KONGSBERG

K-Chief 700
Integrated Control System

Operator Manual

AIM Release 8.6

338309/A

Document history

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Rev. A	December 2015	First version. Valid for the K-Chief 700 8.6 HMI.

The reader

This operator manual is intended as a reference manual for the system operator. This manual is based on the assumption that the system operator is familiar with the K-Chief 700 system.

Note

Warning

The equipment to which this manual applies must only be used for the purpose for which it was designed. Improper use or maintenance may cause damage to the equipment and/or injury to personnel. The user must be familiar with the contents of the appropriate manuals before attempting to operate or work on the equipment.
Kongsberg Maritime disclaims any responsibility for damage or injury caused by improper installation, use or maintenance of the equipment.

Comments

To assist us in making improvements to the product and to this manual, we welcome comments and constructive criticism.
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Abbreviations

AIM	Advanced Integrated Multifunction system
ALC	Alarm & Control Panel
BU-AUT	Business Unit Automation Panel
CAN	Controller Area Network
CCR	Cargo Control Room
	Central Control Room
DFE	Dual Fuel Engine
DG	Diesel Generator
DP	Dynamic Positioning
EAP	Extended Alarm Panel
EAS	Extension Alarm System
ECR	Engine Control Room
FS	Field Station
GCU	Gas Control Unit
GUI	Graphic User Interface
HH	High High alarm limit
HMI	Human Machine Interface
HS	History Station or High Speed
HTML	HyperText Markup Language
IAS	Integrated Automation System
INP	Input Panel
IO, I/O	Input/Output
K-Bridge	Kongsberg Bridge System
K-Chief	Kongsberg Vessel Control System
KFDD	Kongsberg Functional Design Document
K-Gauge	Kongsberg Gauging System
K-Pos	Kongsberg Dynamic Positioning System
K-Pos DPM	Kongsberg Dynamic Positioning and Mooring System
K-Pos PM	Kongsberg Position Mooring System
K-Safe	Kongsberg Safety System
K-Thrust	Kongsberg Thruster Control System
LAN	Local Area Network
LCD	Liquid Crystal Display
LCU	Local Control Unit

LED	Light Emitting Diode
LL	Low Low alarm limit
LNG	Liquefied Natural Gas
LS	Low Speed
MUM	Software Module User Manual
NBO	Normal Boil Off
NCR	Navigation Control Room
NDU	Network Distribution Unit
OCV	Offshore Construction Vessel
OFAS	Operator Fitness Alarm System
OS	Operator Station
PDF	Portable Document Format
PDU	Power Distribution Unit
PID	Proportional Integral Derivative
PMS	Power Management System
PS	Process Station, process software package running on an RCU module
PU	Process Unit
RBUS	Remote I/O bus
RCA	Redundancy and Criticality Assessment system
RCU	Remote Controller Unit
RIO	Remote Input Output
RPM	Revolutions Per Minute
SCADA	Supervisory Control And Data Acquisition
UI	User Interface
UMS	Unmanned Machinery Space
UPS	Uninterruptible Power Supply
WCS	Watch Call System

1 System description

This manual describes the K-Chief 700 system components and applications.

1.1 K-Chief 700 system overview

The K-Chief 700 system is a distributed monitoring and control system that can be used in a wide range of vessels and applications. K-Chief 700 monitors and controls the onboard functions such as power, machinery, fluid, cargo and thruster/propulsion management.

K-Chief 700 can have the following basic functions, applications, and custom functions installed.

Basic functions:

- **Process control**
- **Field equipment remote control** e.g. valves, motors and pumps.
- **Process and system monitoring**
- **Process value history logging**
- **Alarm and event monitoring**
- **Alarm and event history logging**
- **Trend functionality**

Main applications:

- **Power management**
- **Machinery & Auxiliary Systems**
- **Thruster/propulsion control**
- **Redundancy and criticality assessment system**
- **Cargo and ballast control**
- **Extended alarm systems** such as the watch calling system and the operator fitness alarm system.

The K-Chief 700 system is built with modular hardware components and modular application software. Any number of these modules can be combined as necessary to provide an optimal solution for a a vessel's specific requirements.

K-Chief 700 can operate as a standalone system or it can be seamlessly integrated with other K-line systems as part of a larger vessel management system. The K-line systems can, for example, be:

- **Safety system** (K-Safe)
- **Dynamic positioning systems** (K-Pos)
- **Position mooring** (K-Pos DPM)
- **Thruster control** (K-Thrust)
- **Bridge control** (K-Bridge)
- **Gauge systems** (K-Gauge).

The integration can result in overlapping control functions between the systems. For example, you might be able to operate a thruster from the K-Chief 700, K-Thrust or K-Pos systems.

1.2 Distributed architecture

Operator stations provide the human machine interface (HMI), which allows you to interact with the K-Chief 700 system. One or many operator stations can be located in various control areas, such as the Cargo Control Room (CCR), engine control room (ECR) and the bridge.

The process control system is built up by a range of intelligent remote control (RCU) and I/O (RIO) modules. They communicate with each other over a single or redundant, high-capacity process bus, the RBUS. All monitoring and automation functions are executed by the RCUs.

The RIO module has a number of analogue and digital I/O channels. The individual channels are configured to match the field instruments.

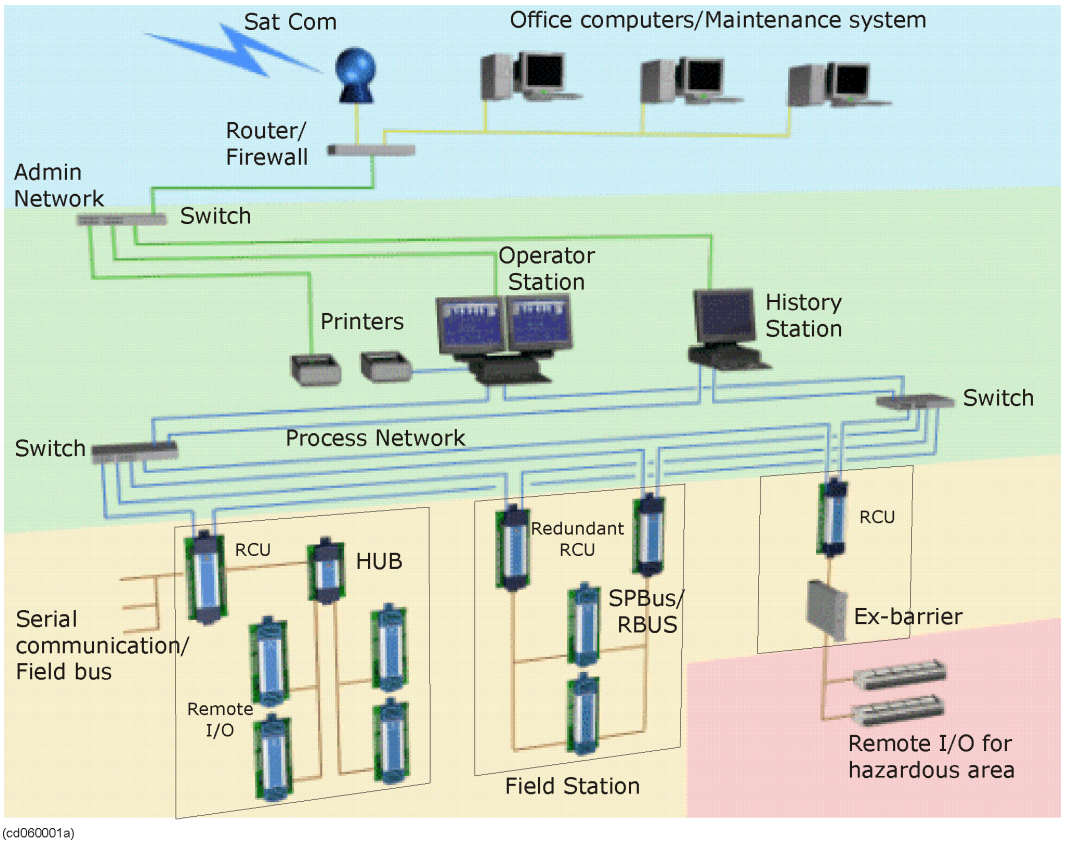
1.3 Main system components

The system consists of several basic components. Although, as an operator, you will primarily be concerned with the operator stations, it is useful to be aware of the other components in the system.

Also see the online AIM User Guide for more detailed information.

The following figure shows a block diagram of the distributed control system.

Figure 1 Typical K-Chief 700 system configuration



The components of the K-Chief 700 are described in the following sections.

1.3.1 Operator stations

The operator stations (OS) are the main interface between the operator and the processes.

An OS has three main parts:

- A colour monitor
- An operator panel with buttons and a trackball
- Computer

These can be installed in a number of different ways, such as in a standard K-Chief 700 console, or as separate units for built-in or desktop operation. More than one OS is usually installed in a K-Chief 700 system. The OS is installed in locations such as the bridge, cargo control rooms (CCR) and engine control rooms (ECR).

1.3.2 Field stations

The field stations (FS) are combined field interface and processing units. They provide the interface between the K-Chief 700 system and the field equipment. A field station is associated with specific items of field equipment. The FS is usually located near the field equipment and instrumentation.

Remote controller unit (RCU)

The remote controller unit (RCU) executes the application program of a process control system and interfaces with different bus systems. The RCU pair use a dedicated network, called REDNET, for exchange of redundancy information.

Distributed processing

K-Chief 700 is a distributed processing system as the process control functions are executed locally in the FS, not centrally in the OS. As the OS is independent of the process, it can be located anywhere on the vessel. Any OS can control any process, provided that it has control of the necessary command group, and the operator has sufficient access rights.

Every OS has a hard disk containing the software files for the K-Chief 700 system. These files are customized for the vessel. Process variables and parameter values shown in the OS are generated in the FS and transferred to any OS on request. The OS screen displays information collected from all the FS units.

1.3.3 History station

A history station (HS) is a computer that is connected to the network. It contains the historical database that stores the process variables over time. This is called a time series, which is mainly used internally by the system, to show historical trends and reports in the operator stations.

1.3.4 Process network

The process network is a dual-redundant local area network (LAN) that interconnects the operator, history, and field stations. All communication between the operator and the equipment that is controlled, takes place over this network.

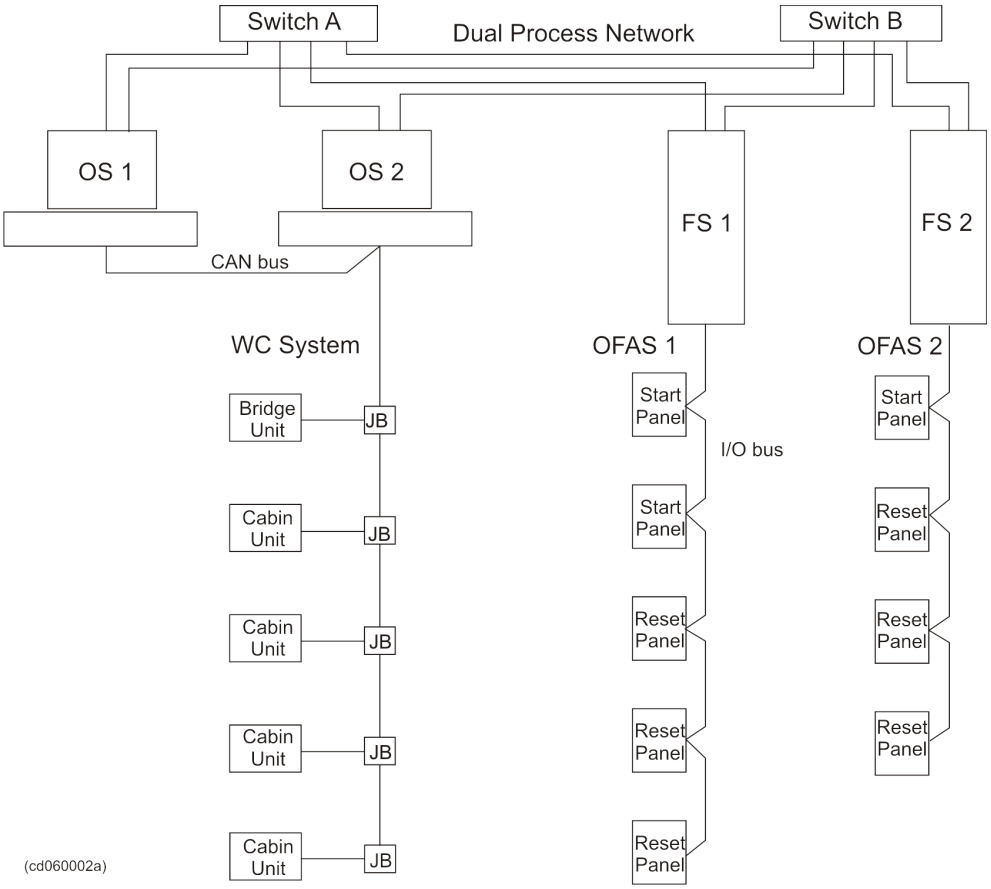
External network

Operator stations and history stations can also be part of an external network, which can have other systems and printers connected.

1.3.5 Extended alarm systems

The watch call system (WCS) and operator fitness alarm system (OFAS) are extended alarm systems.

Figure 2 Extended Alarm Systems topology



Watch call system (WCS)

The watch call system (WCS) allows the engine room to be operated in unmanned mode. It is part of the alarm and monitoring function of the K-Chief 700 system. The WCS is compliant with classification society requirements for unmanned engine room operation.

The WCS consists of a number of panels that are installed at different locations throughout the vessel. It shows the roster for the various watches and alerts the applicable personnel when they have watch duties when an alarm condition occurs. See the section *Watch Call System (WCS)* on page 146 for details.

Operator fitness alarm system (OFAS)

The operator fitness alarm system (OFAS) is also known as dead man alarm system and patrol man alarm system.

OFAS is part of the alarm and monitoring function of the K-Chief 700 system. The OFAS panels are located in the machinery and cargo spaces.

See the section *Operator Fitness Alarm System (OFAS)* on page 156 for details.

1.4 Where to find K-Chief 700 user documentation

The Kongsberg Functional Design Descriptions - *KFDD* - describe the specific system installed, with the unique system configuration and setup.

The standard K-Chief 700 user documentation is available as:

1 This K-Chief 700 Operator Manual

2 The electronic AIM User Guide, which is available online.

The two documents describe the different parts of the K-Chief 700 system functions, as shown in the table below.

Table 1 Information division between the K-Chief 700 Operator Manual and the AIM user guide

Document	Information content
K-Chief 700 **Operator manual**	K-Chief 700 automation applications - Basic monitoring and control, power management and other dedicated K-Chief 700 subsystems. Log on/log off information Start-up and shutdown information
AIM User Guide Configuration information for the basic AIM functions is included.	Alarms and event system Report system Trend system Time series system Command control system Access control system I/O system Various explorers for monitoring of system components and function modules. Information on the operator station, history station and field station. Redundancy Various utility and auxiliary functions.

You can view the online **AIM User Guide** by doing either of the following:

- **a)** From the main menu, choose `Help > User Guide`.
- **b)** Press the keyboard function key **F1**.

More information on the **AIM User Guide** is provided in chapter 2: *User Interface*.

2 User interface

2.1 Overview

The K-Chief 700 user interface consists of a colour monitor screen, an operator panel and an alphanumeric keyboard. The screen shows the K-Chief 700 images and the operator panel is used to interact with those images. The alphanumeric keyboard is used for setup and configuration purposes.

This chapter describes the use of the operator panel and how to use the alphanumeric keyboard. It also gives an overview of the different images available.

Also, refer to the section *AIM User Guide* below and the **operator station** topic in the online AIM User Guide.

2.1.1 System version information

Choose **Help →About AIM OS** to refer to the information about the installed version of the K-Chief 700 system.

The AIM User Guide contains more details about the system information features.

2.1.2 AIM User Guide

The AIM User Guide is an online reference for anyone who configures or operates the AIM-2000 system. The introduction section in the user guide contains all the necessary instructions for using the guide.

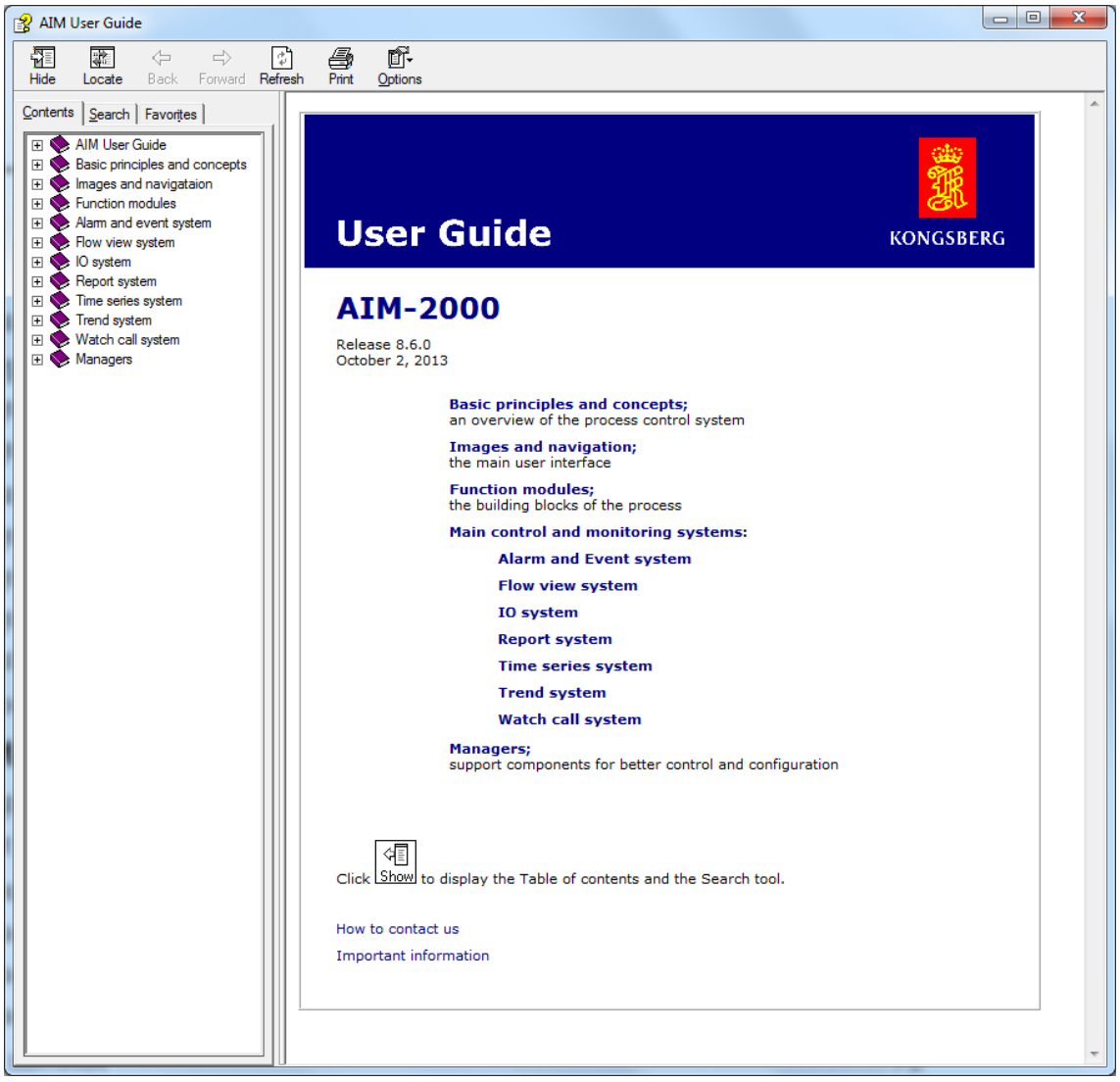
The AIM User Guide can be viewed in two different ways, either by:

- Using the **Help** menu
- Pressing the keyboard **F1** function button

2.1.2.1 Using the command on the Help menu

Choose the `User Guide` menu item in the **Help** menu to access the AIM User Guide.

Figure 3 The AIM User Guide



You can find the information you require by either:

1 Selecting the →**Contents** tab and selecting the required table of contents entry.

2 Selecting the →**Search** tab and typing a search string.

When the User Guide HTML help viewer is shown, a user guide button is added to the end of the toolbar of the currently displayed image. This button allows you to display or hide the viewer as necessary.

2.1.2.2 Using the keyboard F1 function button

Press **F1** function button on the keyboard to view the AIM User Guide.

There are two display options.

- If you press the **F1** key when no dialog box has focus, the AIM User Guide is shown.

- If you press the **F1** key when a dialog box has focus, the AIM User Guide shows information about the dialog box. The AIM User Guide navigation pane closes. The **Hide/Show** toggle button is in the **Show** mode. Click this button to open the navigation pane.

2.2 Operator station images

The concepts behind images are central for understanding how the K-Chief 700 system works.

The operator station (OS) shows views of the process areas. These views, or images, show all or part of a process. They use standard symbols, such as valves and motors, to represent the process equipment. These symbols are called Function Modules. They are further described in the chapter *Basic Monitoring and Control* on page 37. The parts of the process that are displayed use colours and tag marks to show the present state of the process. Alarms and events are also shown - in both general and specific views.

How processes are displayed and controlled

The number of images in a system depends on the amount of equipment controlled by K-Chief 700. The system lets you select images that give varying levels of detail about a process.

When you select an image that shows an overall process (for example, Power Management), there may not be enough space to display all the details on a single image. The K-Chief 700 system will therefore have a number of lower level images, which are linked to the main image via hotspots or View panel buttons, that show this level of details.

Usually, no more than maximum two image levels will be needed, although more can be used if required. Eventually you will reach a point where there is no more detail (i.e. at the level of a single function module).

2.2.1 Image types

The various types of K-Chief 700 images are as follows:

- Process
- Flow Sheet
- List
- Trend
- Event List
- System Status
- I/O
- PDF
- Multiple.

- Safety

For more details on the various type of images, refer to the online AIM User Guide.

2.2.2 Image layout

The K-Chief 700 images are displayed in a primary image window that is divided into areas. Each of these areas has a different function and is updated independently of the others. They contain information about the process and information for the operator. The information displayed varies according to the type of command given or the task being performed.

The arrangement of these areas is shown in the following figure.

Figure 4 K-Chief 700 view layout

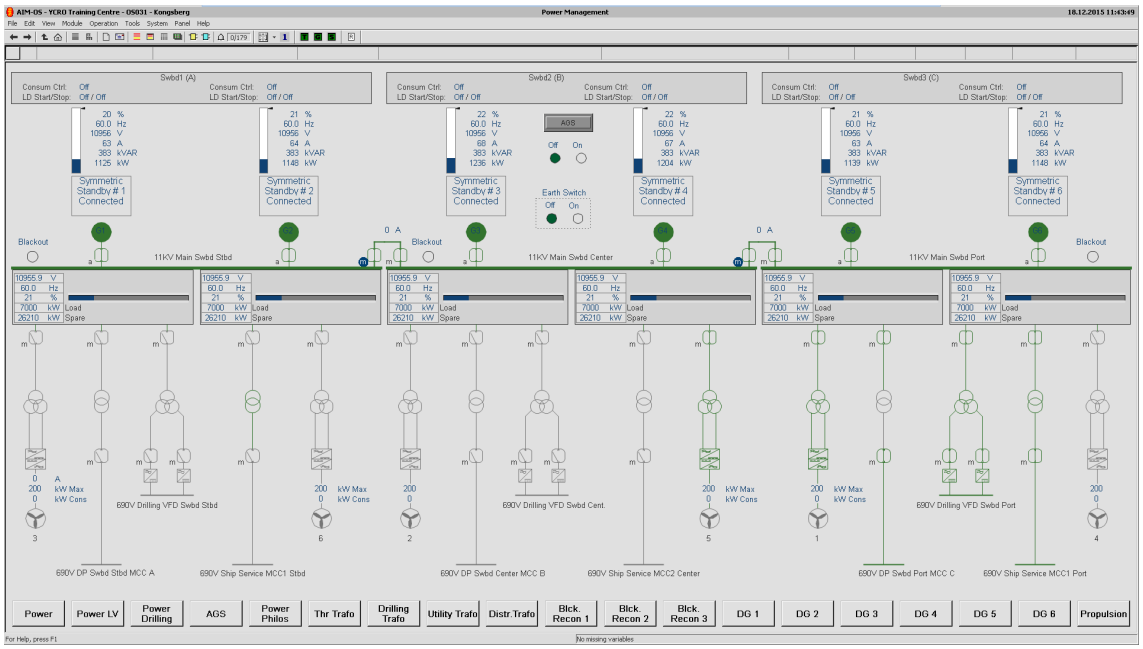
(CD2338D)

2.2.3 Process images

The process image offers enhanced graphical presentation of a process with graphical symbols (software function modules) representing process equipment such as pumps, motors, valves, or switches. Process values and alarms are displayed together with the symbols. The operator interacts with the graphical symbols using the various operation menus.

An example of a process image for the power management application is shown in the following figure:

Figure 5 Process view



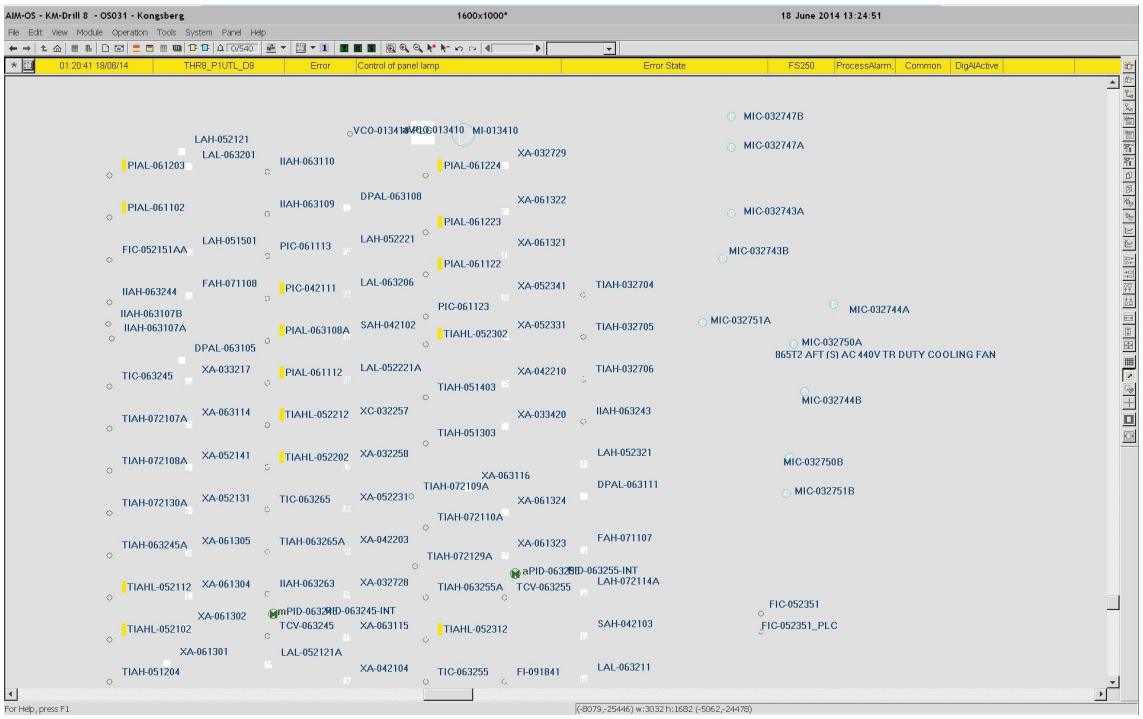
2.2.4 Flow sheet images

Flow sheet images are similar to process images, as they are graphic representations of physical parts of the vessel process.

Flow sheet images are for configuration purposes only (by KM personnel) and are not meant for operation. (Production Unit installations use flow sheets as an alternative way of operating.)

An example of a flow sheet image for the power management application is shown in the following figure.

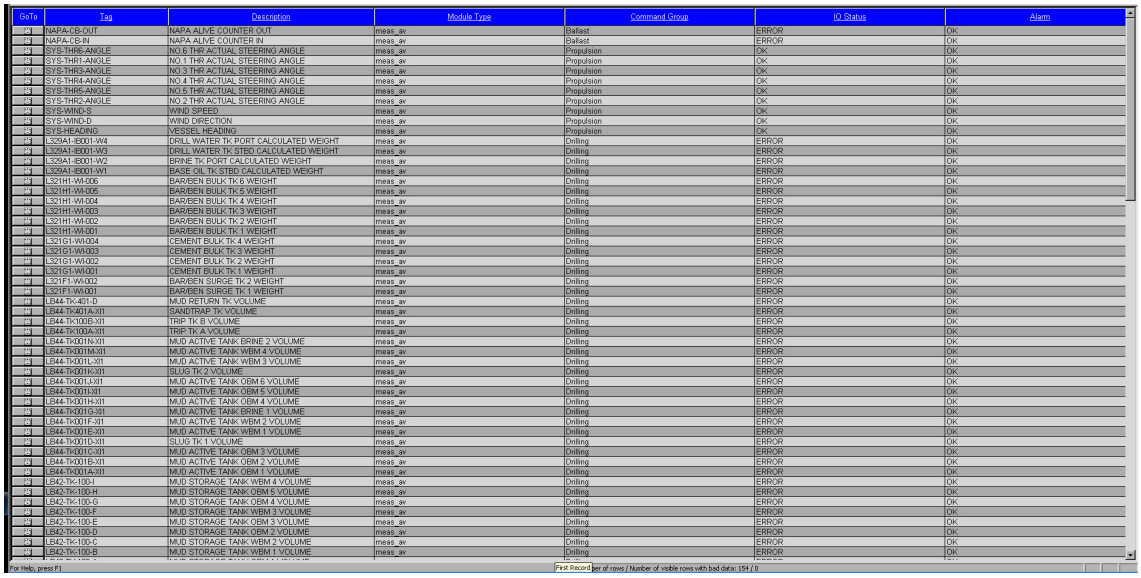
Figure 6 Flow sheet image



2.2.5 List images

The list image lets you easily make views containing selected information from the modules, or tags. These views can be seen by clicking on the tabs at the top of the screen.

Figure 7 List image



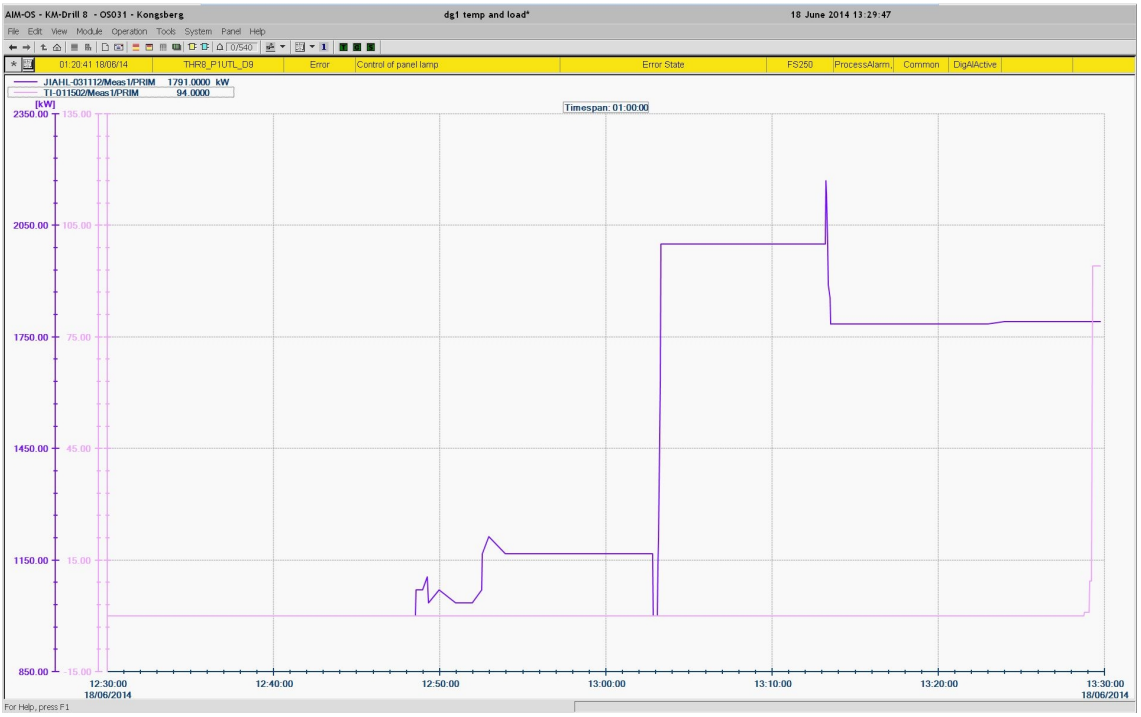
GoTo	Tag	Description	Module Type	Command Group	IO Status	Alarm
	NAPA-CB-OUT	NAPA ALIVE COUNTER OUT	meas_av	Ballast	ERROR	OK
	NAPA-CB-IN	NAPA ALIVE COUNTER IN	meas_av	Ballast	ERROR	OK
	SYS-THR6-ANGLE	NO.6 THR ACTUAL STEERING ANGLE	meas_av	Propulsion	OK	OK
	SYS-THR1-ANGLE	NO.1 THR ACTUAL STEERING ANGLE	meas_av	Propulsion	OK	OK
	SYS-THR3-ANGLE	NO.3 THR ACTUAL STEERING ANGLE	meas_av	Propulsion	OK	OK
	SYS-THR4-ANGLE	NO.4 THR ACTUAL STEERING ANGLE	meas_av	Propulsion	OK	OK
	SYS-THR5-ANGLE	NO.5 THR ACTUAL STEERING ANGLE	meas_av	Propulsion	OK	OK
	SYS-THR2-ANGLE	NO.2 THR ACTUAL STEERING ANGLE	meas_av	Propulsion	OK	OK
	SYS-WIND-S	WIND SPEED	meas_av	Propulsion	OK	OK
	SYS-WIND-D	WIND DIRECTION	meas_av	Propulsion	OK	OK
	SYS-HEADING	VESSEL HEADING	meas_av	Propulsion	OK	OK
	L329A1-IB001-W4	DRILL WATER TK PORT CALCULATED WEIGHT	meas_av	Drilling	ERROR	OK
	L329A1-IB001-W3	DRILL WATER TK STBD CALCULATED WEIGHT	meas_av	Drilling	ERROR	OK
	L329A1-IB001-W2	BRINE TK PORT CALCULATED WEIGHT	meas_av	Drilling	ERROR	OK
	L329A1-IB001-W1	BASE OIL TK STBD CALCULATED WEIGHT	meas_av	Drilling	ERROR	OK
	L321H1-WI-006	BAR/BEN BULK TK 6 WEIGHT	meas_av	Drilling	ERROR	OK
	L321H1-WI-005	BAR/BEN BULK TK 5 WEIGHT	meas_av	Drilling	ERROR	OK
	L321H1-WI-004	BAR/BEN BULK TK 4 WEIGHT	meas_av	Drilling	ERROR	OK
	L321H1-WI-003	BAR/BEN BULK TK 3 WEIGHT	meas_av	Drilling	ERROR	OK
	L321H1-WI-002	BAR/BEN BULK TK 2 WEIGHT	meas_av	Drilling	ERROR	OK
	L321H1-WI-001	BAR/BEN BULK TK 1 WEIGHT	meas_av	Drilling	ERROR	OK
	L321G1-WI-004	CEMENT BULK TK 4 WEIGHT	meas_av	Drilling	ERROR	OK
	L321G1-WI-003	CEMENT BULK TK 3 WEIGHT	meas_av	Drilling	ERROR	OK
	L321G1-WI-002	CEMENT BULK TK 2 WEIGHT	meas_av	Drilling	ERROR	OK
	L321G1-WI-001	CEMENT BULK TK 1 WEIGHT	meas_av	Drilling	ERROR	OK
	L321F1-WI-002	BAR/BEN SURGE TK 2 WEIGHT	meas_av	Drilling	ERROR	OK
	L321F1-WI-001	BAR/BEN SURGE TK 1 WEIGHT	meas_av	Drilling	ERROR	OK
	LB44-TK-421-D	MUD RETURN TK VOLUME	meas_av	Drilling	ERROR	OK
	LB44-TK401A-XI1	SANDTRAP TK VOLUME	meas_av	Drilling	ERROR	OK
	LB44-TK100B-XI1	TRIP TK B VOLUME	meas_av	Drilling	ERROR	OK
	LB44-TK100A-XI1	TRIP TK A VOLUME	meas_av	Drilling	ERROR	OK
	LB44-TK001N-XI1	MUD ACTIVE TANK BRINE 2 VOLUME	meas_av	Drilling	ERROR	OK
	LB44-TK001M-XI1	MUD ACTIVE TANK WBM 4 VOLUME	meas_av	Drilling	ERROR	OK
	LB44-TK001L-XI1	MUD ACTIVE TANK WBM 3 VOLUME	meas_av	Drilling	ERROR	OK
	LB44-TK001K-XI1	SLUG TK 2 VOLUME	meas_av	Drilling	ERROR	OK
	LB44-TK001J-XI1	MUD ACTIVE TANK OBM 6 VOLUME	meas_av	Drilling	ERROR	OK
	LB44-TK001I-XI1	MUD ACTIVE TANK OBM 5 VOLUME	meas_av	Drilling	ERROR	OK
	LB44-TK001H-XI1	MUD ACTIVE TANK OBM 4 VOLUME	meas_av	Drilling	ERROR	OK
	LB44-TK001G-XI1	MUD ACTIVE TANK BRINE 1 VOLUME	meas_av	Drilling	ERROR	OK
	LB44-TK001F-XI1	MUD ACTIVE TANK WBM 2 VOLUME	meas_av	Drilling	ERROR	OK
	LB44-TK001E-XI1	MUD ACTIVE TANK WBM 1 VOLUME	meas_av	Drilling	ERROR	OK
	LB44-TK001D-XI1	SLUG TK 1 VOLUME	meas_av	Drilling	ERROR	OK
	LB44-TK001C-XI1	MUD ACTIVE TANK OBM 3 VOLUME	meas_av	Drilling	ERROR	OK
	LB44-TK001B-XI1	MUD ACTIVE TANK OBM 2 VOLUME	meas_av	Drilling	ERROR	OK
	LB44-TK001A-XI1	MUD ACTIVE TANK OBM 1 VOLUME	meas_av	Drilling	ERROR	OK
	LB42-TK-100-I	MUD STORAGE TANK WBM 4 VOLUME	meas_av	Drilling	ERROR	OK
	LB42-TK-100-H	MUD STORAGE TANK OBM 5 VOLUME	meas_av	Drilling	ERROR	OK
	LB42-TK-100-G	MUD STORAGE TANK OBM 4 VOLUME	meas_av	Drilling	ERROR	OK
	LB42-TK-100-F	MUD STORAGE TANK WBM 3 VOLUME	meas_av	Drilling	ERROR	OK
	LB42-TK-100-E	MUD STORAGE TANK OBM 3 VOLUME	meas_av	Drilling	ERROR	OK
	LB42-TK-100-D	MUD STORAGE TANK OBM 2 VOLUME	meas_av	Drilling	ERROR	OK
	LB42-TK-100-C	MUD STORAGE TANK WBM 2 VOLUME	meas_av	Drilling	ERROR	OK
	LB42-TK-100-B	MUD STORAGE TANK WBM 1 VOLUME	meas_av	Drilling	ERROR	OK

2.2.6 Trend images

The trend image can contain several trends, such as a mixture of x-y, and time trends. A trend can contain several trend curves.

An example of a trend image containing two trends is shown in the following figure.

Figure 8 Trend image

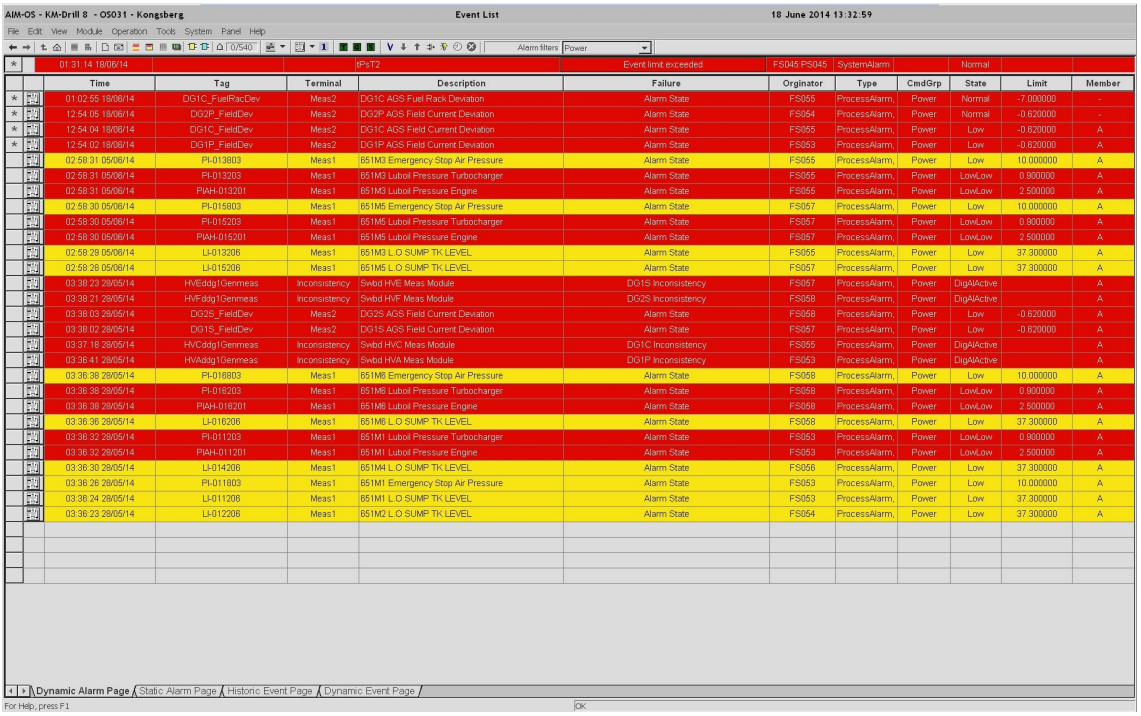


2.2.7 Event list images

An event notifies you of some condition in the system, or the process, that needs your attention. The events are notified, depending on the list that is displayed, and the selected filter.

An example of an event image is shown in the following figure.

