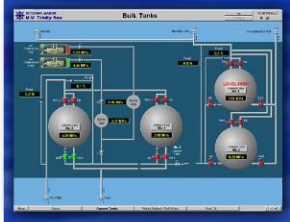
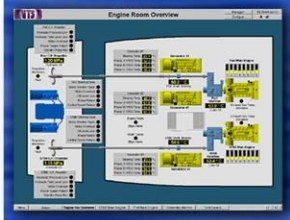
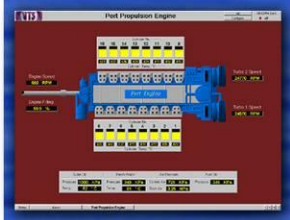
Software for Monitoring & Control

Trihedral

VTS Marine Solutions







Alarm and Monitoring

Tank Level Monitoring

Engineer's Callout

Pump and Valve Control

Other Ships' Systems

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Trihedral

Contents

Standard Solution for Marine Applications

This document describes standardized methods used by Trihedral Engineering Limited to supply the monitoring and control needs of the Marine industry. While each vessel has unique requirements, the system described herein provides a standard framework. Trihedral's unique approach allows engineers to address the immediate monitoring and control requirements of each vessel, choose the options that suit the particular situation, and plan for future expansion of the implementation to tie-in other shipboard functions as needed.

Such an approach requires flexibility in system design. The core of Trihedral's solution is its full-featured user interface software, Visual Tag System (VTS). VTS can communicate with an unlimited number of different devices simultaneously, creating an open system that allows the addition of new hardware from any manufacturer without requiring system upgrades or replacement. In addition, where a driver is not readily available for a particular device, Trihedral can draw upon over 18 years of software driver development experience to bring the data online.

Standard System Applications

Standardized VTS modules presently exist for the following applications:

- Alarm and Monitoring Systems
- Tank Level Monitoring
- Engineer's Callout Systems
- Pump and Valve Control
- Engine/Generator Control Panel Integration

Expansions for Additional Functionality

VTS systems are often expanded to incorporate additional shipboard systems. Expansion modules are not included as standard features of the core product, but are customized to meet specific customer needs.

Such expansions may include:

- Shipboard Crane Control
- Davit Control
- Thruster Control
- Propulsion Systems

Typical System Installations

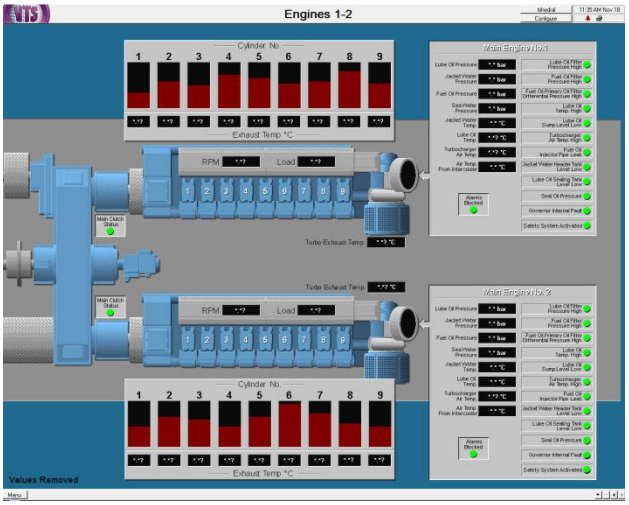
VTS Marine systems have been installed on ships of many sizes and purposes, from simple engine monitoring systems on tugboats to centralized monitoring and control consoles for a variety of ships' functions on large commercial and government vessels.

However, in order to simplify the engineering design process and reduce installation times and costs, Trihedral has devised a standardized marine monitoring and control application with numerous options to tailor a solution to the requirements of the situation.

Standard System Applications

Alarm and Monitoring

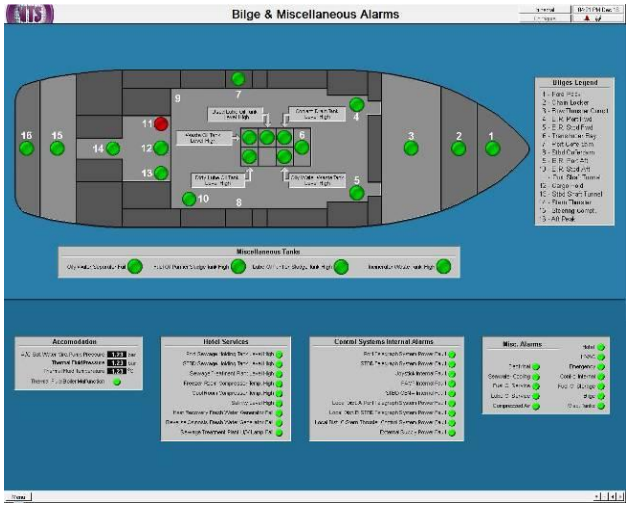
The Alarm and Monitoring system is the most common, standardized Trihedral product in use in the Marine industry. The product returns mission-critical vessel alarm and status data to a central operator interface.



This functionality is achieved by using a distributed system to concentrate alarms within a network of control panels throughout the ship. This methodology reduces wiring and significantly reduces costs.

