

# Trihedral

## Marine Solutions



Alarm and Monitoring  
Tank Level Monitoring  
Engineer's Callout  
Pump and Valve Control  
Other Ships' Systems

Trihedral Engineering Limited, Bedford, Canada  
Trihedral, Inc., Orlando, Florida  
Trihedral UK Limited, Aberdeen, Scotland

1.902.835.1575  
1.407.888.8203  
+44 (0) 1224 258910

[info@trihedral.com](mailto:info@trihedral.com) / [www.trihedral.com](http://www.trihedral.com)  
1.800.463.2783 (North America)  
© Trihedral Engineering Limited 2015

Trihedral

## A Standard Marine Solution

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 requirements of each vessel, choose the options that suit the particular situation, and plan for future expansion 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, VTScada.

VTScada can communicate with an unlimited number of 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 communications driver is not readily available for a particular device, Trihedral can draw upon over 28 years of software driver development experience to bring the data online.

## Open-Architecture Platform for Self-Supportability

Our Open Architecture solutions offer the customer a level of flexibility uncommon in the marine industry. Many ships operate far from shore for extended periods and prefer to have local support for their ships systems. Trihedral provides training to end customers in system configuration, troubleshooting and maintenance, as well as trains 3rd party integration companies who would like to offer configuration and support services for local customers.

## Standard System Applications

Standardized VTScada modules exist for the following applications:

- Alarm and Monitoring
- Pump and Valve Control
- Tank Level Monitoring
- Engineer's Callout
- Engine/Generator Control Panel Integration
- Unmanned Machinery Space (UMS) installations

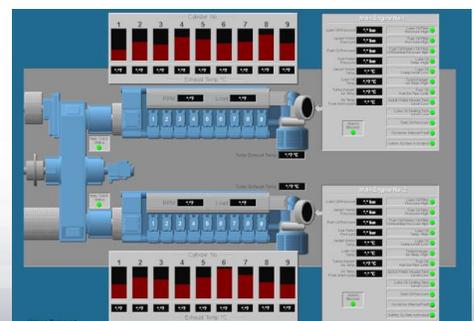
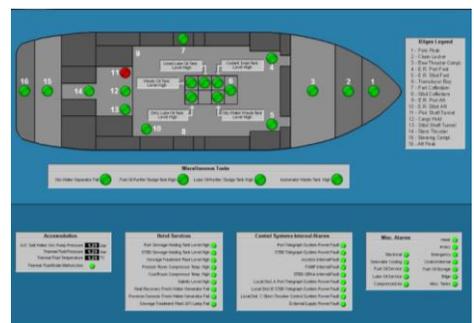
## Expansions for Additional Functionality

Trihedral solutions are often expanded to incorporate additional shipboard systems. Expansion modules are not included as standard features of the core product, but are customized for specific installation needs. Expansions may include:

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

## Typical System Installations

Trihedral solutions are 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 mid-size commercial and government vessels.





## 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 ship-board system management. This is easily accomplished with VTScada due to its versatile scripting language. 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

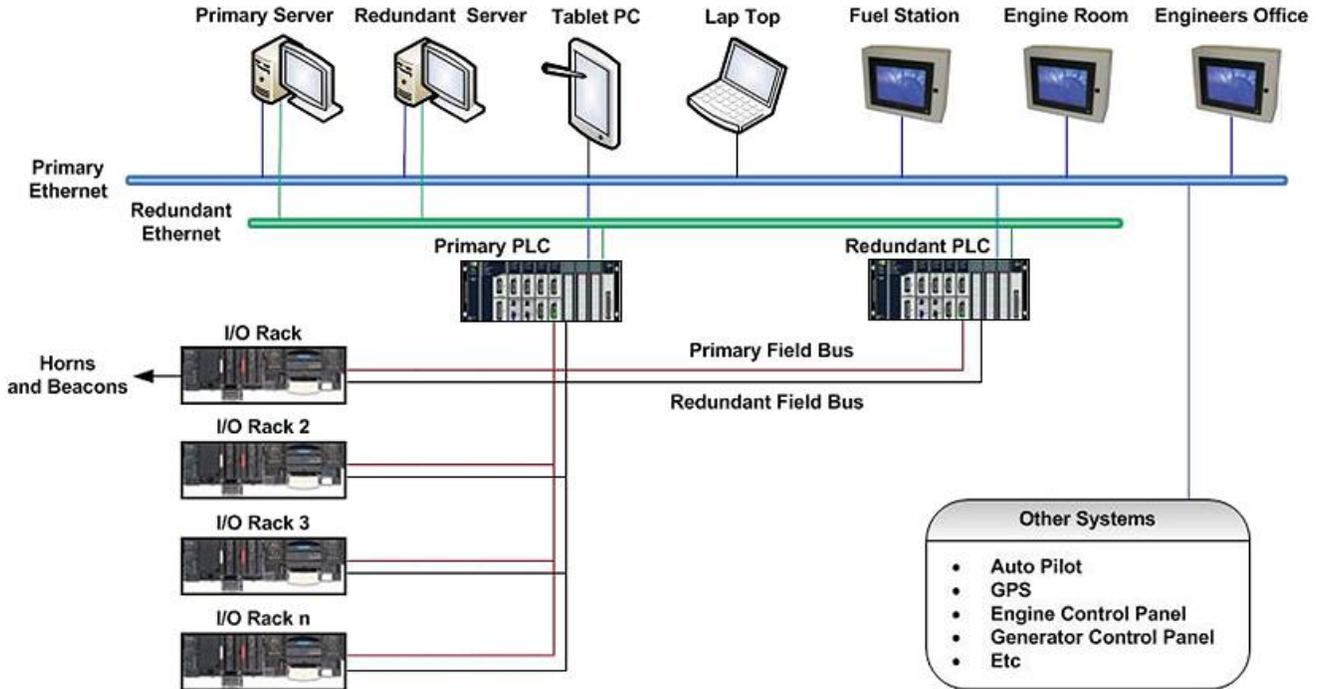
Small systems typically have a small number of PLCs and few I/O points. Users access data via a user interface in the control room, or alternatively via a redundant interface located on the bridge. Users at either location have the choice of silencing audible alarms locally or acknowledging alarms across 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 VTScada servers and a vessel-wide redundant Ethernet network with remote interfaces in cabins and mobile interfaces via laptops and tablet PCs.