Figure 9 Event list image

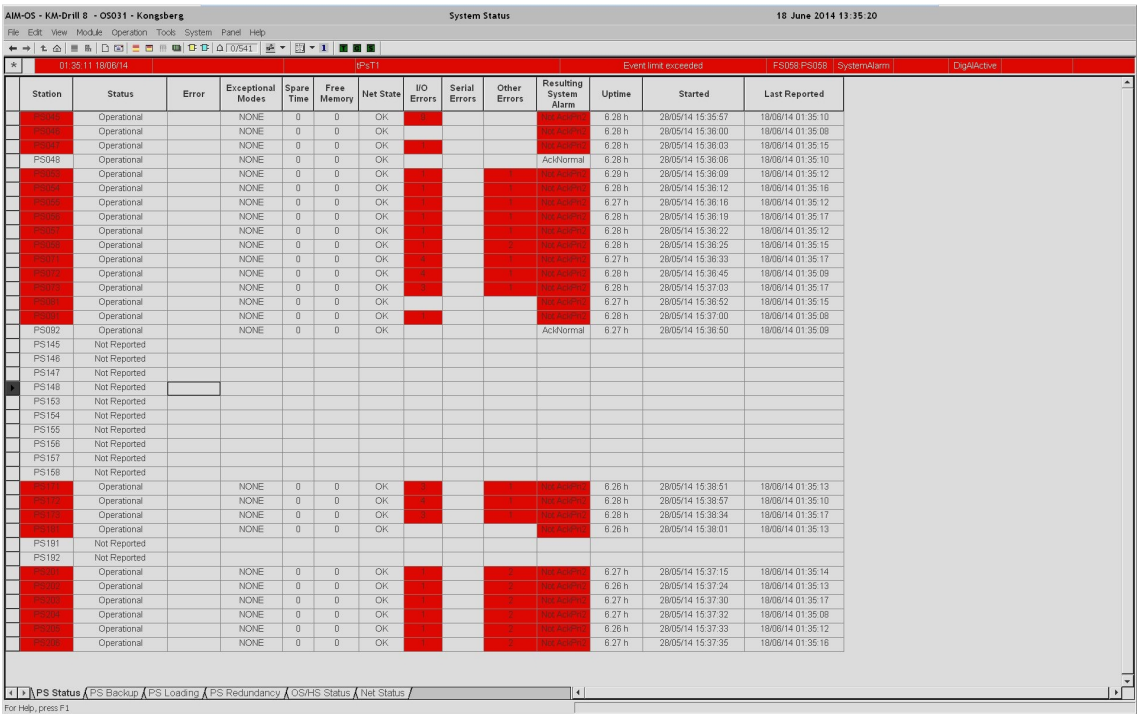


2.2.8 System status images

The system status images show operational status information about the process stations (PS), the history stations (HS) and the operator stations (OS). They also show information about communication with other equipment that are connected to the process network.

An example of a system status image is shown in the following figure.

Figure 10 System status image



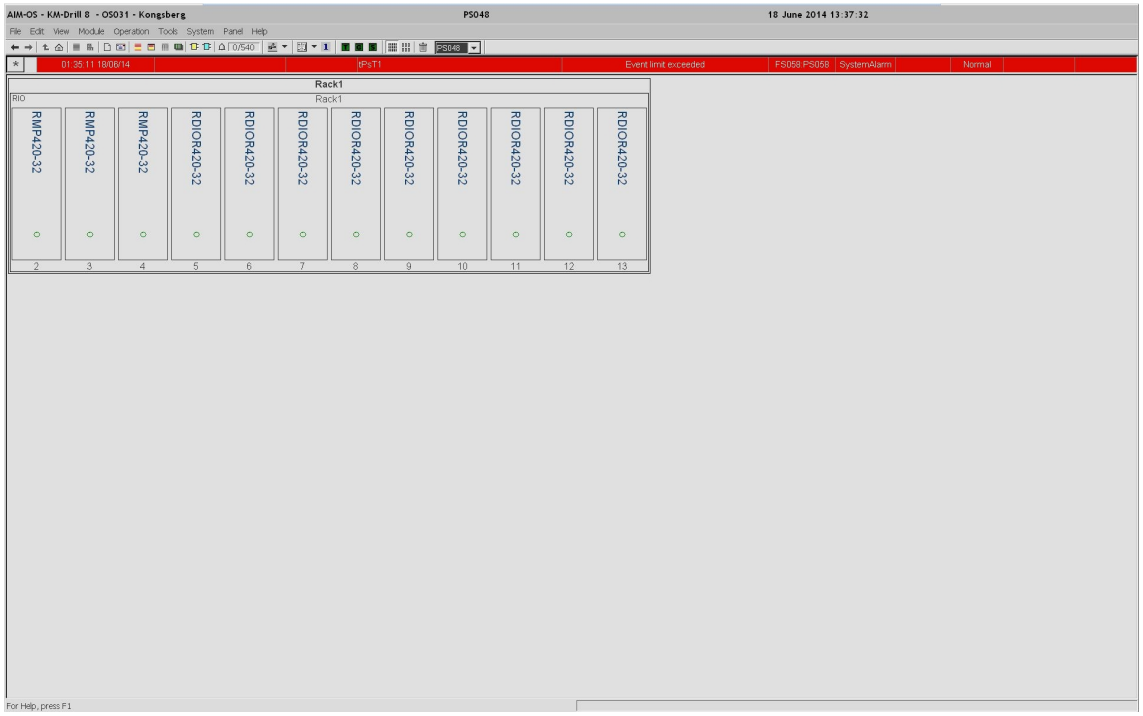
2.2.9 I/O images

The I/O image shows you the I/O configuration of the system. You can drill down into the individual channels to inspect the I/O connections.

The following figure shows an example of an I/O image.

Refer to the online AIM User Guide for more information on the I/O images.

Figure 11 I/O image

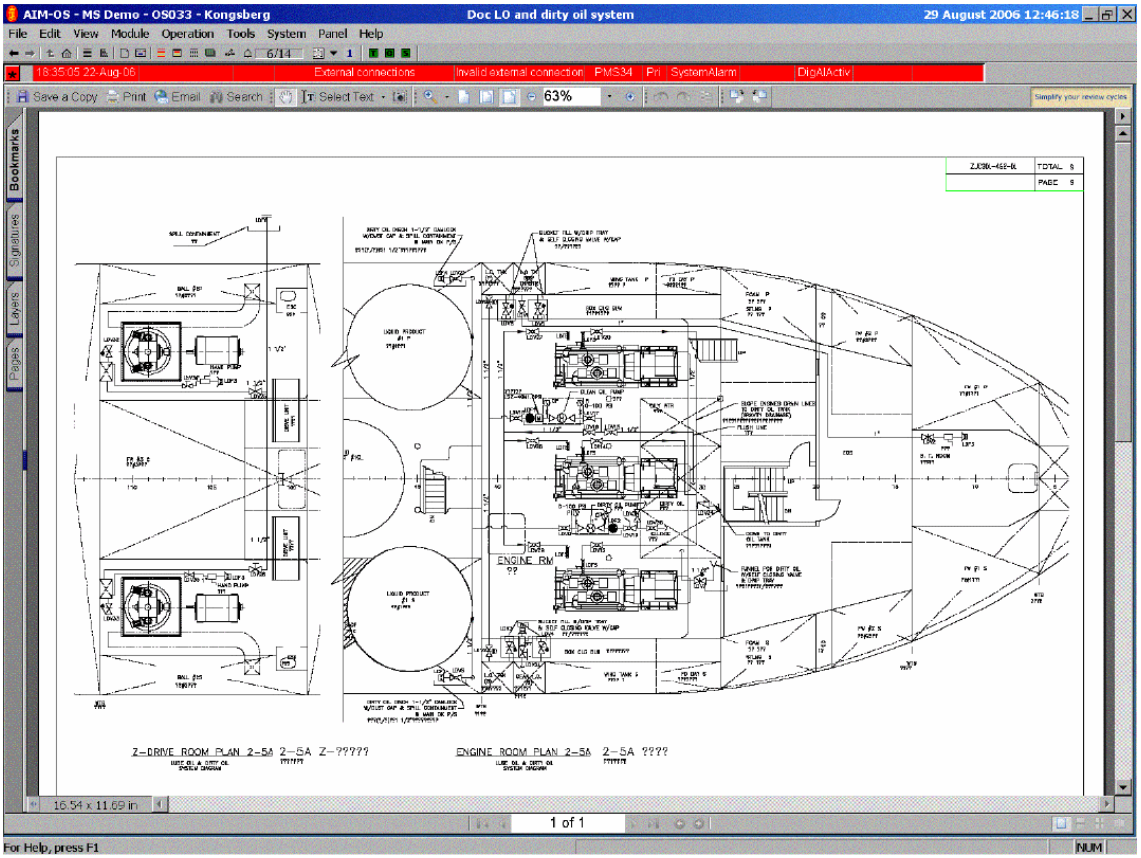


2.2.10 PDF images

The Portable Document Format (PDF) is a file format created for document exchange, by Adobe Systems. PDF images are used to display PDF documents.

An example of a PDF image is shown in the following figure.

Figure 12 PDF image

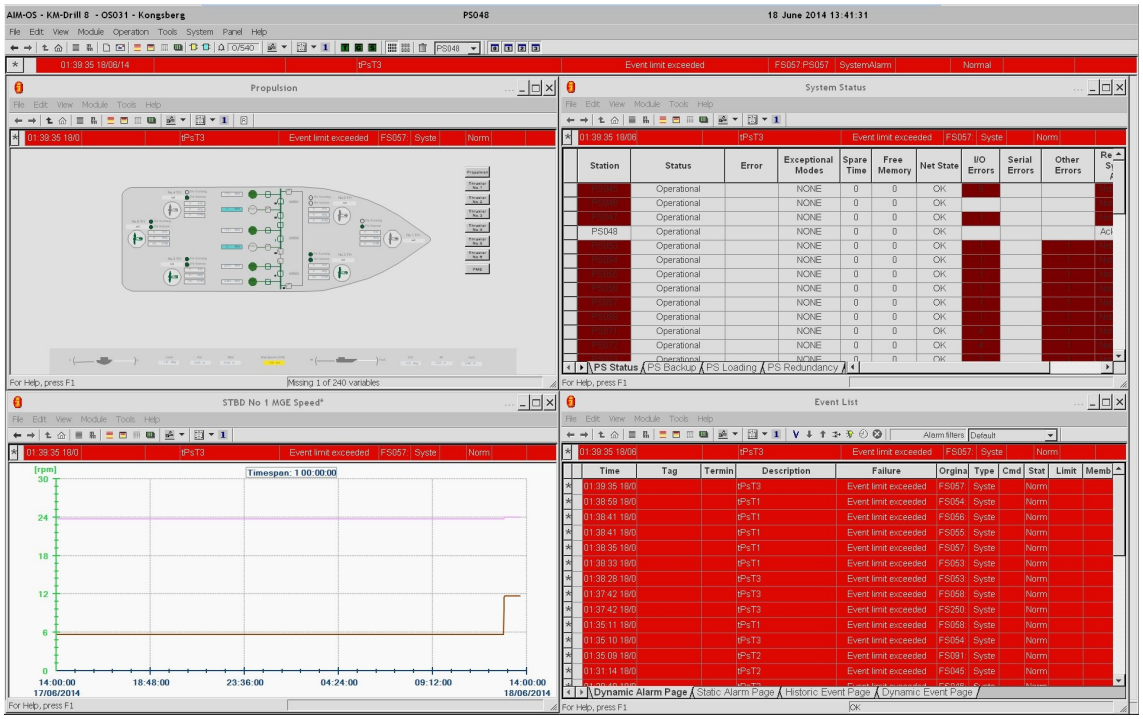


2.2.11 Multiple images

Multiple images are used to display several images on the screen simultaneously.

An example of multiple images is shown in the following figure.

Figure 13 Multiple images

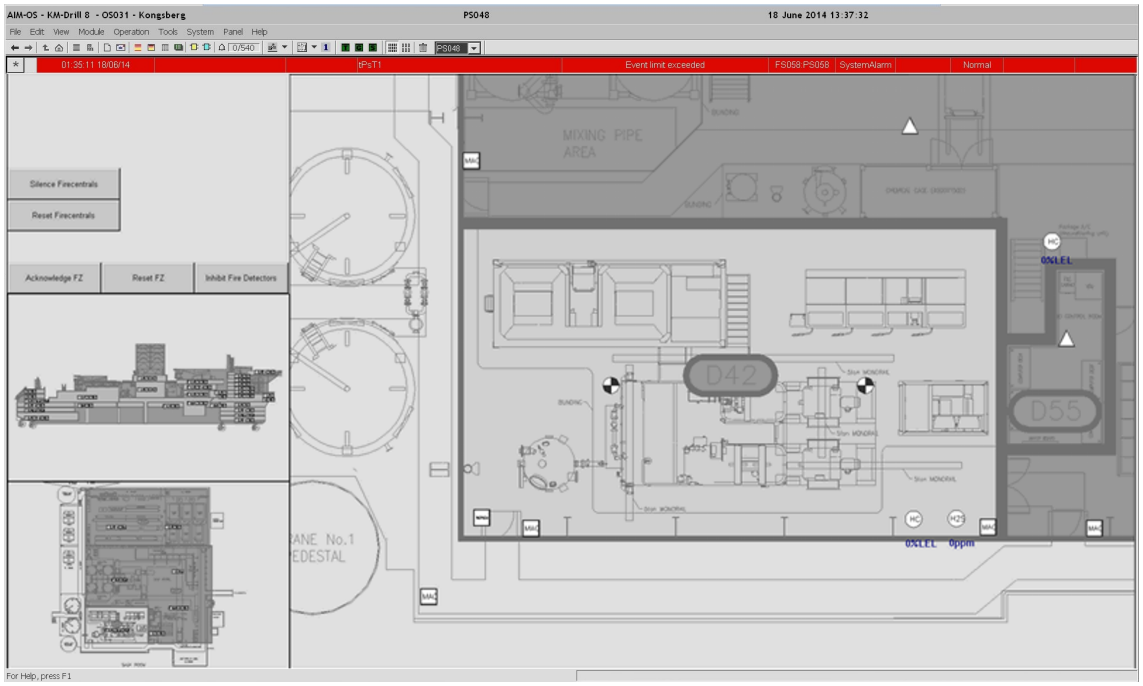


2.2.12 Safety images

The Safety image is the process view for the safety systems. (Not all installations have safety systems configured).

An example of a safety image is shown in the following figure.

Figure 14 Safety image



2.3 OS operator panels

The OS (operator station) operator panel comprises the following sub-panels:

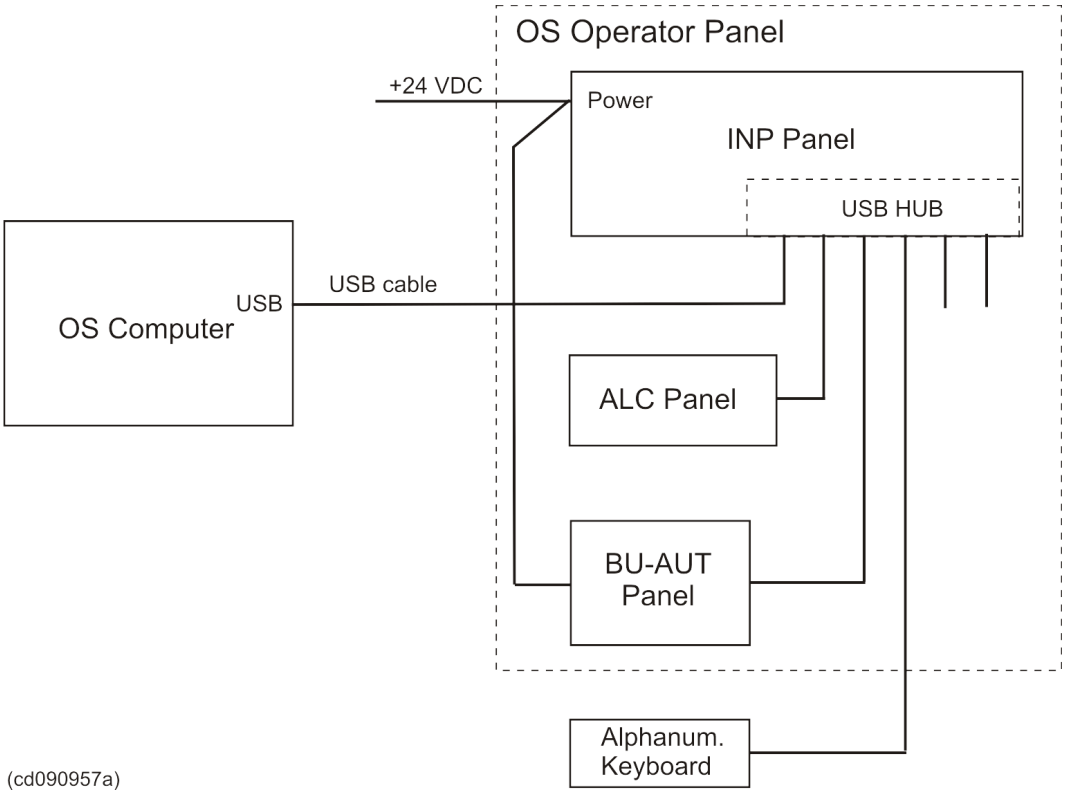
- Input Panel (INP)
- Alarm and Control Panel (ALC)
- Automation Panel (BU-AUT)

They are used to interact with the view and control the process. This is normally done using the trackball and mouse buttons to point at and click on symbols and menus.

The OS operator panel with its sub-panels communicate with the operator station computer using USB links.

See the following figure for communication principles.

Figure 15 Inter-panel communication



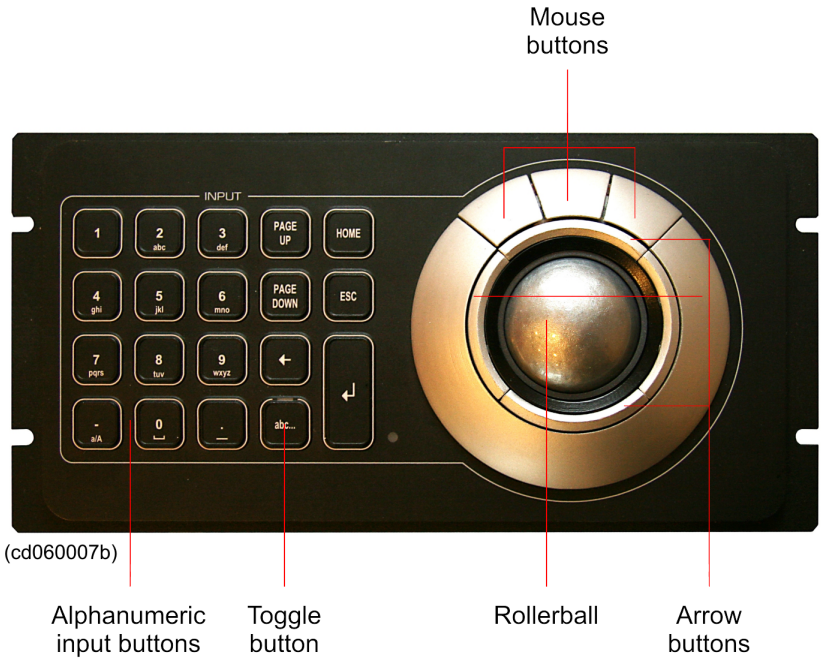
2.3.1 Input Panel (INP)

2.3.1.1 Understanding the INP

The INP is a keyboard which provides easy access to the operator functions.

The following illustration shows the layout of the INP. The buttons and keys on the panel are explained in the following sections.

Figure 16 Input Panel layout



2.3.1.2 Input group buttons and lamp

The input group consists of 19 buttons. One of these has a lamp. This is the **abc...** (toggle) button.

The buttons and keys are:

abc... (toggle button)

This button toggles between numeric and alphanumeric mode. Numeric mode is default. Press the button for one second to toggle. A short beep will confirm the change. The lamp is lit green when the panel is in alphanumeric mode (letters) and not lit when in numeric mode (numbers).

The lamp intensity can be adjusted from the computer.

2 / abc

The result of pressing this button depends on in which mode the panel is, numeric or alphanumeric. The number **2** is entered if the button is pressed when in numeric mode. When in alphanumeric mode the letter **a** will be entered by pressing the button one time. Pressing twice, the letter **b** is entered. Three times enters the letter **c**.

The same applies for the following buttons: **3/def**, **4/ghi**, **5/jkl**, **6/mno**, **7/pqr**, **8/tuv**, **9/wxyz**.

PAGE UP

This button is used to scroll up in list view images (for instance in the **Alarm history** view).

PAGE DOWN

This button is used to scroll down in list view images (for instance in the **Alarm history** view).

2.3.1.3 Trackball

The trackball has one trackball and three mouse buttons. The other four buttons are arrow buttons, located around the trackball. See the figure *Input Panel layout* on page 32.

Trackball

This is used for on-screen navigation.

Mouse buttons

The three mouse buttons located on the outer ring have the same functions as an ordinary three-button computer mouse.

Arrow buttons

The four arrow buttons located on the inner ring are used to move the cursor up, down, left or right.

2.3.1.4 Backlight

A yellow backlight is built into the panel. You can adjust the brightness of the lamp from the computer.

2.3.1.5 Temperature sensor

A temperature sensor in the panel monitors the operational temperature. If the temperature rises above a specified limit (70 °C), a system alarm is given.

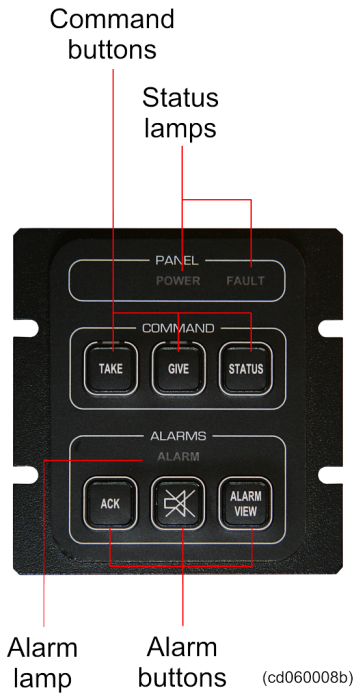
2.3.2 Alarm and Control Panel (ALC)

2.3.2.1 Understanding the ALC

The ALC is a specially designed keyboard which provides easy access to the operator functions.

The following illustration shows the layout of the ALC. The lamps and buttons in the panel are explained in the following sections.

Figure 17 Alarm & Control Panel (ALC) layout



2.3.2.2 Panel group lamps

The panel group have two lamps.

POWER

The lamp is lit green when power is OK

FAULT

The lamp is lit red when the connection between the panel and the computer is lost, otherwise it is not lit.

2.3.2.3 Command group buttons and lamps

The command group have two buttons with lamps and one button without a lamp. They are used to transfer access and control.

TAKE

Press this button quickly twice to take operator control, the lamp is then lit green.

GIVE

Press this button to give control to another operator station, the lamp is then lit green.

STATUS

When you press this button, the control status is shown in the operator station screen.

2.3.2.4 Alarm group buttons and lamps

The alarm group has one lamp, and three buttons without lamps.

ALARM LAMP

The lamp is blinking red when an alarm has been detected. The lamp is steadily lit when the **ACK** button has been pressed and the alarm is still active.

ACK

Press this button to acknowledge an alarm. Two things will happen simultaneously; the alarm buzzer will be silent, and the alarm text will change colour to indicate the acknowledgement.

SILENCE

Press this button to silence the buzzer.

ALARM VIEW

Press this button to view the **Active alarms** on the operator station screen.

2.3.2.5 Backlight

A yellow backlight is integrated in the panel. The brightness can be adjusted from the computer.

2.3.2.6 Buzzer

The buzzer sounds an alarm at the following incidents. Refer also to the figure *Inter-panel communication* on page 31.

- Alarm created by the system.
- Loss of communication between the OS computer (MPxxxx) and the OS operator panel.
- Loss of power to the OS operator panel (sound duration limited by HW).

The buzzer will be silenced at loss of power, or can be silenced by pressing button on local panel or by executing a system command (manually or automatically).

2.3.2.7 Temperature sensor

A temperature sensor in the alarm panel monitors the operational temperature. If the temperature rises above a specified limit (70 °C), a system alarm is given.

2.3.3 Automation Panel (BU-AUT)

2.3.3.1 Understanding the BU-AUT

The BU-AUT is a specially designed keyboard which enables easy access to the operator functions.

The following illustration shows the layout of the BU-AUT. The buttons in the panel are explained below.

Figure 18 Automation panel layout

2.3.3.2 Views group buttons and lamps

The views group have 28 buttons and lamps. You can assign functions to these buttons and lamps.

When you press a button, a signal is sent to the computer to activate, or enable the function that is assigned with the button. Buttons that are not configured do not report anything when pressed.

If an alarm occurs, the associated lamp is lit.

2.3.3.3 Backlight

A yellow backlight is integrated in the panel. The brightness can be adjusted from the computer.

2.3.3.4 Temperature sensor

A temperature sensor in the automation panel monitors the operational temperature. If the temperature rises above a specified limit (70 °C), a system alarm is given.

3 Basic Monitoring and Control

The K-Chief 700 system is built up of software **function modules** that represent the physical plant equipment. These function modules are shown as symbols on the screen - **function module symbols**. The software function modules execute the basic monitoring and control and are used universally by the various K-Chief 700 applications.

The standard function modules are described in this chapter. Information about the basic principles for the function modules' behavior and available commands are given.

The basic function modules are:

- Operation menu buttons
- Analogue measurement modules
- Digital measurement modules
- Pulse measurement modules
- Motor/Pump control modules
- Valve control modules
- PID controller modules
- Sequence control modules.

3.1 Image construction - basic principles

All images are made from a set of standard function modules, shown as standard symbols on the screen. A function module's behavior is determined by its internal parameter values. Although the symbols on the screen can look identical, it is the function module internal parameter values that determine their behavior.

The different function modules often behave in very similar ways due to the nature of the standard functions. For example, most pumps will start and stop. The real differences arise where a function module has logic interlocks implemented that override its normal functions under certain conditions.

A typical example: a pump motor start is inhibited when its output flow control valve is closed.

An operator has limited access to change system parameters.

Your specific system configuration is described in the vessel's Kongsberg Functional Design Description (KFDD).

3.2 Function module symbols

The function module symbols can be either static or interactive, depending on the nature of the equipment a symbol represents.

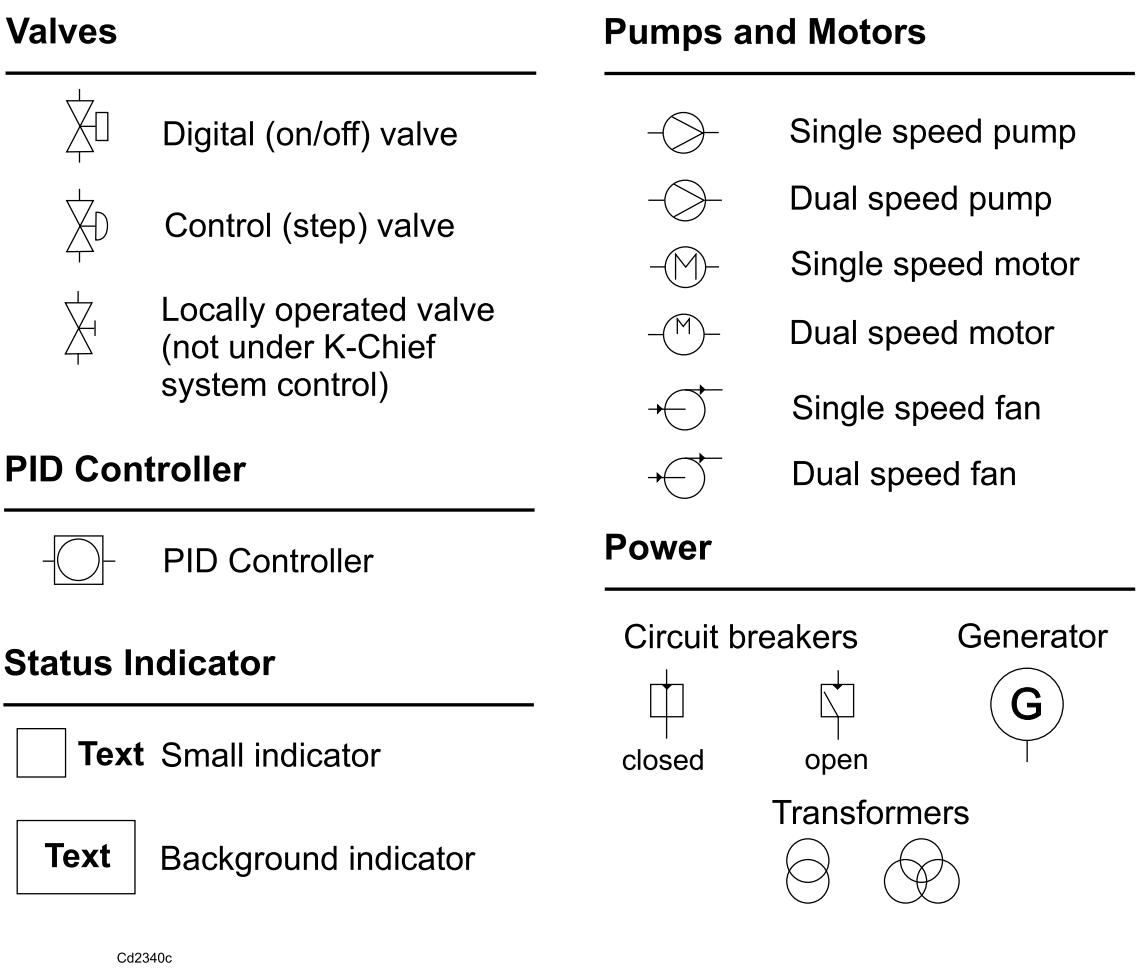
3.2.1 Interactive symbols

Interactive symbols are used to represent active elements in the process.

The nature of the interaction will vary according to the individual symbol's configuration.

Some of the most common interactive function module symbols used in K-Chief 700 are shown in the following figure.

Figure 19 Common interactive symbols



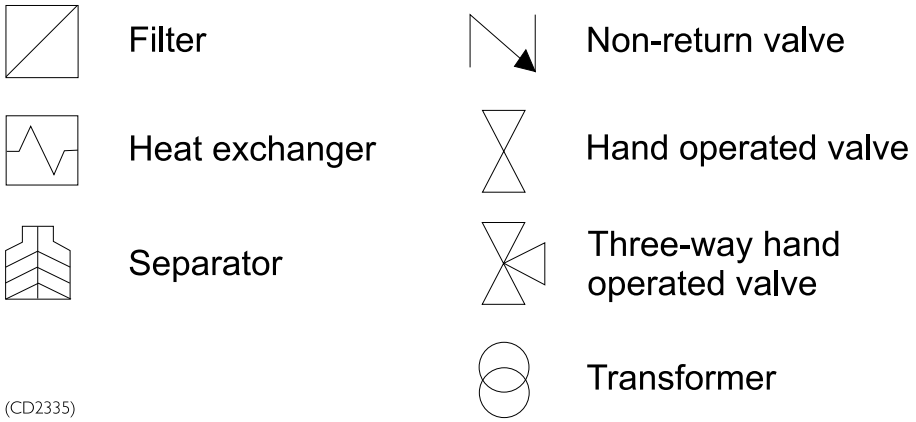
3.2.2 Static symbols

Static symbols are used to represent passive elements in the process such as heat exchangers and filters.

You cannot interact with static symbols.

Some common static function module symbols are shown in the following figure.

Figure 20 Common static symbols



3.3 Function module modes and status

Function modules can be operated in various modes.

The function module symbols show the operational mode and status using tag mark characters and changes in color and appearance.

Note

Note that all colours listed in this manual are standard colours and that a specific system can have different colours configured. Always consult your system's KFDD documentation for specific colour information.

3.3.1 Module mode indication

A tag mark character next to the function module symbol shows the mode. The characters used along with their typical corresponding colours are given in the following table.

Mode	Tag Mark Character	Tag Mark Colour
Manual mode	**m**	Blank space or white
Auto mode	**a**	Green
External	**e**	Cyan
Follow or Freeze mode	**f**	Cyan

Mode	Tag Mark Character	Tag Mark Colour
Interlocked	**I**	Cyan
Local mode	**L**	Cyan
Override	**o**	Cyan
Shutdown	**s**	Magenta

3.3.2 Module status indication

The status of a function module is shown by a small coloured square that is located close to, or inside, the module symbol. The various module states are given in the following table.

Module state	Indicator state
Unacknowledged alarm	Flashing indicator. The colour changes according to the alarm priority.
Acknowledged alarm	Continuously lit indicator. The colour changes according to the alarm priority.
Suppressed alarm	*Cyan* indicator.
Disabled alarm	*Olive* indicator.
Disabled input	*Olive* indicator.
Disabled output	*Olive* indicator.
Passive module (not active)	*Brown* indicator.

3.3.3 Process status indication

Process changes are shown in the process image by changing the colour of the module symbols. For example, the colour of a motor symbol is white when the motor stops. It flashes green when the motor starts and flashes white when the motor shuts down. The symbol becomes green when the motor runs and is fully operational.

More information about showing the module status using colours are given in other relevant sections.

Note

You can specify the process status colours that are used.

3.3.4 Pipe colour coding

The lines in images represent pipes carrying fluids and can be colour coded.

The standard colour coding is given in the following table.

Table 2 Standard pipe colour code

Pipe Colour	Fluid
Green	Water
Brown	Oil
Blue	Air
Yellow	Gas
Violet	Chemicals

3.3.5 Pipe/electrical line process change colour coding

As an option, lines representing electrical lines and pipes can be made to change colour to show a change in the process.

The standard colours used to show process change are listed in the following table.

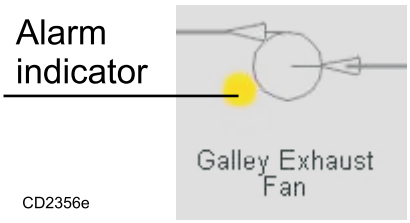
Table 3 Standard process change colour code

Process	Colour	Status
Power Plant	Light Grey	Bus bar dead
	Green	Bus bar live
Ballast System	Light Grey	No flow in the pipe
	Green	Flow in the pipe
Cargo System	Light Grey	No flow in the pipe
	Medium colour	Flow in the pipe

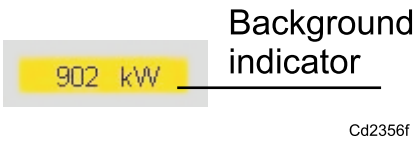
3.3.6 Alarm indicators

If an alarm condition occurs, the colour of the corresponding alarm indicator flashes until the alarm is acknowledged.

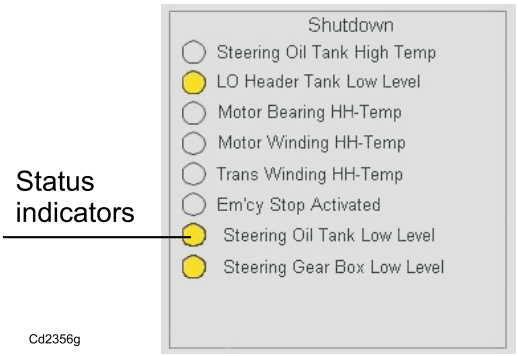
Alarms are shown in the process view as:



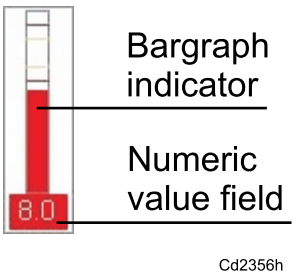
A circular alarm indicator next to a symbol.



The background colour of a numeric or text box.



A circle status indicator to the left of a label.



The colour of a bar graph indicator and the background colour of the numeric value box.

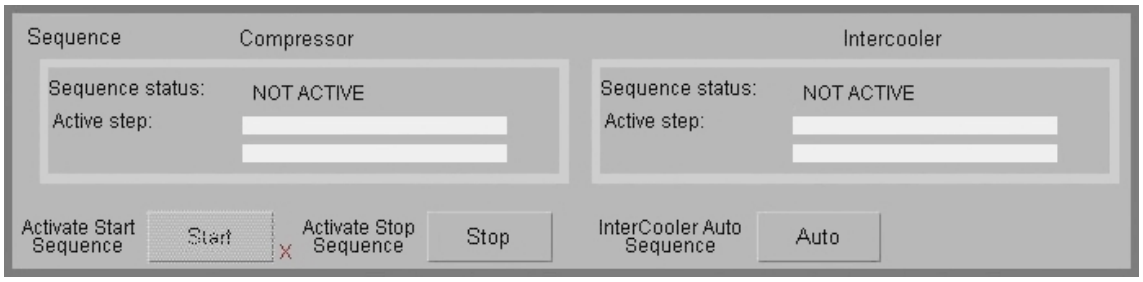
3.3.7 IAS SW button Interlock

Note

The availability of this function depends on your specific system's configuration

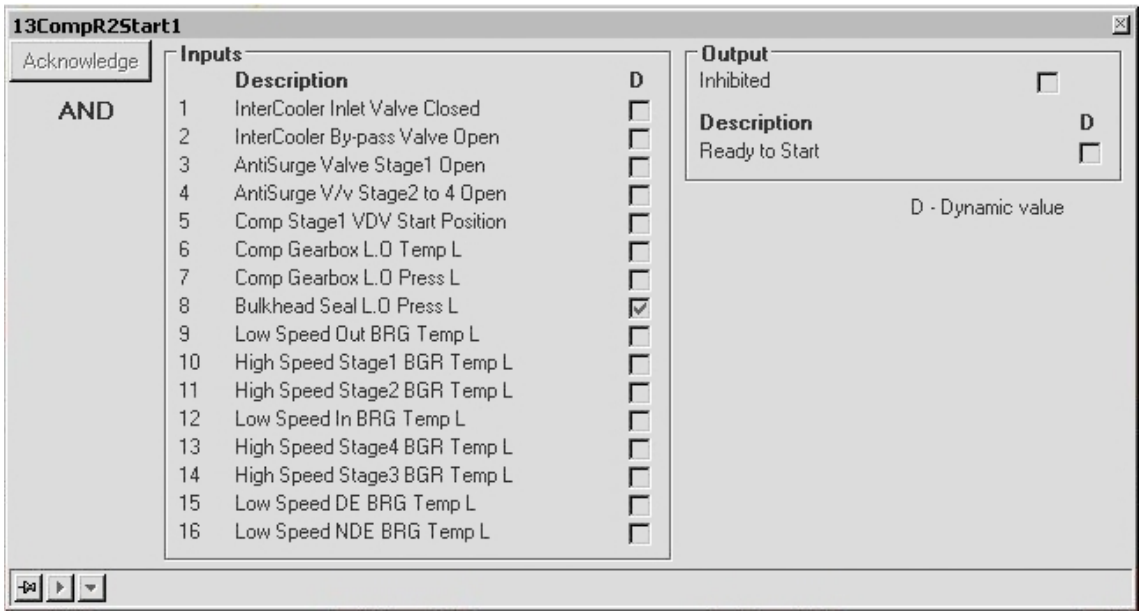
If any criteria for pushing a button is not fullfilled the button will be insenstitive to user input and greyed out. In this case a red **X** marking will appear next to the button to clearly indicate that the button is not available for operation.

Figure 21 IAS SW interlock button - example



By clicking on the red **X** a pop-up window with the interlock criteria will appear.

Figure 22 IAS SW button interlock popup with criteria - example



In the pop-up window all interlock criteria will be displayed with description and the criteria states will be indicated by a mark in the **D** (**Dyanmic**) column.

3.4 Different operation menu types

3.4.1 Operation menu

The module operation menu is used to operate function modules and the equipment they represent. The operation menu contains the commands that can be performed on the module.

The equipment tag name is shown in the module operation menu title bar.

Note

The operation menu may vary, depending on the software version of the function module.

Figure 23 Module operation menu - example

To open the operation menu:
Click the left trackball button when the cursor is over a function module symbol. Not all function modules have an operation menu. The menu layout is similar to the one shown in the figure.

All the operation menus contain the following buttons:

The **Acknowledge** button is enabled when there are unacknowledged active alarms for the function module. Click this button to acknowledge all active alarms for the module.

Click the **Pin** button to anchor the operation menu to a fixed location on the screen. Click it again to move the operator menu elsewhere.

The **Arrowhead right** and **Arrowhead down** buttons are used to expand the operation menu in the horizontal and vertical direction respectively. Not all operation menus can be expanded.

Figure 24 Horizontally expanded module operation menu - example

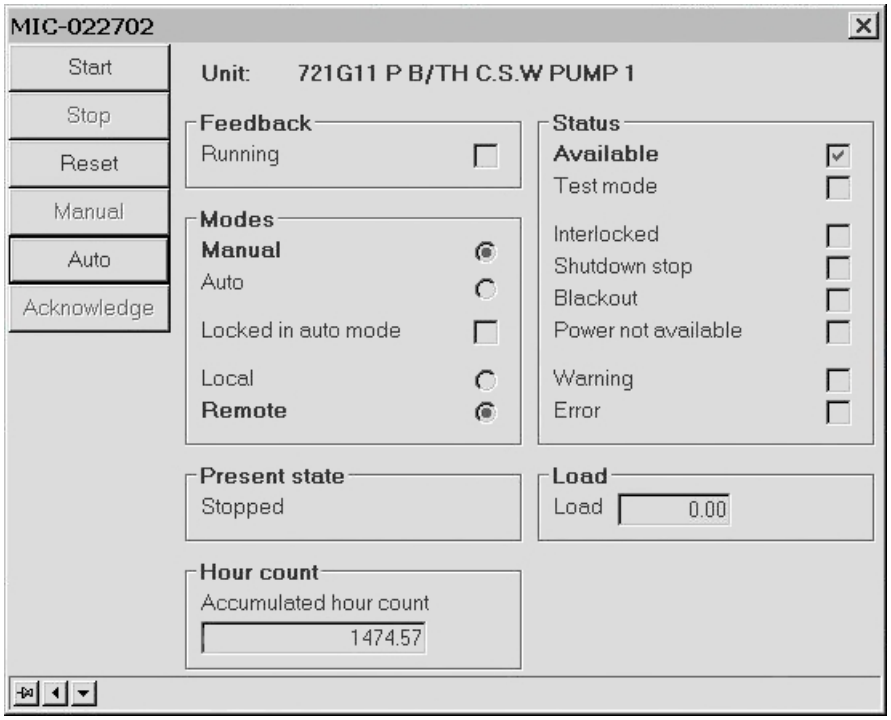
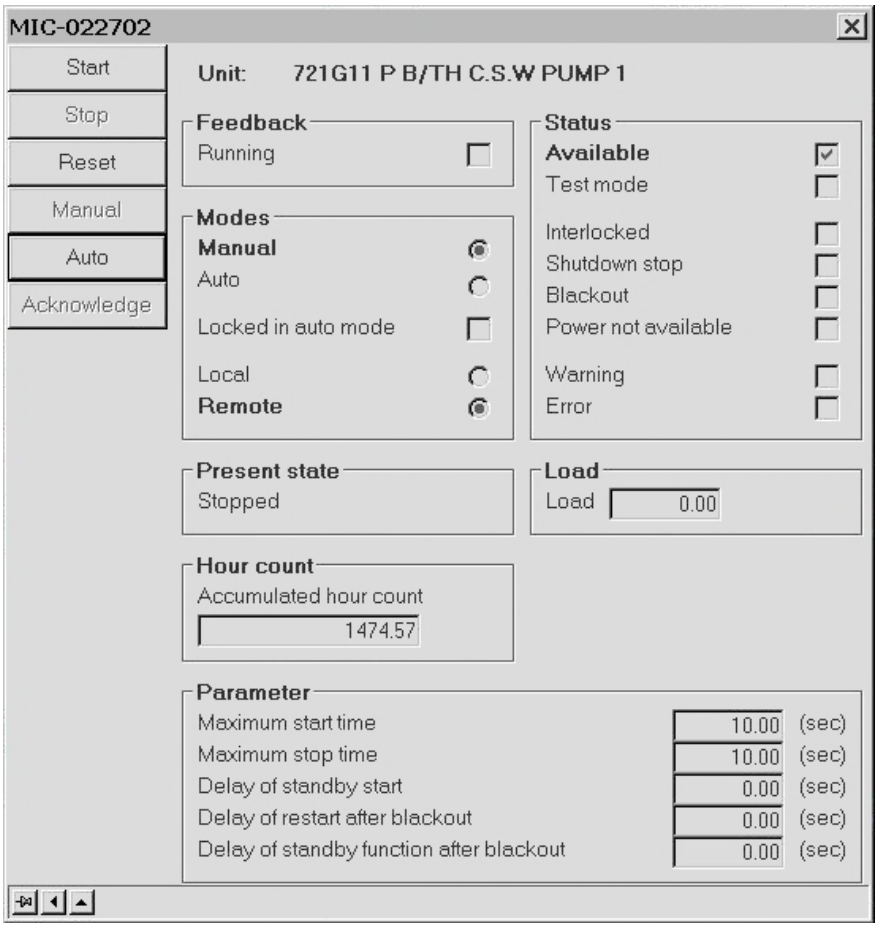


Figure 25 Vertically and horizontally expanded module operation menu - example



Disabled command buttons

Figure 26 Module operation menu with unavailable commands disabled

When a command cannot be operated due to the current equipment operational status the corresponding module operation menu command button is disabled.