These panels are interconnected via redundant field busses and centralized alarm management is controlled by a redundant PLC pair.

PC-based user interfaces are distributed in key areas of the ship and alarm acknowledgement is synchronized with the PLC.



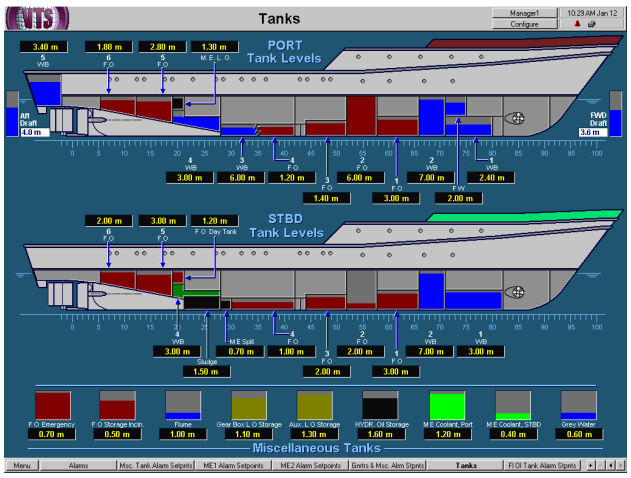
In addition to graphical system overview and alarm management, the system includes data-logging and trending.

The system monitors and displays status and alarms for such systems as:

- Propulsion
- Engines
- Gearbox
- Generators
- Steering Gear
- Bilges

Tank Gauging (Sounding)

Tank gauging systems use hydrostatic sensors or pneumatic bubbler system to read tank levels. These values are returned to the centralized monitoring interface and are cross-referenced against the ship's sounding tables to improve accuracy.



The user interface accurately reflects the physical layout of the ship, rather than a simple list of tank levels.

The layout is generated from a photograph of the ship. Alarms and levels are then easily located by their position on the graphic.

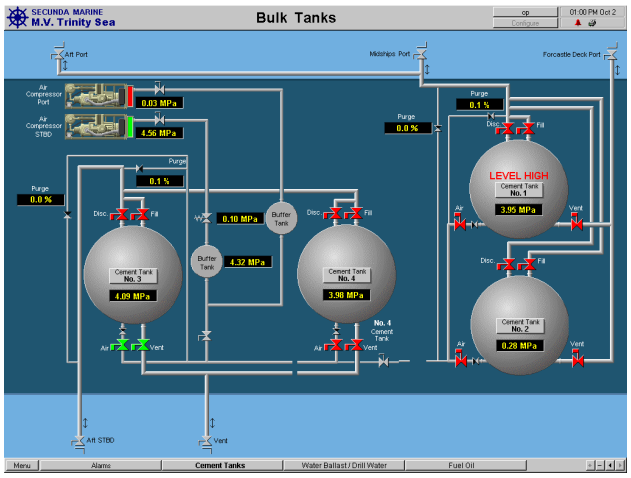
Engineer's Callout

The engineer's callout system is rarely a standalone system, but usually provides extended functionality to other applications, such as Alarm and Monitoring or Engine Monitoring. Callout interfaces consist of digital readouts in cabins, mustering points, bridges or other strategic locations.

Group alarm displays provide alarm annunciation and allowing remote alarm acknowledgement. Alarm escalation may be included for Unmanned Machinery Space applications where deemed necessary.

Pump and Valve Control

Pump and valve control is fully customizable and combines the control functionality and system protection of a PLC with the supervisory control of a user interface.



Devices can be displayed either as a list of analog and digital status and control items, or can be displayed in a graphical layout which mirrors the actual process. This allows operators to remotely monitor and control the entire ship's pump and valve system.

Operators can provide any number of control commands to digital and analog devices and can customize VTS to include control strategies for pump and valve system management.

Engine & Generator Control Panel Integration

Engines and generators using standard control panels and industry standard communication protocols can be fully integrated with the alarm and monitoring system to annunciate critical alarms and to gather historical data.

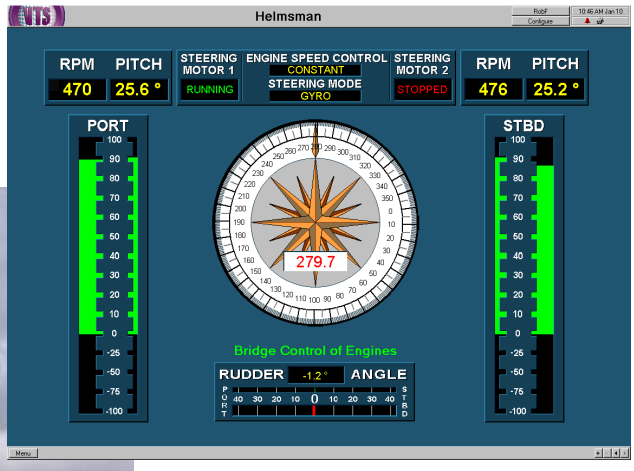
Expansions for Additional Functionality

In addition to the applications listed above, Trihedral systems are often expanded to include other shipboard system management. This is easily accomplished with the VTS software interface due to its versatile scripting language.

