHINERY SPACE VENT SYSTEMS	HVAC
5132	MACHINERY SPACE VENT SYSTEMS - EM GEN ROOM	HVAC
5144	FIRE- AND SMOKE DAMPERS	FFDC
6244	DOOR CATCHERS	FFDC
6243	DOOR PUSHERS	FFDC
6242	FIRE CLASS DOORS	FFDC
5556	FOAM SYSTEM FOR HELIDECK	FFDC
5555	FOAM INSTALLATION AVIATION FUEL PUMP ROOM	FFDC
5554	FOAM INSTALLATION ENGINE ROOMS	FFDC
5553	CO2 INSTALLATION	FFDC
5552	SPRINKLER INSTALLATION	FFDC
5550	FIRE EXTINGUISHING SYSTEMS	FFDC
5551	FIRE MAIN SYSTEM	FFDC
4361	FIRE DETECTION AND ALARM SYSTEMS	FFDC
4231	DGPS SYSTEM	Navigation
4426	RADIO CABINET SYSTEM	Navigation
4331	PUBLIC ADDRESS SYSTEM	Navigation
4263	HEADING AUTOPILOT	Navigation
4425	GMDSS	Navigation
4321	AUTOMATIC TELEPHONE SYSTEM	Navigation
4283	ECDIS SYSTEM	Navigation
4282	NAVIGATION RADAR SYSTEM	Navigation
4610	HULL MOUNTED SONAR	Navigation
4230	ELECTR NAVIGATION SYSTEMS	Navigation
4240	ELECTRICAL NAVIGATION SYSTEM, ACOUSTICAL	Navigation
4241	DEPTH SOUNDING SYSTEM	Navigation
4260	NAVIGATION SYSTEMS	Navigation
4261	(GYRO) COMPASS SYSTEM	Navigation
4262	SPEEDLOG SYSTEM	Navigation
4280	NAVIGATION CONTROL MONITORING	Navigation
4281	NAVIGATION DATA DISTRIBUTION SYSTEM	Navigation
4200	GENERAL REQUIREMENTS FOR NAVIGATION SYSTEMS	Navigation
4510	RADAR SYSTEM	Navigation
4220	ELECTR NAVIGATION AIDS	Navigation
5292	BALLAST SYSTEM	Ballast
5291	BILGE SYSTEM	Ballast
5290	DRAINAGE AND BALLASTING SYSTEM	Ballast
4381	IPMS EQUIPMENT	IPMS
4362	GENERAL ALARM SYSTEM	IPMS
4380	INTEGRATED PLATFORM MANAGEMENT SYSTEM	IPMS
4000	GENERAL REQUIREMENTS FOR ELECTRONIC SYSTEM	IAS

Table 3-3 Systems and Installation groups

At IPMS system start-up the installation group to workstation assignments will be restored according to the last setting known by the IPMS servers.

3.5.2 Human Machine Interface

Function Allocation settings are visualized by a matrix showing the installations groups (by rows) and the control operators (by columns). Each control operator can start the installation group reassignment following the next steps:

1. Authorization, this will do the authorization process by typing the password;
2. Request of installation groups by clicking at the intersection of rows and columns;
3. Execution, this will start the reassignment of groups as requested;
4. Confirmation of alarms involved with the installation groups to be moved.

The layout of the function allocation matrix is defined by document: Technical Specification IPMS HMI, ref. [5]

3.6 Data logger (DTL)

For the purpose of technical monitoring of installations on the ship, the condition of certain parts of the installation is recorded regularly. On the basis of these data and with the help of technical analysis, it is possible to pronounce upon the future behaviour or the future performance of the concerning installation. Owing to this it is possible to plan, for instance major, preventive repairs in periods that the ship is in the harbour. On top of that, data recording can be the help for the planning of normal maintenance on board of the ship.