For example, if a motor is controlled automatically, i.e. in the **Auto** mode, the stop and start commands are not available. The **STOP** and **START** buttons are disabled, as shown in the figure.

If you select the manual mode, by clicking the **MANUAL** button, the **STOP** and **START** buttons are enabled.

3.4.2 Context menu

In addition to the regular operation menu there is a **context menu** that allows you to access the function module settings and any other images in which the function module is configured.

There are two versions of the context menu - with or without the **Operate...** command. The **Operate...** command is available from the context menu in the cases where there is no access to the operation menu via the regular clicking the left trackball button.

To open the context menu:

Click the right trackball button when the cursor is over a function module symbol.

Examples of the two versions of the module context menus are shown in the following figures.

Figure 27 Module context menu - from a module

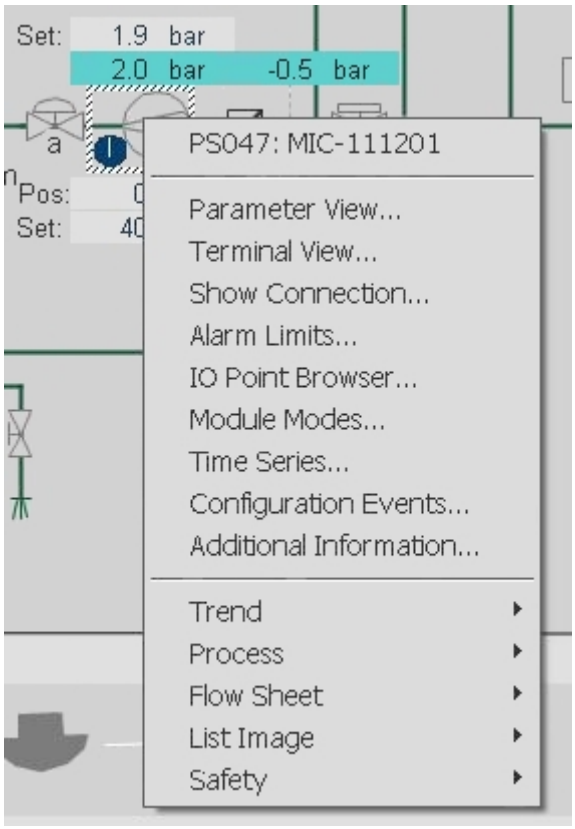
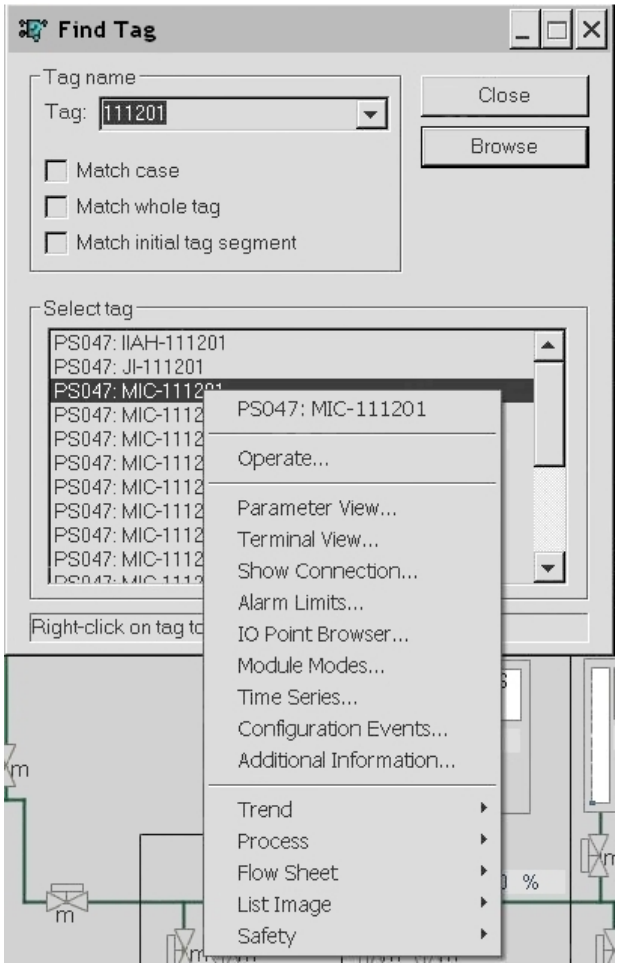


Figure 28 Module context menu - from a find tag list



Different commands are enabled in the menu depending on the selected function module and your user group.

If you log in as a member of the *Users* group, the `Alarm Limits` and `Module Status` commands are unavailable.

The available commands in these menus are given in the list below:

Operation

Operate

Shows the operation menu for the selected function module.

See the section *Operation menu* on page 43 for more information.

Properties

Parameter View

Allows you to view and change the configuration parameters of the selected function module.

See the **Module Editor** topic in the online AIM User Guide for more information.

Terminal View

Allows you to view and change the signal values for the terminals of the selected function module.

See the **Flow system** topic in the online AIM User Guide for more information.

Show Connection

Allows you to view and trace the connections to and from the function module input and output terminals.

See the **Show connections** topic in the online AIM User Guide for more information.

Alarm Limits

Allows you to view and change the alarm limits for the terminals of the selected function module.

You can change alarm limits only if you are logged in as an authorised user. See the **Alarm Limits** topic in the online AIM User Guide for more information.

IO Point Browser

Allows you to gather and display information on any IO point related to the browse criteria entered on the selected station.

See the **IO system** topic in the online AIM User Guide for more information.

Module Modes

Allows you to view and change the operational mode of the function module.

You can change the operational mode only if you are logged in as an authorised user. See the **Module Editor** topic in the online AIM User Guide for more information.

Time Series

Allows you to display, create, delete and edit time series from a function module terminal, or log-variable of a function module running in a FS.

See the **Time series** topic in the online AIM User Guide for more information.

Configuration Events

Allows you to view events generated by changes to the configuration of the selected function module.

See the **Event system** and **Version control** topics in the online AIM User Guide for more information.

Additional information

Displays the software **Module User Manual** (MUM) for the function module.

Navigation

Trend

Displays, if available, a submenu containing the names of the trend images that are linked to the selected function module.

See the **Trend system** topic in the online AIM User Guide for more information.

Process

Displays, if available, a submenu containing the names of the process images that are linked to the selected function module.

Flow Sheet

Displays the flow sheet image linked to the selected function module.

See the **Flow system** topic in the online AIM User Guide for more information.

List Image

Displays the list image linked to the selected function module.

Safety

Displays the safety image linked to selected function module.

3.4.3 Operation menu buttons

There are two types of operation menu buttons:

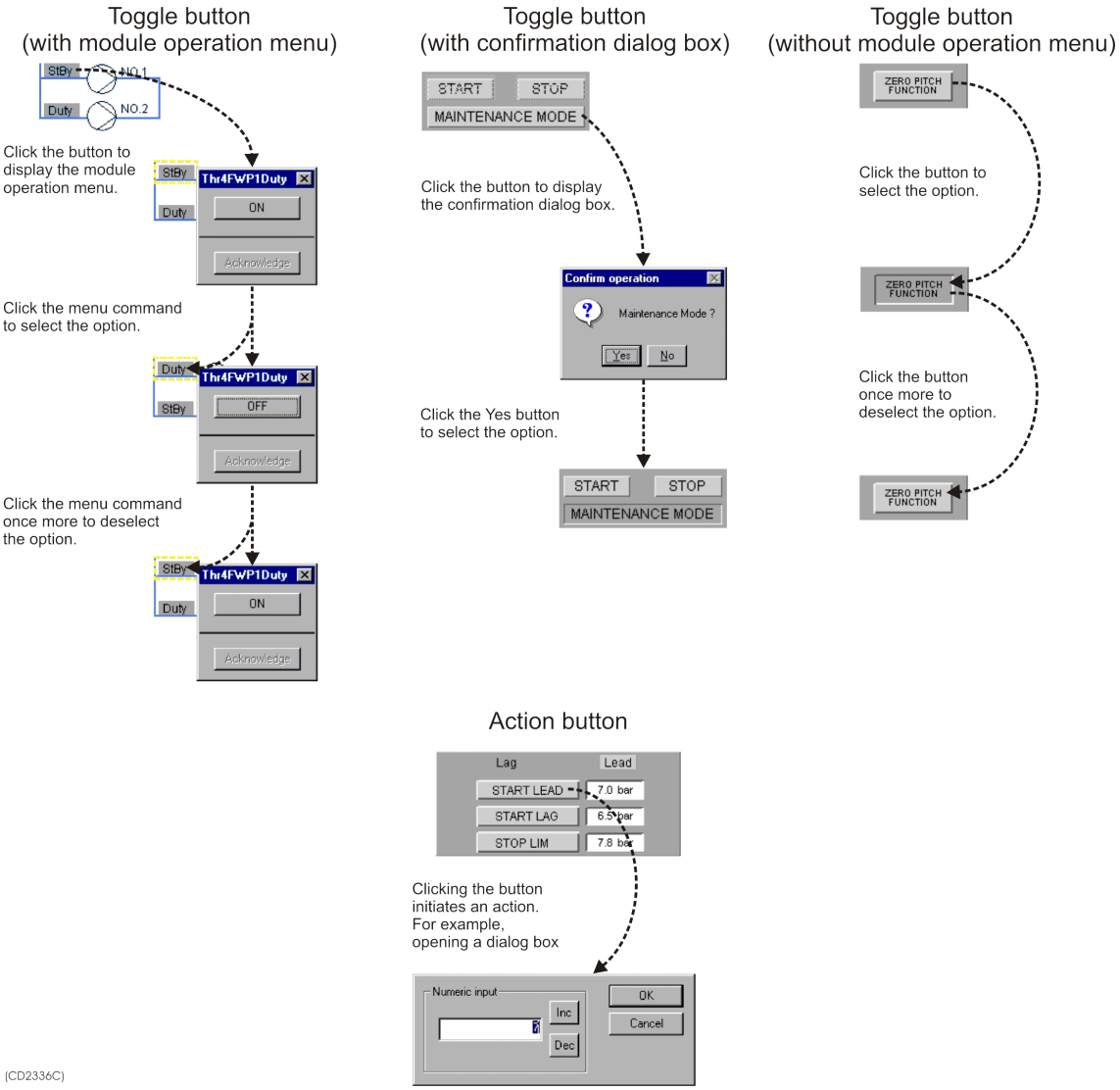
- **Toggle** button which selects or cancels an option.
- **Action** button which performs an action when you click it.

The toggle button may or may not, depending on the configuration, have an operation menu.

The action button does not have an operation menu.

The operation of these buttons is shown in the following figure.

Figure 29 Operation of Toggle and Action buttons



3.5 Analogue measurements modules

Analogue measurements are widely used in K-Chief 700.

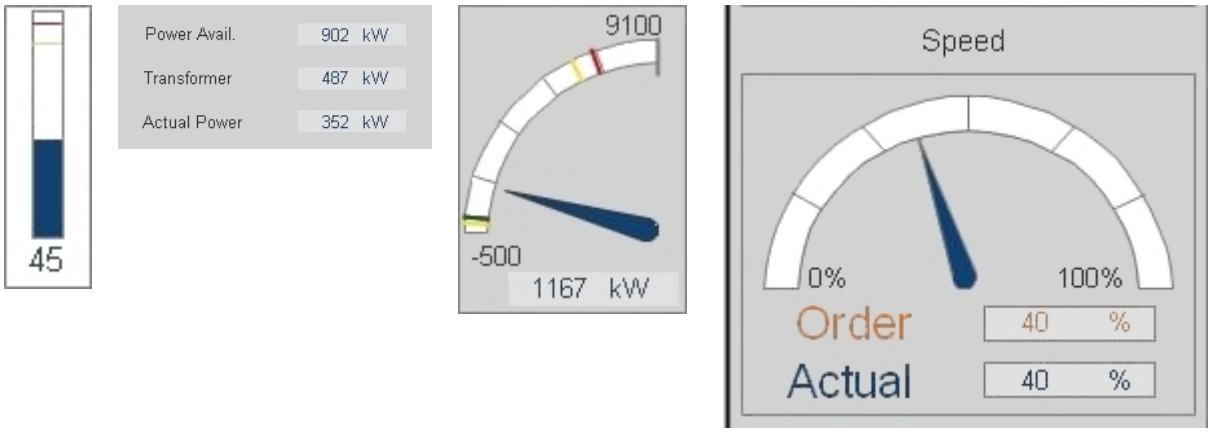
These modules are used to display measured analogue process values such as temperatures, pressures, power consumption and setpoints.

They can be shown in a number of ways such as a simple numeric field displaying a single value, or a multiple bar chart showing the deviation from a mean value.

3.5.1 Analogue measurement module symbols

The following figure shows some ways in which analogue measurements are displayed.

Figure 30 Analogue measurement symbols



3.5.2 Analogue measurement module status indication

If the signal limit function is inhibited or alarm suppression is enabled, the numeric value box is *cyan* in colour. This box can also show an alarm status.

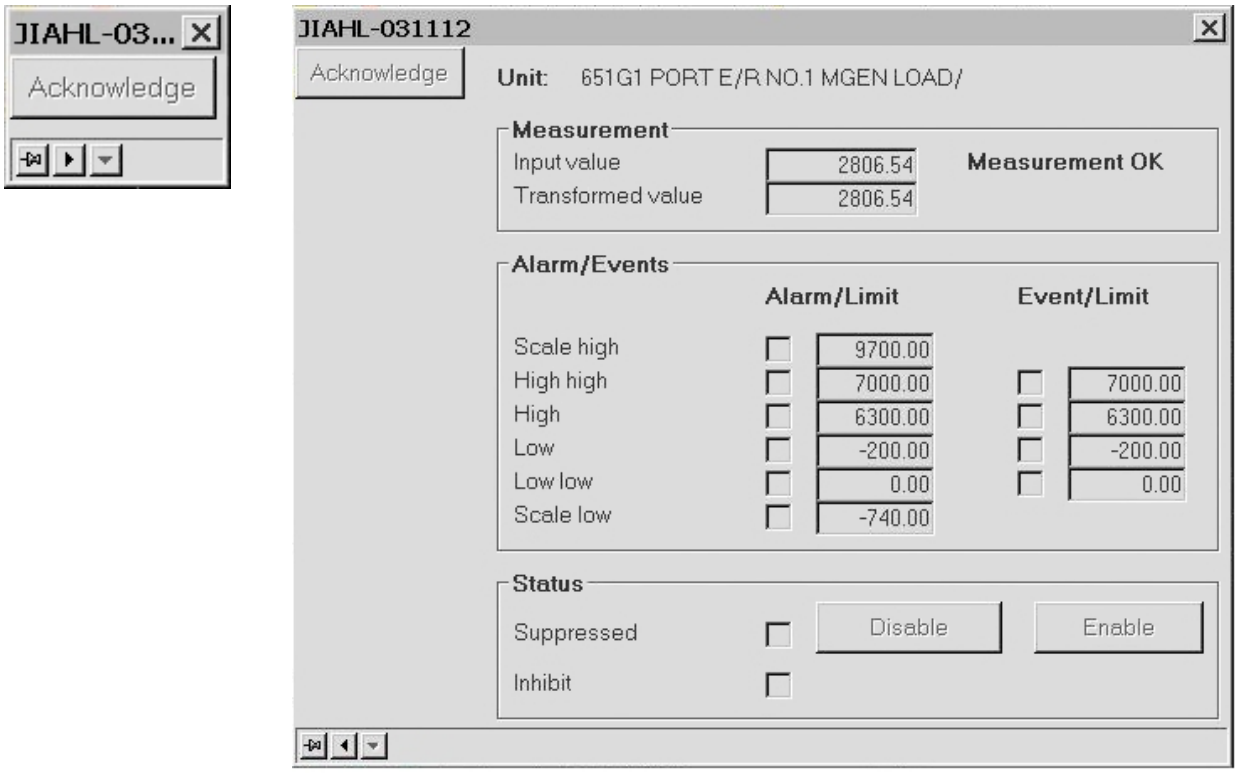
3.5.3 Analogue measurement module operation menu

Note

The operation menu varies according to the software version of the function module.

The following figure shows an example of the analogue measurement module operation menu.

Figure 31 Analogue measurements operation menu



Click the command buttons to **Enable** or **Disable** the alarm suppression function. When you disable the alarm suppression, it is automatically enabled again after 10 minutes.

3.5.4 Analogue measurement module configuration options

One or more of the following functions can be added to the analogue measurement modules.

- Input signal limits
- Alarm suppression
- IO failure
- Event generation.

You can view and change the status of these functions using the module shortcut menu commands. See the section *Context menu* on page 46.

Module functions	Description
Input signal limits	Analogue measurement modules have the following limits for the input signals: • High High • High • Low • Low Low If these limits are exceeded, digital limit signals are given. The input signal limits can be individually enabled or disabled.
Alarm suppression	Analogue measurement modules have an alarm suppression function that can be activated and reset by other modules. It is normally used to prevent alarms being given by equipment that is not operational. The reset for this function can be delayed. You can specify the duration of the delay. See the **Event system** and **Alarms and messages** topics in the online AIM User Guide for more information.
IO failure	When an IO failure is registered, an error handler controls the value shown in the numeric value field, which is then either: • Frozen at the last legal input value (default) or • Corrected to a fixed value, which you specify or • The input value, the IO failure status is ignored. See the **IO system** and **Alarms and messages** topics in the online AIM User Guide for more information.
Event generation	Analogue measurement modules generate an event whenever the input value increases above the limit, or an IO failure occurs. See the **Event system** topic in the online AIM User Guide for more information.

3.6 Digital measurement modules

Digital measurement modules are usually used to indicate digital alarms. They can also be used to indicate the status of equipment such as pumps, motors, valves and switches.

3.6.1 Digital measurement module symbol

The following figure shows an example of a digital measurement module.

Figure 32 Digital measurement module symbol

A digital measurement module can also be shown as a symbol that changes colour to give the status. See the section *Process status indication* on page 40.

3.6.2 Digital measurement module status indication

When a digital measurement module is inhibited, or alarm suppression is enabled, the status indicator colour in the module symbol is *Cyan*.

3.6.3 Digital measurement module operation menu

Note

The operation menu varies according to the software version of the function module.

The commands in the operation menu are shown in the example on the left.

The command buttons let you:

- Test the value and give the digital measurement status to show in the process image. The function module and the field station must be in the simulation mode. See the **Module Editor** topic in the online AIM User Guide for more information.
- Toggle the module inhibit function on or off. When the module operation menu is open, the button text shows the condition that can be selected.

3.6.4 Digital measurement module configuration options

One or more of the following functions can be enabled for the digital measurement modules:

- Alarm delay
- Alarm suppression
- Text string
- Module inhibit.

You can view and change the status of these functions using the commands in the module shortcut menu. See the section *Context menu* on page 46.

Module functions	Description
Alarm delay	Digital measurement modules have an alarm delay to prevent short-duration signal changes from generating alarms. You can specify the duration of the delay.
Alarm suppression	Digital measurement modules have an alarm suppression function that is enabled or disabled by other modules. The reset for this function can be delayed. You can specify the duration of the delay. See the **Event system** and **Alarms and messages** topics in the online AIM User Guide for more information.
Text string	Digital measurement modules can display one of two text strings. You can specify the text strings. The text string is displayed according to the logical state of the module's output signal.
Module inhibit	You can use the **INHIBIT ON/INHIBIT OFF** button in the operation menu to toggle the module inhibit function. The inhibit can also be toggled by other function modules.

3.7 Pulse measurement modules

Pulse measurement modules are used to read pulse signals and calculate accumulated values and frequency. These modules are used to read pulse signals for applications such as engine speed or fluid flow. They can also be used to read other analogue measurements and count running hours.

Accumulated values are calculated on raw input, and total accumulated values are calculated from the previous reset. Last day and last hour values are calculated for both the current day and hour, and previous day and hour.

3.7.1 Pulse measurement module symbol

The following example shows the display of a pulse measurement module.

Figure 33 Pulse measurement module

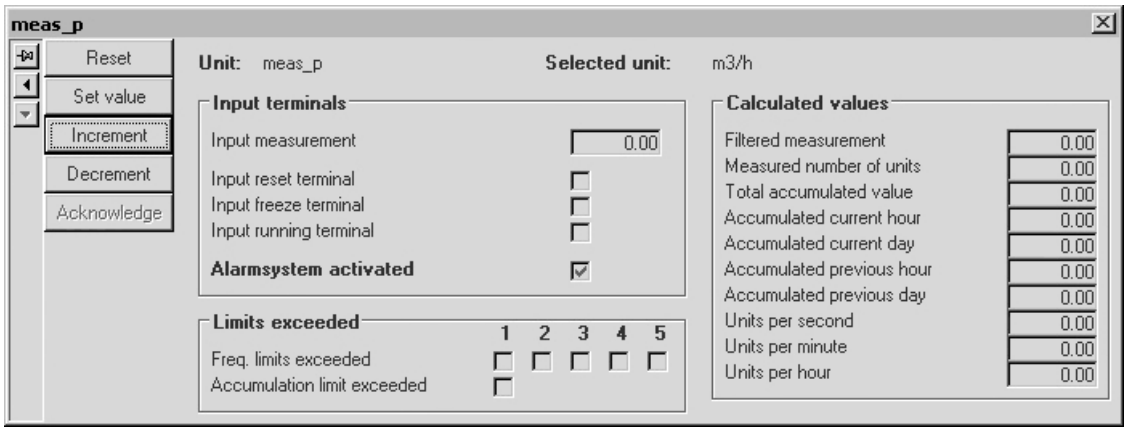
3.7.2 Pulse measurement module operation menu

Note

The operation menu varies according to the software version of the function module.

The pulse measurement module operation menu commands are shown in the figure below.

Figure 34 Pulse measurements operation menu



The command buttons are given in the following list:

Reset

Reset the accumulated value to zero.

Set value

Give a value to the function module. The value is given from the numeric input dialog box.

The command is only available in the manual mode.

Increment

Increase the total accumulated value by 1.

Decrement

Decrease the total accumulated value by 1.

3.7.3 Pulse measurement module configuration options

One or more of the following functions can be enabled for the pulse measurement modules:

- Pulse counting
- Block operation
- Count running hours.

You can view and change the status of these functions using the commands in the module shortcut menu. See the section *Context menu* on page 46.

Module functions	Description
Pulse counting	Pulse measurement control modules read pulse signals from modules such as for example the RDIOR4xx. The number of pulses for each sample is filtered and the frequency calculated. The number of pulses per unit, gain and bias are used to calculate the number of units per sample. The frequency is expressed in the number of units per second, minute and hour, based on a filtered value. The frequency is also compared with five different limits, and if any of these limits are exceeded over a specified period, a corresponding digital output is set to 1.
Block operation	The operation menu commands can be blocked. If this option is selected the **RESET**, **INCREMENT** and **DECREMENT** command buttons in the operation menu become unavailable. The **SET VALUE** command is disabled.
Count running hours	Pulse measurement modules count running hours when the input value is set to either 1.0 or 0.0. This depends on whether or not the system is running. The pulse per unit is set to 3600, the gain is set to 1 and the module cycle time is set to 1 second.

3.8 Motor and pump control modules

All the motors and pumps are controlled by function modules. These modules can control single- and dual-speed electrical motors and pumps, and hydraulically-driven pumps. The function modules are interfaced to the local starter panel of their respective motor or pump.

The motor and pump control modules can perform the following basic functions:

- Auto and manual control
- Local or remote control
- Control logic interlocking
- Power demand
- Standby start
- Restart after blackout and shutdown.

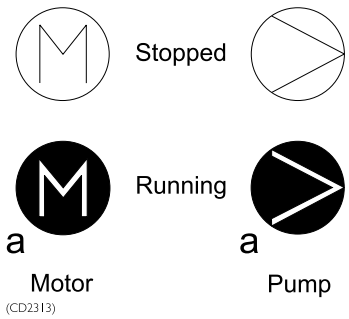
3.8.1 Motor and pump control module symbols

A Motor/pump control function module is shown as a symbol and a tag mark character, which gives the current operational mode.

3.8.1.1 Single speed electrical motor/pump symbols

The symbols for single speed electrical motor and pump modules are shown in the following figure:

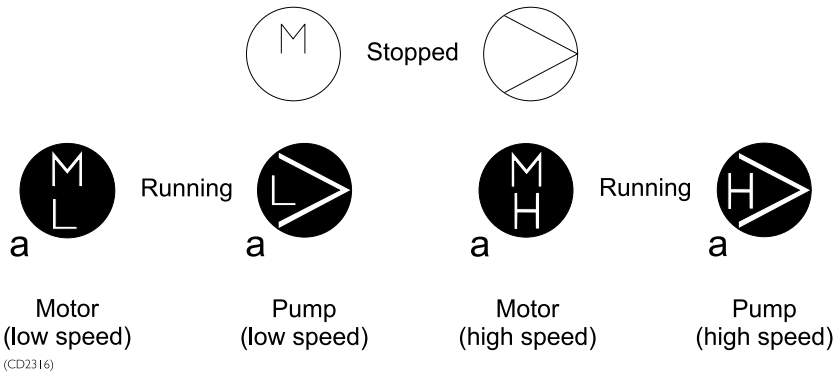
Figure 35 Single speed electrical motor/pump module symbols



3.8.1.2 Dual speed electrical motor/pump symbols

The symbols for dual speed electrical motor and pump modules are shown in the following figure.

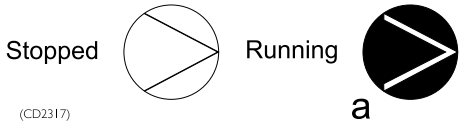
Figure 36 Dual speed electrical motor/pump module symbols



3.8.1.3 Hydraulic-driven pump symbol

The symbols for hydraulic-driven pump modules are shown in the following figure:

Figure 37 Hydraulic-driven pump module symbols



3.8.2 Motor/pump control module status indication

The operational status of a motor or pump is shown by the colour of the function module symbol.

The colours used to show the operational status of a motor or pump are given in the table below.

Colour	Operational status
Green	The motor or pump is running.
White	The motor or pump is stopped.
Flashing green	The motor or pump is starting.
Flashing white	The motor or pump is stopping.

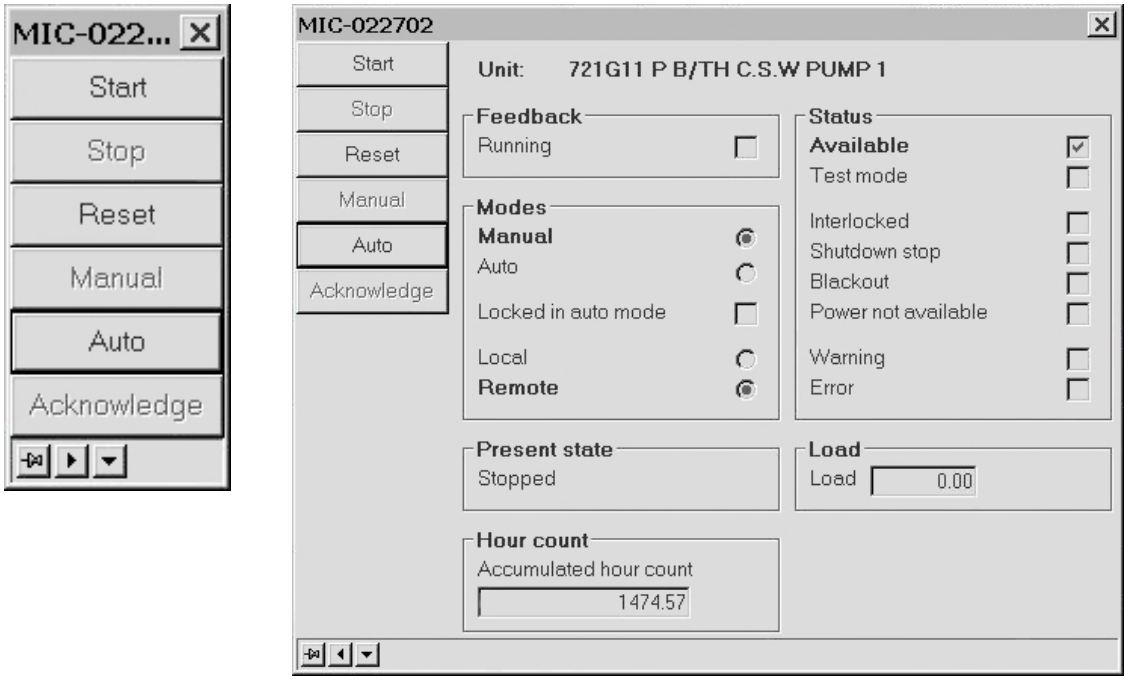
3.8.3 Single speed electrical motor/pump operation menu

Note

The operation menu varies according to the software version of the function module.

The following figure shows the operation menu commands.

Figure 38 Single speed electrical motor/pump operation menu



The command buttons are given in the following list:

Start

Click this command button to start a motor or pump.

Stop

Click this command button to stop a motor or pump.

The `START` and `STOP` commands can also be used to cancel a start or stop operation. These commands are only available in the *Manual* mode.

Reset

Click this command button to reset the applicable timeout counters in order to recover from failed start or stop operations.

Automatic

Click this command button to select the *Automatic* mode for the motor or pump.

Manual

Click this command button to select the *Manual* mode for the motor or pump.

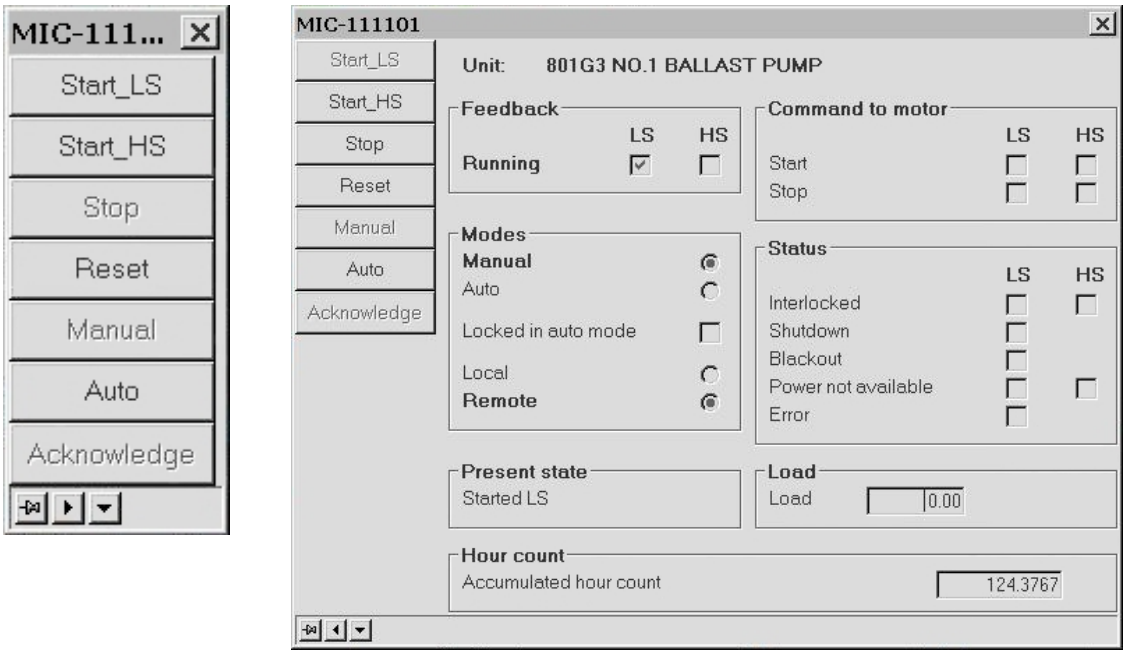
3.8.4 Dual speed electrical motor/pump operation menu

Note

The operation menu varies according to the software version of the function module.

The following figure shows the operation menu command buttons.

Figure 39 Dual speed electrical motor/pump operation menu



The command buttons are given in the following list.

Start_LS

This command button starts a pump or motor in low speed.

Start_HS

This command button starts a pump or motor in high speed.

If the motor or pump is already running, you can use the commands to change the speed. For example, you can click the **Start_LS** button to slow down a motor running at high speed. These commands are only available in the manual mode.

Stop

Click this button to stop a running motor/pump, or cancel a start operation. The command is only available in the *Manual* mode.

Reset

Click this button to reset the applicable timeout counters, to recover from failed start or stop operations.

Manual

Click this button to select the manual mode for the motor/pump.

Auto

Click this button to select the automatic mode for the motor/pump.

3.8.5 Hydraulically-driven pump operation menu

Note

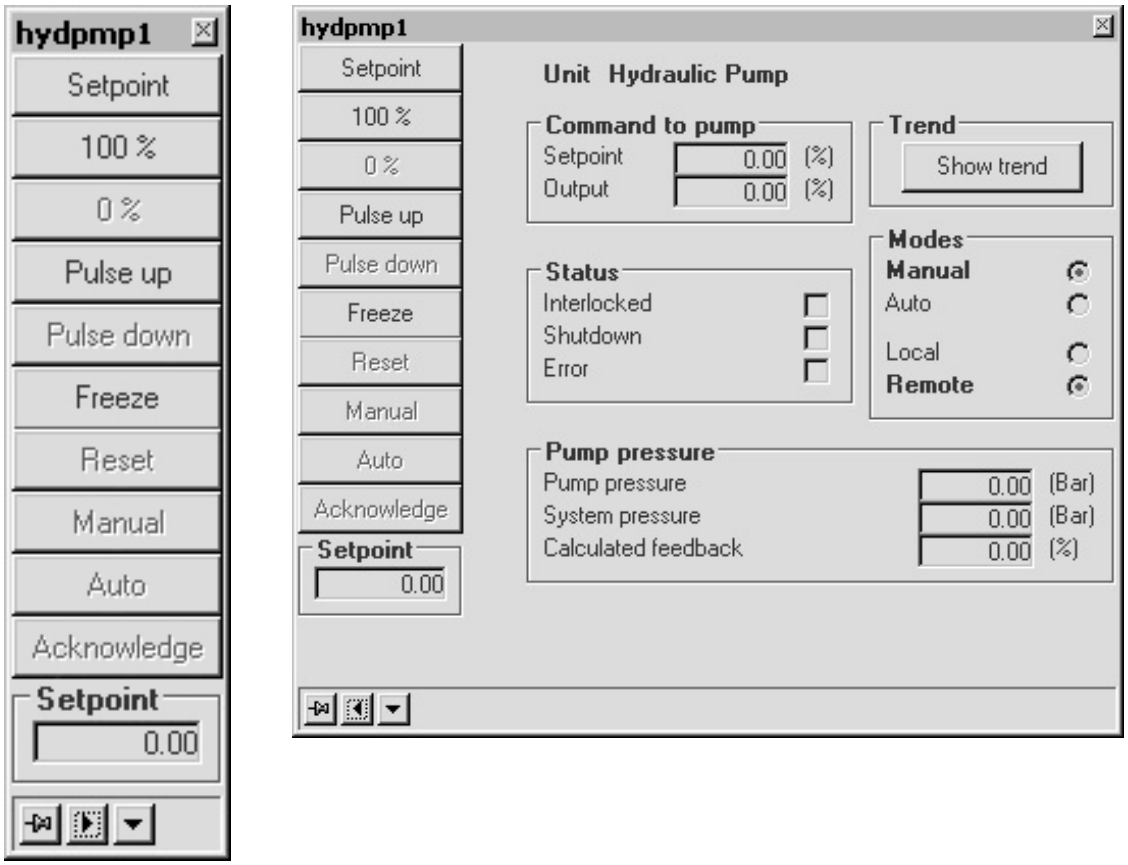
The speed of a hydraulically-driven pump is controlled using a regulator valve to adjust the hydraulic pressure.

Note

The operation menu varies according to the software version of the function module.

The operation menu commands for a hydraulically-driven pump are shown in the following figure.

Figure 40 Hydraulic-driven pump operation menu



The command buttons are given in the following list:

Setpoint

Click this button to decrease or increase the setpoint (control signal) for the valve that regulates the hydraulic pressure to the motor. The setpoint can range from 0% to 100%. This causes the valve to fully close or fully open, decreasing or increasing the hydraulic pressure, to stop or run the pump. The setpoint can also specify the operating speed of the pump. These commands have no effect on a stopped hydraulic pump. They are only available in the Manual mode.

100%

Click this button to set the setpoint to 100%.

0%

Click this button to set the setpoint to 0%.

Pulse up

Click this button to increase the setpoint.

Pulse down

Click this button to decrease the setpoint.

Freeze

Click this button to lock the setpoint at its present value. The command is only available in the Manual mode. applicable time-out counters.

Reset

Click this button to reset the applicable time-out counters after a failed start or stop operation.

Manual

Click this button to select the manual operation mode.

Auto

Click this button to select the automatic operation mode.

3.8.6 Motor and pump modules configuration options

One or more of the following functions can be enabled for the hydraulically-driven motor or pump control modules:

- Control logic interlocks
- Local/Remote mode
- Power demand
- Standby start
- Blackout restart
- Shutdown.

You can view and change the status of these functions using the module shortcut menu; see section *Context menu* on page 46.

Module functions	Description
Control logic interlocks	All motor/pump control modules have interlocks to prevent damage to the motor/pump. The interlock functions are: • Inhibit the **Stop** command when the interlock condition occurs • Inhibit the **Start** command when the interlock condition occurs • Execute the **Stop** command when the interlock condition occurs • Execute the **Start** command when the interlock condition occurs. For hydraulic pumps, the interlock functions are: • Inhibit all commands when the interlock condition occurs.
Local/Remote mode	All motor/pump control modules can be put in *Local* or *Remote* mode. In the *Local* mode, you control the motor or pump from the local panel. In the *Remote* mode, it is controlled by K-Chief 700. You can change between local and remote control from the local panel.
Power demand	Both types of electrical motor/pump control module have a power interlock function. This prevents the motor/pump from starting if there is insufficient power available. This function is only used for major consumers.
Standby start	Both types of electrical motor/pump control module have a standby start function. This allows for specifying a duty/standby sequence with up to a maximum of four electrical motors/pumps. A standby motor/pump can be started as follows: • In the *Manual* mode. It will continue to run when put into the *Automatic* mode. • Automatically, if another pump in the sequence stops due to a failure. • Automatically, if a specific condition occurs. For example, a pressure switch can be used to start up additional pumps if the lubrication oil pressure for a generator is low.

Module functions	Description
Blackout restart	Both types of electrical motor control module have a blackout restart function. This automatically restarts a motor that stopped because of a blackout, when power becomes available. You can specify a delay for the motors that start, to prevent many motors starting simultaneously.
Shutdown	All motor/pump control modules have a shutdown function. It overrides all other control inputs and performs an emergency stop.

3.8.7 Duty/Standby configuration

Motor/pump control modules can be connected in either one of two duty/standby configurations.

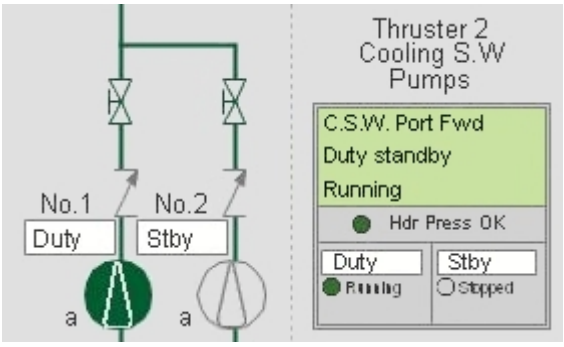
One configuration uses the *Standby start* function. See the **Standby start** table entry in *Motor and pump modules configuration options* on page 62.

The duty motor/pump is in the *Manual* mode and the standby motor/pump is in the *Automatic* mode. The duty motor/pump is manually started. The standby motor/pump automatically starts when additional capacity is necessary. This happens, for example, when the discharge pressure of a duty pump decreases below a set limit.

You can also operate the motors/pumps in the *Automatic* mode. You can select the duty/standby mode by clicking the toggle buttons.

The following figure shows two single speed pumps in a duty/standby configuration.

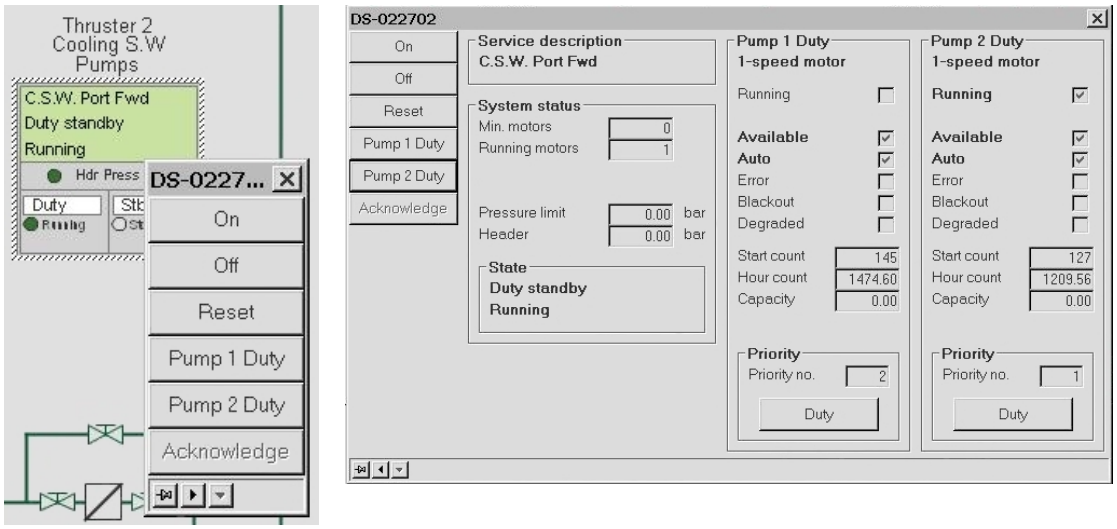
Figure 41 Two single speed electrical pumps in a redundant configuration



Operation menu

The duty/standby system can be started and stopped from either the operation menu or by configured logic.