VTS Scripting allows every facet of the system to be customized, yet does not interfere with the core VTS engine, thus system upgrades are backwards compatible and do not affect the intended functionality of the system.

Trihedral systems have been expanded for the following ship's systems:

- Crane Control
- Davit Control
- Thruster Control
- Propulsion Systems



Typical System Architecture

Typical System Installations

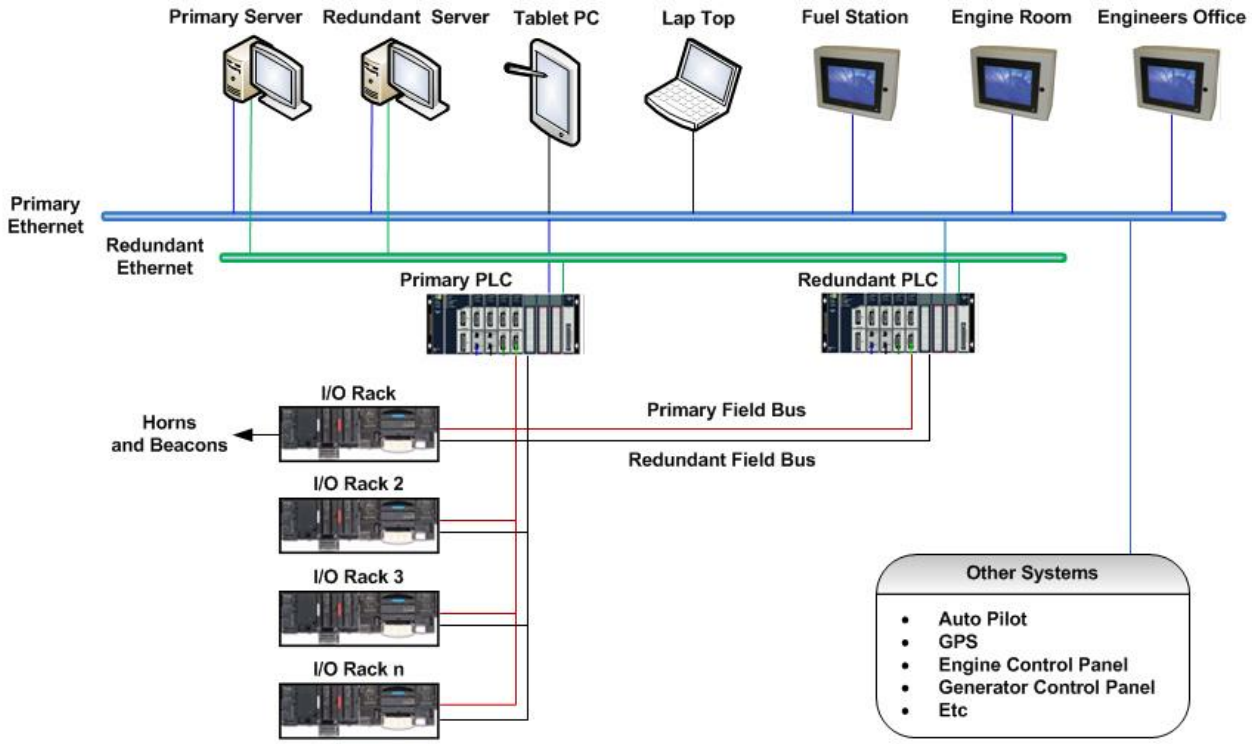
Small Systems

Small systems typically may have a small PLC and few I/O points. Users access data via a user interface in the control room, or alternatively via a redundant interface located on the bridge. Users at either location have the choice of silencing audible alarms locally or acknowledging alarms across the ship. Alarms are annunciated via horns and lights controlled from the PLC.

Medium and Large Systems

Larger systems can manage an unlimited number of PLCs, devices and user interfaces. The typical large system includes a set of redundant VTS servers and a vessel-wide redundant Ethernet network with remote interfaces in cabins and mobile interfaces via laptops and tablet PCs. A series of distributes I/O concentrator panels bring data back to the central monitoring and control servers utilizing either a self-healing Ethernet ring network or a redundant fieldbus network. Redundant PLC's may or may not be employed.

Servers are configured in redundant fashion, allowing one or more designated backup servers to automatically take over for the primary server in the case of primary server failure. These servers perform as both I/O communications servers and runtime user interfaces, and are the central hub of data for any number of strategically placed user interfaces throughout the ship. Often, these user interfaces are placed in engine rooms and mess halls for use as ship-wide system reference points.



User Interface

Interface options range from simple grouped alarm readouts to wide area client/server applications with multiple levels of redundancy. Any number of devices and subsystems can interface to the application.