Each IPMS server will record the following data instances with a predefined sampling rate or on a specified event:

Data instance	Sampling rate	Event description	Archive period
Alarm events	-	Generate, acknowledge, reset and delete	**180 days**
Analogue values	3 seconds	-	**7 days**
IPMS platform commands		On command	**7 days**
Platform parameters		On change	**180 days**
Running hours counters	3 seconds	-	**7 days**
Switch event counters	3 seconds	-	**7 days**

Table 3-4 Data log definitions

3.7 Signal trending (TRE)

To gain insight into the behaviour and the performance of platform components, it is possible to record, for a limited period of time and with a predefined sampling rate, the values that are derived from the output signals of platform components, and to present the results of the recording in a graphical trend presentation (historical and real time).

The signal trending mimic is displayed as a pop-up child window and can be called from every IPMS workstation by right clicking on an analogue representation and then selecting 'Add to Trend' from the menu.

Depending the element type the operator may make a selection of signals that apply to the element. Once the selection has been made, the system will look for historical data. If historical data can be obtained from the data-logger the trend window will show this data. If not then a notification will be displayed. The operator may still proceed adding the applicable signal however since there is no historical data available only real time trending data will be shown.

The layout of the trend window and its features are defined by document: Technical Specification IPMS HMI. Ref.[5].

3.8 Health monitoring (HMT)

Health Monitoring comprises build in diagnostic software to perform online tests on most of the IAS- / IPMS components. To support the 'repair by replacement' philosophy hardware diagnostics are based on the level of exchangeable hardware modules such as PLC-boards, PC's, network switches etc.

Two targets exist within HMT. One applies to test software on IAS and CSN level (Classified for installation group: IAS), the other one concerns test software for the PDN and the LPU's (Installation group: IPMS).

All IPMS workstations will be notified on their alarm presentation list in case HMT detects a failing IAS or CSN object. This is because the HMT alarm may apply to an IPMS workstation. A reassignment of installation groups currently allocated to the failing station might be needed to regain monitoring and control abilities. Caution: This is a not an automatic action!

Dedicated mimics will be available to achieve diagnostic overviews of all HMT statuses.

3.9 Tank Monitoring System (TMS)

The Tank Monitoring System serves monitoring and alarm functions regarding the various liquids on board (such as fuels, oil, sewage, fresh water, etc.). A pressure sensor mounted inside each tank near the tank bottom is an input for determining the contents inside each tank. Along with additional information regarding tank shape and the specific gravity constant of the liquid within the tank it is possible to derive the following values:

- Fluid height [m]: based on measured pressure and gravity constant;
- Tank content [m^3]: by interpolation from the tank curve;
- Fluid mass [tons]; Calculated from tank content and specific gravity of the fluid inside;

It is assumed that tank-specific parameter curves (liquid levels as a function of volume) will be provided.

4. Interfaces

4.1 General

Besides interfacing the platform by discrete IO the IPMS incorporates other interfaces as well. These interfaces are used to connect to other systems/equipment either internal or external to IAS. The following sections summarize the relevant links.

4.1.1 Interface with PMS / GENSYS modules.

The PMS features several power related functions. It is implemented by four GENSYS generator management modules (one for each generator section) interconnected to each other by a CAN-bus based communication link.

Besides this each GENSYS module solely interfaces either LPU 3 or LPU 4 for monitoring purposes via a Modbus master/slave protocol based on a RS-422 hardware link. The IPMS itself doesn't carry out any key role regarding power management functions. Hence there will be no major consequences for PMS functions whenever the Modbus link should fail.

See: GENSYS technical documentation, ref. [14] for a detailed interface description.

4.1.2 Interface with PCS / Main Engines

The PCS manages several tasks related to the propulsion of the vessel. The PCS resides within LPU 1 and LPU 2 along with related IPMS functions that interface the main engines' native control and monitoring systems. Each of them is solely connected to the IPMS by a serial link for monitoring and control purposes.