Figure 42 Duty/Standby operation menu



The command buttons are given in the following list:

On

Clicking this button starts the system.

When system start is activated all available motors/pumps will be set in auto mode and duty motor/pump will start up.

Off

Clicking this buttons stops the system; all running motors/pumps will be stopped.

Reset

Clicking this button resets the system.

Pump 1 Duty

Clicking this button sets motor/pump no. 1 to priority no. 1.

Pump 2 Duty

Clicking this button sets motor/pump no. 2 to priority no. 1.

3.9 Valve control modules

Valve control modules are used to control valves. The basic module functions are:

- Auto/manual control
- Local/remote control
- Control logic interlocking
- Shutdown.

3.9.1 Valve module symbols

The valve control module is represented by the valve symbol. A tag mark character shows the operational mode. A number below the tag mark either gives the position of the valve or the setpoint of the valve as a percentage.

Symbols for the most commonly used valves:

Figure 43 Control and throttle valve module symbols

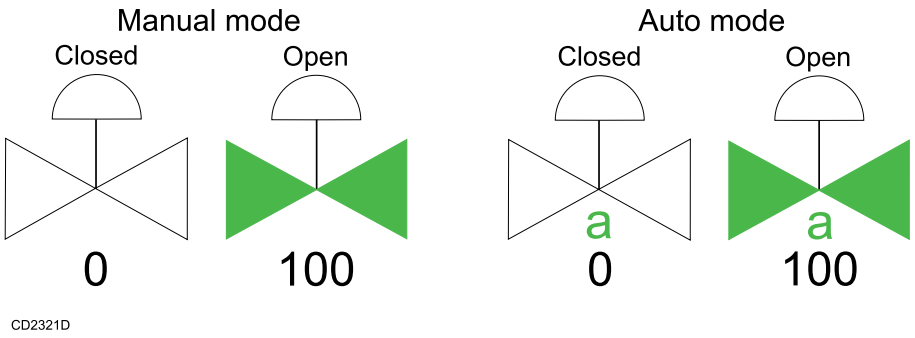
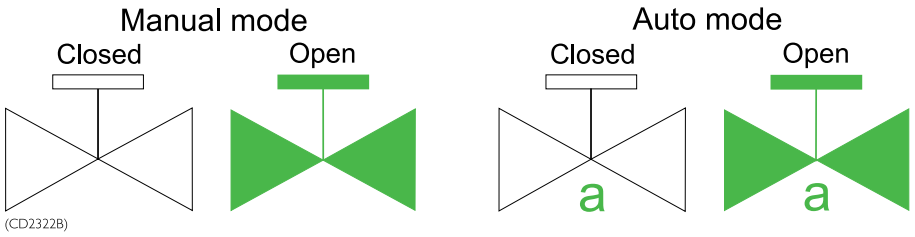


Figure 44 On/off valve module symbols



3.9.2 Valve module status indication

The operational status of a valve is shown by the symbol colour. The colours are given in the table below.

Colour	Mode
Green	The valve is open.
Flashing green	The valve is opening.
Flashing white	The valve is closing.
White	The valve is closed.

3.9.3 Control valve operation menu

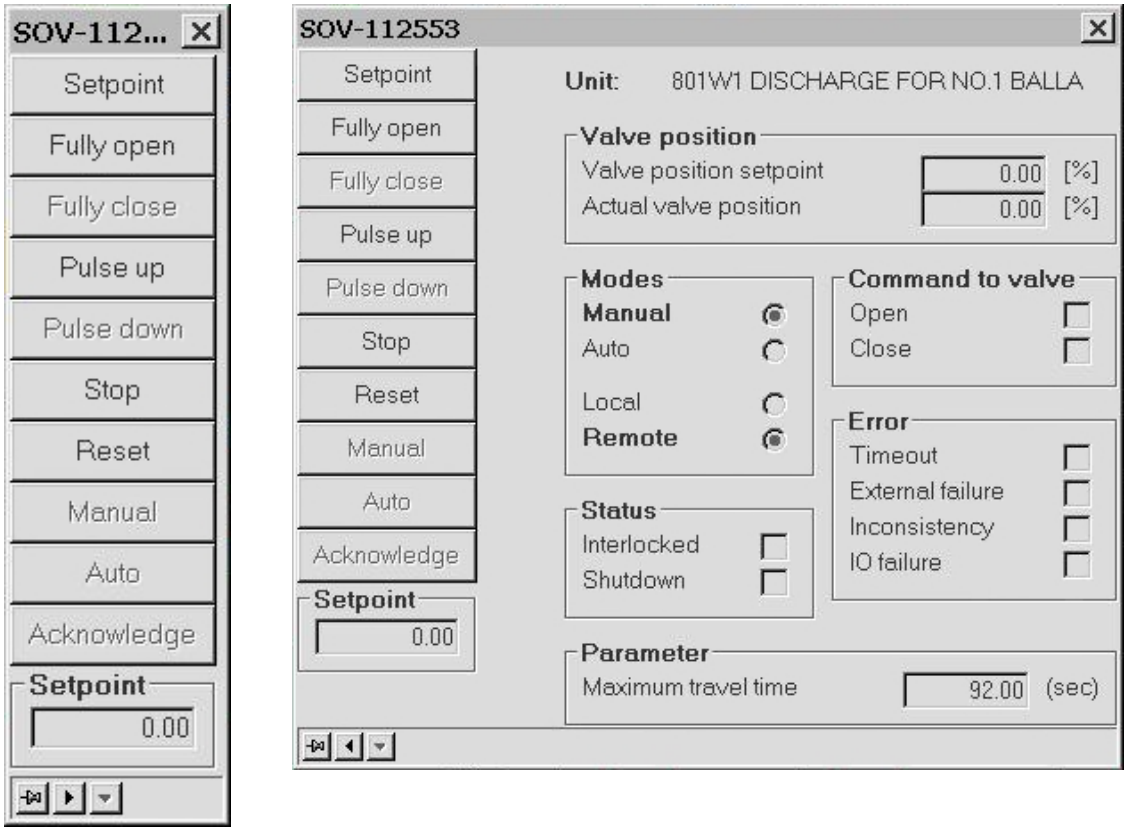
Note

The operation menu varies according to the software version of the function module.

A pneumatically operated valve is a type of control valve.

An example of control valve operation menu commands is shown in the following figure.

Figure 45 Control valve operation menu



The command buttons are given in the following list.

Setpoint

Lets you give the setpoint position for the valve.

You give the setpoint from the **Numeric input** dialog box. The command is only available in the **Manual** mode.

Fully Open

Fully opens the valve (100%).

This command can be used to cancel a close operation. It is only available in the **Manual** mode.

Fully Close

Fully closes the valve (0%).

Pulse up

Increase the setpoint by a predefined value, when the valve is in the **Automatic** mode.

When the Control valve is in the **Manual** mode, this commands increases the output value.

Pulse down

Decrease the setpoint by a predefined value, when the valve is in the **Automatic** mode.

When the Control valve is in the **Manual** mode, this commands decreases the output value.

Stop

Immediately stops the operation of the valve.

The command is only available in the **Manual** mode.

Reset

Reset the applicable time-out counters.

Use this button to reset the time-out counter after a failed start or stop.

Manual

Place the valve under manual control.

Auto

Place the valve under automatic control.

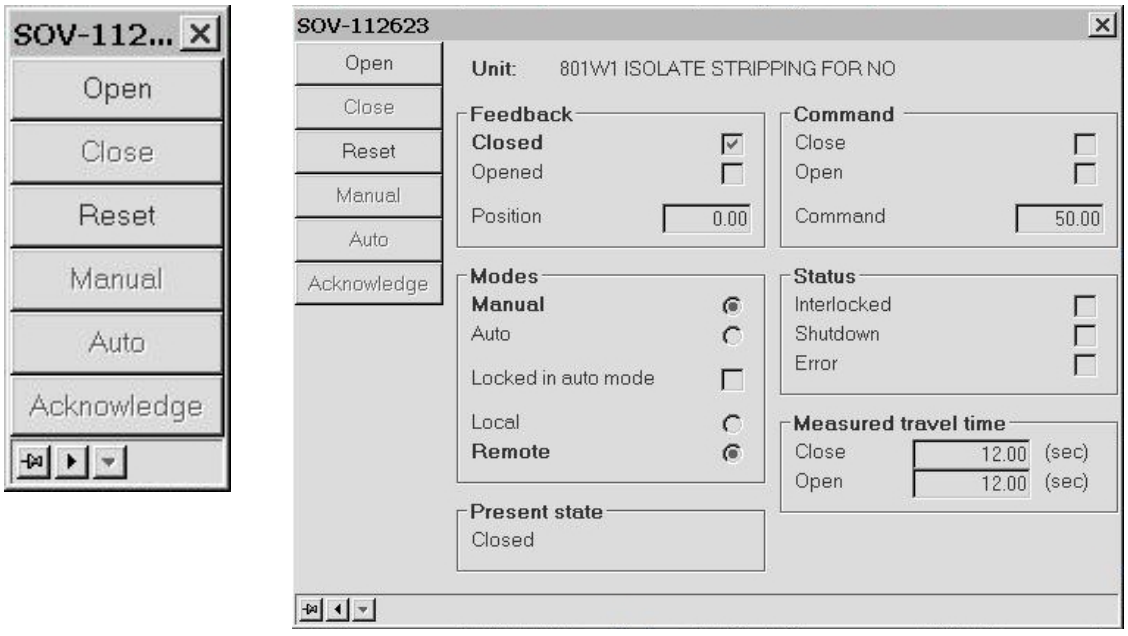
3.9.4 On/off valve operation menu

Note

The operation menu varies according to the software version of the function module.

An example of on/off valve operation menu commands is shown in the following figure.

Figure 46 On/off valve operation menu



The command buttons are given in the following list.

Open

Fully opens the valve.

This command can be used to cancel a close operation. It is only available in the **Manual** mode.

Close

Fully closes the valve.

This command can be used to cancel an open operation. It is only available in the **Manual** mode.

Reset

Reset the applicable time-out counters.

Use this button to reset the time-out counter

Manual

Place the valve under manual control.

Auto

Place the valve under automatic control.

3.9.5 Valve control module configuration options

One or more of the following functions can be enabled for the valve control modules:

- Control logic interlocks
- Local/Remote mode
- Shutdown.

The status of these functions can be viewed and changed using the commands on the module shortcut menu (See section *Context menu* on page 46) that gives you access to the module setup facilities.

Module functions	Description
Control logic interlocks	All valve control modules have interlocks to prevent damage to the valve. The interlock functions are: • Inhibit the **Close** command when the interlock condition occurs • Inhibit the **Open** command when the interlock condition occurs • Execute the **Close** command when the interlock condition occurs • Execute the **Open** command when the interlock condition occurs.

Module functions	Description
Local/Remote mode	You can set any valve in **Local** or **Remote** mode. In the **Local** mode, you control the valve from a local panel. In the **Remote** mode, K-Chief 700 controls the valve. You can change the mode from the local panel.
Shutdown	The shutdown function closes the valve. It overrides all other commands to the function module. This function is used to close the valve in an emergency.

3.10 PID controller modules

The proportional integral derivative (PID) controller is a function module that controls various process equipment, e.g. temperature, level, flow and pressure control of various systems.

The PID controller can be used in various ways in a number of systems. The list below show a few examples:

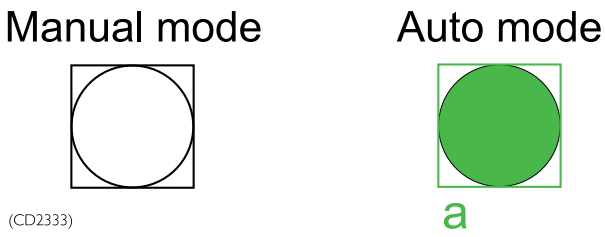
- Temperature control in lubrication oil systems
- Temperature control in water cooling systems
- Temperature control of heavy fuel oil supplied to main and auxiliary engines
- Temperature control of fuel oil storage and cargo tanks
- Viscosity control of heavy fuel oil
- Level and feed control of boiler water
- Servo control of thruster and propulsion pitch/azimuth.

3.10.1 PID controller modules symbols

PID controllers are shown in various ways, such as a box or a bar chart with many values.

The standard symbols for a PID controller are shown in the following figure.

Figure 47 Standard PID controller symbols



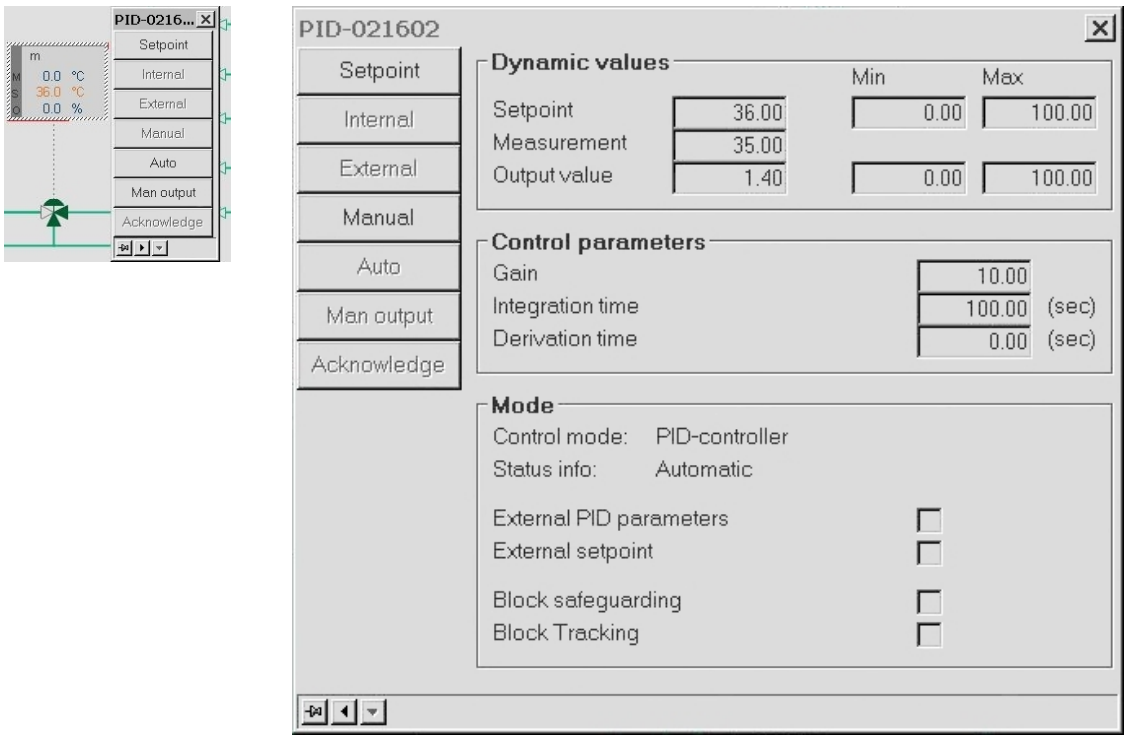
3.10.2 PID controller module operation menu

Note

The operation menu varies according to the software version of the function module.

An example of an operation menu for a PID controller is shown in the following figure.

Figure 48 PID controller operation menu



The command buttons are given in the following list.

Setpoint

Lets you give the setpoint position for the PID controller.

You give the setpoint from the **Numeric input** dialog box. The command is only available in the *Manual* mode.

Internal

Select the internal control inputs (setpoint and controller parameters).

When internal control inputs are selected, the *Automatic* mode is automatically selected.

External

Select the external control inputs (setpoint and controller parameters).

When external control inputs are selected, the PID controller gets the setpoint and controller parameters from the output signals of other function modules.

Manual

Place the PID controller under manual control.

Auto

Place the PID controller under automatic control.

Man output

Click this button to give a manual output value for the PID controller. You give the output value from the numeric input dialog box.

The command is only available in the *Manual* mode.

3.10.3 PID controller module configuration options

During system configuration one or more of the following functions may have been configured for the PID controller modules:

- Follow mode
- Freeze mode
- Control logic interlocks.

The status of these functions can be viewed and changed using the commands on the module shortcut menu (See the section *Context menu* on page 46) that gives you access to the module setup facilities.

Function	Description
Follow mode	All PID controller modules have a *Follow mode* function. In this mode, the controller output follows the value of the Follow A input.
Freeze mode	All PID controller modules have a *Freeze mode* function. In this mode, the controller output is frozen at either the current or a predefined value. If the Manual mode is selected, the controller output value may be changed using the **UP**, **DOWN** and **MAN OUTPUT** commands.
Control logic interlocks	All PID controller modules have interlock functions in the control logic, to protect the process from damaging conditions. These interlock functions are: • No mode change if interlocked. The controller output is set to a preset value. • *Manual* mode selected if interlocked. The controller output is set to a preset value. • *Auto* mode selected if interlocked. • External control inputs are selected if interlocked. The controller output is set to a preset value.

3.11 Sequence control modules

Sequence control modules are used to specify and control a set of actions that are executed in a predefined sequence.

A typical **example** of the use of sequence control modules is when starting a thruster, where several subsystems must be started in the correct sequence. There must be delays between each action, or step. When all the steps are successfully completed and all the subsystems are in the necessary states, the thruster can be started.

If a subsystem fails to obtain the necessary state, or something else fails, the sequence is normally terminated. You must then stop the started subsystems. In critical applications, a new sequence can be initiated to bring the equipment to a safe state.

Multiple (top level) control sequences are also available. These are normally used to change the operational mode of the vessel.

For **example**, when transferring the vessel to the DP control mode, these sequences configure the power management system and start the necessary thrusters.

The sequence control module group contains the following main modules:

- **Sequence step module**
- **Sequence administrator module**
- **Sequence recipe module**

A control sequence for the operation of a system, such as a thruster, can consist of several sequence step modules under the control of a sequence administrator module. Up to a maximum of 100 sequence step modules can be chained into a single sequence.

The **sequence recipe module** specifies the steps in a control sequence and the order in which they are executed. This module is only available to KM personnel; the operator does not need to relate to this module type. It is therefore not described in this manual.

3.12 Sequence step module

The sequence step module defines the actions to be executed by one subsystem and the conditions expected on completion of the actions. Time delays can also be given to allow sufficient time for the equipment to carry out the necessary actions.

Note

The sequence step module does not have an operation menu.

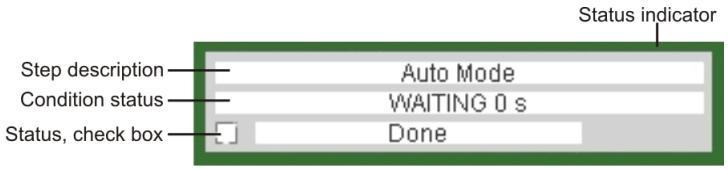
3.12.1 Sequence step module symbol

The symbol appearance for the sequence step module depends on the actions performed in the step.

The symbol for a sequence step module can be shown in an application process image. It is normally only shown in a dedicated sequence process image.

An example of a sequence step module symbol is shown in the following figure.

Figure 49 Sequence step module symbol



The following table describes the parts of the sequence step module symbol.

Function	Description	
Step description	A text field that describes the performed action.	
Status indicator	A coloured rectangular border to indicate the status of the step.	
	Colour	**Status**
	Red	Failed
	Green	Active
	Cyan	Hold
	Light Grey	Completed/Not active
Condition status	A red condition status text field, together with a list of conditions. The condition is preceded by a status check box and followed by a collective logical operation indicator. A status check box with a tick shows that the condition is achieved. The collective logical operation indicator shows the logical relationship between the conditions. & (AND) — all the given conditions must be available for the step to complete. > (OR) — one of the given conditions must be available for the step to complete.	

3.12.2 Sequence step module configuration options

One or more of the following functions can be enabled for the sequence step modules during system configuration:

- Allow **stop** in step
- Allow **force** in step

Function	Description
Allow **stop** in step	All sequence step modules have an **Allow stop** function. When the **Allow stop in step** parameter is set to 0, the **TERMINATE** and **HOLD** commands in the operation menu of the sequence administrator module are disabled. The step continues to run, regardless of the status. When the parameter is set to 1, the **TERMINATE** and **HOLD** commands are enabled.
Allow **force** in step	All Sequence Step modules have an **Allow force** function. When the **Allow force in step** parameter is set to 0, the **FORCE NEXT** command in the operation menu of the sequence administrator module is disabled. When the parameter is set to 1, the **FORCE NEXT** command is enabled.

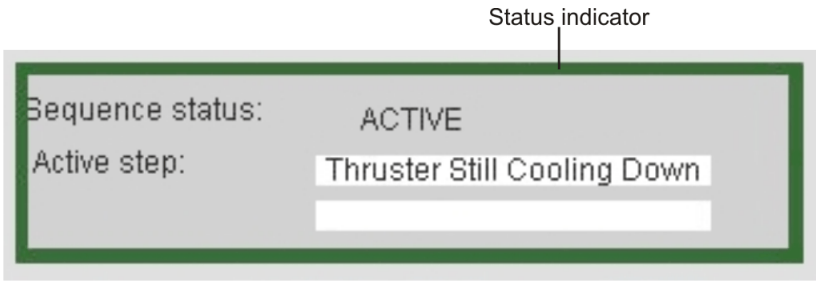
3.13 Sequence administrator module

The sequence administrator module contains the control logic for executing the steps in a control sequence. It specifies the steps and the order in which the steps are to be executed. It is also the interfaces with the operator and external logic for controlling the sequence.

3.13.1 Sequence administrator module symbol

The sequence administrator module symbol is shown in the following figure.

Figure 50 Sequence administrator module symbol



Function	Description	
Status indicator:	A coloured rectangular border around the symbol to show the status of the sequence.	
	Colour	**Status**
	Red	Failed
	Green	Active
	Cyan	Hold
	Light Grey	Completed/Not active
Sequence status:	A text field that shows the status of the control sequence as: ACTIVE NOT ACTIVE HOLD	
Active step:	A two-line text field. The top line describes the action of the currently active step. If a step fails, the bottom line shows the error condition that caused the failure.	

The function module symbol for the Sequence Administrator module is normally included as part of a relevant K-Chief 700 Application Process image and as part of a dedicated Sequence Process image.

The sequence step module symbol can be shown in an application process image. It is normally only shown in a dedicated sequence process image.

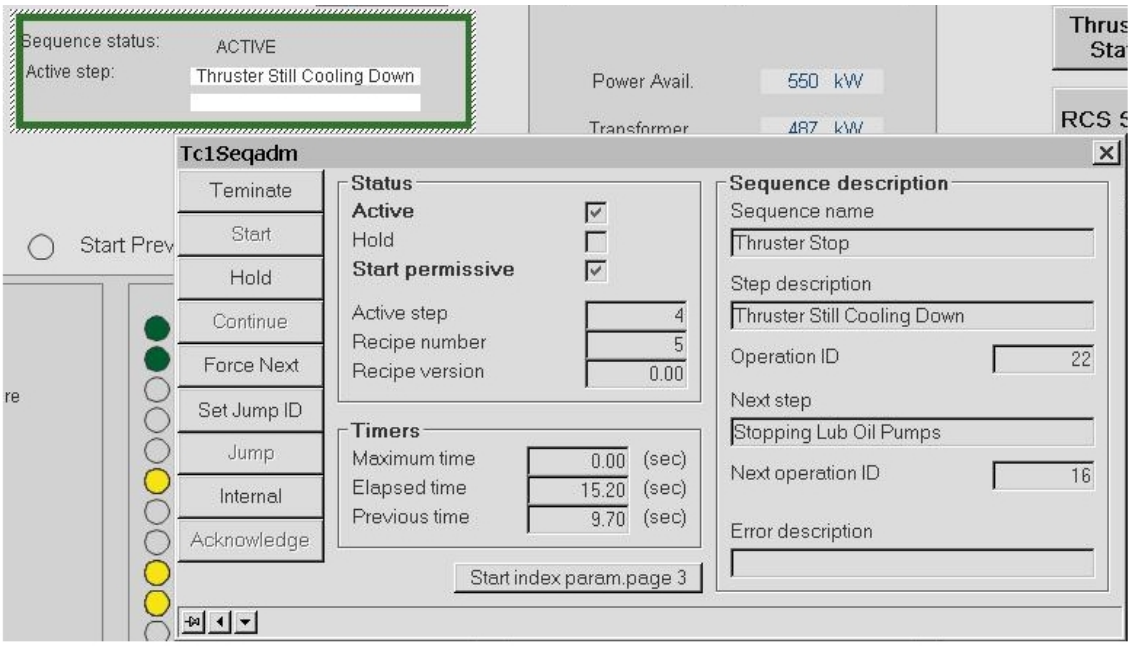
3.13.2 Sequence administrator module operation menu

Note

The operation menu varies according to the software version of the function module.

The sequence administrator module operation menu commands are shown in the following figure.

Figure 51 Sequence administrator operation menu



The command buttons are given in the following list.

Terminate

Stop and reset the running control sequence.

This command, which has the highest priority, can be disabled for individual steps using the **Allow stop** option.

Start

Start a control sequence.

It is only possible to start a control sequence when in *Internal* mode; if the *External* mode is selected, this command button is disabled.

Hold

Pause the running control sequence at the present step.

This command, has a higher priority than the `FORCE NEXT` command.

Continue

Will continue the sequence after a `HOLD` command. All timers will continue from the freeze value.

Force next

Force jump to next step if the sequence is running.

If the sequence has stopped due to an error (step time-out or external error), the next step will be executed when a `FORCE NEXT` command is given and continue with normal execution.

Set Jump ID

If the operator wants to manually jump to a specified step, the step ID to jump to must be set by this command button.

You can jump to a new step although the current step is not completed.

This command is often not available to the operator.

Jump

This command button performs the jump to the step ID specified by the command button above.

This command is often not available to the operator.

Internal

Toggles internal/external mode.

Internal mode: the sequences are controlled directly from the operation menu.

External mode: The sequences are controlled from external buttons or panels.

3.13.3 Sequence administrator configuration options

During system configuration, one or both of the following functions can be enabled:

- External mode
- Start permissive

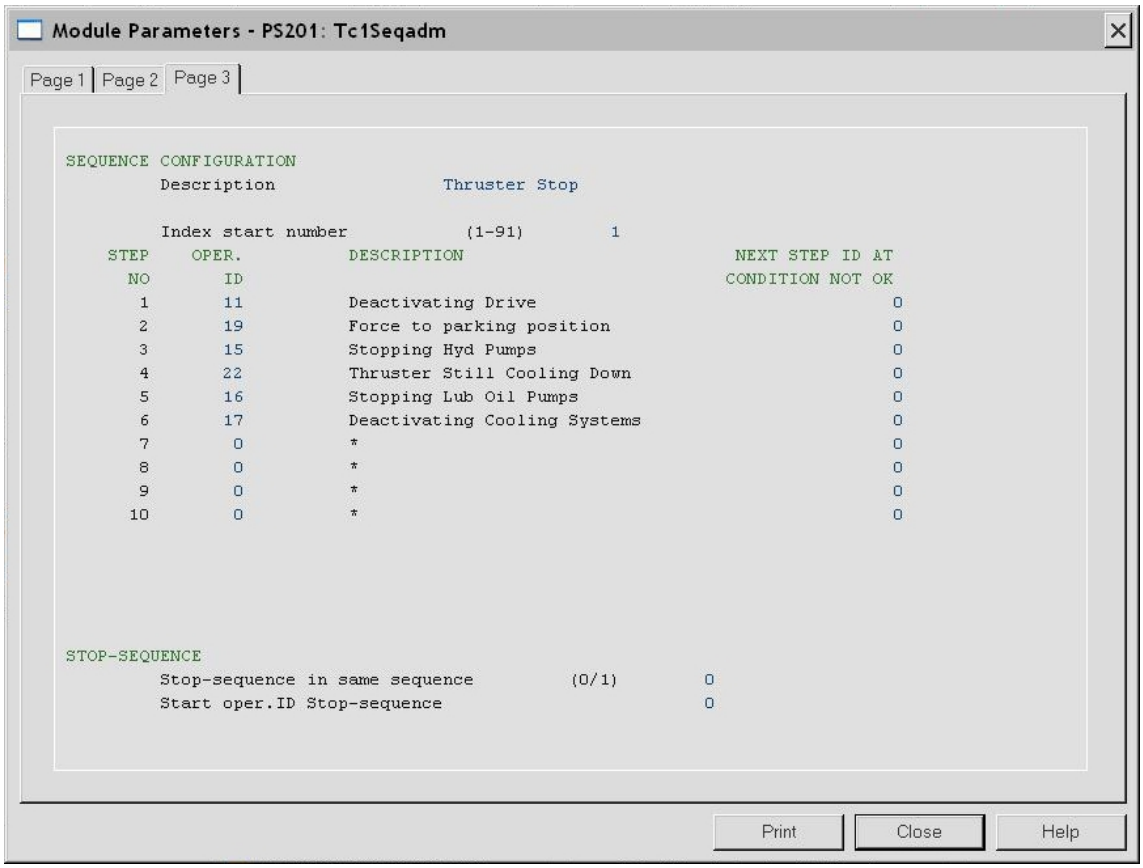
Function	Description
External mode	You can enable the *External* mode function to control the function module using external control logic. The **START** command in the operation menu becomes disabled.
Start permissive	If you connect the start permissive terminal and set it to 0, the **START** command in the operation menu becomes disabled. If you connect the terminal and set it to 1, the **START** command becomes enabled.

3.13.4 Control sequence overview

You can view a list of the steps in the currently active or most recently run control sequence. The **Page 3** tab of the **Module Parameters** window shows this information. For more details, see the **Module Editor** topic for the sequence administrator module, in the online AIM User Guide.

An example of the **Page 3** tab, showing the sequence configuration for stopping a tunnel thruster, is given in the following figure.

Figure 52 Module parameters window for a sequence administrator module



3.14 Sequence process image

An example of a typical sequence process image for loading cargo is shown in the following figures.

Figure 53 Sequence process image for cargo loading - overview

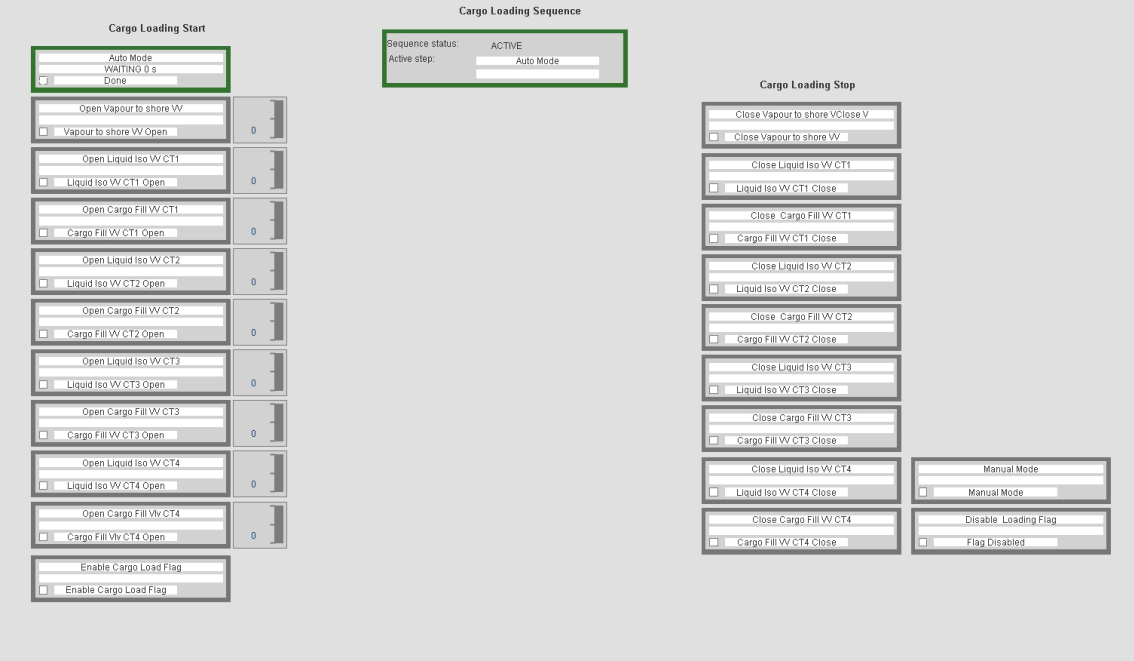
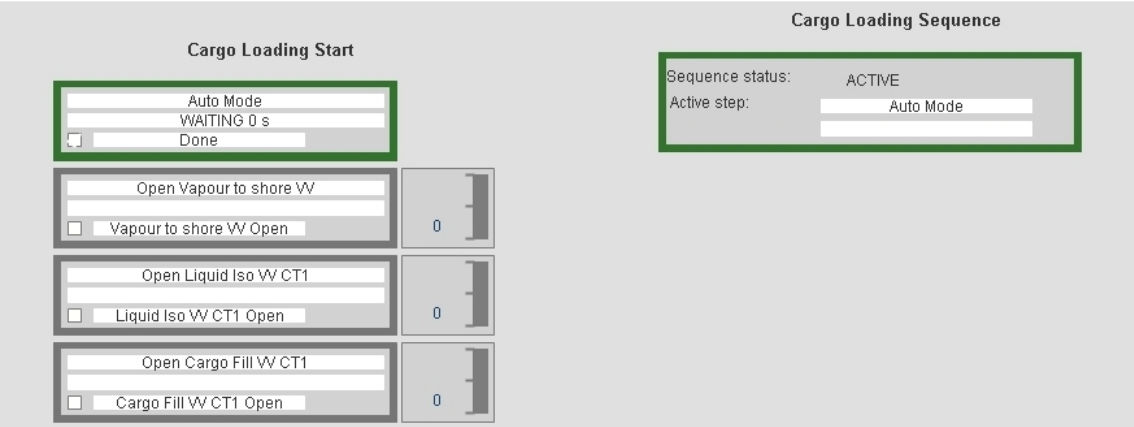


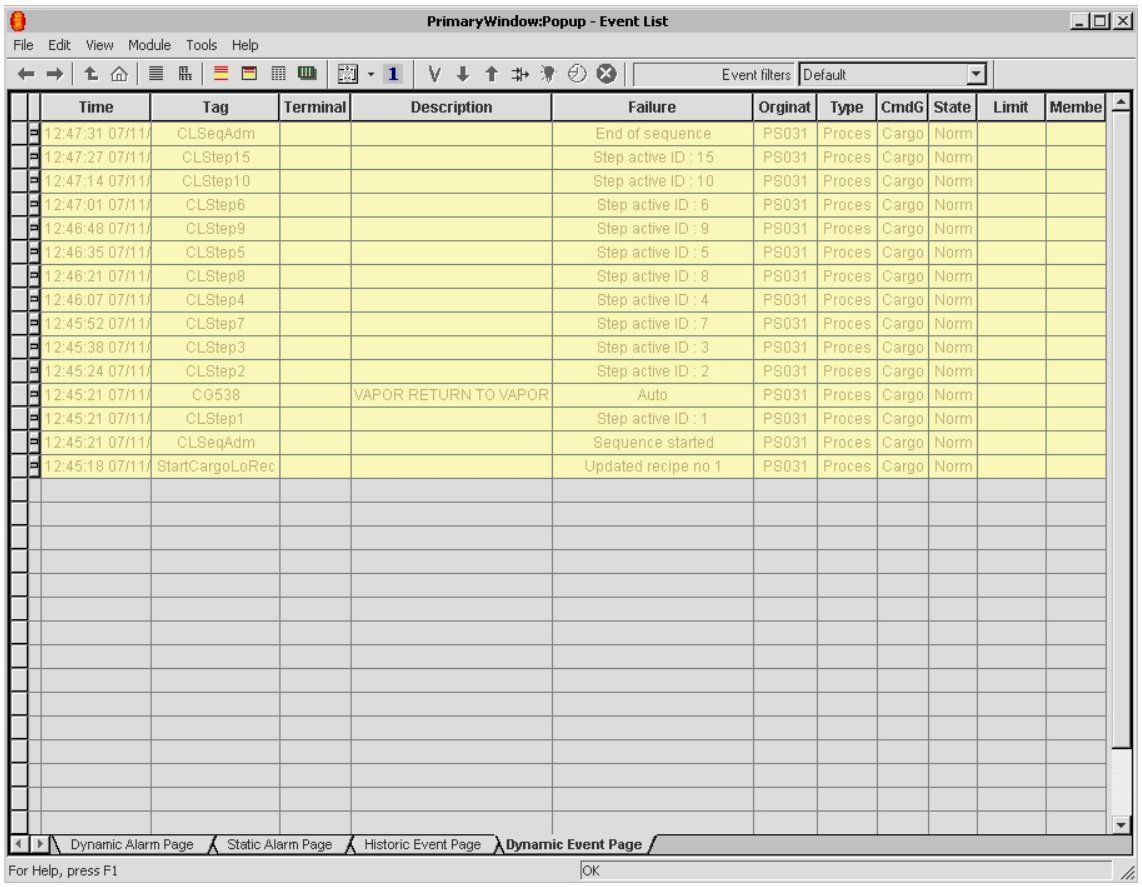
Figure 54 Sequence process image for cargo loading - detail



When a step in a control sequence is started, a record is created in the event database. You can view these events by opening the **Historic Event Page** of the **Event List view**, with the **Universal** event filter selected (See the **Event system** topic in the online AIM User Guide).

The following figure shows an example of events that occur when loading cargo.

Figure 55 Sequence events for loading cargo



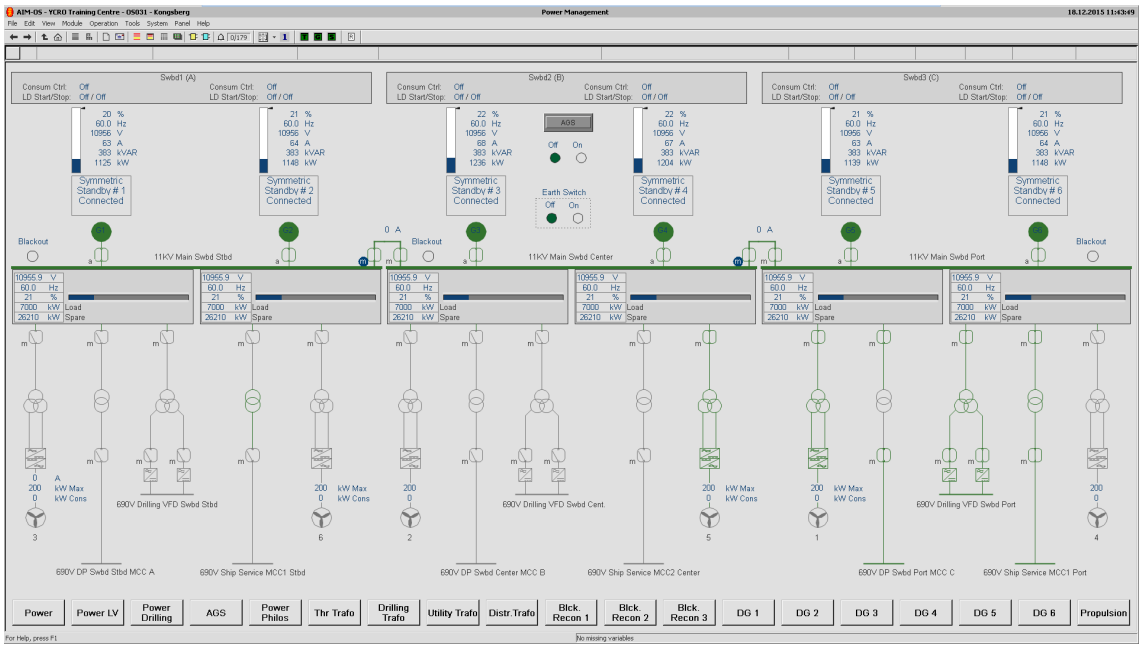
4 Power Management

The Power Management application provides monitoring, control and safety functions for the power generating systems.

The Power Management Process image shows the power generation system and consumers. From this image, you can monitor the power network and operate the generators, switchboards and circuit breakers. Heavy consumers are usually shown in the power management image.

A typical power management process image is shown in the following figure.

Figure 56 Power management process image



You can view some of the equipment in more detail by selecting a lower-level process image. The contents of the lower-level process images depends on the equipment installed on the vessel. For specific information on a device, see the the user documentation for the device. For example, you can click the DG1 button at the right of the top-level power management screen to view the generator set process image for diesel generator 1.

The power management application contains the following basic functions:

- Generator control (for diesel, turbine and shaft driven generators)
- Switchboard control
- Circuit breaker control.

Only the main basic functions and the associated sub-functions are described in the following sections, although other functions can be implemented for special applications.

4.1 Power management user interface

The top level power management process image shows the complete electrical power production and distribution system. The condition of each generator set is shown, together with the status of all switchboards, breakers and connections. The process image also shows the supply voltage and load status.

The power management process image has various lower level process images that allow you to:

- View a separate process image for every generator engine and electrical generator
- Alternatively, to view a separate process image for every generator set
- View a separate process image for each switchboard, if not already shown in the top-level power management process image
- View optional process images showing detailed information about the low voltage distribution system and/or safety systems.

You can use the power management images to monitor and control the power generation system.

The **generator engine process image** gives you more detailed information about the status and condition of the generator engine. It also gives you information about exhaust gas temperatures if applicable, and the engine auxiliaries. The amount of data shown depends on the type of engine and the installation.

If there is a separate **electrical generator process image**, it shows information and alarms related to the electrical generator.

A **generator set process image** usually shows the generator engine and electrical generator status, condition, measurements and alarm information for a complete generator set in a single image, if there is sufficient space.

A **switchboard process image** shows the selected mode for load dependent start/stop and consumer control, together with any relevant electrical measurements.