Each user interface leverages the VTS user interface software, which includes a proven set of features valuable for use in any industry:

- Network and Server Redundancy
- Version Control
- Graphical Equipment Overviews
- Alarms and Events Management
- Security
- Online System Configuration
- Encrypted Operator Notes
- Reporting
- Data Logging
- Historical Data Trending
- PC Resource Monitoring

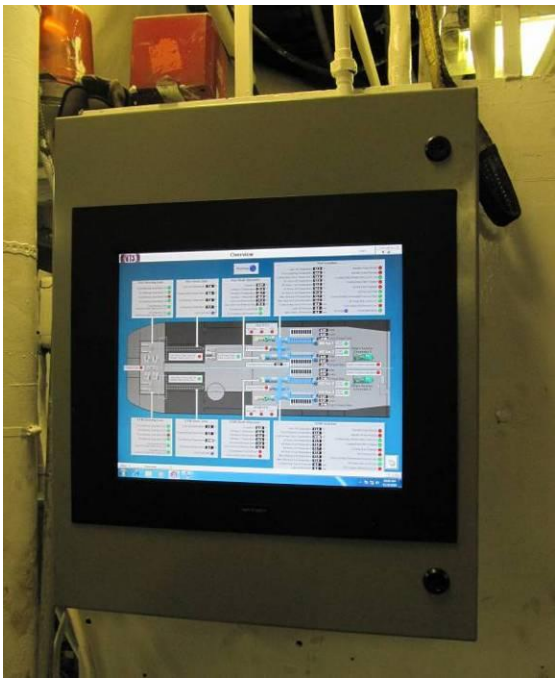
Panel PC

System computers run the Windows XP Pro, Windows 7, Server 2003 or Server 2008 operating system.

Touch-screen Nema 4 panel PCs are often utilized with optional keyboard and mouse or trackball.

Panel PCs are available as class-approved and non-class-approved units.

Panel PCs have a small footprint, making them the perfect choice for control rooms and engine rooms with little space to spare.



Desktop PCs

On larger ships, where space is less of a concern, systems often run on desktop PCs with Windows 7, XP Pro, Windows 2008 Server or Windows 2003 Server operating systems. 32 and 64 bit versions of these systems are supported

These desktop units can be configured for multiple monitors, allowing multiple interfaces to be viewed simultaneously from the same PC.

These PCs may be class-approved or can be matched with class-approved digital readout or a class-approved panel PC to fulfill the class-approval requirements.

Laptop PCs and tablet PCs

Systems may include Ethernet drops at fuel fill stations and cabins to accommodate additional user interfaces, such as laptops and tablet PCs.

This allows remote connectivity to the VTS software server for monitoring, configuration, or diagnostic purposes.

Remote system access

Where remote access is deemed of value, VTS allows remote connectivity via secure client access.

Remote users may perform the following actions:

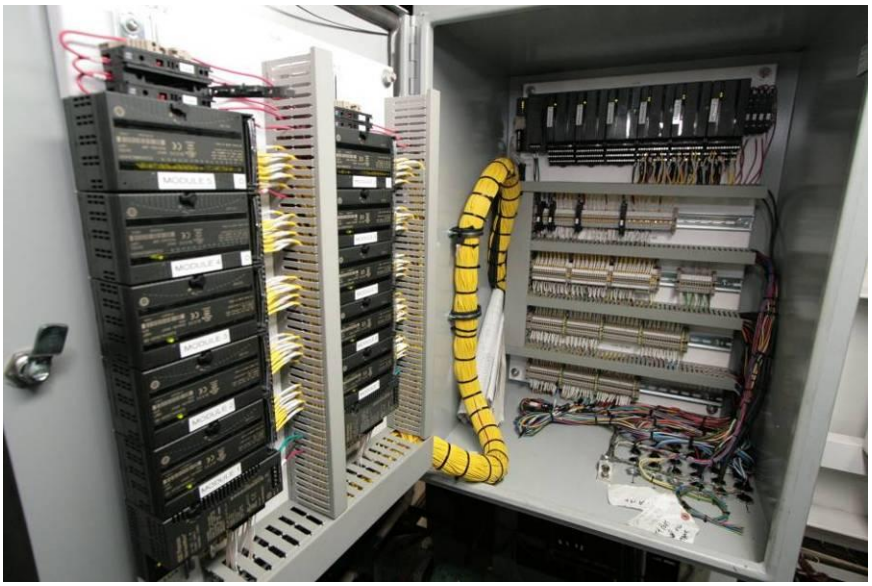
- Monitor system variables
- Monitor PC resources and network connectivity
- Make online configuration changes
- Troubleshoot and diagnose issues

Controllers and Subsystem Integration

VTS Marine systems use redundant communications paths to all control panels, PLCs and operator interfaces.

Operator interfaces are connected via CAT6 cable and PLC networks may use either Ethernet or proprietary fieldbus.

The system supports drivers for numerous device types. Typically, designs include Omron, GE or Allen Bradley PLCs.



VTS Marine systems have also been tested with the following devices:

- CAT Diesel ECM - SAE J1939 CANBUS
- CAT Diesel CCM - Modbus
- CAT Diesel ECM. Used on legacy CAT engines - SAE J1939 Serial Non-Standard
- Volvo Genset ECM – Modbus
- Woodward Easygen – Modbus
- Woodward EGCP-3 – Modbus

Custom software interfaces have been developed for the following devices:

- Security Cameras – Ethernet protocol
- GPS Systems – National Marine Electronics Association (NMEA) protocol
- Autopilot Systems - National Marine Electronics Association (NMEA) protocol

Alarms and Events Printer

Alarms and events printers may be included to print each alarm upon occurrence or may be used to print any portion of the alarms and events history.