The IPMS interface concerning both main engines is realized by a Modbus master/slave transfer protocol. The IPMS will act as a Modbus slave. The RS422 standard with galvanic isolation will be used as a hardware interface. The detailed interface description concerning this link is specified by document: "Local Control Panel Communication Modbus definition", ref. [16]

4.1.3 Interface with SCS.

The SCS is responsible for the control and monitoring of the rudders. The IPMS task considering the SCS mainly concerns the visualization of the actual rudder position. There will be no control features involved.

An Ethernet interface module that is installed in LPU 5 will support the link needed for SCS to IPMS data transfer. This Ethernet interface module will be connected to the CSN via network switch # 4.

4.1.4 Interface with INFRA

The INFRA – IPMS interface is needed to monitor the actual state of IAS hardware components. Although IAS status monitoring is actually performed by INFRA functions, visualization of those statuses and alarms is an IPMS feature. Whenever the interface to INFRA itself should fail then an alarm will be generated. Besides this all INFRA derived statuses will be marked unavailable.

An Ethernet interface module that is installed in LPU 5 will support the link needed for INFRA to IPMS data transfer. This Ethernet interface module will be connected to the CSN via network switch # 4.

4.1.5 Interface with Fire Detection System

The fire detection system is linked to LPU 5 in order to display the alarm of fire detectors on dedicated IPMS mimics. If a fire is detected then an IPMS alarm concerning the fire will be generated. Whenever the interface to the LPU should fail then the fire detection system itself continues to work. An IPMS alarm will be generated concerning the broken link.

Because of this independency an alarm will be also be generated by the fire detection controller itself in case of fire. Owing to this alarm acknowledgement has to be done on both the fire detection controller and the IPMS.

The IPMS to FDS interface is realized by a serial link based on the Modbus master/slave transfer protocol. The IPMS will act as a Modbus slave. The RS-422 standard with galvanic isolation will be used as a hardware interface. The Tyco System Specification ref. [15] specifies the detailed interface description concerning this serial link.

Appendix A
Mimic table of contents

In this appendix a list of mimics of the IPMS is specified.

Section	Mimic reference nr.	MimicName
	001	TABLE OF CONTENTS
GENERAL	002	FUNCTION ALLOCATION
GENERAL	002	NAV & COMMUNICATION SYSTEMS
GENERAL	005	NETWORK ARCHITECTURE
ENERGY	011	POWER MANAGEMENT OVERVIEW
ENERGY	012	230V-115V POWER DISTRIBUTION
ENERGY	013	24V DC POWER DISTRIBUTION
ENERGY	014	UNINTERRUPTIBLE POWER SUPPLY
PROPULSION	030	PROPULSION SYSTEM OVERVIEW
PROPULSION	031	CPP
PROPULSION	032	ME PORT
PROPULSION	033	ME STBD
PROPULSION	034	ME PORT EXHAUST GAS SYSTEM
PROPULSION	035	ME STBD EXHAUST GAS SYSTEM
PROPULSION	036	PROPULSION CONDITIONS
SAFETY	041	FIRE DETECTION DECK 2 & 3 & 4
SAFETY	042	FIRE DETECTION DECK 1&01&02&03
SAFETY	043	MACHINERY SPACE VENTILATION
SAFETY	050	FIRE FIGHTING SYSTEM
AUXILIARY	060	BALLAST SYSTEM
AUXILIARY	061	BILGE SYSTEM
AUXILIARY	070	AUXILIARY SYSTEMS OVERVIEW
AUXILIARY	071	FUEL OIL SYSTEM
AUXILIARY	072	TANKS OVERVIEW
AUXILIARY	073	SEA AND FRESH WATER SYSTEMS
MISCELLANEOUS	100	RUNNING HOURS
MISCELLANEOUS	200	LIST OF DISABLED ELEMENTS
MISCELLANEOUS	210	LIST OF PARAMETER CHANGES
MISCELLANEOUS	220	COMMAND HISTORY