You can see the lower-level process images by:

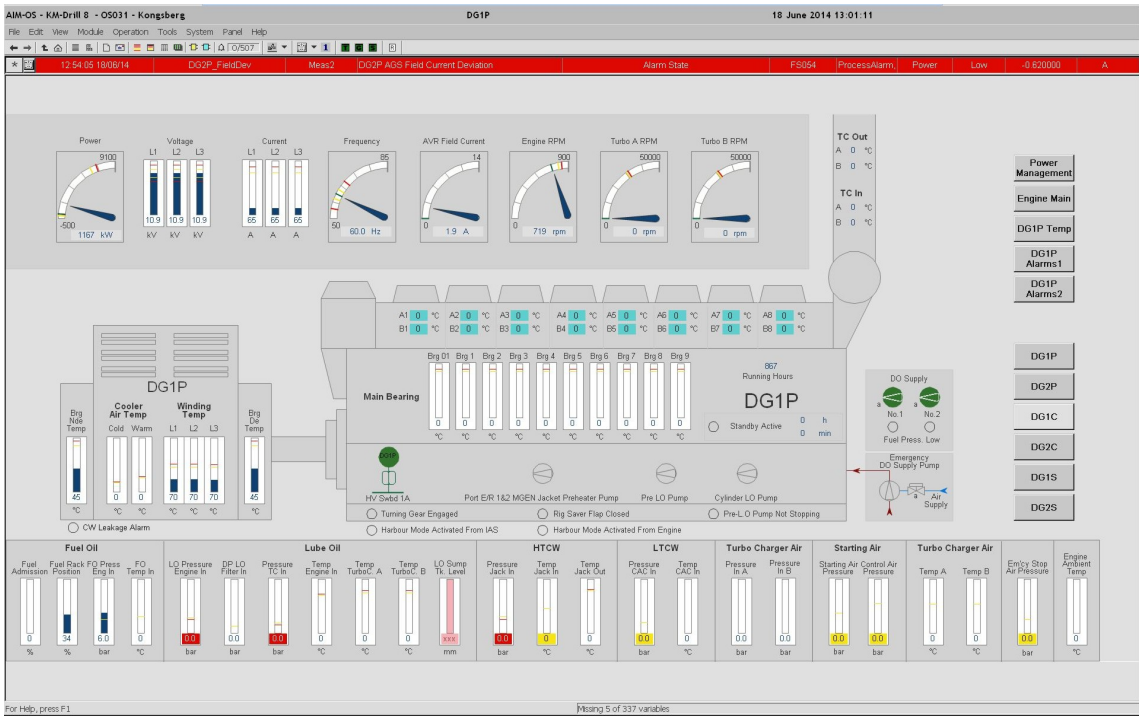
- Clicking on a hot spot in the power management process image or, where applicable, in one of the lower-level process images.
- Selecting the necessary image in the navigator. For more information see the **Toolbars** section in the operator station topic, in the online AIM User Guide.
- Clicking the **NAVIGATOR (VIEW MAP)** button in the operator panel. See the figure *Automation panel layout* on page 36.

- Opening the **History** mimics.

4.2 Generator set process image

An example of the generator set process image is shown in the following figure.

Figure 57 Generator set process image



This process image is divided into areas that show information about the different parts of the generator set.

Note

The information shown in the process image depends on the type of engine and generator.

4.3 Generator control module

Module symbols represent generators in the power management process images.

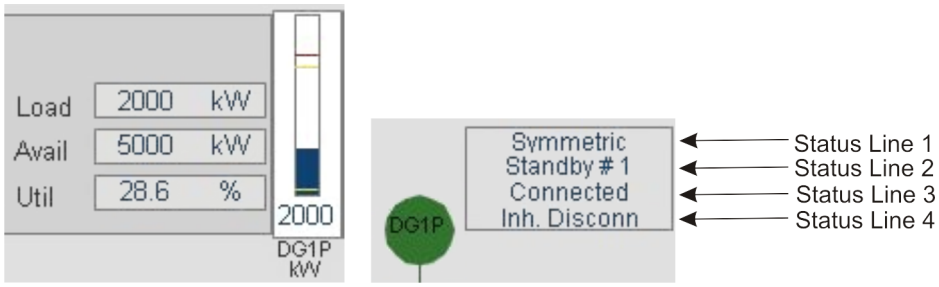
The generator module symbol is used to show the generator operational status and control the generator operation.

4.3.1 Generator module symbols

A generator module symbol has an analog dial that shows the load on the generator. The generator symbol has four lines of status text that show the state of the generator. Section *Generator module status indication* on page 85 describes the status text lines in detail.

An example of the generator symbols are given in the following figure. The information shown by the symbol can vary on different vessels.

Figure 58 Generator control module symbols



Optional information such as the power factor, output voltage, load current and frequency of the generator can also be shown near the generator symbol.

4.3.2 Generator module status indication

The symbol colour and the four lines of status text show the state of the generator. SeeFigure 58.

Colours

The colours used to show the generator operational state are given in the following table.

Colour	Meaning
Green	The generator is running and operates correctly.
Yellow	The generator is either starting or stopping.
White	The generator is stopped.

Status text

The status text varies according to the operational conditions, and the commands given from the generator module operation menu. For information about the operation menu see the section *Generator module operation menu* on page 88.

Line 1 shows whether the generator is controlled from a local panel, or by the power management application. If the power management application controls the generator, the selected load mode is shown.

The table lists other text that can be shown in Line 1.

Status text	Meaning
LOCAL	K-Chief 700 does not control the generator.
EXTERNAL LOADSHARING	*External Load sharing* mode is selected. K-Chief 700 does not control the load sharing.
MANUAL	*Manual* mode is selected.
FIX LOAD	*Fixed Load* mode is selected.
SYMMETRIC	*Symmetric* mode is selected.
ASYMMETRIC	*Asymmetric* mode is selected.
ASYMMETRIC MAIN	*Asymmetric* mode is selected. This generator is now the main generator.
DIESEL LOCAL	The diesel engine is set in **Local** mode.
BREAKER LOCAL	The generator breaker is set in **Local** mode.
MANUAL ISOCH.	The generator is in the **Manual Isochronous** mode.
SYMM ISOCH.	The generator is in the **Symmetric Isochronous** mode.
ASYMM ISOCH.	The generator is in the **Asymmetric Isochronous** mode.
TRACK MODE	The generator is in the **Track** mode.

Line 2 shows the **control mode** for the generator.

The table lists the text that can be shown in Line 2.

Status text	Meaning
NOT STANDBY	The K-Chief 700 system cannot start, connect, disconnect or stop the generator.
STANDBY #	The K-Chief 700 system can start, connect, disconnect or stop the generator. The hash symbol # stands for the standby number (from 1 to 15), which determines the order of automatic operation.

Line 3 gives the **current state** of the generator engine.

The following table gives the text that can be shown in Line 3.

Status text	Meaning
STOPPED	Engine is stopped.
START HELP SYSTEM	Start help system.
START ENGINE	Start the engine.
START ENGINE WAIT	Start engine wait.

Status text	Meaning
RUN IDLE	Running at idle speed.
RUN RATED	Running at rated speed.
SYNCHRONISING	The generator is synchronising the phase with the bus.
DEAD BUS CLOSE	The generator circuit breaker is closing.
CONNECTED	The generator is connected to the bus.
REDUCE LOAD	The load on the generator is being reduced.
DISCONNECTING	The generator is disconnecting from the bus.
RUNNING COOLING DOWN	The engine is running in the cool down sequence. This sequence is used to cool the engine before shutdown.
RUNNING CLEANING UP	Running and cleaning up the status
STOPPING	Generator stopping
SHUT DOWN	Shutdown This can be due to various reasons, which are shown in the process image that gives the generator shutdown information.

Line 4 shows the **condition** of the generator.

The table lists the text that can be shown in Line 4.

Status text	Meaning
INTERNAL BLOCKED	The generator is shut down and must be reset before starting.
INHIBIT DISCONNECT	The generator is not allowed to disconnect from the bus.
INHIBIT STOP AND CONNECT	Inhibit the Stop and Connect processes.
INHIBIT CONNECT	The **Breaker Ready** signal not present, the breaker is not ready.
INHIBIT STOP	The Stop process is inhibited.
INHIBIT START	Starting is inhibited because at least one of the measured values are missing or out of range. The value(s) in error are shown in the Process image containing generator start-inhibit information.
FIRST TO STOP	The generator is set as the first generator to stop.
FIRST TO START	The generator is set as the first generator to start.
FIRST STBY. START	The generator is set as the first generator to standby start.
FIRST LDEP. START	The generator is set as the first generator for a load dependent start.

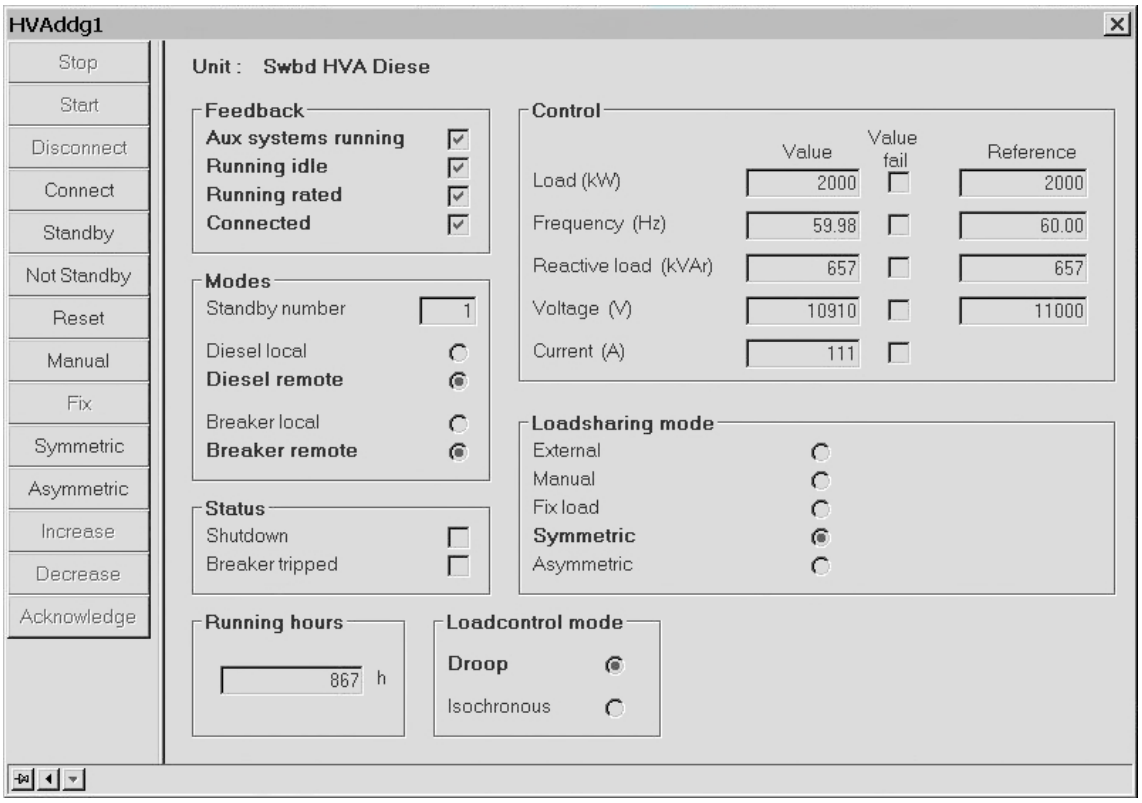
4.3.3 Generator module operation menu

Note

The operation menu varies according to the software version of the function module.

Figure 59 Generator control operation menu

Figure 60 Generator control operation menu - extended



The command buttons allow you to:

- **Stop** or **Start** the generator. The generator can be started either manually by the operator or automatically by the system logic.

  Note

  *The **Stop** and **Start** commands are not available for shaft generators.*

- **Disconnect** or **Connect** the generator to the bus. The generator can be connected or disconnected either manually by the operator or automatically by the system logic.

  If you give the **Disconnect** command to a **Not standby** generator, the generator is disconnected from the bus but not stopped. If you give the **Disconnect** command to a **Standby** generator, the generator is disconnected from the bus and stopped.

  You can only disconnect the generator if it is supplying sufficient power to the switchboard.

  You must manually start a **Not standby** generator before you give the **Connect** command.

  If you give the **Connect** command to a **Standby** generator, the generator is automatically started, synchronised and connected to the bus.

- Set the generator to the **Standby** mode, or in **Not standby** mode, which acts on a single generator, and can only be activated manually. The commands are given from the **Numeric** dialog box.

Note

*The **Standby** mode is not available for shaft generators. Shaft generators are always in **Not standby** mode.*

- **Reset** a blocked operation, whenever a generator is shut down.
- Set the generator to the **Manual** mode. This mode is one of four available load sharing modes. The others three are automatic load sharing modes:
  - **Fixed Load**
  - **Symmetric**
  - **Asymmetric**

  To leave the **Fixed Load** mode, set the generator to the **Manual**, **Symmetric** or **Asymmetric** mode.

  Note

  *Selecting the **Manual** mode for a generator that is in **Standby** mode sets the generator to **Not standby** mode.*

- Set the generator to the **Fixed Load** mode, which is only available for generators that are connected to the switchboards of the power distribution network.

  You cannot stop a generator when it is operating in the **Fixed Load** mode.

  To leave the **Fixed Load** mode, set the generator to the **Manual**, **Symmetric** or **Asymmetric** mode.

  Note

  *You cannot select the **Fixed Load** mode for a generator that is set to the **Standby** mode.*

- Select the **Symmetric** mode.

  To leave this mode, set the generator to the **Fixed Load**, **Manual** or **Asymmetric** mode.

  Note

  *Setting a generator to the **Symmetric** mode can affect the load sharing with other generators that are in the **Symmetric** or **Asymmetric** modes.*

- Set the generator to the **Asymmetric** mode.

  In the **Asymmetric** mode, the load is shared in the following ways:

  - One generator in **Asymmetric** mode is set as the main generator. The load on the main generator correlates with the optimum load value for the generator. The optimum load value is typically between 70 and 80% of the nominal load.

  - The other load sharing generators in **Symmetric** and **Asymmetric** mode are called the topping up generators.

  They share the remaining load as equal percentages of their nominal load.

  The load shared by the topping up generators is the total load on the switchboard, excluding fixed loads, manual loads and the main asymmetric load.

To leave this mode, set the generator to the **Fixed Load**, **Manual** or **Symmetric** mode.

Note

*The **Asymmetric** mode is not available for shaft generators.*

- Click the **Increase** or **Decrease** button to increase or decrease the load on the generator by a preset amount. These commands are only available when the generator is running in the **Manual** or **Fixed Load** mode.
- Click the **Isochronous** button to set the speed governors in isochronous mode. Click **Droop** to set the speed governors in droop mode.

In compensated droop mode, PMS supports the following load sharing options:

- Symmetric load sharing
- Asymmetric load sharing
- Fixed load
- Manual load sharing

Isochronous load sharing automatically divides the total load proportionally between the generator sets, while maintaining a fixed frequency on the bus. All the generators share the load equally.

PMS monitors the load on all the connected generators. It gives an alarm if the load between the connected generators deviates from a defined limit, when in the isochronous control mode. This function can be turned on or off, and the limits adjusted from the main power mimic. The load sharing functions can be selected individually for each generator.

PMS controls the active load sharing using the speed governor when the speed governors are in droop load sharing mode. The engine speed is controlled by the speed controller. The normal operation mode is symmetric load sharing. The speed governors are set up with equal droop setting, to manage proportional load sharing.

In **Isochronous** mode, you can select the following load sharing modes:

- Symmetric
- Asymmetric
- Fixed

If you want to set a generator in **Isochronous** mode to **Asymmetric** of **Fixed** load sharing mode, the external generator controller must have Base Load/MW control enabled. Otherwise, only the **Symmetric** mode can be set.

4.4 Switchboard module

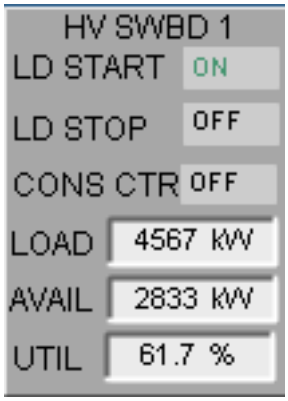
Use the switchboard module to operate the load and consumer control function of the switchboard, and to see the current load and spare capacity.

4.4.1 Switchboard module symbol

The switchboard module symbol shows the identification name of the switchboard, the status of the load and consumer controls, the current power loading on the switchboard and the available unused power (spare capacity).

An example of a switchboard module symbol is shown in the following figure.

Figure 61 Switchboard symbol



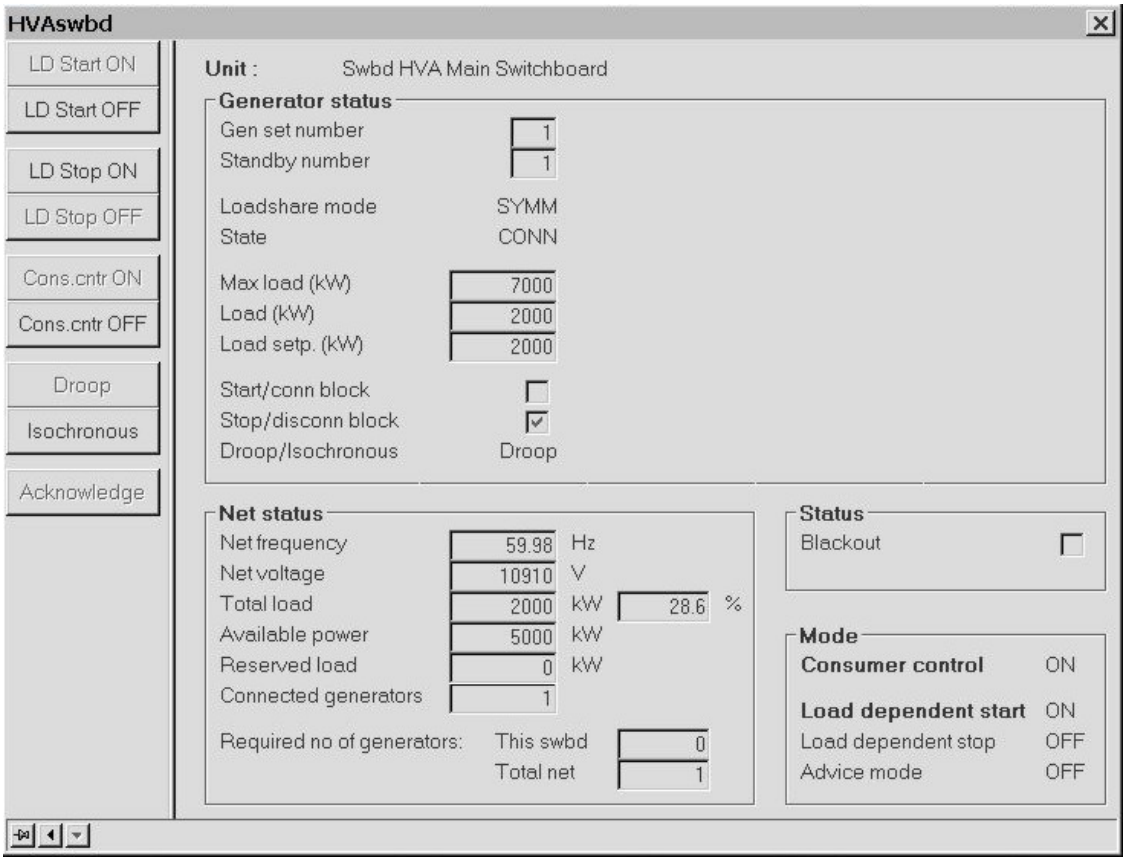
You can turn the **Load Start**, **Load Stop** and **Consumer Control** on or off from the module operation menu. To open this menu, use the left trackball button to click the **ON/OFF** label in the **Load and Consumer Control** status field.

4.4.2 Switchboard module operation menu

Note

The operation menu varies according to the software version of the function module.

Figure 62 Switchboard module operation menu



The command buttons allow you to:

- Select the **Load Dependent Start On**. This setting acts on **Standby** generators that are in the **Asymmetric** or **Symmetric** mode. Selecting this command starts the **Next standby** generator.
- Select the **Load Dependent Start Off**. This setting acts on **Standby** generators that are in the **Asymmetric** or **Symmetric** mode. Selecting this command inhibits the **Next standby** generator from starting automatically due to variations in symmetrically or asymmetrically shared loads.
- Select the **Load Dependent Stop On**. This setting acts on all **Standby** generators connected to the switchboard, that are in the **Asymmetric** or **Symmetric** mode. Selecting this command stops the running generators in descending order of their standby number.
- Select the **Load Dependent Stop Off**, which applies to all **Standby** generators that are in the **Asymmetric** or **Symmetric** mode and connected to the switchboard. Selecting this command inhibits the automatic stop of any of the **Standby** generators due to variations in symmetrically or asymmetrically assigned loads.
- Select the **Consumer Control On**, which applies to all **Standby** generators that are currently not connected to the switchboard. If you select this command, the spare capacity is checked when a heavy consumer gives a start request.

  Note

  Heavy consumers are usually the thrusters, main hydraulics and large pumps.

- Select the **Consumer Control Off** , which applies to all **Standby** generators that are connected to the switchboard. If you select this command, any consumer demand causes a generator to start, whether spare capacity is available or not. The number of generators connected or simultaneous start attempts from other consumers also do not have any effect on the attempt to start.
- Toggle between **Isochronous** and **Droop** mode. Click the **Isochronous** button to set the generator to isochronous mode. Click the **Droop** button to set the generator to isochronous mode.

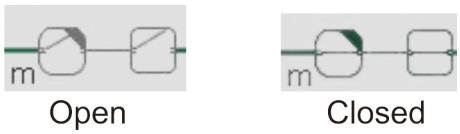
4.5 Circuit Breaker module

Circuit breakers are used to connect and disconnect the generators and consumers to the power distribution network. The circuit breaker module is used to interact with the circuit breaker.

4.5.1 Circuit Breaker module symbol

A circuit breaker module is represented by the following symbols.

Figure 63 Circuit breaker module symbols



4.5.2 Circuit Breaker module mode indication

The operational mode of a circuit breaker is shown by the tag mark character that appears next to its symbol.

The tag mark characters used in circuit breakers are listed in the table below:

Tag mark character	Colour	Mode
Blank		Manual
m	White	
a	Green	Automatic
i	Cyan	Interlocked
l	Cyan	Local

4.5.3 Circuit Breaker module status indication

The symbol colour is changed to show the operational state of the circuit breaker.

Status Colour	Status
White	The circuit breaker is open.
Green	The circuit breaker is closed.
Yellow	The circuit breaker is in a transient or unknown state.

4.5.4 Circuit Breaker module operation menu

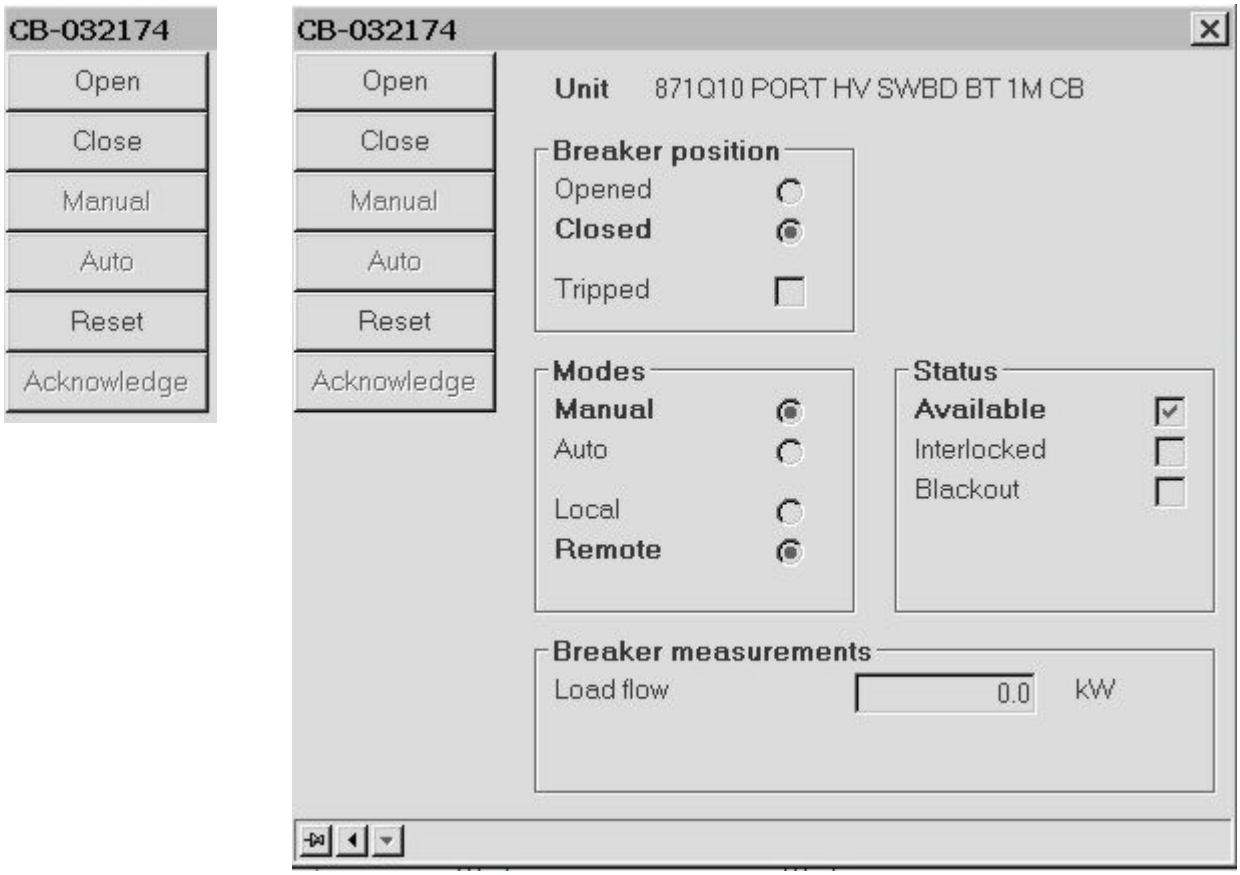
The commands given in the module operation menu depend on the system configuration, such as the configuration of the circuit breaker. If it is configured as remote (**rem**) the commands are available. If the circuit breaker is configured as monitoring (**mon**) or automatic (**auto**), the commands are not available.

Typical circuit breakers are those fitted on both sides of transformers. The circuit breaker between a generator and a switchboard is controlled from the generator control module.

Note

The operation menu varies according to the software version of the function module.

Figure 64 Circuit breaker operation menu



The command buttons allow you to:

- **Open** or **Close** the circuit breaker.
- Set the circuit breaker to **Auto** or **Manual** operation.

An inconsistency check compares the flow through the breaker against the breaker status signal. If the breaker status signal reports the breaker open while a flow is measured across the breaker, the status indication is changed to **Breaker closed**. If the breaker status signal reports the breaker closed while no flow is measured across the breaker, the status indication is changed to **Breaker open**.

4.6 Consumers

Although the major consumers are shown in the power management process images, they are usually controlled from process images within other applications. For example, the thrusters are controlled from the thruster/propulsion process images.

The colours used to indicate the operational status of consumers are as follows:

Status Colour	Status
Green	The consumer is running.
White	The consumer is stopped.
Yellow	The consumer is in a transient state such as starting, stopping or changing speed.

4.7 Typical procedures

The following procedures are examples that show how to do a set of typical tasks. They illustrate regular interaction between the operator and the power management application. More advanced operations are not covered in this section.

Note

The operation menu varies according to the software version of the function module.

4.7.1 How to set a generator as standby generator

The following procedure describes how to set a generator as standby generator.

It is assumed that the generator is stopped and in the **Manual** mode, and that the generator or the switchboard are not in the alarm condition.

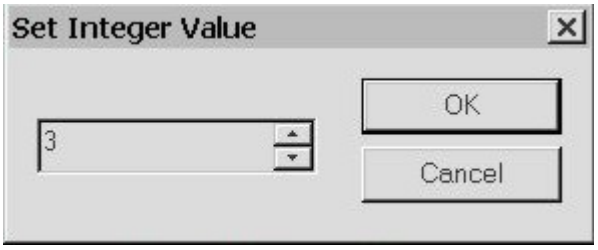
1. Open the power management process image.

   The image shows the status of the power plant.
2. Note the information given for the generator.
3. Move the cursor over the generator symbol and click the left trackball button.

   A selection box appears around the generator symbol and the generator operation menu appears. See the figure *Generator control operation menu - extended* on page 89.
4. Click the **Standby** button.

   The numeric input dialog box appears.

   Figure 65 Numeric input dialog



5. Type the necessary standby number value in the **Numeric input** field and click **OK**. One can also click the **Inc** or **Dec** button to increase or decrease the value by 1.

The generator symbol Line 2 status text changes to show the new standby status.

4.7.2 How to connect a generator

This procedure describes how to set a generator in the **Symmetric** mode, do a manual start and connect the generator to the switchboard bus.

It is assumed that the generator is stopped and in the **Manual** mode, and that the generator and the switchboard are not in the alarm condition.

1 Open the power management process image.

The image shows the status of the power plant.

2 Note the information given for the generator.

3 Move the cursor over the generator symbol and click the left trackball button.

A selection box appears around the generator symbol and the generator operation menu appears. See the figure *Generator control operation menu - extended* on page 89.

4 Click the **Symmetric** button.

The generator is set in the **Symmetric** load sharing mode. The generator symbol Line 1 status text changes from **MANUAL** to **SYMMETRIC**.

5 Click **Start**.

The generator symbol Line 3 status text changes from **STOPPED** to **START ENGINE**. The generator symbol colour changes from white to yellow. ***Check this.***

The generator symbol Line 3 status text changes from **START ENGINE** to **RUN RATED**. The generator symbol colour changes from yellow to green.

6 Click **Connect**.

The generator symbol Line 3 status text changes from **RUN RATED** to **SYNCHRONISING**, then to **CONNECTED**. When the generator is connected to the switchboard bus, the circuit breaker symbol changes from white to green.

7 Close the module operation menu.

4.7.3 How to start and reset a failed generator

This procedure describes the events that occur when a generator fails to start. It describes how to reset the blocked condition after the generator is repaired. These procedures can also be used after an automatic start fails.

It is assumed that a generator has failed to start and one of the remaining generators, set as a **Standby** generator, is not connected to the switchboard.

1 The generator symbol Line 3 status text changes. The maximum number of start attempts allowed is set by the parameter **Max. no. of start trials**.

2 When the last start attempt fails, a **Start fail** alarm is given. The generator symbol Line 3 status text changes to **STOPPED**. The generator symbol Line 4 status text changes to **BLOCKED**. The generator symbol colour changes to white.

3 The blocked generator is excluded from the standby starting sequence.

4 The **Next standby** generator is started and connected to the switchboard power bus.

5 After the **Next standby** generator is connected, the generator symbol Line 3 status text changes to **CONNECTED**.

The generator symbol colour changes to green.

The bus circuit breaker symbol shows the breaker is closed.

To reset the blocked generator:

1 Open the necessary generator and/or safety process image.

2 Look at the information given in the images as this can give the reason why the generator failed to start.

3 When recovery or repair of the generator is complete, open the power management process image.

4 Open the blocked generator module operation menu.

5 Click **Reset**.

The generator symbol Line 4 status text changes from **BLOCKED** to blank.

You can start and connect the generator to the bus and/or set it as a **Standby** generator. See the section *How to connect a generator* on page 98.

4.7.4 How generator changeover is performed

The following sequence describes how a generator changeover is performed, i.e. what occurs when a generator that is online enters the alarm condition. A **Standby** generator is started and connected and then the generator in the alarm condition is stopped.

No operator action is required if the generator that enters the alarm condition is set in the **Standby** mode.

If the alarm condition generator is set in **Not Standby** mode, the generator engine must be stopped manually, using the **Stop** command.

When an online generator enters the alarm condition, the following happens:

1 An alarm condition occurs in the connected generator.

2 The **Next standby** generator is started and connected to the switchboard.

3 The load on the generator in alarm condition is reduced.

4 The generator symbol Line 3 status text for the generator in alarm condition changes from **CONNECTED** to **REDUCE LOAD**.

5 The **Standby** generator symbol Line 3 status text changes to **CONNECTED** and the generator symbol colour changes to green. The DG circuit breaker symbol shows that the circuit breaker is closed.

6 When the load is less than n% (where n is the value of the parameter **Max. rel. load to disconnect**), the DG circuit breaker opens and the generator is disconnected from the switchboard.

7 The generator symbol Line 3 status text changes from **REDUCE LOAD** to **DISCONNECT**. The circuit breaker symbol shows that the circuit breaker is open

and changes colour from green to white. The generator symbol changes colour from green to yellow.

8 The generator in alarm condition is stopped.

9 The generator symbol Line 3 status text changes from **DISCONNECT** to **STOPPING** and then to **STOPPED**. The generator symbol changes colour from yellow to white. The generator symbol Line 4 status text changes to **BLOCKED**.

10 The blocked generator is removed from standby duty.

When the generator in alarm condition is repaired, reset the blocked state. See the section *How to start and reset a failed generator* on page 98.

4.7.5 How to set Fixed Load operation

The following procedure describes how to set the generator for fixed load operation. It also describes the effects of this action on the other generators.

It is assumed that three generators that are set in the **Symmetric** load sharing mode are connected to the switchboard.

1 Open the first **Standby** generator module operation menu.

2 Click **Fix**.

The Line 2 status text changes from **STANDBY 1** to **NOT STANDBY**. The generator symbol Line 3 status text changes from **SYMMETRIC** to **FIX LOAD**.

The generator load setpoint is set as the present value of the generator load.

3 Click **Decrease**.

The generator load setpoint is decreased by a predefined amount.

4 Observe the changes in load for all three generators.

The generator load decreases until the load setpoint, and the remaining load is shared symmetrically between the other two generators.

If the result of the load reduction on the generator with fixed load causes 100% load on the other two generators, the **Fixed** load mode is bypassed and the total load is distributed symmetrically between all the three generators.

5 Close the module operation menu.

4.7.6 How to set Asymmetric Load sharing

The following procedure describes how to set **Asymmetric** load sharing with three generators. Two generators are in the **Symmetric** mode and one in the **Fixed Load** mode. All three generators are connected to the switchboard.

The procedure also describes the effects on the load of each generator due to changes in the total load.

1 Open the generator module operation menu in the **Fixed Load** mode.

2 Click **Asymmetric**.

The generator symbol Line 3 status text changes from **FIX LOAD** to **ASYMMETRIC**

The generator load setpoint is preset at typically between 70 and 80% of the generator's load capacity.

The other two generators share the remaining load symmetrically.

3 Close the module operation menu.

4 Decrease the total switchboard load by disconnecting a consumer.

Initially, the load shared by the two **Symmetric** mode generators is reduced while the load on the **Asymmetric** mode generator remains constant. If the load on two **Symmetric** mode generators reduces below a predefined limit (typically 25%), the load on these two generators remains unchanged while the load on the generator in **Asymmetric** mode is reduced.

5 Increase the total load by connecting more consumers.

The asymmetric load limit increases. If the increase in the total load continues, and the two generators in **Symmetric** mode reach the same load limit, the additional load is shared symmetrically between all three generators.

4.7.7 How to turn the Load Dependent start on and off

This section describes the effect of an increase in the total load when Load Dependent start is selected, with at least three generators in the **Symmetric** mode.

It is assumed that one of these generators is running and connected to the switchboard and the other two are set in **Standby** mode.

To turn the Load Dependent start on, do the following:

1 Open the switchboard module operation menu.

2 Click **LDSTRT ON**.

3 Close the module operation menu.

4 Increase the total load on the switchboard by connecting more consumers.

The load on the connected generator increases.

When the generator load increases above the Start 1 (or Start 2) limit and remains above these limits for a time period greater than the Start 1 (or Start 2) limit delay, the **Next standby** generator is automatically started and connected to the switchboard.

5 When the **Next standby** generator is connected, the generator symbol Line 3 status text changes to **CONNECTED**. The generator symbol colour changes to green. The circuit breaker symbol shows the bus circuit breaker closed.

The total switchboard load is shared symmetrically between the two connected generators.

When the generator load increases above the Start 1 (or Start 2) limit and remains above these limits for a time period greater than the Start 1 (or Start 2) limit delay, the **Next standby** generator is automatically started and connected to the switchboard.

To turn the Load Dependent start off, do the following:

1 Open the switchboard module operation menu.

2 Click **LDSTRT OFF**.

The switchboard module symbol text changes from **ON** in green colour to **OFF** in black.

3 Close the module operation menu.

4.7.8 How to turn the Load Dependent stop on and off

To turn on the Load Dependent stop, do the following:

1 Open the switchboard module operation menu.

2 Click **LDSTOP ON**.

The switchboard module symbol text changes from **OFF** in black colour to **ON** in green.

3 Close the module operation menu.

To turn off the Load Dependent stop, do the following:

1 Open the switchboard module operation menu.

2 Click **LDSTOP OFF**.

The switchboard module symbol text changes from **ON** in green colour to **OFF** in black.

3 Close the module operation menu.

4.7.9 How to turn the Consumer control on and off

To turn the consumer control on, do the following:

1 Open the switchboard module operation menu.

2 Click **CONCTR ON**.

The switchboard module symbol text changes from **OFF** in black colour to **ON** in green.

3 Close the module operation menu.

To turn off the consumer control, do the following:

1 Open the switchboard module operation menu.

2 Click **CONCTR OFF**.

The switchboard module symbol text changes from **ON** in green colour to **OFF** in black.

3 Close the module operation menu.

5 Propulsion Control

The Propulsion Control application enables monitoring, control and safety functions for the vessel's thruster and main propulsion system.

Normal operation is performed from the K-Thrust and/or K-Pos Operator Stations (OS) as these are the main control locations for propulsion control, while the K-Chief 700 Operator Stations (OS) presents information concerning each thruster's status and alarm monitoring.

The K-Chief 700 OSs are however provided with a downgraded control mode, called **Maintenance mode** which allows for individual manual control of each unit, mainly used for fault-finding the system.

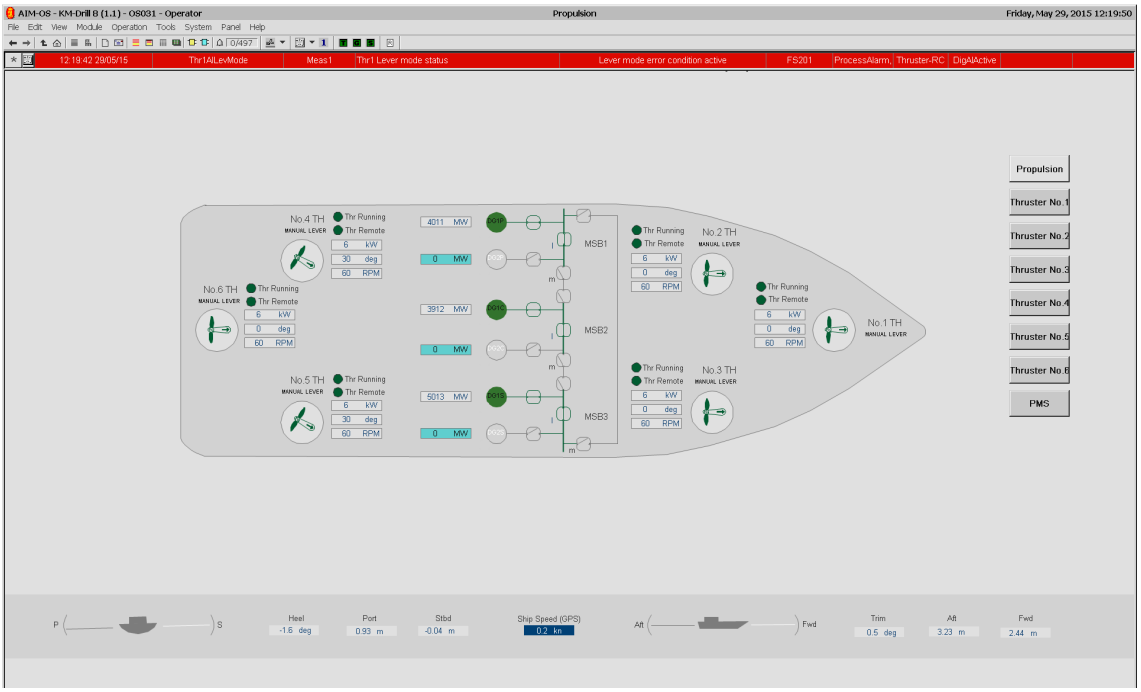
Note

Normal operation of the Propulsion Control application is therefore described in the ***K-Thrust Operator Manual****.*

A **Propulsion Process view** (see figure below) is a SCADA image that visualizes the vessels thrusters and main propulsion system. Additionally it shows the main electrical generators and information concerning load and draught. Once the OS has been given **Command Control** of the Thruster/Propulsion Command Group(s), the operator can control the thrusters and main propulsion units.

To open the **Propulsion Process view**, select **View** and →**Propulsion**.

Figure 66 Example of Propulsion Process view for a Offshore Supply Vessel (OSV)



The propulsion control application comprises the following basic functions:

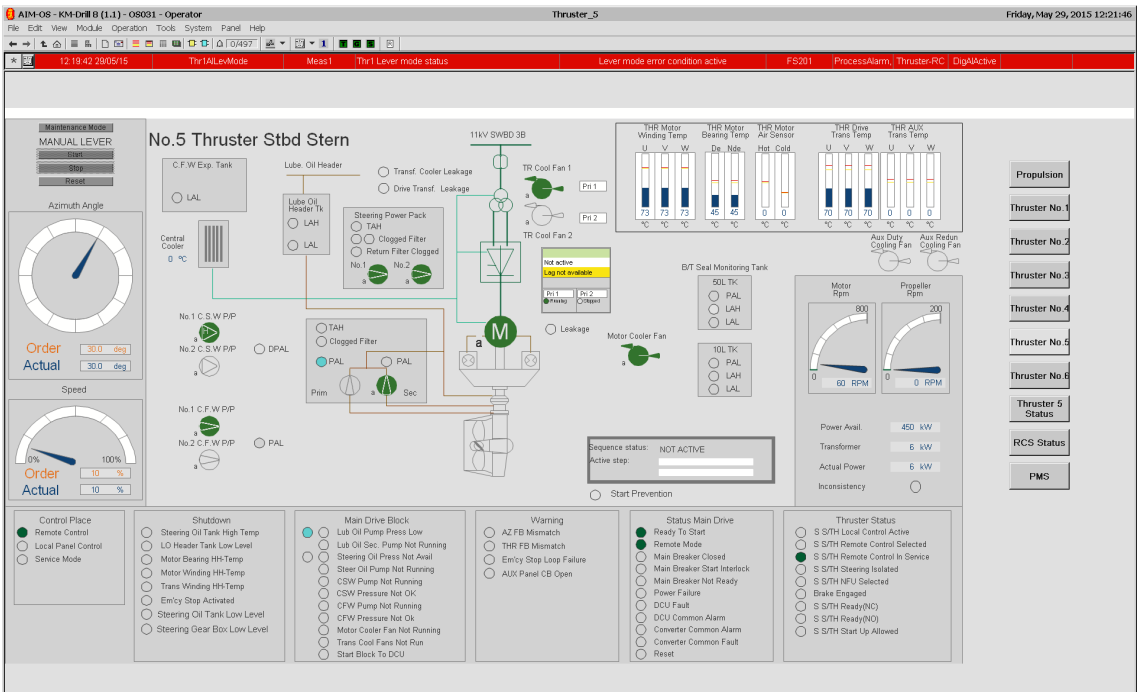
- Thruster Start/Stop sequences
- Auxiliary Equipment control
- Pitch control
- Azimuth control
- Speed (rpm) control
- Maintenance mode
- Safety
- Zero pitch
- Alarm monitoring.