Typically, the printer is located in the engine control room. If a laser printer is used, it can also print trends, reports and graphics screens.

Dot matrix printers are required for continuous alarms and events printing.

VTS User Interface Software

VTS is human-machine interface (HMI) software developed by Trihedral Engineering Limited. The product's main advantage lies in its unprecedented flexibility.

VTS allows operators to interact with the process using features tailored specifically to the installation, and which are displayed in a way that is meaningful to the operators.

Online modifications eliminate downtime and system configuration is enhanced by drag-and-drop tools and fill-in-the blank database configuration.

Using the powerful, built-in, object-oriented VTS scripting language, new tools and features may be added to enhance any part of the software.

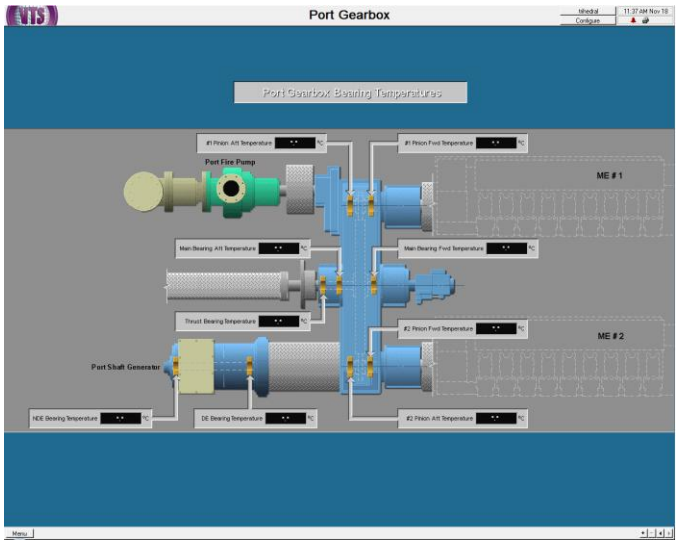
VTS is built on a pyramid of layers, with application independence from the standard VTS system, thus accommodating VTS software upgrades without the need to modify the configured application itself.

An extensive library of device drivers allows VTS to communicate with almost any commercially available field device. This means you can integrate hardware from a variety of manufacturers based on your specific needs and budget.

The number of communication drivers running on a single VTS application is limitless.

The software runs on standard personal computer (PC) hardware, utilizing off-the-shelf operating systems. Developments in PC systems are always available to VTS users, ensuring a long-term source of readily available central hardware.

Trihedral's highly skilled research and development team are always on the cusp of new and emerging technologies as PC technology advances.



Graphical Process Overview

Each VTS installation utilizes graphical process overview screens, providing users a quick graphical reference for identifying status and alarm data.

VTS includes a library of over 3900 graphical images and a set of useful navigational tools:

- A Popup Menu of Available Screens (Pages)
- Next and Previous Screen Buttons
- Hot-Boxes for Drilling into Processes
- Online Access to Configuration Tools
- Full Screen and Windowed Application Pages
- Configurable Screen Change Hot-Buttons

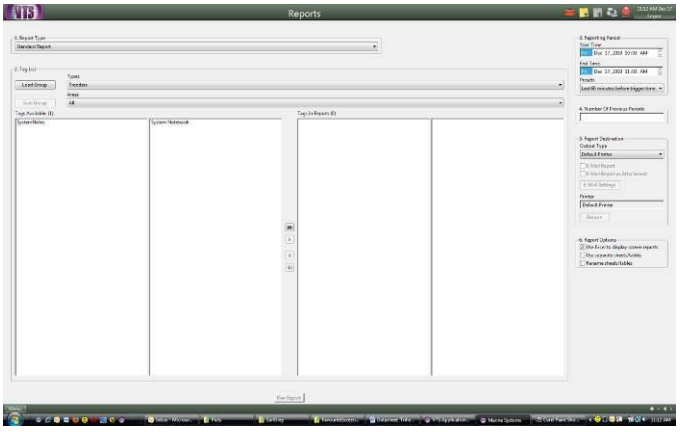
To enhance the look of process overview screens, VTS supports the use of background images in its application pages. Background images can be created in .BMP and .JPG format.

All standard VTS system screens and system functions can be accessed from the interface, including reporting, trending, alarm management, online configuration and security.

Reporting

The VTS Report Generator is an integrated feature and is included in the VTS base package. Reports can be run on an as-required basis, or can be saved and scheduled to run periodically for any defined time range.

They may be output to the screen, to email, to a database or to a file. Data may also be output to a defined Excel template.



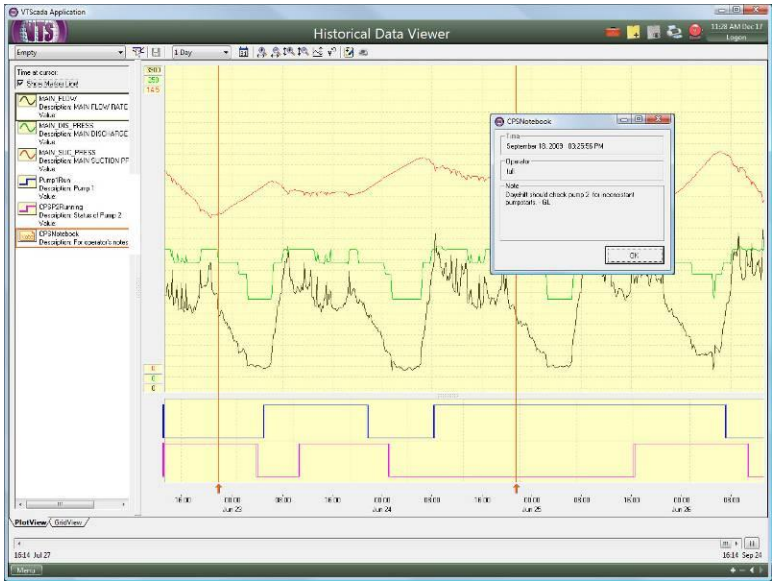
Data Logging

VTS supports the logging of alarm data and I/O data through specially designed logger tags. Logged data is maintained in individual binary files, reducing data file size, and all log files are stored with the application.

All data logged for each month is maintained in a set of logger files which are stored in a directory named for that month. Thus, one folder exists for all historical data logged during the month, making data backup easier to manage. This methodology eliminates the requirement for a relational database and improves data access time. The result is a more efficient application that requires less computer infrastructure.

Trending

VTS provides an integrated data trending function called the Historical Data Viewer. This allows users to display historical and real-time data in a continuously updated graph. Users can select from the following features:



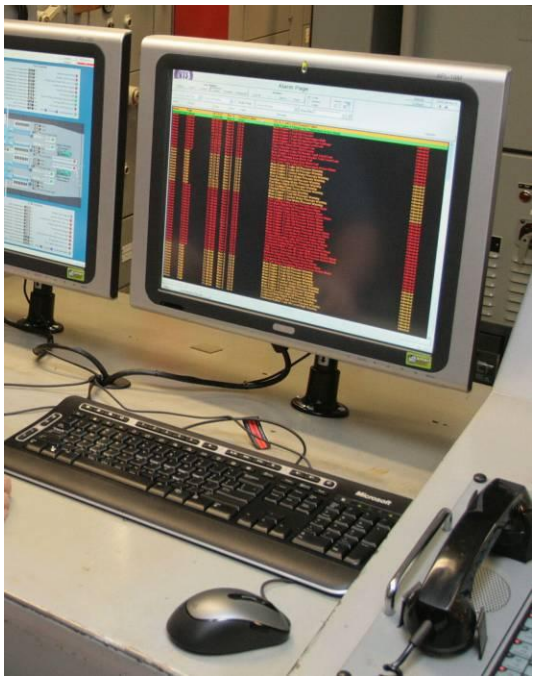
- Create and save 'quick-select' groups of I/O for future reference
- Select specific dates from a calendar
- View unlimited simultaneous trends
- Zoom horizontally and vertically
- Display up to 10 years of data
- Print trends
- Change pen colors per trended value
- Display alarms, peaks, min, max, avg
- Export data for external data analysis
- Add encrypted operator notes to any point on a trend to explain unusual occurrences

Alarm Management

VTS is integrated with the PLC alarm system, allowing PLC alarms to be displayed on the VTS alarm screen. When an alarm occurs, an alarm bell graphic in the top right corner flashes and the alarm is annunciated through the computer speakers, regardless of which application screen the user is viewing.

This alarm is seen and heard at all user interfaces throughout the ship, and also at local annunciation panels. Selecting the flashing alarm bell graphic takes the user to the alarm manager page, where the user can choose to silence or acknowledge the alarm. An acknowledge command will also acknowledge the alarm in the PLC. In the event VTS/PLC communications are interrupted, PLC alarms will continue to annunciate locally.

The alarm manager maintains its alarm data in a compressed binary file format. Besides being a compact storage format, the binary format makes data difficult to alter, thus the alarm history becomes a permanent system alarm log.



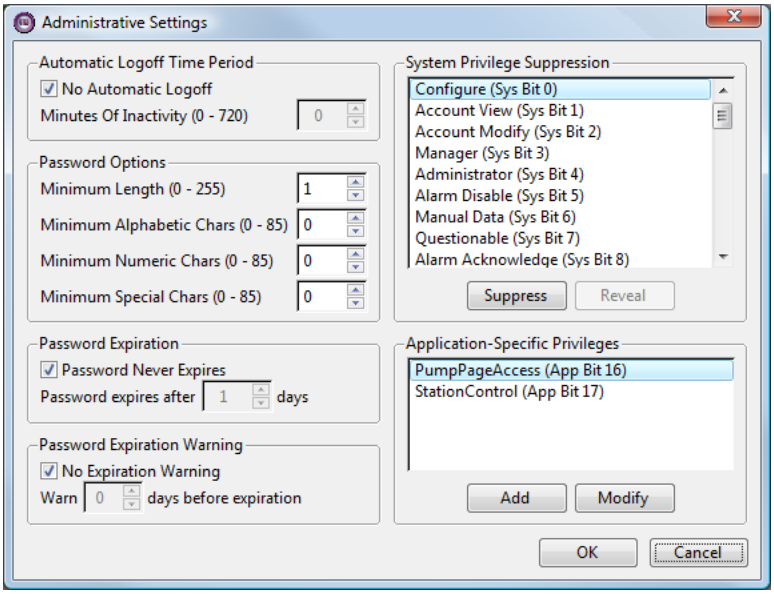
Alarms can be sorted by time or priority and users can filter the alarm list by selecting from a set of pre-defined functional areas within the vessel (i.e. aft thrusters). The list can also be filtered to show current, disabled, unacknowledged or historical alarms.