Note

Only the basic functions together with their associated sub-functions are described in the following sections. Other functions may be implemented for special applications. These functions are then described in the Kongsberg Functional Design Document (KFDD) for Thruster Control supplied for the vessel.

To see further details on each thruster or main propeller, select the unit (see the following figure) or use the GUI buttons (located either at the bottom or to the right of the HMI).

Figure 67 Example of Thruster process view



The content of the lower level process view depends on the type of thrusters and main propulsion units installed on the vessel. These are further described in the following sections:

- *Azimuth thruster process view* on page 107,
- *Tunnel thruster process view* on page 108 and
- *Main propulsion process view* on page 109.

5.1 Propulsion control user interface

The Propulsion Process view (example shown in *Example of Propulsion Process view for a Offshore Supply Vessel (OSV)* on page 104) enables monitoring, control and safety functions of the vessel's thruster and propulsion system. This top level process view has various lower level process views such as separate views for each Azimuth Thruster, Tunnel Thruster, Main propulsion unit. Additionally lower process views are used if there are insufficient space in the upper levels to show the necessary details.

Azimuth thruster view

- An **Azimuth Thruster** view typically shows the status, condition, measurement and alarm information for the azimuth thruster, thruster motor and associated pumps and valves.

  From each **Azimuth Thruster** view the operator can:

- **Start**/ **Stop** the thruster with or without sequence control.
- Manually **Start**/ **Stop** the thruster.
- Manually control the thruster-propeller azimuth, **Pitch** and/or **rpm** (speed)
- Manually control the auxiliary equipment of the thruster.

Tunnel thruster view

- A **Tunnel Thruster** view shows the status, condition, measurement and alarm information for the Tunnel Thruster. The thruster motor and associated pumps are also normally shown.

  From each **Tunnel Thruster** view the operator can:

  - Manually **Start**/ **Stop** the thruster, with or without sequence control.
  - Manually control the thruster-propeller **Pitch** and/or **rpm** (speed).
  - Manually control the auxiliary equipment of the thruster.

Main propulsion view

- A **Main propulsion** view shows for each unit installed on the vessel.

  From each **Main propulsion** view the operator receives information concerning:

  - The status, condition, measurement and alarm information for the main propulsion unit
  - The status, condition, measurement and alarm information for the thruster engine and associated equipment.

  The main propulsion process image typically allows you to:

  - **Start**/ **Stop** the main propulsion unit with or without sequence control
  - Manually control the main propulsion-propeller **rpm** (speed), and/or **Pitch**
  - Manually control the auxiliary equipment of the main propulsion unit.
  - Optionally, control the **Rudder angle**.

Lower level process view

Additional process views that show detailed information about the thruster and propulsion system may also be configured. These are being used if there is insufficient space in the upper levels to show the necessary details.

These lower level process images can be viewed by:

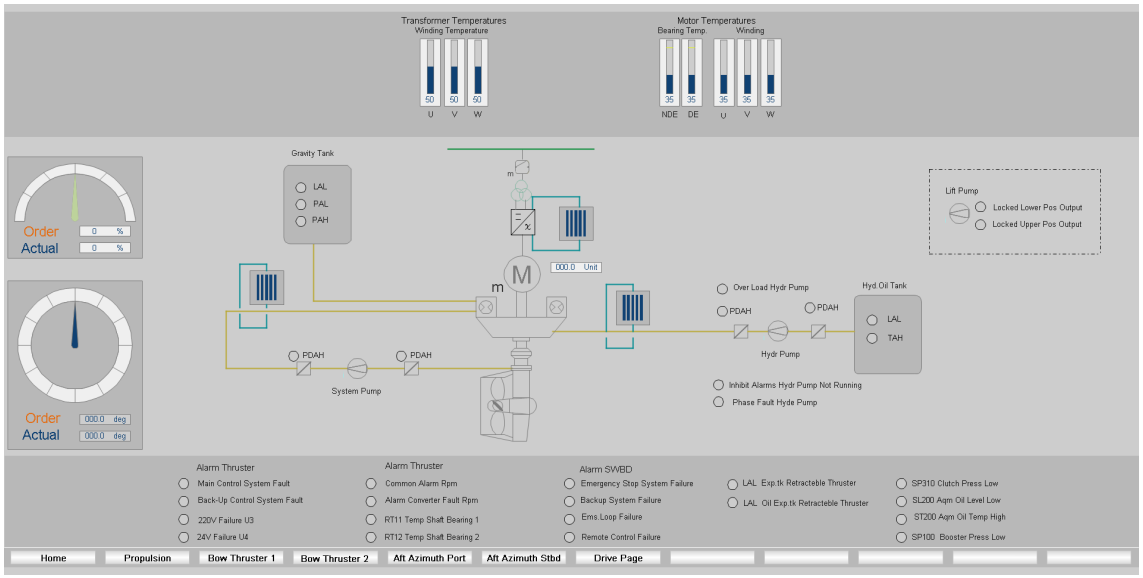
- Clicking a hot spot on the thruster/propulsion process image or, where applicable, one of the other lower level process images.
- Using the navigator. For more information see the **Toolbars** section in the **Operator Station** topic, in the online AIM User Guide (F1).
- Clicking the **NAVIGATOR (VIEW MAP)** button in the operator panel.

5.2 Azimuth thruster process view

The example of an **Azimuth Thruster** process view shown in the following figure presents the status, condition, measurement and alarm information for the actual azimuth thruster, thruster motor and associated pumps and valves. The contents and complexity of the process views depends on the type of thruster and control (azimuth, pitch and/or rpm) available.

To open this view, press the appropriate **Thruster object** or **button** in the Propulsion Process view.

Figure 68 Example of a Azimuth Thruster view for a Offshore Construction Vessel (OCV)



Depending on the type of azimuth thruster and auxiliary equipment installed, the following subsystems may also be shown:

- The thruster electric motor, current consumption and winding temperature measurements.
- The auxiliary hydraulic equipment, pump status, fluid pressure and temperature measurements.
- The thruster control mode plus facilities for manual and sequence control together with azimuth, pitch and/or rpm measurements.
- Status indicators can be shown in the process image to indicate operational and fault conditions. If there is not enough space, these indicators are placed on a separate Thruster Safety process view.

Note

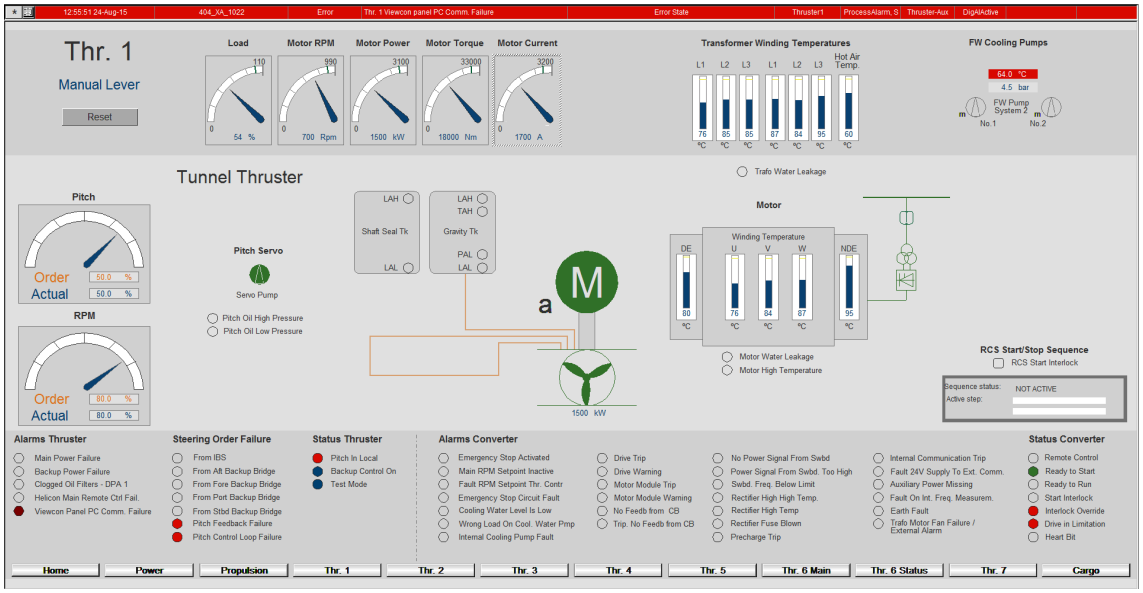
If an azimuth thruster is enabled and controlled by a K-Pos or K-Thrust system, the K-Chief 700 Maintenance mode is disabled. However, when the thruster motor is stopped, the K-Chief 700 system can be used to test the thruster start/stop sequences. In general, this only affects the auxiliary equipment of the thruster, the thruster is not started.

5.3 Tunnel thruster process view

An example of a **Tunnel Thruster** view is shown in the figure below. This view is divided into several areas that presents the subsystems of the tunnel thruster, however what is shown depends on the type of thruster and which type of control (**pitch** and/or **rpm**) available.

To open this view, press the appropriate **Thruster object** or **button** in the **Propulsion** Process view.

Figure 69 Example of Tunnel Thruster process view for a Offshore Supply Vessel (OSV)



Depending on the type of tunnel thruster and auxiliary equipment installed, the following subsystems may also be shown:

- The thruster electrical motor, current consumption and winding temperature measurements can also be shown.
- The auxiliary hydraulic equipment, pump status, fluid pressure levels and temperature measurements can be shown.
- The thruster control mode, the controls for manual and sequence control, and the pitch and/or rpm measurements can be shown.

- A number of status indicators may appear on the image to indicate operational and fault conditions. If there is not enough space, these will however be placed on a separate Thruster Safety Process view.

Note

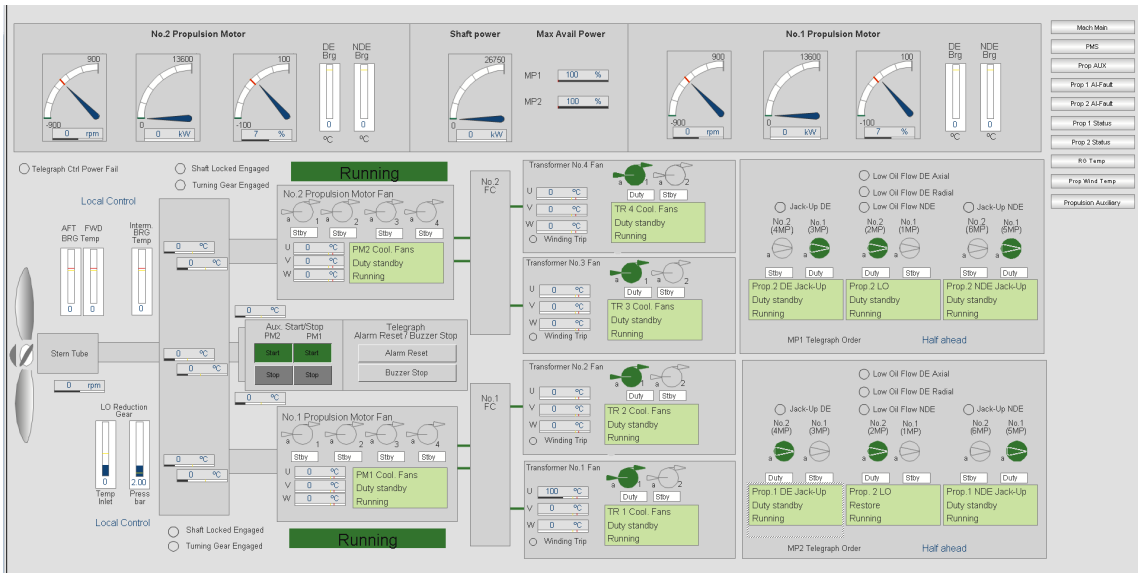
If a tunnel thruster is enabled and controlled by a K-Pos or K-Thrust system, the K-Chief 700 Maintenance mode is disabled. However, when the thruster motor is stopped, the K-Chief 700 system can be used to test the thruster start/stop sequences. In general, this only affects the auxiliary equipment of the thruster, the thruster is not started.

5.4 Main propulsion process view

An example of a **Main propulsion** process view is shown in the figure below. This process view is divided into several areas that provide information concerning the subsystems of the main propulsion unit. The contents of the process image depend on the type of main propulsion unit and type of control (rpm and/or pitch or rudder) available.

To open this view, press the **Drive** button in the **Azimuth/ Tunnel Thruster** process view.

Figure 70 Example of electrical Main propulsion process view for a LNG Carrier



For an electrically driven main propulsion unit, the motor together with bearing, temperature and winding temperature measurements, and pump and cooling fan status may be shown.

For a mechanically driven main propulsion unit, the following information is given:

- The thruster engine exhaust gas temperature and deviation
- Liner and bearing temperatures
- Crankcase pressure.

In addition, the following information can be given:

- Temperature and pressure of fuel oil
- Temperature and pressure of lubrication oil
- Temperature and pressure of cooling water
- Temperature and pressure of the charge air
- Temperature and pressure of the starting air.

For controllable pitch propellers (CPP), the following information is shown:

- The auxiliary hydraulic equipment
- Hydraulic pump status
- Pressure and temperature of the hydraulic fluid

Optionally, the following information can be shown:

- The main propulsion unit control mode
- Controls for manual and sequenced control
- Pitch and/or rpm measurements
- Rudder position measurements.

Status indicators can be shown on the process image to indicate operational and fault conditions. If there is not enough space, these are shown on a separate main propulsion safety process image.

5.5 Thruster/propulsion control

The local thruster/propulsion controllers are installed close to the thruster/propulsion drive units. They control and monitor the drive units and auxiliary equipment.

5.5.1 Thruster start/stop sequences

When the **K-Thrust** console gives a thruster start and stop request, a sequence of checks is done before the thruster is started or stopped.

Before starting the thruster, start interlock conditions such as brakes or critical process alarms are checked. If no such conditions are present, the **Ready to start** lamp is lit. If there is not enough electrical power capacity available, the K-Chief 700 system automatically requests the PMS application to start another generator. Any auxiliary equipment is started and the thrust is set to zero. If all of the process conditions are correct, the drive motor starts, if the thruster is not set in the **Maintenance** mode. If the thruster fails to start before the start timeout expires, a **Start failure** alarm is given.

The stop sequence:

- Reduces the thrust to zero
- Stops the thruster drive motor
- Stops the auxiliary pumps.

If the thruster does not stop before the thruster stop timeout expires, a **Stop failure** alarm is given.

5.5.2 Auxiliary equipment control

The auxiliary equipment supported by the K-Chief 700 system depends on the configuration of the thruster/propulsion system installed on your vessel.

The most common types of auxiliary equipment are:

- Hydraulic valves
- Hydraulic pitch pumps
- Hydraulic azimuth/steering pumps
- Lubrication pumps
- Cooling water pumps
- Cooling fans.

Starting and stopping the pumps and fans and opening and closing the valves is normally part of the automatic thruster/propulsion start and stop sequences. These sequences are initiated from the **K-Thrust** console. In the **Maintenance** mode, you can control the auxiliary equipment using the applicable module operation menu.

Pumps that are critical to the process can have a redundant standby pump. The standby pump logic is incorporated into the K-Chief 700 thruster/propulsion application.

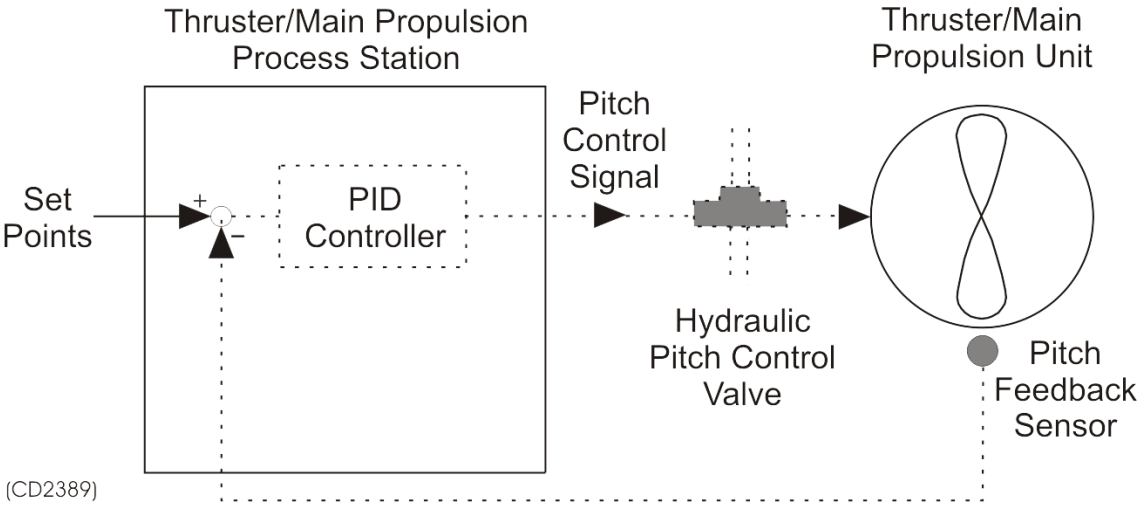
5.5.3 Pitch control

Servo control of the pitch can be done internally through the control logic in the applicable process station, or externally by a Local Control Unit.

If the process station for the thruster/main propulsion contains the pitch servo loop, the setpoints are received from the K-Thrust/ K-Pos or K-Chief 700 system through the network. A PID controller compares the pitch feedback from the thruster/main propulsion unit against setpoint value from the K-Thrust/ K-Pos or K-Chief 700 system and controls the hydraulic pitch valve accordingly. For more information see the section *PID controller modules* on page 70.

The principle of pitch follow-up (servo) control via a thruster/main propulsion Process Station is illustrated in the following figure:

Figure 71 Servo control of the pitch by a process station



Manual pitch control, which is implemented by means of the commands on the PID controller module operation menu, is only possible in the **Maintenance** mode. See the section *Maintenance mode* on page 113 and the section *Typical procedures* on page 114.

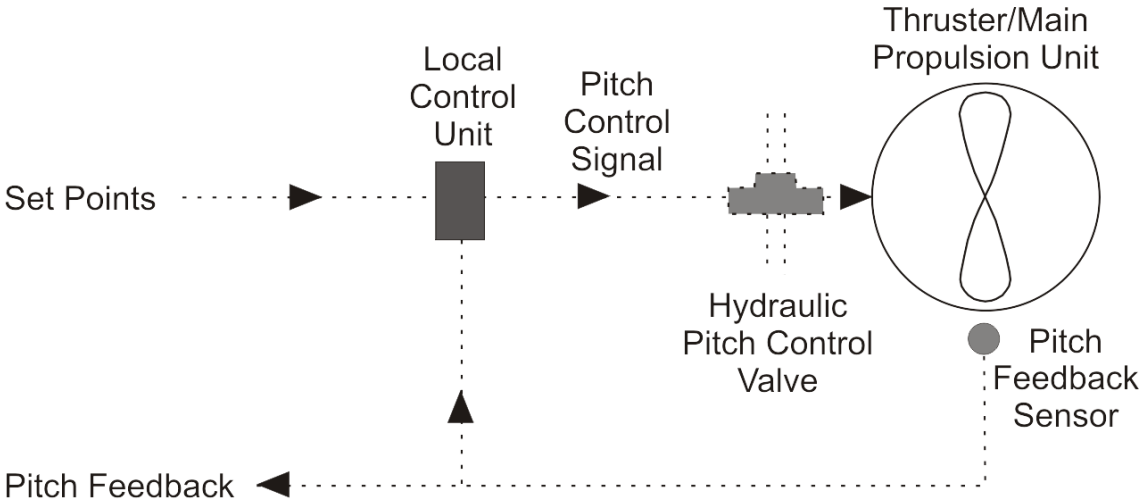
If, after a predefined timeout period, no more setpoints are received by the thruster/propulsion Process Station, the pitch is automatically reduced to zero. The pitch setpoint is also reduced to zero when a thruster/propulsion start or stop is requested.

For electrically driven thrusters, the motor current is monitored so that if it exceeds a specified limit, the pitch is temporarily reduced before it is gradually stepped back to the commanded setpoint.

If the Local Control Unit contains the pitch servo loop, setpoints are received cyclically from the K-Thrust/ K-Pos or K-Chief 700 system via the dual communication network. The Local Control Unit compares the pitch feedback from the thruster/main propulsion unit against setpoint value from the K-Thrust/ K-Pos or K-Chief 700 system and controls the hydraulic pitch valve accordingly. The pitch feedback from the thruster/main propulsion unit is also sent to the K-Thrust/ K-Pos or K-Chief 700 system for monitoring purposes.

The principle of pitch follow-up (servo) control by a Local Control Unit is illustrated in the following figure:

Figure 72 Pitch servo control by a Local Control Unit



Local (non follow-up) control is normally achieved by means of control handles on the local hydraulic-pitch valve control unit or tailor-made control panels interfaced to the hydraulic-pitch valve control unit.

5.5.4 Azimuth control

Azimuth follow-up (servo) control may be performed internally via the control logic in a thruster/main propulsion Process Station or externally by means of a Local Control Unit.

The follow-up (servo) control for the azimuth angle is similar to that described for pitch control. The feedback angle is normally monitored by a sine/cosine potentiometer.

Manual azimuth control, which is implemented by means of the commands on the PID controller module operation menu, is only possible in the **Maintenance** mode.

5.5.5 Speed (rpm) control

Speed (rpm) control is usually always done through a local control unit similar to that used for pitch control.

5.5.6 Maintenance mode

The **Maintenance** mode is used during system installation, maintenance and fault finding, and can be selected for each thruster individually from the Operator Stations.

When in **Maintenance** mode, the individual units in the thruster/propulsion system such as pumps, valves, motors and so on can be checked and manually controlled from the Operator Station. For more information see the chapter *Basic Monitoring and Control* on page 37.

Tuning and adjustments of pitch, rpm and azimuth controllers for each thruster or main propulsion unit can be carried out while in the **Maintenance** mode. Dedicated Trend images will normally be available so that they can be used as an aid when tuning and adjusting pitch, rpm and azimuth controlled thrusters and main propulsion units.

Caution

All pitch and azimuth servo loop controllers are tuned during thruster/propulsion commissioning prior to vessel delivery. Under NO circumstances should any attempt be made to readjust these controllers without first consulting Kongsberg Maritime.

5.5.7 Safety

Emergency Stop buttons that are connected directly to the starter control circuits by hard wiring may be provided for each thruster. If installed, these are normally located on a panel near the K-Thrust Operator Station.

Control and feedback signals for pitch and azimuth are monitored, and any failure in these signals will normally stop the thruster. The control actions taken depend on the application and the type of thruster system. Deviations outside a specified limit between setpoint and feedback values over a certain time will cause an alarm to be generated. For sine/cosine measurements, an alarm will be generated if the two signals do not match. Equipment protection systems can shutdown the thruster unit. See the KFDD for Thruster control supplied for the project.

5.5.8 Zero pitch

The Zero pitch control function is only available for pitch controlled tunnel thrusters. This function, which is usually enabled by a **ZERO PITCH FUNCTION** button in the **Thruster Process** image, automatically sets the pitch of a stopped thruster to zero.

Normally, when a thruster is stopped, its pitch setting is maintained. However, when the Zero pitch control function is enabled, it checks the pitch and if it is other than zero, the function automatically starts the hydraulic pumps, reduces the pitch to zero and then stops the hydraulic pumps.

5.5.9 Alarm monitoring

Alarms in the Propulsion Control application images are monitored and displayed in the same way as for all other images (See the **Alarms and messages** topic in the online AIM User Guide).

5.6 Typical procedures

The following procedures are examples and only intended to illustrate the interaction between the operator and the **Propulsion Control** application for typical tasks.

Note

The operation menus may differ depending on the software version of the function module in question.

5.6.1 How to change pitch setpoint

The following procedure describes how to change the pitch setpoint for a thruster or main propulsion unit propeller.

Note

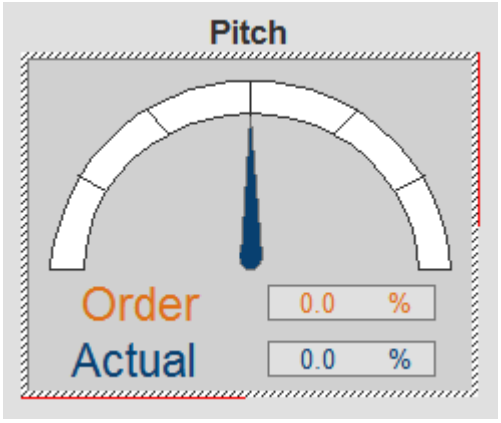
It is assumed that no alarms or other conditions blocking the operation of the thruster or main propulsion unit, are active.

If the thruster/main propulsion pitch can be operated using a **SET PITCH** button, proceed as follows:

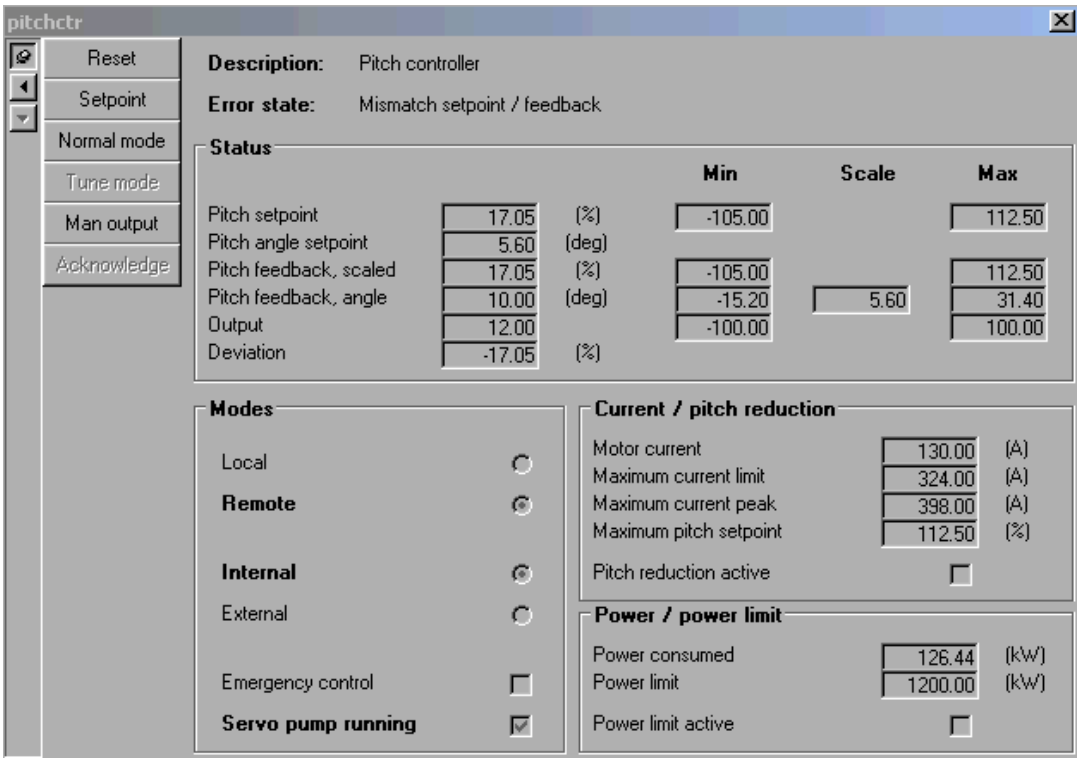
1. Display the appropriate Thruster or Main Propulsion Process image.
2. Observe the displayed information for the thruster or main propulsion unit.
3. If applicable, ensure that the Operator Station has command control of the thruster command group (See the **Command Control** topic in the online AIM User Guide).
4. If the thruster is under K-Thrust/ K-Pos control, press the **DP CONTROL/MAINTENANCE MODE** toggle button on the Thruster Process image:

   The **Maintenance** mode is selected for the thruster or main propulsion unit.
5. Start the necessary auxiliary machinery.
6. Make sure that the thruster motor is not running.
7. Press the **PITCH CONTROLLER** button/symbol:

   A **Numeric input** dialog box opens:



8 Change the displayed value to the required pitch value (in positive or negative %) and click the **OK** button.

The **Numeric input** dialog box is closed and the ordered pitch symbol changes to indicate the entered value.

As the pitch of the propeller changes to the given pitch value, the pitch symbol shows the new pitch value.

5.6.2 How to change azimuth setpoint

The following procedure describes how to change the azimuth setpoint for an azimuth thruster.

Note

It is assumed that no alarms or other conditions blocking the operation of the thruster or main propulsion unit, are active.

If the thruster/main propulsion pitch can be operated using a **SET AZIMUTH** button, proceed as follows:

1 Display the appropriate **Azimuth Thruster Process** image.

2 Observe the displayed information for the thruster.

3 If applicable, ensure that the Operator Station has command control of the thruster command group (See the **Command Control** topic in the online AIM User Guide).

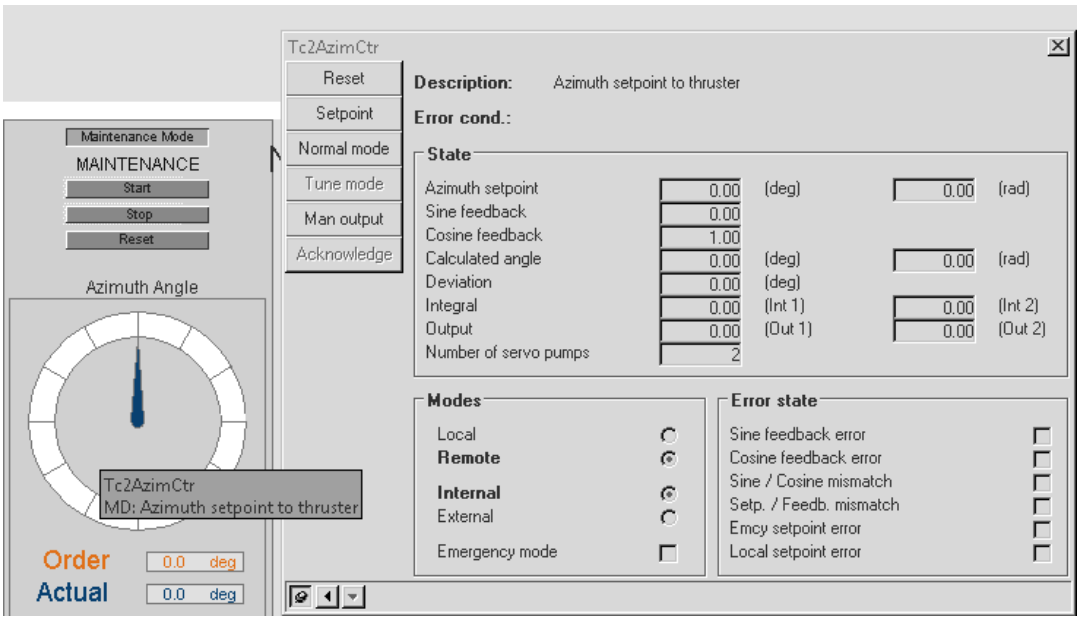
4 If the thruster is under K-Thrust/ K-Pos control, click the **DP CONTROL/ MAINTENANCE MODE** toggle button on the **Thruster Process** image.

The **Maintenance** mode is selected for the thruster or main propulsion unit.

5 Start the necessary auxiliary machinery.

6 Make sure that the thruster is not running.

7 Press the **Azimuth Angle** symbol.



A **Numeric input** dialog box is opened.

8 Change the displayed value to the required azimuth value (0 to 360) and then press the **OK** button.

The **Numeric input** dialog box closes and the azimuth symbol shows the new value.

As the thruster azimuth angle changes to the given value, the azimuth symbol shows the new value.

6 Liquefied Natural Gas (LNG)

The Liquefied Natural Gas (LNG) application is a monitor and control facility covering the onboard LNG system.

The LNG application will usually provide the functions for the following main systems:

- Cargo control
- Gas management
- Gas handling
- GCU control.

The configuration and functions of any LNG system will, however, depend on the vessel concerned, and the design and specification of the actual LNG system.

The application is controlled by the K-Chief 700 system. Operation of the LNG application will normally be performed at one of the Operation Stations (OS) which are divided into the following OS groups:

OS groups	Main control
CCR	Common, Cargo, Ballast, Gas Handling and System control
ECR	Common, GCU, Power, Machinery and Fire control
Bridge	Common and Navigation control.

The control of all valves, heaters, cargo/spray pumps, vaporizers, compressors is integrated in the K-Chief 700 system and monitored by the OSs. All monitoring and control functions are available to the operator at each OS by viewing relevant process images. The operational control is, however, normally restricted to one command location (OS group) by means of the Command transfer function (see *Command Control* topic in the online AIM User Guide). See also the chapter *Basic Monitoring and Control* on page 37 for general information.

All deck piping instruments (pressure, temperature, flow) and valve position indicators are interfaced to K-Chief 700 by remote input or output units approved for installations in hazardous areas. Process control stations for control of compressors, heaters and vaporizers are normally installed in the Cargo Equipment Room (CER).

6.1 LNG Cargo control

The K-Chief 700 system includes the following interface or controls:

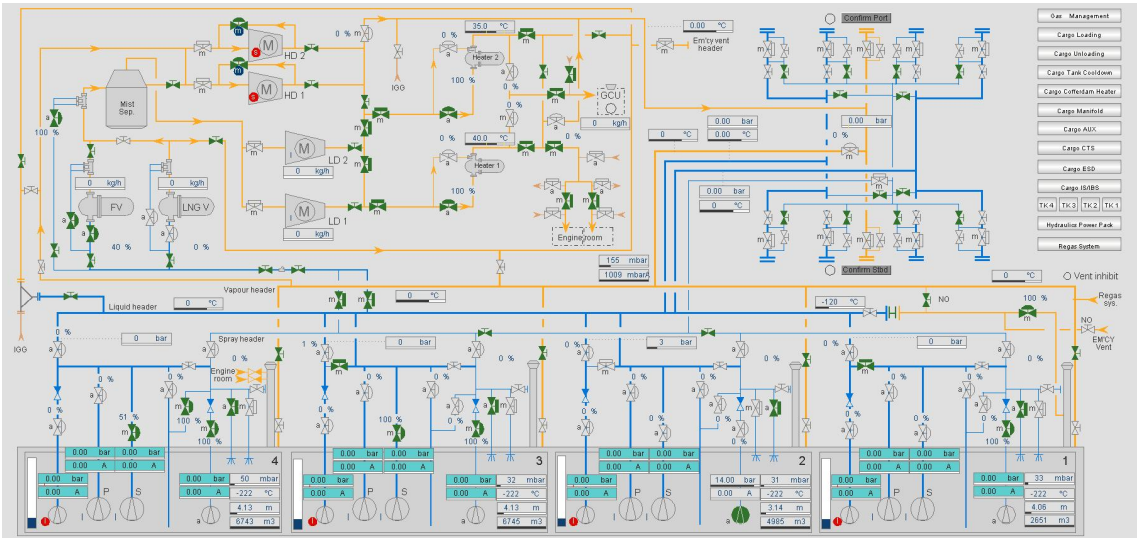
- Interface to tank level gauge
- Pump control
- Valve control.

The cargo plant is controlled from the K-Chief 700 system. Control is performed from the OS in the CCR, and monitoring is available from all the K-Chief 700 OSs.

Depending on the configuration, one or more process images may be configured and viewed, and be accessed by means of hot spots, one for each process image of the system. The process image visualizes the cargo control subsystem and is accessed via the Cargo-Plant Process image.

A typical Cargo-Plant Process image is shown as follows:

Figure 73 Typical DFE Cargo-Control Process image



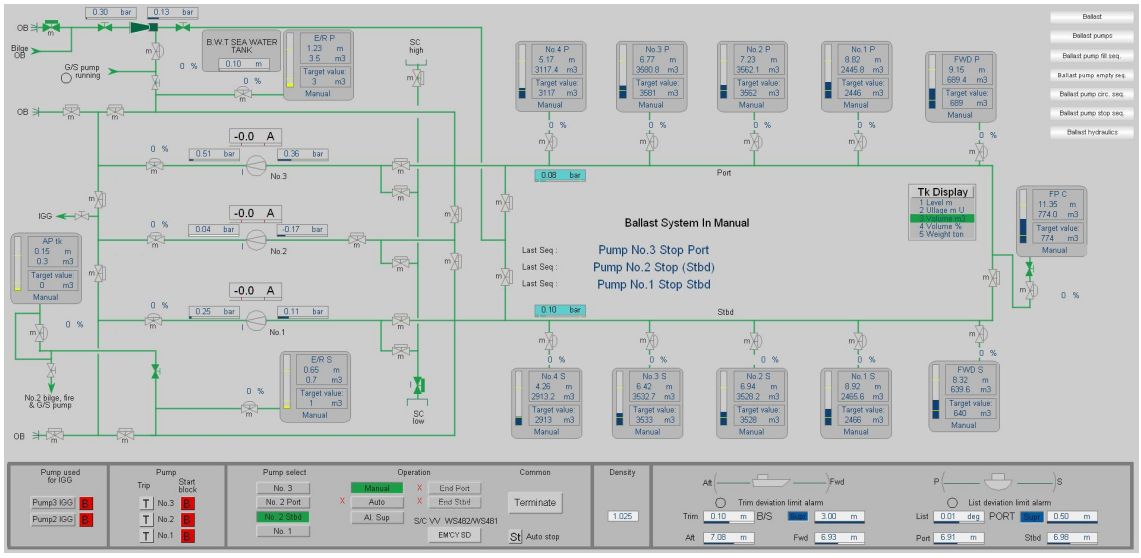
From the Cargo-Plant Process image you can monitor the deck piping instruments (sensors for pressure, temperature and flow) and valve position indicators. Temperature pressure sensors in void spaces are interfaced to the K-Chief 700 by means of barriers installed in the Process Stations.

6.2 Ballast Control

The Ballast Control function usually has one single main Process image that visualizes the entire ballast system. From this image you can monitor the tank levels of all vessel fluids used as ballast, and control the ballast system pumps and valves. It will also show vessel heel and trim data and, if installed on the vessel, include facilities for communicating with and showing values from an online Load and Stability Calculator.

A typical Ballast Process image is shown in the following figure:

Figure 74 Typical Ballast Process image - example



System and alarm status can be viewed in more detail by selecting a second (lower) level Process image. The contents of this second (lower) level Process image will depend on the equipment installed on board the vessel.

The Ballast Control function comprises the following:

- Manual control
- Automatic control

Manual Ballast Control

In manual mode the operator can start/stop pumps and open/close valves by operating on the selected pump or valves from the operator station.

The ballast pump safety system is also working in manual mode.

Automatic Ballast Control

In automatic mode all valves and pumps will be set to automatic control. The control of valves and pumps are then performed by the sequential logic described in the following sections. Automatic ballast/de-ballast sequence.

The operator can terminate an automatic ballast operation at any time by operating one of the **terminate** buttons on the Ballast mimic. A terminate action stops any sequence that is running and starts a stop sequence to close all tank and line valves and stop the duty pump(s).

6.3 Gas management

The LNG Gas management system is controlled from the K-Chief 700 system. Control is performed from the OS in the CCR, but operating responsibility can be transferred to the other K-Chief 700 operator stations when required. Monitoring is available from all the K-Chief 700 OSs.

The Gas Management System contains the following main functions:

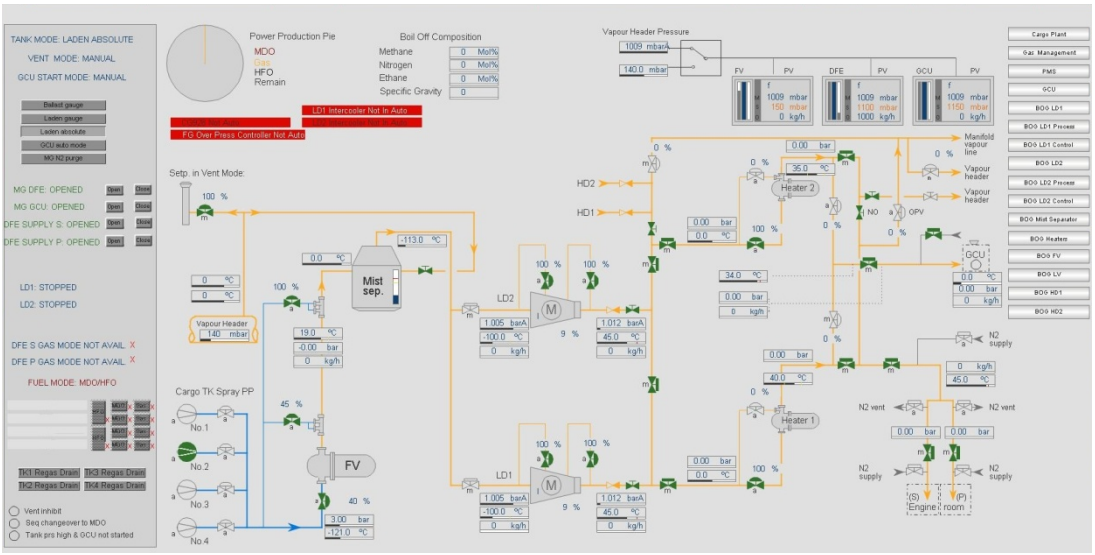
- Tank pressure control
- Fuel mode controls
- Fuel supply control to Dual Fuel Engines according to demand
- Fuel supply control to GCU according to tank pressure
- Vent control

Depending on the configuration, one or more process images may be configured and viewed, and be accessed by means of hot spots, one for each system process image. These process images visualizes the gas management subsystems and can be accessed via the Gas-Management Process image.

From the Gas-Management Process image you can monitor all the control of valves, heaters, vaporizers and compressors. All deck piping instruments (pressure, temperature and flow) and valve position indicators are interfaced to K-Chief 700 by remote input or output.

A typical Gas-Management Process image is shown as follows:

Figure 75 Typical DFE Gas-Management Process image



The Gas Management System will try to keep the cargo tank pressure within normal operation limits. It also includes safety function if the tank pressure exceeds the normal operation limits.

The cargo tank pressure is controlled by calculating the NBO by means of the tank pressure controller. The calculated NBO signal is used to calculate the DFE gas loading.

6.4 Gas handling

The gas-handling plant consists of the following main equipment:

- **Low-duty gas compressor control**

  The main task for the low-duty gas compressors is to compress the boil-off gas from the cargo tanks to a pressure sufficient for the burners. The main task of the LD Compressor control logic is to maintain a stable operating point for the fuel gas control valve.

- **High-duty gas compressor control**

  The high-duty gas compressors are used for return of vapour to shore during loading, tank purging and tank warming up. The HD compressor control must maintain a stable vapour main pressure during these operations.

- **Forcing vaporizer control**

  The forcing vaporizer is used to produce extra LNG gas, either to increase the LNG gas rate to the burners or to increase the cargo tank pressure.

- **LNG vaporizer**

  During unloading, the volume of unloaded LNG has to be replaced, either from shore via the vapour crossover header or, if LNG gas is not supplied from shore, by using the LNG vaporizer. The LNG vaporizer is also used for vaporizing N2 for purging of tanks.

- **Boil-off gas heating**

  The main purpose of the vapour heaters is to heat the boil-off to be used as fuel gas during voyage.