VTS maintains a system event log which is also viewed from the alarm interface. The event log includes such information as user logon/logoff activity, manual data entries, system startup and shutdown and engineer callout activity.

Security

The integrated VTS security manager is also accessed from the VTS user interface. Using a set of drop-down menus, administrators can:

- Add and remove users. There is no limit to the number of users the system can have.
- Change passwords and default logout times.
- Suppress or allow access to system privileges.
- Create custom privileges for screen access, thus controlling access to certain system functionality.



The VTS security system is extremely versatile, allowing administrators to design as open, or as secure a system as they feel necessary.

Networking

The VTS core product is designed with future expansion and mission-critical, uninterrupted service in mind. For this reason, a great amount of the system's power is in its integrated networking capabilities. In a matter of seconds, a VTS system can be made fully-redundant across numerous server computers and placed in strategic locations on the vessel.

Client computers can also be configured to perform as backup servers and there is no limit on the number of backup computers VTS is capable of managing.

VTS offers a set of tools to expand a networked Marine application, including:

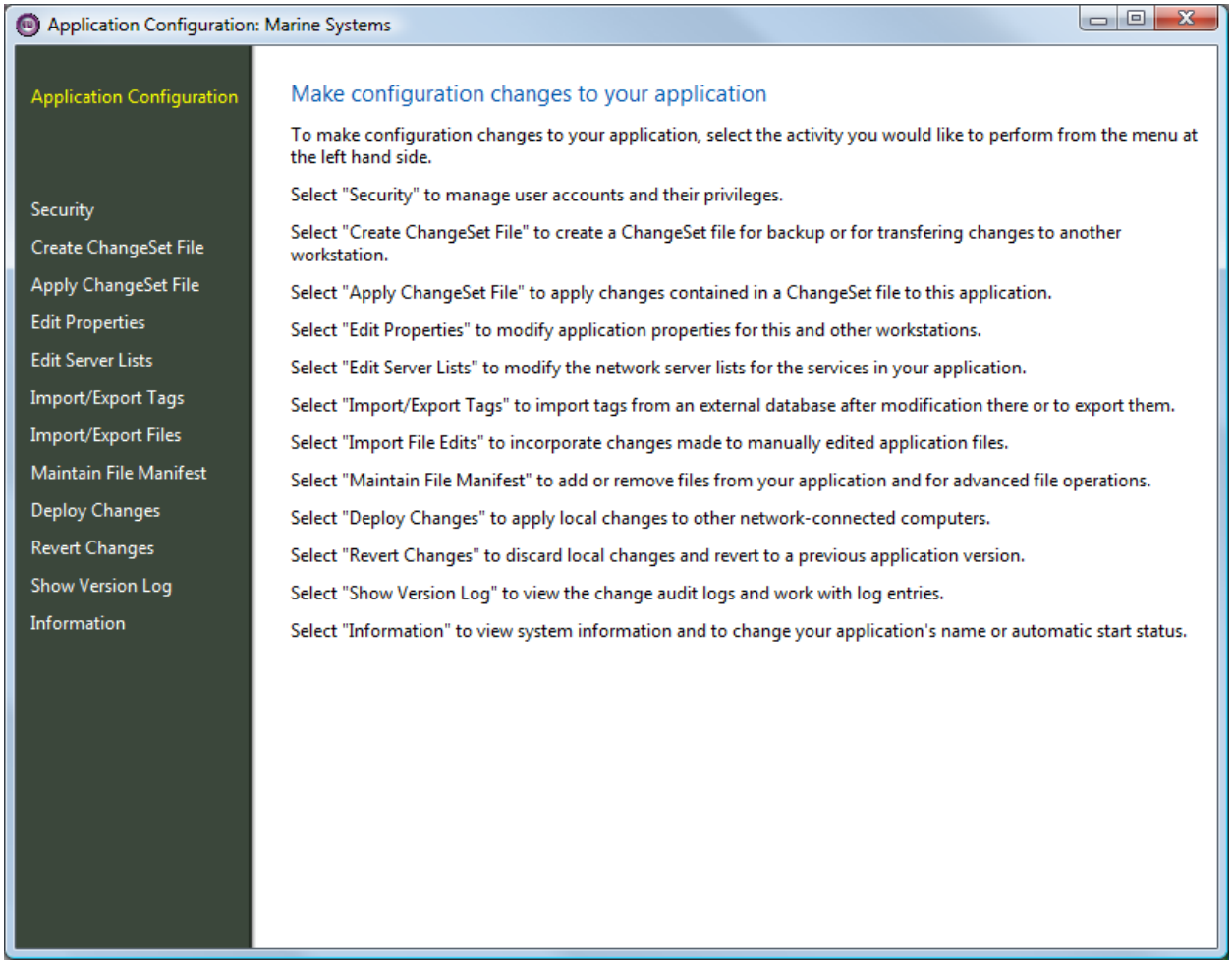
- Internet/Intranet clients
- Dial-in capabilities
- I/O load sharing across servers
- Automatic server fail-over