6.5 GCU control and monitoring

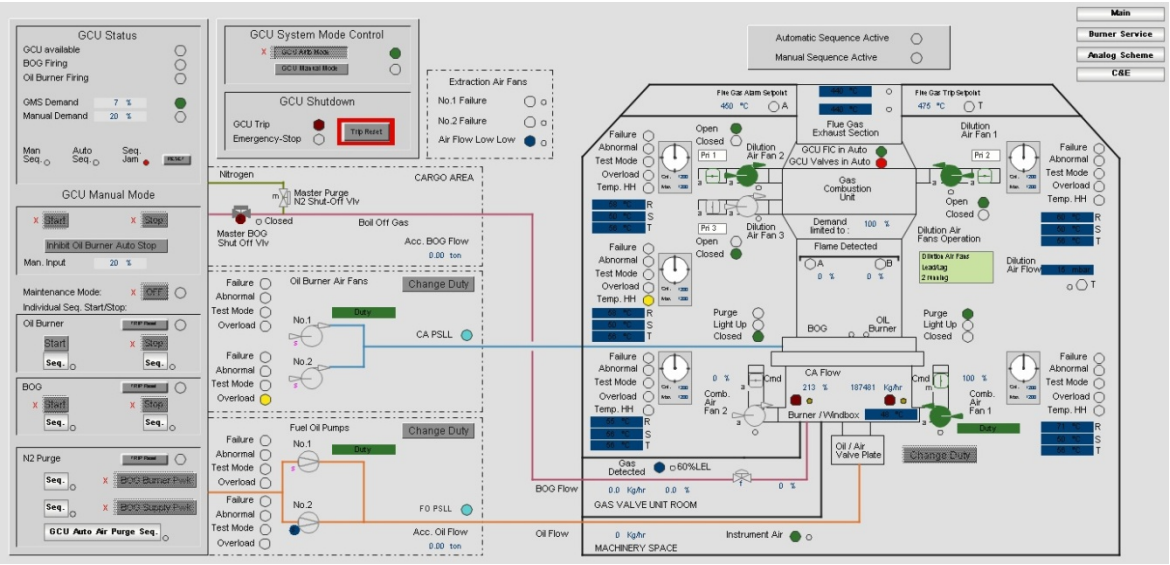
The GCU control is controlled from the K-Chief 700 system. Control is performed from the OS in the ECR while monitoring is available from all the K-Chief 700 OSs.

Depending on the configuration, one or more process images may be configured and viewed, and be accessed by means of hot spots, one for each process image of the system. The process image visualizes the GCU control subsystem and is accessed via the GCU-Control process image.

6.5.1 Control

A typical GCU-Control process image is shown as follows:

Figure 76 Typical GCU Control process image



The GCU operation panel contains buttons of control of sequences and lamps for feedback.

The process image is divided into process areas, which describes different subsystems of GCU control. The exact configuration will depend on the type of boiler control.

The GCU control normally consists of a process station and a cabinet located in the engine room.

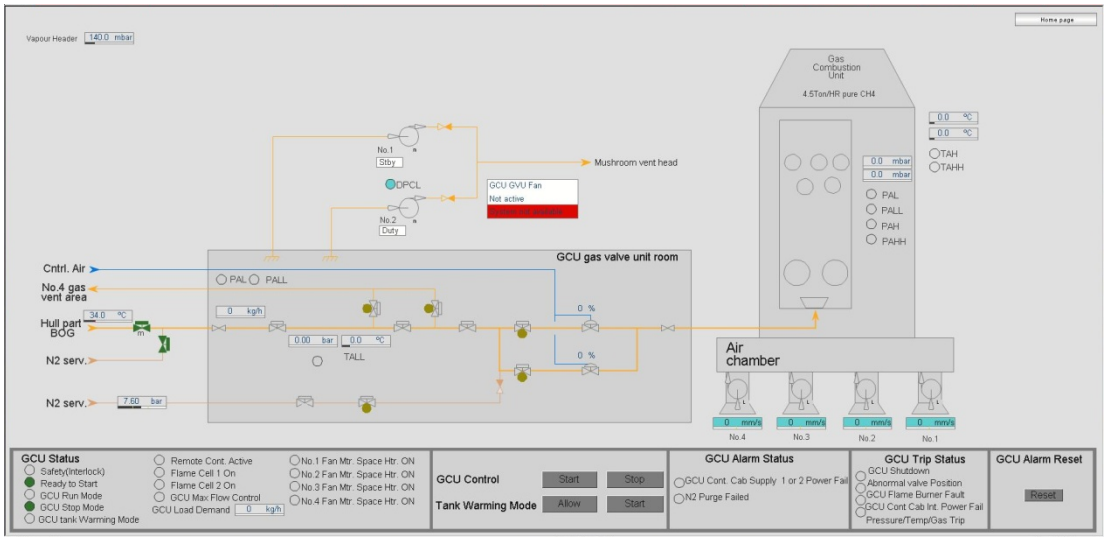
GCU control main functions:

- Start / Stop of oil burner
- Start / Stop of gas supply
- Nitrogen purge of gas lines
- GCU shut down system

6.5.2 Monitoring

In some projects, boiler control is performed by the GCU manufacturer. In these cases the K-Chief 700 system is interfaced to the GCU control and performs monitoring and alarm initiation. A typical GCU-Monitoring process image is shown as follows:

Figure 77 Typical GCU Monitoring process image



7 Redundancy and Criticality Assessment System

The Redundancy and Criticality Assessment (RCA) application is a integrated online fault monitoring and evaluation application that monitors and confirms that the required resources for a specific operational control mode are available.

First, the RCA verifies that the equipment is set up correctly according to the intended mode before it continuously verifies that the equipment is working correctly. Secondly, the RCA monitors and reports the status of all standby equipment to provide the operator with an overall redundancy status. When a malfunction is detected, the status is reported in the **RCA System Process** view (see figure below) according to the criticality of the event.

To open the **RCA System Process** view from the menu bar, select **View →RCA System Process**.

Figure 78 Example of RCA System Process view

The **RCA System Process** view is often divided into four parts; **Mode Control**, **Equipment State Diagram**, **Mode Transfer** and **Event Presentation** that provides facilities for operational mode control and visualization of the status of all the involved equipment, both Process Units (PU) such as Thrusters (**Thr**^{n}), Generators (**G**^{n}) with power buses and Main Engines (**ME**^{n}) together with Subsystems (**SS**) symbols that represent the various auxiliary systems associated with each PU.

7.1 RCA user interface

The user interface for the RCA application is divided into the following main parts:

- *Equipment State* on page 126
- *Mode Control* on page 130 (optional)
- *Mode Transfer* on page 134 (optional)
- *Event presentation* on page 135 (optional)

7.1.1 Equipment State

The example of the **Equipment State** part of the RCA system process view as shown in the figure below allows for monitoring of the overall status of all the PUs and associated SSs that are involved with the various Vessel Control modes.

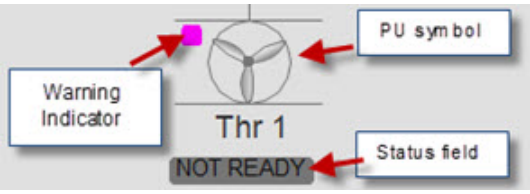
Each PU and each of the associated SSs are controlled by special RCA modules whose tag names are prefixed with 'pu_' for PUs and 'ss_' for SSs.

Figure 79 Equipment State Diagram

7.1.1.1 Process Unit status

The current state of the equipment monitored by a PU (pu_) module is indicated by means of the color of the PU module symbol, a status field and a warning indicator. The arrangement of these status indications for a thruster is shown in the figure below.

Figure 80 PU status indications



The state of each PU is indicated by the color of the PU symbol, the text and the background color in the status field adjacent to the PU symbol and a warning indicator as listed in the tables below.

Table 4 Process Unit Symbol state indications

Color	Status Field	State
Green	**IN SERVICE**	The PU is running correctly with all SS requirements fulfilled.
White	**READY**	All SS conditions for "ready to start" are fulfilled.
White	**STANDBY**	The PU is **IN STANDBY** state (only indicated if the PU has a standby state).
Grey	**NOT READY**	The PU or one of its SSs are **NOT READY**.

Note

The background color of the status field is always the same as the color of the PU symbol.

Table 5 Process Unit Warning Indicator

Color	State
Magenta	PU tripped or conditions exist that will quickly implement a trip.
Red	Major fault in the PU. Example: a High High (HH) or Low Low (LL) alarm condition, as defined in the appropriate RCA-PU State Diagram (See section *State diagrams* on page 136) is active.
Yellow	Minor fault in the PU. Example: a High (H) or Low (L) alarm condition, as defined in the appropriate RCA-PU State Diagram (See section *State diagrams* on page 136) is active. SS requirements warning.

7.1.1.2 Subsystem status

The current state of the equipment monitored by a subsystem (ss_) module is indicated by means of the background color of the four fields that make up the SS module symbol as shown in the figure below.

Figure 81 Subsystem state indications

- Field A indicates the state of the subsystem by the colors detailed in the table below.

Table 6 Sub-system states indicated by Field A

Color	State
Green	The SS is **IN SERVICE** and the critical criteria for "SS running" are fulfilled.
White	The SS is **READY** and the critical criteria for "SS ready" are fulfilled.
Grey	The SS is **NOT READY** for operation, i.e. one or more of the critical criteria for "SS running" or "SS ready" are not correct.

- Field B indicates the state of the subsystem by the colors detailed in Table 7 (in order of priority).
  - Not required (highest priority)
  - Tripped warnings
  - Major warnings
  - Minor warnings
- Field C indicates the state of the subsystem by the colors detailed in Table 7 (in order of priority).
  - Standby equipment not ready warnings (highest priority)
  - Tripped warnings
  - Major warnings
  - Minor warnings

Note

Field C is only used when Field B indicates "Not required".

Field D indicates the state of the subsystem by the colors detailed in Table 7 (in order of priority).

- Standby equipment not ready warnings (highest priority)
- Not required
- Tripped warnings
- Major warnings
- Minor warnings

Note

If more than one warning is active, the warning with the highest priority is always indicated.

Table 7 Subsystem states indicated by Fields B, C and D

Color	State
Magenta	SS tripped, or conditions exist that will quickly implement a trip.
Red	Major fault in the SS. For example, a High High (HH) or Low Low (LL) alarm condition, as defined in the appropriate RCA-SS State Diagram is active (See the*State diagrams* on page 136).
Yellow	Minor fault in the SS. For example, a High (H) or Low (L) alarm condition, as defined in the appropriate RCA-SS State Diagram (See the is active *State diagrams* on page 136).
Cyan	The required SS standby equipment is **NOT READY**.
Grey	There are no active requirements for the SS.
Same color as Field A	There are no warnings.

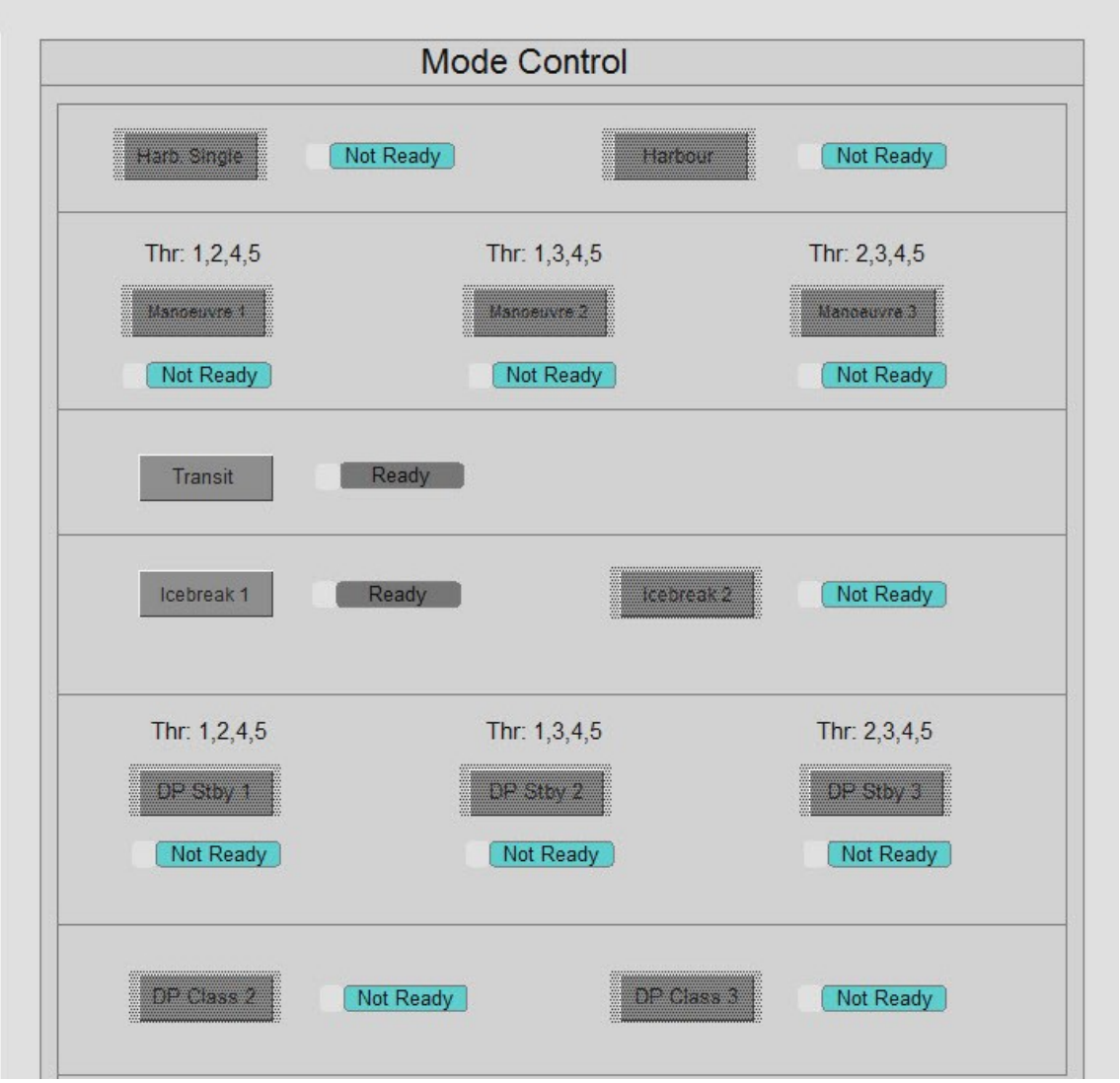
The current state of the PU and SS equipment can also be viewed by selecting the appropriate level of Process view for the particular items of equipment. For example, the **Generator Set Process** view for a diesel generator.

Details of the equipment state requirements for each PU and SS can be viewed by displaying the **Module Parameters** dialog box (See the **Module Editor** topic in the online AIM User Guide) for the module symbol of the corresponding PU or SS.

7.1.2 Mode Control

The example of the **Mode Control** part of the RCA system process view as shown in the figure below comprise an overview of the vessels available RCA modes (project dependant) including their corresponding mode control buttons each with an adjacent status field.

Figure 82 Mode Controls including buttons and status field, Example



The example provided in this figure includes the available modes listed in the table below, however these configuration modes are project dependant and may therefore deviate from what is installed on your vessel.

Table 8 Example of available RCA modes

Mode	Operation	Setting
Harbour Single	In harbour - No propulsion active	One generator running on one diesel (other diesel in set is de- clutched)
Harbour	In harbour - No propulsion active	One generator running on one diesel set
Manoeuvre mode 1-3	Manoeuvring to/from quay or in open sea	2 bow thrusters, both azipods, four generators

Table 8 Example of available RCA modes (cont'd.)

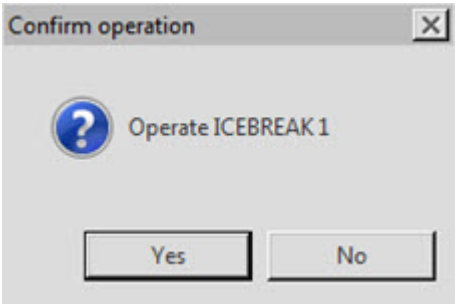
Mode	Operation	Setting
Transit mode	Transit	Both azipods, 2 generators
Icebreak 1-6	Icebreaking	Both azipods, 1-6 generators
DP Standby 1-3	Waiting for DP operations	2 bow thrusters, both azipods, two generators, DP system OK
DP Class 2	DP Class 2 operations	All thrusters, four generators, closed bus tie
DP Class 3	DP Class 3 operations	All thrusters, four generators, open bus tie

The **Mode Control** buttons allow the operator to:

- Select the initial Vessel Control mode provided that the required equipment is running.
- Deselect the chosen Vessel Control mode and enter a 'no Vessel Control mode'.
- Change the chosen Vessel Control mode and start an equipment start/stop sequence program.

Provided that all the required equipment is running and that the their state requirements are met, the operator can select the initial Vessel Control mode by means of the appropriate Mode control button. Once selected, a **Confirmation Operation** dialog box for the chosen mode (**ICEBREAK 1** in Figure 83) is shown.

Figure 83 Confirm operation dialog box



7.1.2.1 Vessel Control mode state

The state of each Vessel Control mode is indicated by the text and the background color in the Mode status field adjacent to the mode control button as listed in the table below.

Table 9 Vessel Control mode state indications

Mode	Color	State
Not Ready	Grey	One or more of the PUs required for the mode are not in a legal state, hence the Vessel Control mode cannot be selected.
Ready	White	The equipment state requirements have been met. Once a Vessel Control mode is selected, a predefined sequence of equipment start/stop is performed provided that an automatic mode control program is applied.
Blocked	Grey	The control mode is blocked, i.e. the Vessel Control mode cannot be selected due to the current system set up, or because another mode is in the selected state. The required system set up is defined during the configuration of the Vessel Control mode modules.
In Service	Green	The equipment state requirements have been fulfilled and the selected Vessel Control mode is running.
Invalid	Red	The Vessel Control mode has changed to **Invalid** because one or more of the equipment state requirements was not fulfilled when **In Service** was activated or because the equipment start/stop sequence program has aborted. If an **Invalid** state occurs after a mode has been established, the mode requirements are kept. This means the power system requirements will be maintained if, for example, one of the thrusters fails. The **Invalid** state will change to **Ready** or **Not Ready** when another mode is selected.
Selected	Yellow	The Vessel Control mode has been selected but not fully established, i.e. the equipment start/stop sequence program is still being performed.
Terminating	Yellow	An exit is being made from the Vessel Control mode (an equipment start/stop sequence for entering another control mode is in progress).
Available	White	All conditions and equipment state requirements for Vessel Control mode selection are fulfilled (required equipment is already **In Service**). The equipment start/stop sequence program must be started to enter the mode. Any equipment that is not required for the mode is automatically stopped.

The states indicated by the color of the warning indicator at the left-hand end of the status field are listed in the following table:

Table 10 Mode status indicator

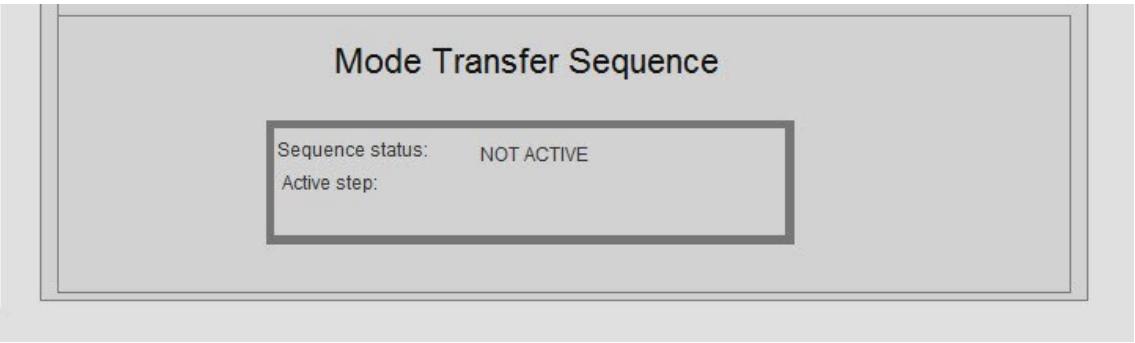
Color	Warning State
Magenta	PU or one or more SSs tripped, or conditions exist that will quickly implement a trip.
Red	Major fault in the PU or one or more SSs. For example, a High High (HH) or Low Low (LL) alarm condition, as defined in the appropriate RCA-PU or RCA-SS State Diagram. See section *State diagrams* on page 136.
Yellow	Minor fault in the PU or one or more SSs. For example, a High (H) or Low (L) alarm condition, as defined in the appropriate RCA-PU or RCA-SS State Diagram (See section *State diagrams* on page 136) is active. SS requirements warning . Refer to the on page and on page .
Cyan	The required SS standby equipment is **NOT READY**.

Details of the equipment state requirements for each Vessel Control mode can be viewed by displaying the **Module Parameters** dialog box (See the **Process images** topic in the online AIM User Guide) for the module symbol of the corresponding Vessel Control mode status text field.

7.1.3 Mode Transfer

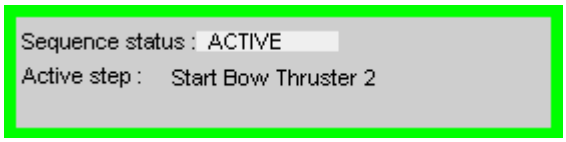
The example of the **Mode Transfer** part of the RCA system process view as shown in the figure below is managed by a multiple (top-level) control sequence that has a separate control sequence and sequence process view (Figure 86) for each Vessel Control mode.

Figure 84 Mode Transfer Sequence



All of these Vessel Control mode control sequences are controlled by a common Sequence Administrator module (see the section *Sequence administrator module* on page 75) which is represented as shown in the figure below.

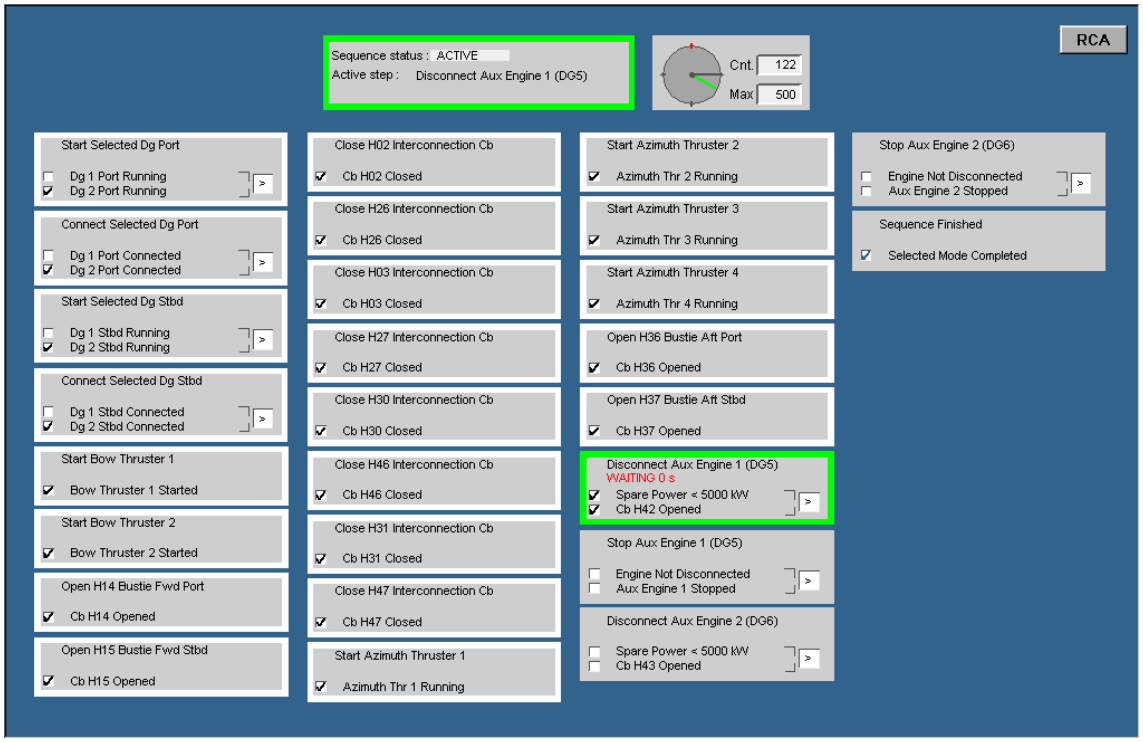
Figure 85 Sequence Administrator



An example of a typical Sequence process view for a Vessel Control mode transfer is shown in the figure below.

The sequence process view for each Vessel Control mode can be displayed by means of a **Sequence** hot spot, located next to the corresponding Mode control button.

Figure 86 Typical Vessel Control mode transfer Sequence Process view

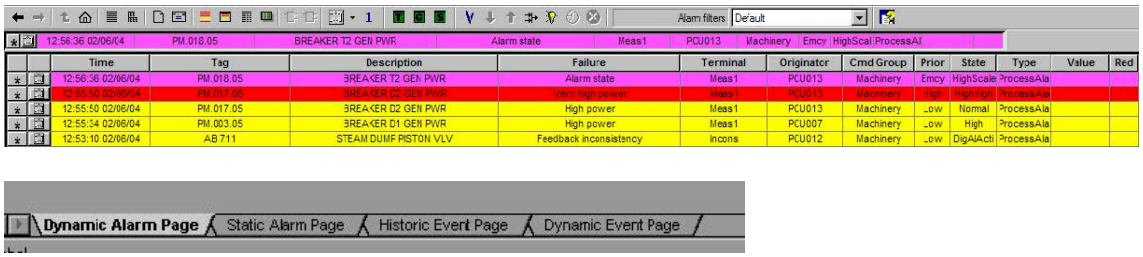


7.1.4 Event presentation

Historic events is presented by opening the **Event List** and selecting the **Historic Event Page** (For more information see the **Event system** topic in the online AIM User Guide). If provided, the **Historic Event Page** can be displayed by selecting the **RCA EVENTS** button on the RCA system process view.

In order to only display the alarms and events related to the RCA system, you must change the active event filter to the **RCA mode** group filter by selecting **Group: Mode_RCA** from the **Alarm Filter** drop-down menu on the toolbar.

Figure 87 Event List



7.2 State diagrams

The **RCA-PU State Diagrams** constitute the basis for the state composition of the PU and SS modules. Each PU and SS module has its own state diagram whose layout has a fixed format and whose content is used as input for the configuration of the RCA system. It should be noted that the layout of a RCA-PU state diagram is slightly different to that of a RCA-SS state diagram.

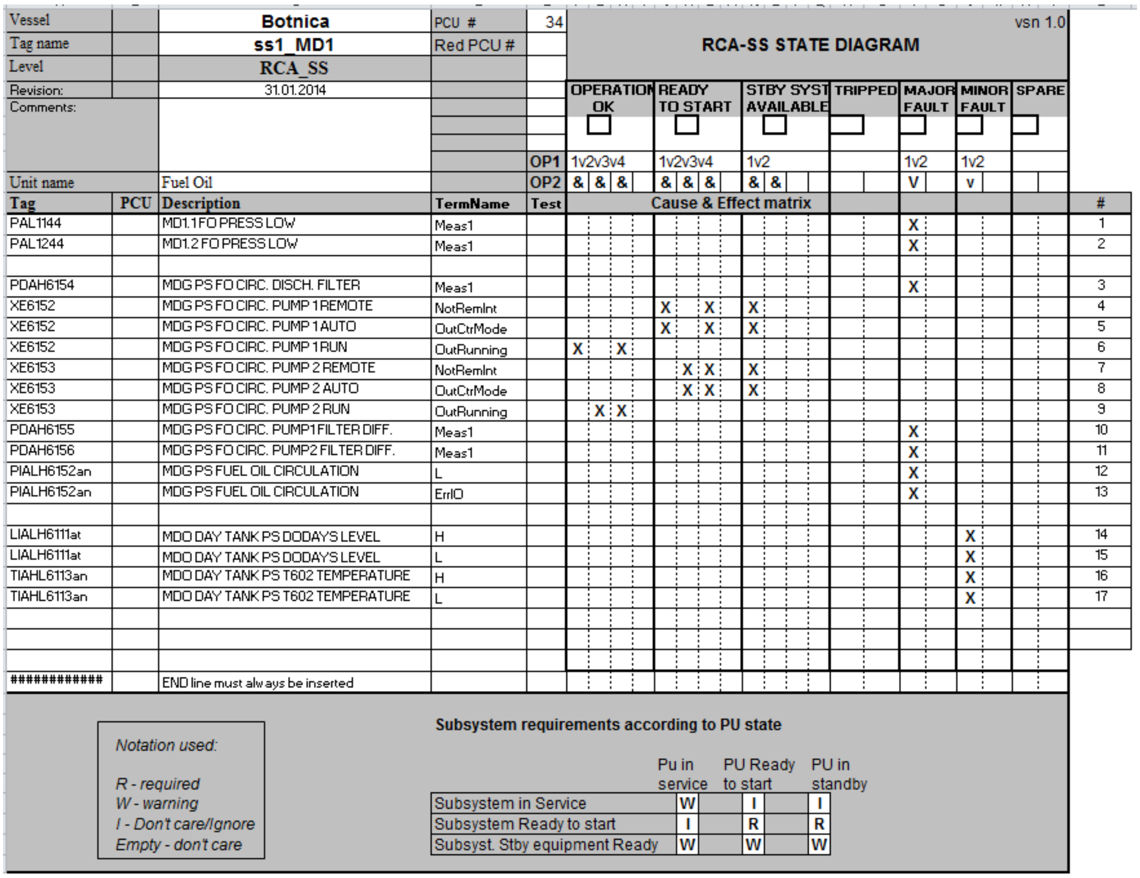
The state diagrams are prepared as part of the engineering work and are automatically integrated into the K-Chief 700 configuration files. An example of a completed **RCA-PU State Diagram** is shown in the figure below.

Figure 88 RCA-PU state diagram, Example

Vessel		Botnica	PCU #	34	RCA-PU STATE DIAGRAM						vsn 1.0
Tag name		pu_MD1	Red PCU #								
Level		RCA_PU			IN SERVICE	UNIT IN STANDBY	UNIT READY TO START	TRIPPED	MAJOR FAULT	MINOR FAULT	
Revision		31.01.2014			☐	☐	☐	☐	☐	☐	
Comments		PU for MD1 Use StartHelpS to determine if in Stopping/starting phase		OP1	1&2	1v2	1v2	1v2	1v2		
Unit name		GENERATOR 1		OP2	& & & &	& & & &	& & & &	V	V		
Tag	**PCU**	**Description**	**TermName**	**Test**	**Cause & Effect matrix**						**#**
SH1151		MD1.1 RUNNING	Meas1		X						1
SH1251		MD1.2 RUNNING	Meas1		X						2
XI1153		MD1.1 AVAILABLE	Meas1			X X	X X				3
XI1253		MD1.2 AVAILABLE	Meas1			X X	X X				4
EA5118		MDG1 BREAKER AUX VOLT FAULT	Meas1			C C	C C				5
XE5101		MDG1 BREAKER CLOSED	OutClosed		X						6
XE5101		MDG1 BREAKER OPENED	OutOpened			X X	X X				7
XE5101		MDG1 BREAKER REMOTE, ReadyClose	ReadyClose			X X	X X				8
EA5116		MDG1 BREAKER SHORT CIRC TRIP	Meas1					X			9
XE5101		MDG1 BREAKER TRIPPED	CBTripped			C C		X			10
TIAH5104an		MDG1 BEARING 1 TEMP	H						X		11
TIAH5105an		MDG1 BEARING 2 TEMP	H						X		12
TIAH5101an		MDG1 WINDING U TEMP	H						X		13
TIAH5102an		MDG1 WINDING V TEMP	H						X		14
TIAH5103an		MDG1 WINDING W TEMP	H						X		15
FAH5107		MDG1 LEAKAGE ALARM	Meas1						X		16
EZA5117		MDG1 SHORT CIRC	ShutDwn					X			17
EZA5117		MDG1 SHORT CIRC	Error					X			17
XE1100		MDG1 in Standby	Standby			X X					18
XE1100		MDG1 Ready to start	ReadySt			X	X				19
XE1100		MDG1 EMERGENCY STOP	ActEmcyStop					X			20
XE1100		Start Aux systems	StartHelpS			X	X				
GAZ1155		COMBAIR SHUTOFF MD 1.1	Meas1		C	C C	C C				
GAZ1255		COMBAIR SHUTOFF MD 1.2	Meas1		C	C C	C C				
##########		END line must always be inserted									

An example of a completed **RCA-SS State Diagram** is shown in the following figure.

Figure 89 RCA-SS state diagram, Example



The information contained in the fields of the two state diagrams is expanded in the following three tables:

- Describes the information contained in the 'Header' part of the RCA-PU and RCA-SS State Diagrams.
- Describes the information contained in the 'Matrix' part of the RCA-PU and RCA-SS State Diagrams.
- Describes the information contained in the 'Subsystem requirements' part of the RCA-SS State Diagram.

Table 11 Header part of RCA-PU and RCA-SS State Diagrams

Information field	Used in K-Chief 700	Data Type	Description
Vessel	No	text string	Identification of system/vessel.
Tag name	Yes	text string	Used as tag name for the module.

Table 11 Header part of RCA-PU and RCA-SS State Diagrams (cont'd.)

Information field	Used in K-Chief 700	Data Type	Description
Level	Yes	fixed text string 'RCA-PU' or 'RCA-SS'	Used to define module type, 'RCA-PU' - Process Unit 'RCA-SS' - Subsystem
Revision	Yes	date string (e.g. yy/mm/dd)	Included in the module.
Comments	No	text lines	For diagram construction use only.
PCU#	Yes	integer > 0 (PCU no.)	PCU for which a configuration file has been made. The corresponding SS module is located in this PCU.
OP1	Yes	text string (logical expression)	Logical expression comprising column numbers and operators AND (&) or OR (v). For example, 1v2 which means state OK if column 1 OR column 2 is true. (1&2)v(3&4) which means: state OK if either column 1 AND column 2 or column 3 AND column 4 is true.
OP2	Yes	text string (logical operator “&" or “v")	Logical operator used for the computation of a Boolean value by applying the operators AND (&) or OR (v) between all used digital input values marked as included in this column of the “Cause & Effect matrix". Note that fields marked with “C" are inverted (complemented) before they are used.
State labels (**IN SERVICE** etc.)	No	—	Defined states used by this RCA module.
Unit name	Yes	text string	Denotes the actual PU or SS. For PUs the syntax is <equipmentname> <equipmentnumber>

Table 12 Matrix part of RCA-PU and RCA-SS State Diagrams

Information Field	Used in K-Chief 700	Data Type	Description
Tag	Yes	text string	'Tag' (name), 'PCU' and 'TermName' together define an incoming signal that is to be used in the 'Cause & Effect matrix'. It must correspond to a tag name and an output terminal for a module configured in the K-Chief 700 system.
PCU	No (not required)	integer > 0 (PCU no.)	PCU number for the signal with the tag 'TagName' and the signal name 'TermName'. (For information only).
Description	Yes	text string	Copy of the description from the K-Chief 700 signal database. (Used for the creation of a Help file).
TermName	Yes	text string	Corresponds to the terminal name of a module with the tag 'TagName' that is configured in the K-Chief 700 system.
Test	No	character (“ " (blank), “0" or “1")	Values used for internal validation in the diagram (if requested by the user). Not yet implemented.
Cause & Effect fields	Yes	character (“X", “C" or “ (blank))	Input signals corresponding to fields marked with 'X' are taken into account for the Boolean value for the column. For fields marked with 'C', the input signal is inverted first. (Typically used for alarms.)
End Line	Yes	##########	This line terminates the module terminal connection lines and is used by the generation process.

Table 13 Subsystem requirements part of RCA-SS State Diagram

Information Field	Used in K-Chief 700	Data Type	Description
Subsystem in service	Yes	character ('R' - required, 'W'- warning 'I' - Ignore or “ “(blank) - don't care)	These three fields define how the SS is required to operate for the various states of the PU.
Subsystem ready to start	Yes	character ('R' - required, 'W'- warning 'I' - Ignore or “ “(blank) - don't care)	These three fields define the required “ready to start" conditions for the various states of the PU.
Subsystem standby equipment Ready	Yes	character ('R' - required, 'W'- warning 'I' - Ignore or ” “(blank) - don't care)	These three fields define the SS standby equipment that must be ready to operate for the various states of the PU.

7.2.1 Failure analysis

The first step of a online failure analysis is to check the RCA system process view for **Mode** failures and **Equipment State** failures. After this, the specific events generated by the RCA system should be checked.

In the situation where a selected Vessel Control mode fails, the first reason for the failure will be reported in the event database and shown in the **Historic Event Page** of the **Event list** (See the section *Event presentation* on page 135). The PU that fails and the SS that causes the failure will also report an event. In addition, the reason for failure can also be viewed by displaying the **Module Parameters** dialog box (For more information see the **Module Editor** topic in the online AIM User Guide) of the PU and SS modules concerned.

An example of the RCA events that result when a Vessel Control mode is running and then fails, is shown in the figure below.

Figure 90 RCA Events for a Vessel Control mode failure

Time	Tag	Description	State	Value	Terminal	Cmd Group	Station	Priority	Type	Red
05:22:51 23/05/01	Dpmode	# GEN. on SWBD 1 not ok	Void	On		RCA	PCU11	UnPri	ProcMsg	
05:22:51 23/05/01	Dpmode	Dpmode ABORTED	Void	On		RCA	PCU11	UnPri	ProcMsg	
05:22:51 23/05/01	pu_G1P	Fail: OPER. OK	Void	On		RCA	PCU05	UnPri	ProcMsg	
05:22:51 23/05/01	ss_G1P_CW	OPER. OK -> READY	Void	On		RCA	PCU05	UnPri	ProcMsg	
05:22:51 23/05/01	ss_G1P_CW	Fail: OPER. OK	Void	On		RCA	PCU05	UnPri	ProcMsg	
05:22:50 23/05/01	ss_G1P_CW	Fail: In6 PUMP43.01/OutRunning	Void	On		RCA	PCU05	UnPri	ProcMsg	
05:22:50 23/05/01	Dpmode	Dpmode now IN SERVICE	Void	On		RCA	PCU11	UnPri	ProcMsg	
05:22:50 23/05/01	Dpmode	Transfer to Dpmode OK.	Void	On		RCA	PCU11	UnPri	ProcMsg	

Note

*The events have been filtered to show only RCA events. This is achieved by creating an Alarm Filter (e.g. Group: Mode_RCA) that allows only events from the RCA Command group to be displayed (Refer to the **Event system** topic in the online AIM User Guide).*

The above example shows the RCA events that are generated when the DP Vessel Control mode is selected and running, and then suddenly the generator cooling water pump (PUMP43.01) stops.

This causes the 'Generator 1 Port' PU module to report that the pump is 'not running' and the corresponding Cooling Water SS to report both an error and a state change. This, in turn, causes the DP Vessel Control mode module to report a mode failure. The mode control module also causes the DP Vessel Control mode status text field to indicate **Invalid**.

8 Extended Alarm Systems

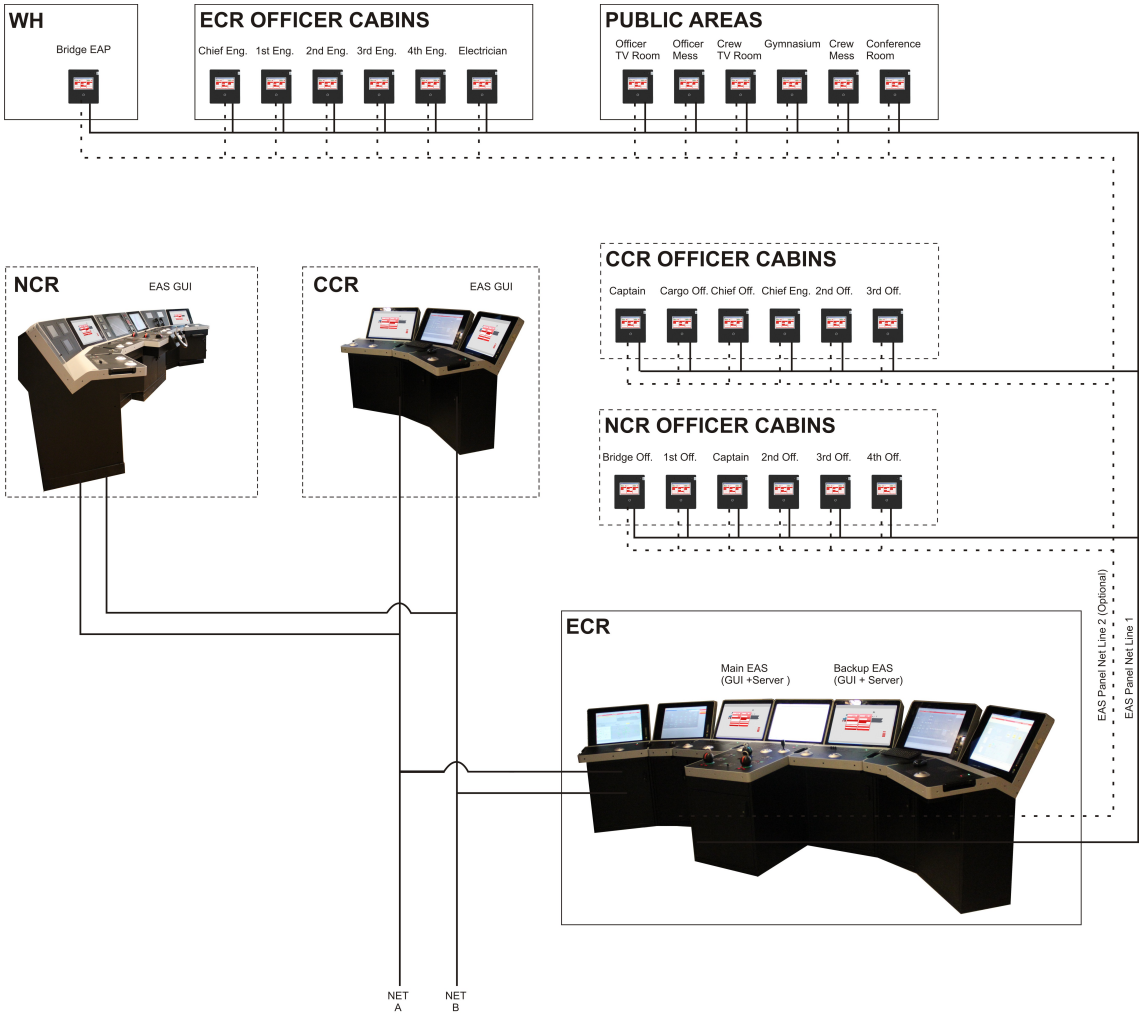
KM provides the following three extended alarm systems for integration with the K-Chief 700 Alarm & Event System:

- *Extension Alarm System (EAS)* on page 143 or
- *Watch Call System (WCS)* on page 146 and
- *Operator Fitness Alarm System (OFAS)* on page 156

8.1 Extension Alarm System (EAS)

The Extension Alarm System (EAS) shown in the figure below is the second generation extended alarm system for the K-Chief 700 Alarm & Event System where alarms and calls are forwarded from a K-Chief Operator Station (OS) and announced on Extended Alarm Panels (EAP) that is distributed on the vessel.

Figure 91 EAS System Topology with three qualifications



The main purpose of the EAS is to allow locations such as the *Engine Control Room (ECR)* to be temporary operated unmanned (during night shift or during loading/ off-loading etc). In addition to Engine alarms, alarms from other spaces such as the *Cargo Control Room (CCR)* and the *Navigation Control Room (NCR)* can be integrated as autonomous parts of the EAS.

For the system to be active, a minimum of one officer must be defined as **ON DUTY**. Once activated, Bridge EAP, all Public EAPs and Duty/Officers EAP display system alarms. Further definitions of the main EAS concepts are explained in the table below.

Table 14 EAS consept

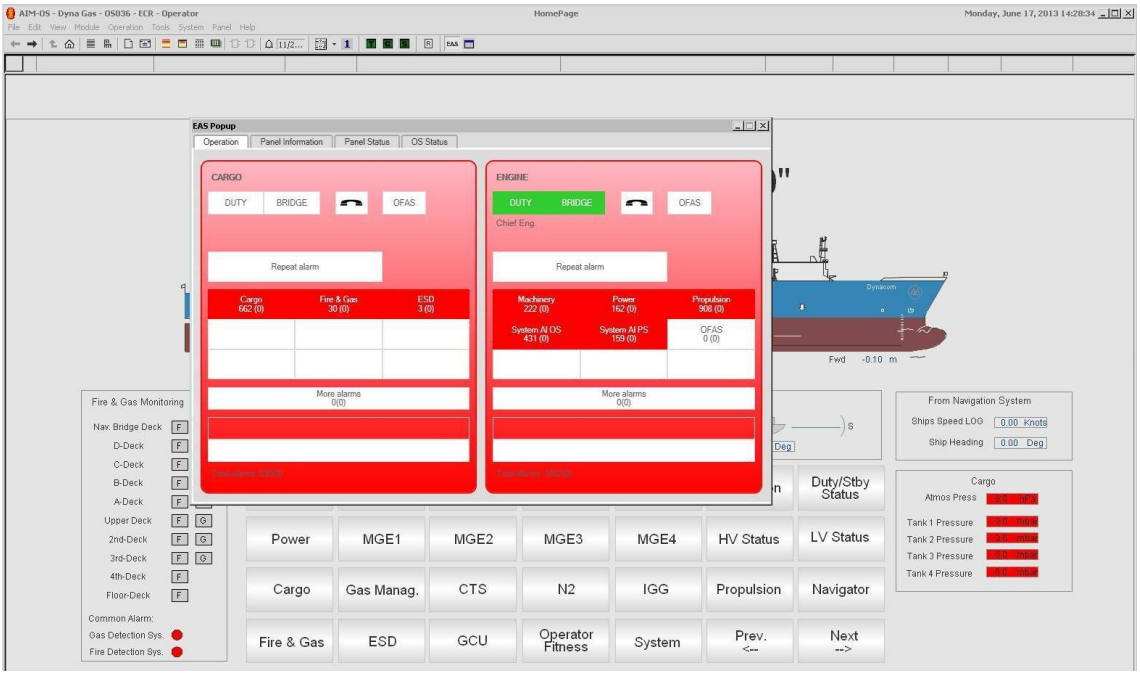
Term	Description
ACCU	
Bridge Watch	*Bridge Watch* mode or Unmanned Machinery Space (UMS) means that the vessel can operated without operator presence in the ECR as the bridge maintains supervision with the duty officer responding to process alarms.
Duty	Each officer defined in the system is either **ON DUTY** or **OFF DUTY**. When **ON DUTY**, the officer is so for all his current qualifications.
Engine Zero	Engine Zero alarm (E0).
EAP	The Extended Alarm Panel (EAP) is provided with three slightly different User Interfaces (UI) depending on where the panel has been physically installed (Navigation Bridge, Officer Cabin or Public area). Bridge EAP: Apart from the normal controls, the Bridge EAP has facilities to **REJECT/ ACCEPT WATCH TRANSFER**. When in *Bridge Watch* mode, all configured EAS alarms are announced with visual indication and buzzer on the Bridge EAP, the Duty/Officer EAP and Public EAPs. Additionally, the Bridge EAP has **CALL** functionality to invoke call duty for the qualifications installed (Engine, Cargo and Navigation). Duty/Officer EAP: When an officer is **ON DUTY**, all alarms configured for EAS are announced with visual indication and buzzer on the Duty/Officer EAP and Public EAPs. Public EAP: When in *Bridge Watch* mode or one or more officers are **ON DUTY**, all alarms are announced with buzzer.
EAS OS	Two K-Chief OSs are equipped with EAS Servers and OS UI, however other K-Chief OSs may be equipped with UI. The EAS Servers and EAP Panels communicate though a separate EAS Network.
GUI	Graphical User Interface. The AIM OS has an embedded view that resembles a watch call panel. This panel is for duty assignment and watch transfer. There is normally no physical panel in CCR or ECR.
Officer Call	The system allows a simple call system (notification and acknowledgement only) that allows bridge and GUI to request the attention of either all officer within a qualification or the sub set that represent those on watch within a qualification.
Operator Fitness	EAS is interfacing the *Operator Fitness Alarm System (OFAS)* and **OFAS** status is shown on both the OSs and EAP's. OFAS alarms are announced with visual indication and buzzer on the Bridge EAP, all Officer EAPs and Public EAPs.
Qualifications	All configured alarm groups are members of one of three possible qualifications: **Machinery**, **Cargo** and **Navigation**.

8.1.1 EAS user Interface

The figure below shows an example of a User Interface (UI) with two qualifications i.e. **Cargo** and **Engine**. Operation of the EAS is done from the K-Chief 700 OSs in the dedicated control room for each qualification. There are two ways to open the **EAS Popup**.

- From the toolbar, select **Operation** and →**EAS**, or
- if **EAS Popup** previously has been opened, select the **EAS icon**.

Figure 92 EAS User Interface with two qualifications, example



Note

*Operations in **EAS Popup** are limited by the user access. Users with **Operator access** can set officers **ON DUTY** and transfer Watch Responsibility to/from Bridge and observe Panel- and OS Status, but not configure the system.*

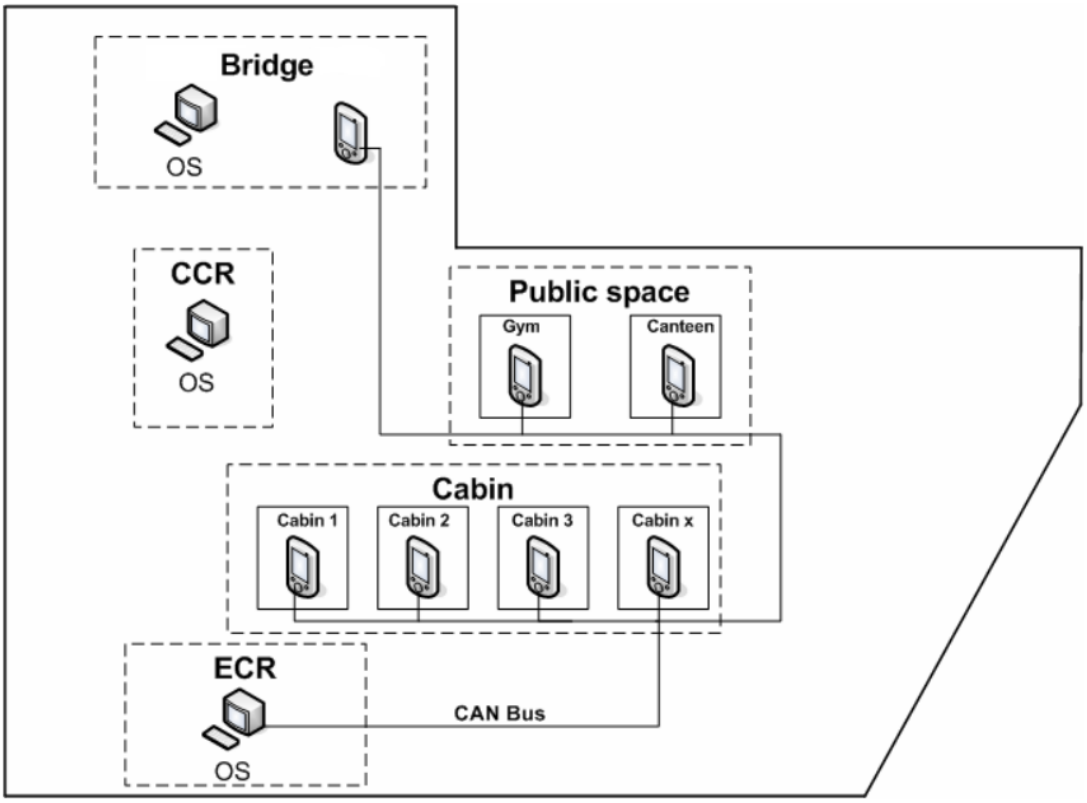
*EAS configuration settings in **Role Configuration** and **Panel Configuration** are limited to users with **Extended access**.*

For further details regarding operation and configuration of the EAS installed on your vessel, see to the separate *Extension Alarm System Operator Manual* (KM doc. no 383636) and *Kongsberg Functional Design Document, General System* .

8.2 Watch Call System (WCS)

The Watch Call System (WCS) (see figure below) is the first generation of an extended alarm system for the K-Chief 700 Alarm & Event System where alarms and calls are forwarded from a K-Chief 700 Operator Station (OS) and announced on the Bridge Unit and on the distributed Cabin/Duty and Public Units on the vessel.

Figure 93 Watch Call System topology with two qualifications



The main purpose of the WCS is to allow critical locations such as the Engine Control Room (ECR) to be temporary operated unmanned (during night shift or during loading/ off-loading etc). In addition to Engine alarms, alarms from other spaces such as the Cargo Control Room (CCR) can be integrated as autonomous parts of the WCS. Some definitions of the main concepts in the WCS are explained in the table below.

Table 15 Watch Call definitions

Term	Description
Cabin/Duty Unit	Cabin/Duty Unit: A panel for cabin and public area placement.
Bridge Unit	Bridge Unit: A panel to be used on the bridge. There is normally only one of these panels in the system. Apart from the normal controls, the Bridge Unit also has facilities to reject/accept a watch transfer initiated/requested by ECR. The Bridge Unit has call functionality to invoke call duty for engine and cargo.

Table 15 Watch Call definitions (cont'd.)

Term	Description
Duty	Each officer defined in the system is either on or off duty. When on duty, he will be so for all his current qualifications
Qualifications	All configured alarm groups are members of one of two possible qualifications: Engine and Cargo.
OFAS	Also called Dead Man System. An alarm group can be defined with special properties that force the alarm to be handled with instant propagation. This can optionally depend on the activation of the watch call tag **DeadManIn**.
UMS	Unmanned Machinery Space, or “ECR, unmanned”. This mode defines that the vessel can operate without operator presence in the ECR. Also called bridge watch, as the bridge maintains supervision with the duty officer responding to process alarms.
Officer Call	The system allows a simple call system (notification and acknowledgement only) that allows bridge and GUI to request the attention of either all officer within a qualification or the sub set that represent those on watch within a qualification.
GUI	Graphical User Interface. The K-Chief 700 OS has an embedded view that resembles a watch call panel. This panel is for duty assignment and watch transfer. There is normally no physical panel in CCR or ECR.
CAN/CAL	The CAN bus (control area network) is the low level transport protocol used in the WCS.

8.2.1 Watch call system topology

The vessel is equipped with two types of panels; Bridge Unit(s) and Cabin Units. The Bridge Unit is installed on the bridge and the Cabin Units are installed in public areas and cabins.

Public panels are a collective group of equal panels whereas cabin/duty panels are associated with either a specific cabin or role. All panels are connected through a serial bus (CAN Bus) which interfaces all panels to the two K-Chief 700 OSs in the ECR for operational redundancy. The physical bus is not redundant.

The two operating stations in the ECR, as well as the operating stations in the CCR are provided with a graphical user interface for operating and maintaining the watch call system. Restrictions based on the logged in user and location (CCR/ECR) apply. The GUI is serviced using the normal AIM Process net, so no CAN bus is available to the CCR operator stations.

Selected alarms from the process system are associated with alarm groups. Every alarm group is associated with a qualification, i.e. Engine or Cargo. A selected number of officers/cabins are associated with one or more qualifications for which they are

responsible. Panels are distributed in cabins, in offices associated to a particular officer, on the bridge and in public areas. The system is normally inactive, and is activated by officers being set ON DUTY from the normal OS GUI at the location responsible for the qualification.

8.2.2 Watch call operation

The system is not active until an officer is set **ON DUTY**. When this is done, all cabin panels, bridge panel and duty panels are active. All GUIs and active panels reflect the duty assignment by lighting the duty indicator associated with the applicable officer. Alarms within the qualification(s) of that officer are notified to this person using the public panels and the cabin panel.

With an officer on duty, the ECR can request to transfer watch responsibility to bridge. When the bridge accepts, the bridge assumes a monitoring responsibility. Engine officers cannot be set ON/ OFF DUTY without the bridge first accepting a new request for non-UMS state. It is common practice that, in UMS state, an alarm also triggers the Operator Fitness Alarm System (also known as the Dead Man and/or Patrol Man System). While the watch is on bridge, it observes alarm notification and duty officer responding. The bridge panel will reflect when officer acknowledges notifications and alarms. The aim of any such notification is to make the officer acknowledge the alarm on the ECR K-Chief 700 OS. Until the alarm is acknowledged, the system repeats the alarm and alerts more officers according to the configuration and timers.

8.2.3 Areas of operation

The table below details the operations allowed for each location.

Table 16 Allowed operations from each location

Operations \ Locations	ECR	CCR	Bridge Panel
Set Duty Engine	*		
Set Duty Cargo		*	
Call Duty Engine	*	*	*
Call Duty Cargo	*	*	*
Call All Engine	*	*	
Call All Cargo	*	*	
Request UMS\Non-UMS	*		
Approve\Decline UMS			*

8.2.4 Watch call repeat alarm feature

The repeat alarm feature monitors all responses to an alarm condition to ensure that the alarm is acknowledged. The repeat alarm feature distributes the alarms using three sequences to make sure that the alarm does not go unacknowledged:

First alarm

The first alarm is relayed to:

- The area designated as **Watch Responsible**
- The **ON DUTY** engineers **Cabin Units**
- The **Cabin Units** in all public areas

First repeat alarm

If the first alarm remain unacknowledged after a set period of time, it is repeated and relayed to:

- The area designated as **Watch Responsible**
- The **ON DUTY** engineers **Cabin Units**
- The **Cabin Units** in all public areas

Second repeat alarm

If the alarm is still not acknowledged, after a set period of time, it is repeated and relayed to:

- The area designated as **Watch Responsible**
- The **Cabin Units** for **ALL QUALIFIED** engineers
- The **Cabin Units** in all public areas

The system can be configured to trigger the second repeat alarm setup at the first repeat alarm. Then the alarm will be relayed to the cabin units for **all** qualified engineers at both the first and the second repeat alarm.

8.2.5 Watch Call touch panels

There is one standard touch-screen watch call control unit available, configurable as either Bridge Unit or Cabin Unit. The following describe the panel menus and their functions.

8.2.5.1 Homepage

Cabin unit homepage features:

- Indicators for duty engineers.

In addition, the top bar and the triangle for alarm group view on the bottom part of the screen is present. These are equally displayed on both bridge- and cabin units.

Bridge unit homepage features:

- Control buttons for duty call functionality

- Indicators for duty engineers
- Control buttons and indicators for watch responsibility transfer and status

Cabin Unit home page

Bridge Unit home page

If there are up to six alarm groups configured, the alarm group names will be displayed in the bottom bar.
If there are more than six watch call alarm groups, there will be unnamed smaller fields on the bottom bar. The alarm group name will be displayed in the extended alarm group view.

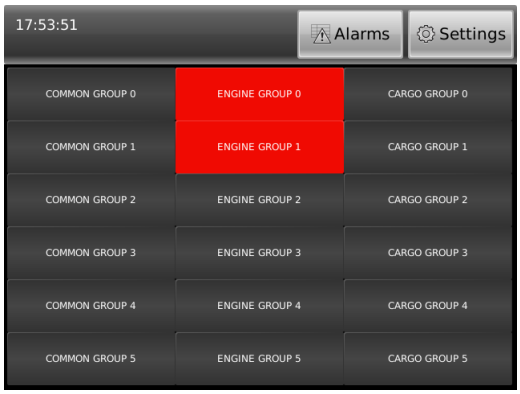
An alarm group will flash while there are unacknowledged alarms in the group. It will turn to steady red colour when all alarms in the group are acknowledged

When an alarm condition occurs the buzzer will sound and the alarm is indicated on the Watch Cabin Unit.

A flashing indicator will appear in the bridge unit top bar when there is a repeated alarm

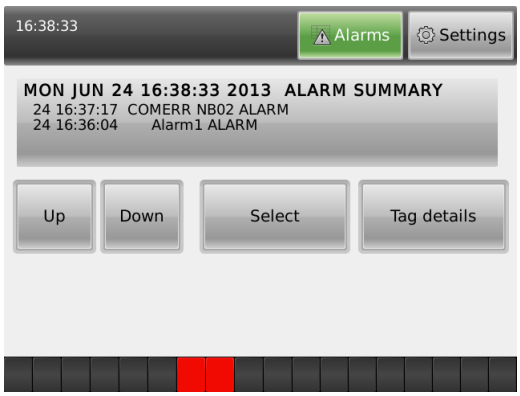
Call duty engineer / -officer functionality is available by dedicated buttons on Bridge unit

8.2.5.2 Alarm group view:



Pressing triangle (or bar when there is an active alarm) on bottom part of screen opens alarm group view.

8.2.5.3 Alarm Menu:



Pressing Alarms button in top bar opens alarm summary view. Within this view you may navigate within alarm summary and view more detailed information of selected alarms.

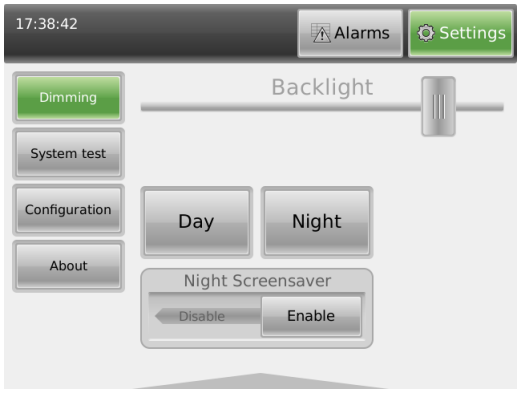
8.2.5.4 Settings Menu:

The **Settings** button opens a view with these options:

- Dimming
- System Test
- Configuration
- About

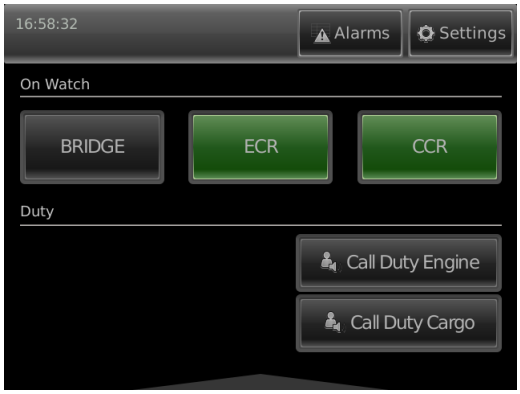
Common for the settings menu and sub-menus is that the panel exits to display the panel homepage after 1 minute of no action in the menu.

The “Dimming” menu:



Cabin Unit dimming menu

Bridge Unit dimming menu



Example of a bridge unit using night palette.

This menu selection enables backlight settings change. A ‘Glider’ button can easily adjust the light, or the user can select one of two Optional buttons: **Day** or **Night**.

The night screensaver turns off the screen when the panel is not in use or there is no alarm, to reduce light at night time in the cabin. If the panel is touched while the screensaver is on, or there is an alarm condition, the screen will be turned on. The night screensaver functionality is only implemented and permitted in panels configured as cabin units.

To increase the backlight without using slider button, touch upper left and right side of panel screen simultaneously and hold down for a few seconds while the panel gets brighter. This can be done in any of the panel views.

The “System Test” menu:

Pressing the **System Test** button displays a test window. A **Buzzer test** button lets the user test the alarm sound. Pressing the button again turns the test off. The user also has the option to use the “Sound Off” soft-button appearing in the top bar :

to turn off buzzer.

The “About” menu:

Three alternatives appear when pressing the **About** button.

- Version Info. Display software and hardware versions.
- Legal Info. Display legal considerations related to the panel.
- Unit Status. Display the current Watch Call Panel condition.

Common functionality:

The Top Field of the panel contains additional information. A digital clock is localized in the upper left field. A warning signal and a failure warning button appear if the system has an error condition.

- The **Alarm** and **Settings** buttons are available in all menus. Pressing one of the buttons will return to the main or previous view.
- Re- pressing a button returns to previous state or view.
- Acceptance of persons in duty etc. will initiate a need to accept the setting in the OS menu.

Configuration menu is password protected by two user-levels, chief and administrator level. At chief level, the configuration menu contains "Labels" and "Screen" sub-menu. At administrator level, there is a sub folder named "maintenance" visible. Passwords are obtained from project documentation.

Common functionality for all Configuration menus are

- Press one field to change settings.
- Press the **X** button to return to previous menu.

Additional buttons are **Done** and **Next**. Pressing **Done** will return the view to the previous menu. The **Next** button makes the user navigate through the alarms, settings etc.

8.2.6 Graphical User Interface (GUI) Panel on K-Chief 700 OS

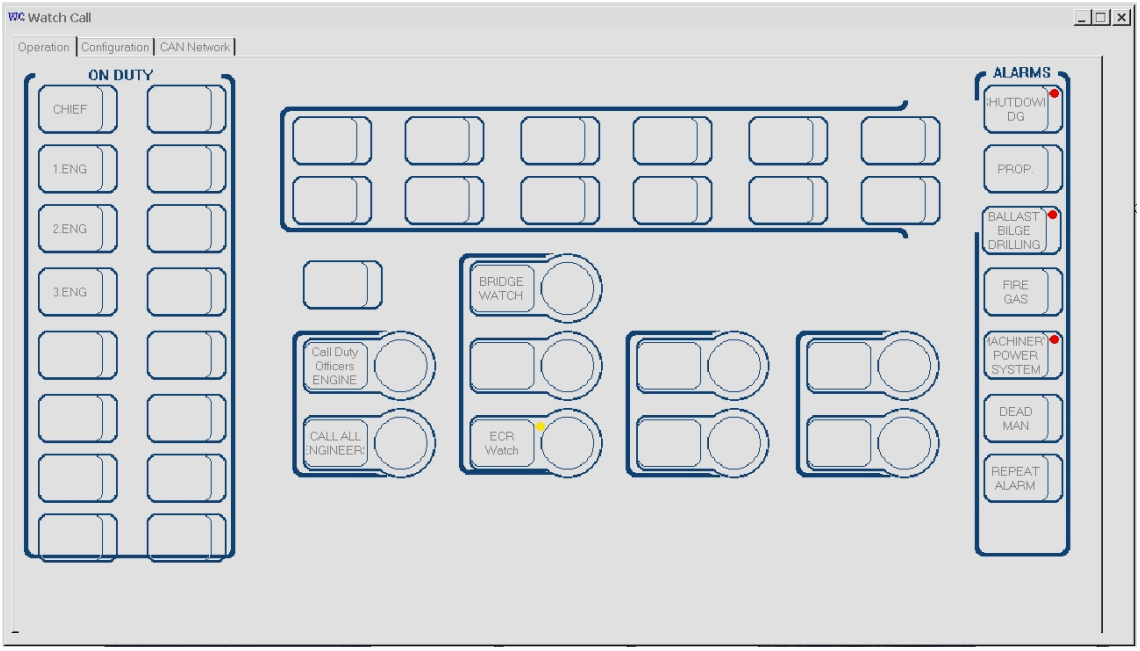
The figure below shows the GUI used in the K-Chief 700 system (on the K-Chief 700 OS) to access Watch Call. The K-Chief 700 OS has an embedded view that resembles a watch call panel which allows an officer to:

- Set the officer on duty
- Initiate watch responsibility to bridge
- Call the duty officer
- Call all the officers of a similar qualification.

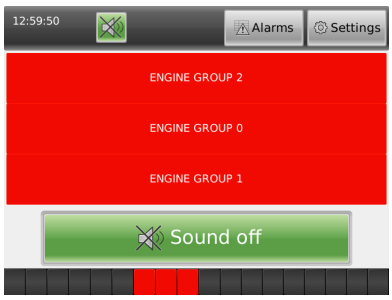
Note

The figure shows the GUI for the ECR qualification. The GUI for other qualifications will be different.

Figure 94 Watch Call GUI as shown on the K-Chief 700 OS



8.2.7 How to respond to alarms



An alarm condition triggers the buzzer and alarm indication on the Cabin Unit. Do the following:

1 Push **SOUND OFF** .

2 Read the alarm information on the display or the text next to the indicator.

3 Take appropriate action.

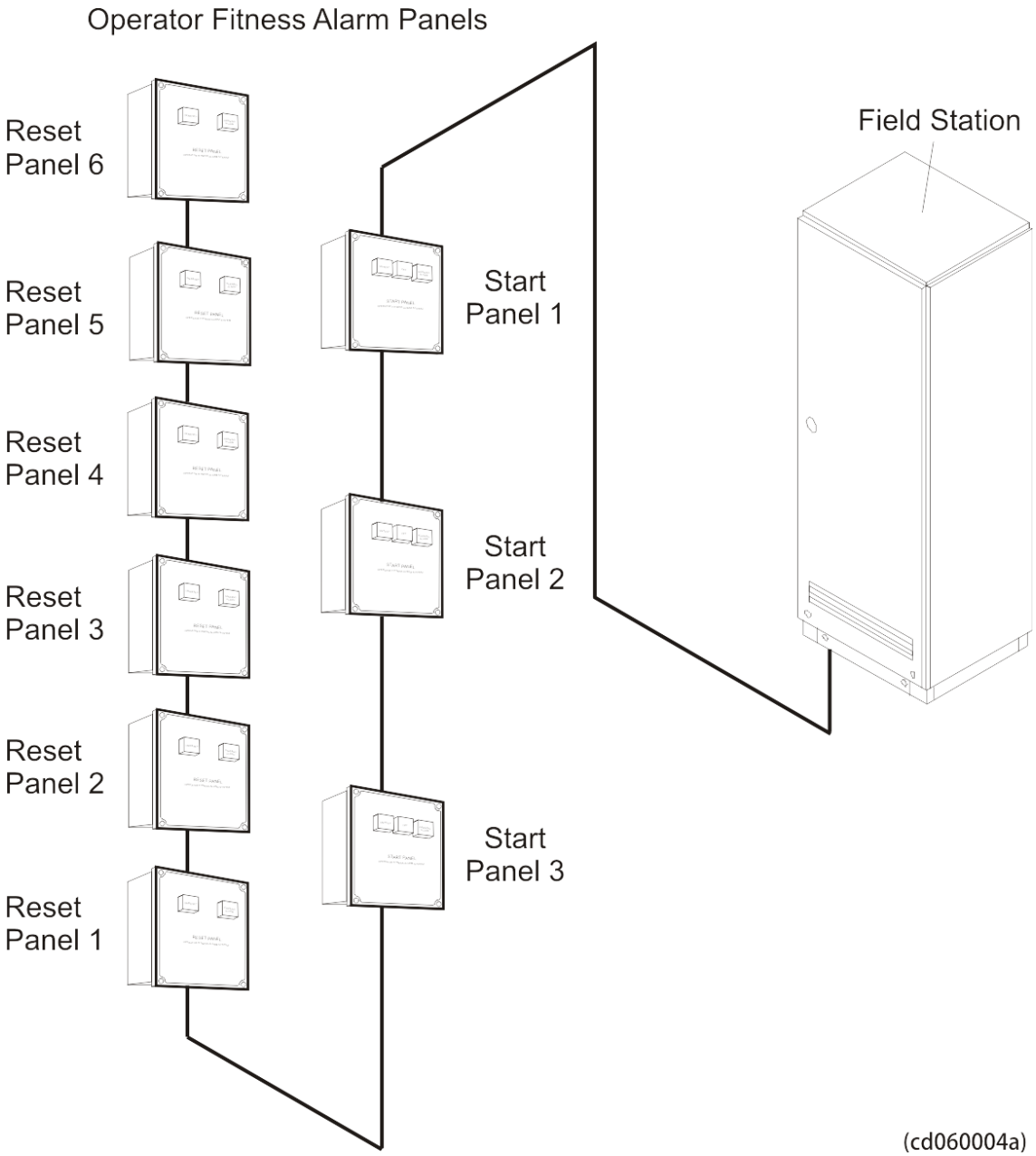
4 Check that the alarm disappears when the situation returns to normal.

If, at any time, the process alarm is acknowledged from the AIM Operator Station, the buzzers switch off and the alarm indicator enters the steady state. When the alarm enters the normal state, the alarm indicator is switched off. No further notification is given for that alarm.

8.3 Operator Fitness Alarm System (OFAS)

The Operator Fitness Alarm System (OFAS) is part of the K-Chief 700 Extended Alarm and Monitoring application and OFAS panels are located in strategic areas or rooms onboard the vessel. The figure below shows a typical OFAS configuration.

Figure 95 Typical OFAS configuration



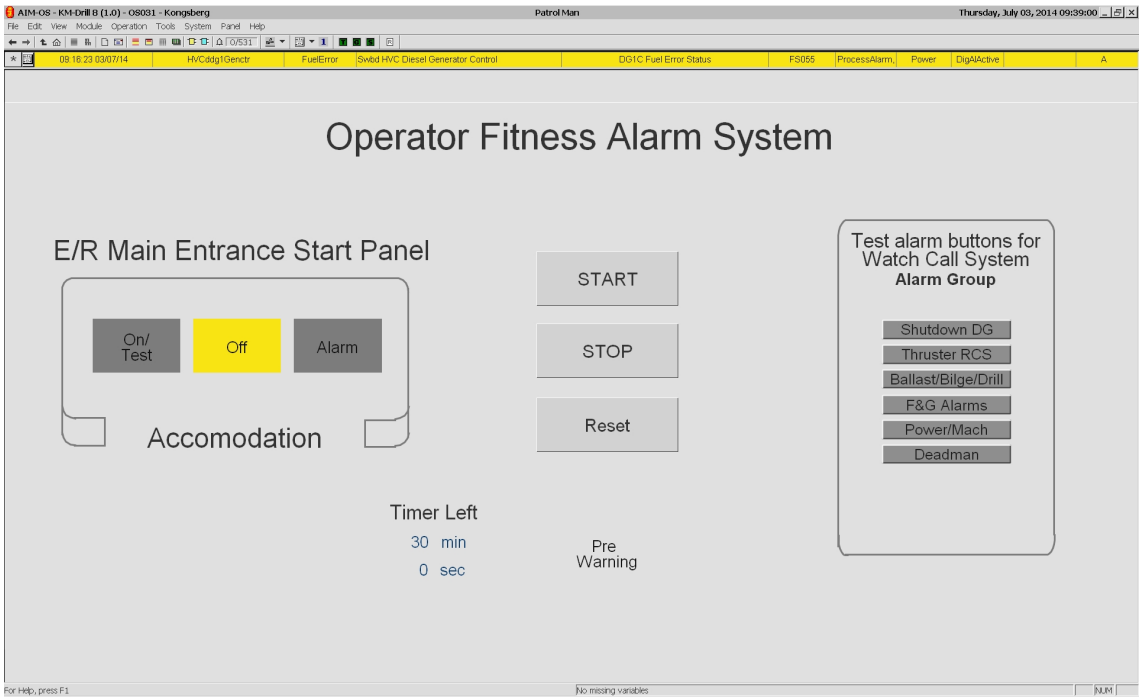
The Start Panel, located in the entrance of the Engine Room, is connected by a single cable to a Remote Controller Unit (RCU) in a Field Station (FS) in one end and to the Reset panels in the other end. The FS is further connected by the local area network (LAN) to the K-Chief 700 OS from which the OFAS status can be remotely observed.

For specific details regarding the configuration of OFAS on your vessel, see the Kongsberg Functional Design Document (KFDD) for General System.

8.3.1 OFAS user interface

The OFAS is activated manually from one of the Start Panels located in the entrance to the engine room or alternatively from the **Operator Fitness Alarm System** process view (see figure below) on the K-Chief 700 OS. OFAS alarms are also activated automatically by the watch calling system when an **ENGINE ZERO (E0)** alarm is given.

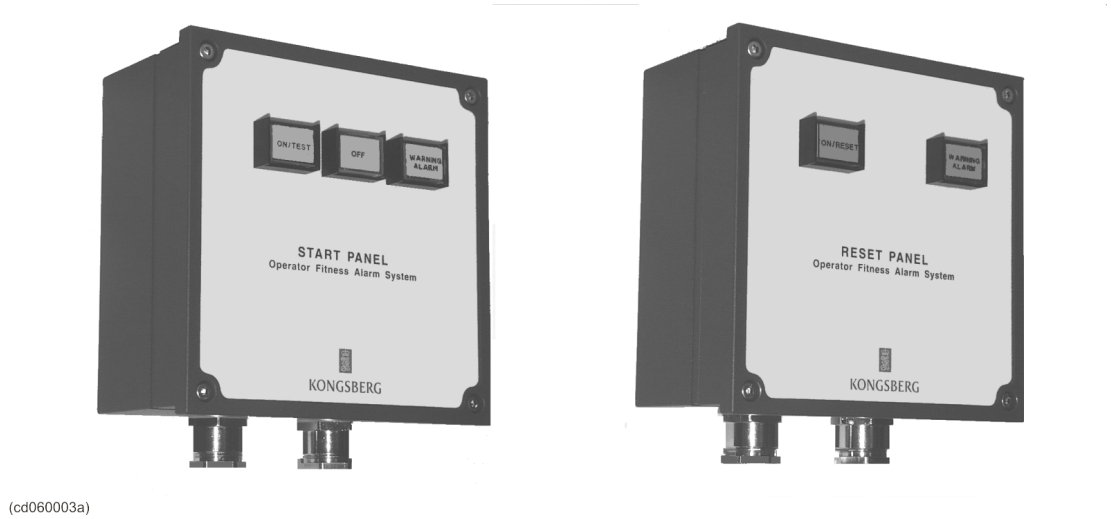
Figure 96 Operator Fitness Alarm System view



The Reset period is set to 30 minutes and a pre-warning alarm is given 5 minutes before the operator fitness/dead man alarm is initiated. If an active OFAS is not manually turned OFF or reset within the specified reset period, the OFAS/ Dead Man alarm is shown in the **Event List** on the K-Chief OSs and on the EAS/Watch Call Panels.

The main physical difference between the Start- and the Reset panels is the number of buttons available on the front. Refer to the figure below with the start panel to the left.

Figure 97 OFAS panels, Start and Reset



8.3.2 Start panel

The Start panels have a green **ON/TEST** button, a yellow **OFF** button and a red **WARNING ALARM** indicator lamp. Lamp test can be performed by pressing the **ON/TEST** button for more than 10 seconds.

Press the **ON/TEST** button to set the OFAS ON. A down count of the allowed work window is then started. The work window is typically set to 30 min, and a pre-warning is given after 25 min.

Press the **OFF** button to turn the OFAS OFF.

8.3.3 Reset panel

The reset panels have a green **ON/RESET** button and a red **WARNING ALARM** indicator lamp. You can test the lamp by pressing the **ON/RESET** button for more than 10 seconds.

To switch the OFAS ON, press the **ON/RESET** button. Press the **ON/RESET** button when the OFAS is active, to reset the counter to the start of the thirty minute count down.

The **WARNING ALARM** indicator on both panel types flashes when the pre-warning time expires, typically after 25 minutes. You can stop the indication by either pressing the **RESET** button in the OFAS reset panel or by pressing the **OFF** button in the OFAS start panel or on the OFAS process image. However, if you do not push the **RESET** or **OFF** button within the alarm limit time of thirty minutes, the dead man alarm is activated, and the flashing indicator lamp is steadily lit.

9 System Startup and Shutdown

The K-Chief 700 Operator Stations (OS) and Field Stations (FS) are usually left with power switched on and the system fully operational.

9.1 How to start up the system

If, for some reason, the complete system has been shut down, for example after maintenance, use the following procedures to restart the system.

However, if only a part of the system has been shut down (such as one of the Operator or Field Stations), then only the relevant station startup procedure needs to be performed.

9.1.1 Uninterruptible Power Supply startup

At each of the K-Chief 700-related Uninterruptible Power Supply (UPS) cabinets, switch on power and start up the equipment as described in the manufacturer's manual.

9.1.2 Power Distribution Units startup

The following procedure should be performed at each K-Chief 700-related Power Distribution Unit (PDU).

To switch on power at a PDU, do the following:

1 Unlock and open the front door of the PDU.

2 Switch on the 230 (120) VAC circuit breaker.

3 Switch on the 24 VDC circuit breakers.

4 Close and lock the front door of the PDU.

9.1.3 Network Distribution Units startup

The following procedure should be performed at each K-Chief 700- related Network Distribution Unit (NDU).

To switch on power at a NDU, do the following:

1 Unlock and open the front door of the NDU.

2 Switch on the 230 (120) VAC circuit breaker.

3 Switch on the 24 VDC circuit breakers.

4 Close and lock the front door of the NDU.

9.1.4 Operator Stations startup

The following procedure should be performed at each K-Chief 700 Operator Station.

To start up an Operator Station, do the following:

1 Remove the front panel from the computer compartment below the Operator panel table.

2 Switch on the 230 (120) VAC circuit breakers.

3 Switch on the 24 VDC circuit breakers.

4 Check that the Windows based operating system loads and performs an automatic log on.

5 After the automatic log on has been completed, check that the K-Chief 700 Operator Station application software starts and displays the K-Chief 700 wallpaper picture on the colour monitor screen.

6 After approximately one and a half minutes, check that the K-Chief 700 wallpaper picture is replaced by the AIM-2000 splash-screen with a status window at the bottom left corner showing the starting progress of the configured OS components.

7 After approximately one more minute, check that the AIM-2000 splash-screen is replaced by the K-Chief 700 Root Process image.

8 Refit the front panel to the computer compartment below the Operator panel table.

9.1.5 Field Stations startup

The Field Stations automatically request and download their application software from their dedicated server Operator Station. This means that at least one of the Operator Stations should be running before you start any of the Field Stations.

The following procedure should be performed at each K-Chief 700 Field Station.

To start up a Field Station, do the following:

1 Open the door of the Field Station.

2 Switch on the 230 (120) VAC circuit breakers.

3 Switch on the 24 VDC circuit breakers.

4 After approximately one minute, check that the RUN LED on the front panel of each of the RCU or RIO modules shows green.

5 Close the door of the Field Station.

9.2 User access

9.2.1 Access control levels

K-Chief 700 has four levels of access control:

Guest

Operator

Power user

System user

Note

The User access setup is configurable and may be set up differently.

Often the system is configured with Operator as default user role. However, after an Operator Station power on/re-boot it may be necessary to log on with the appropriate user level if a default user is not configured.

For operator interactions with the process, e.g. operating a ballast valve, one must be logged on at the correct operator level and the Ballast Command Control Area must be controlled from the Operator Station group of which this Operator Station is a member. It may thus be necessary to transfer/take command over the Ballast Command Control Area before operating can take place. See the AIM User Guide for details about Command Control.

User access rights at the various levels

User level **Guest** does not have access to operate on any Command Group.

User level **Operator** is allowed to operate the system within the Command Control System limits.

Power user can in addition to having basically the same rights as Operator set/change alarm limits and parameter values.

System user has all the Power user rights as well as all advanced system configuration rights.

9.2.2 Logging on to a different user level

To change user on an Operator Station, do the following:

1. On the **File** menu, point to →**User...** and select →**Change User/ Log Off....** The **Change User** dialog box is displayed.
2. Select the wanted user name from the drop-down list and type in the applicable password.
3. Click the **Change user** button.

   The new user is now logged on.

9.2.3 Automatic switch to default user on time-out

The system is often configured with a function that automatically switches to a default user after a time-out based on operator inactivity (e.g. 30 min.). However, if the log-on level is Guest, this function is not activated.

9.3 How to shut the system down

If the system has to be stopped for some reason, for example for maintenance, use the following procedures to shut the system down.

However, if only a part of the system requires to be shut down (such as one of the Operator or Field Stations), then only the relevant station shutdown procedure needs to be performed.

Note

Shutting down the entire system or any part of it should normally only be performed after authorisation has been given by the system administrator.

9.3.1 Field Stations shutdown

Caution

Do not turn off units that are shared with other systems before the consequences are understood and permission is given from proper authority.

The following procedure should be performed at each K-Chief 700 Field Station.

To shut down a Field Station, do the following:

1. Open the door of the Field Station.
2. Switch off the 24 VDC circuit breakers.
3. Switch off the 230 (120) VAC circuit breakers.
4. Close the door of the Field Station.

9.3.2 Operator Stations shutdown

The following procedure should be performed at each K-Chief 700 Operator Station.

To shut down an Operator Station, do the following:

1. If applicable, log on as a member of the **Power User** group. Refer to the **Access system** topic in the online AIM User Guide.
2. On the **File** menu, click →**Exit...**. The **Shut Down?** dialog box is displayed.
3. Click the **Yes** button. The K-Chief 700 Operator Station application software closes down and you are returned to a blank Windows Desktop.
4. Click the **Shut Down** button.

5 The Operator Station shuts down.

6 Remove the front panel from the computer compartment below the Operator panel table.

7 Switch off the 24 VDC circuit breakers.

8 Switch off the 230 VAC circuit breakers.

9 Refit the front panel to the computer compartment below the Operator panel table.

9.3.3 Network Distribution Units shutdown

Caution

Do not turn off units that are shared with other systems before the consequences are understood and permission is given from proper authority.

The following procedure should be performed at each NDU associated with K-Chief 700.

To switch off power at a NDU, do the following:

1 Unlock and open the front door of the NDU.

2 Switch off the 24 VDC circuit breakers.

3 Switch off the 230 VAC circuit breaker.

4 Close and lock the front door of the NDU.

9.3.4 Power Distribution Units shutdown

Caution

Do not turn off units that are shared with other systems before the consequences are understood and permission is given from proper authority.

The following procedure should be performed at each K-Chief 700-related PDU.

To switch off power at a PDU, do the following:

1 Unlock and open the front door of the PDU.

2 Switch off the 24 VDC circuit breakers.

3 Switch off the 230 VAC circuit breaker.

4 Close and lock the front door of the PDU.

9.3.5 Uninterruptible Power Supply shutdown

Caution

Do not turn off units that are shared with other systems before the consequences are understood and permission is given from proper authority.

At each K-Chief 700-related UPS cabinet, shut down the equipment and switch off power as described in the manufacture's manual.

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