On-Line Configuration

VTS has the inherent ability to allow users to make modifications to an application without service interruption. This is particularly useful in mission-critical marine applications for two reasons.

Firstly, it allows changes to be made to the system while it is still monitoring and controlling the system. Secondly, it allows the engineers to configure the system and receive immediate feedback on their actions.

Since the alarm and monitoring system is essential for the operation of the vessel, this feature will allow for system maintenance while the vessel is in service.



Marine Class Approvals

VTS Marine system components are class-approved where required. Software installations are built to meet the requirements of the class for each particular vessel. However, Trihedral's typical installations provide a standard system that meets the generic requirements for all such approvals.

Listed below are examples of projects in which class approvals were attained by vessels with Trihedral system installations:

- CCGS Teleos - DNV (UMS)
- CCGS Cowley - Lloyds
- Great Eastern Shipping DLV 900 - BV
- Tignish Sea - ABS

Installation History

Trihedral Engineering has been designing and integrating control and monitoring systems in the marine industry for more than fifteen years. Following are some of Trihedral's marine projects. Details on these projects are available upon request.

Commercial Projects

Trinity Sea, Offshore Supply Vessels (Secunda Marine)
Alarm and Monitoring System
Tank Gauging (Sounding)
Pump & Valve Control Systems

Burin Sea, Offshore Supply Vessel (Secunda Marine)
Alarm and Monitoring System
Tank Gauging (Sounding)
Pump & Valve Control Systems

Tignish Sea, Offshore Tug (Halifax Grain)
Remote Glass Bridge on Attached Barge

Pipe Laying Barge (GAL Offshore Resources)
Complete Controls Refit

Government Projects

Remote Lighthouse Monitoring (Canadian Coast Guard: Marine Navigation Services)

Research Vessel Atlantic Champion (Canadian Department of Fisheries and Oceans)
Alarm and Monitoring System

CCGS Earl Grey, Medium-endurance Multi-tasked Vessel **(**Canadian Coast Guard)
Alarm & Monitoring
Tank Gauging

CCGS Louis S. St-Laurent, Heavy Icebreaker **(**Canadian Coast Guard)
Inlet Guide Vane Control for Centrifugal Compressor (bubbler system)

CCGS Terry Fox, Heavy Icebreaker **(**Canadian Coast Guard)
40 Ton Crane, Control System
Clutch Control System
Alarm and Monitoring System
Tank Gauging (Sounding)

CCGS Henry Larsen, Medium Icebreaker (Canadian Coast Guard)
Alarm and Monitoring System Feasibility Study

CCGS Cygnus, Offshore Patrol Vessel (Canadian Coast Guard)
Power Management System (All work completed by others)
Bearing Temperature Monitoring System

CCGS Leonard J. Cowley, Offshore Patrol Vessel (Canadian Coast Guard)
Alarm and Monitoring System
Tank Gauging (Sounding)

CCGS Hudson, Oceanographic Science Vessel (Canadian Coast Guard)
Engine Cylinder Temperature Monitoring System

CCGS Alfred Needler, Fishery Science Vessel (Canadian Coast Guard)
Alarm and Monitoring System
Tank Gauging (Sounding)

CCGS Teleos, Fishery Science Vessel (Canadian Coast Guard)
Alarm and Monitoring System (Work completed by Trihedral and others)

CCGC Bickerton, SAR Lifeboat (Canadian Coast Guard)
CAT Engine Monitoring System

CCGC Sambro, SAR Lifeboat (Canadian Coast Guard)
CAT Engine Monitoring System

CCGC Spindrift, SAR Lifeboat (Canadian Coast Guard)
CAT Engine Monitoring System

CCGS Mathew, Hydrographic Survey Vessel (Canadian Coast Guard)
Alarm and Monitoring System
Power Management System
Tank Gauging (Sounding)

Alarm and Monitoring System Simulator *(*Canadian Coast Guard)
Diagnostics and Maintenance Training Simulator

Warranty

Trihedral warrants its systems for a period of one year following system commissioning. During this period, Trihedral will correct any system configuration and/or software problems that arise out of normal system operation, at no additional charge. Warranties of supplied components will be based on their respective manufacturer's warranties.

Replacement of faulty equipment will be limited to shipping the replacement equipment to the required site. Installation of the equipment is not included in the warranty, but can be carried out by Trihedral at our standard hourly rates.

Subsequent to this one year period, customers may purchase additional support from Trihedral for the VTS software portion of their system. Support for hardware components may be available through the hardware manufacturer.