A series of distributed 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 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 VTScada user interface software, which includes a proven set of features valuable for use in any industry:

- Network and Server Redundancy
- Application 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 Server 2008 or 2012, and Windows 7 or 8 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 computers running Server 2008 or 2012, or Windows 7 or 8 operating systems.

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

PCs may be class-approved or can be watched 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 interfaces, such as laptops and tablet PCs. This provides connectivity to the system servers for monitoring, configuration, or diagnostic purposes.

## Remote System Access

Where remote access is required, the VTScada thin client provides complete monitoring and control capabilities. Alternatively, remote users may connect to the system using a remote desktop client for troubleshooting and diagnostic purposes.

## Controllers and Subsystem Integration

VTScada systems use redundant communications paths to all control panels, PLCs and operator interfaces. Networks may use Ethernet, fiber or fieldbus, depending upon the type of equipment required.

Typical Marine approved PLC's include Omron, GE or Rockwell. VTScada Marine systems have also been installed with the following:

- 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 are available 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 occurrence or 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.

## VTScada User Interface Software

VTScada is human-machine interface (HMI) software developed by Trihedral Engineering Limited. The product's main advantage lies in its unprecedented flexibility. It 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 VTScada scripting language, new tools and features may be added to enhance any part of the software. VTScada is built on a pyramid of layers, with application independence from the standard VTScada system, accommodating software upgrades without modifying the configured application itself.

An extensive library of device drivers allows the system 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 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 VTScada 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 installation utilizes graphical process overview screens, providing users a quick graphical reference for identifying status and alarm data. VTScada includes a library of over 3900 graphical images and a set of useful navigational tools:

- 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 pages
- Configurable screen change hot-buttons

VTScada supports the use of background images in its application pages. Background images can be created in .BMP and .JPG format. All standard VTScada system screens and system functions can be accessed from the interface, including reporting, trending, alarm management, online configuration and security.

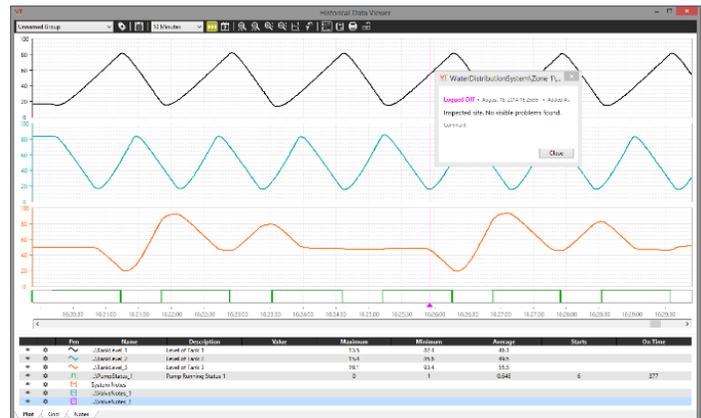
### Reporting

The Report Generator is an integrated feature and is included in the VTScada 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 and Trending

VTScada 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.



VTScada 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 '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 points on a trend

## Alarm Management

VTScada is integrated with the PLC alarm system, allowing PLC alarms to be displayed on the alarm screen. When an alarm occurs, an alarm 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 interfaces throughout the ship, and also at local annunciation panels. Selecting the flashing alarm icon takes the user to the alarm manager page where the user can silence or acknowledge the alarm. An acknowledge command also acknowledges the alarm in the PLC. If 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 predefined functional areas within the vessel (i.e. aft thrusters).

The list can also be filtered to show current, disabled, unacknowledged or historical alarms. VTScada 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.

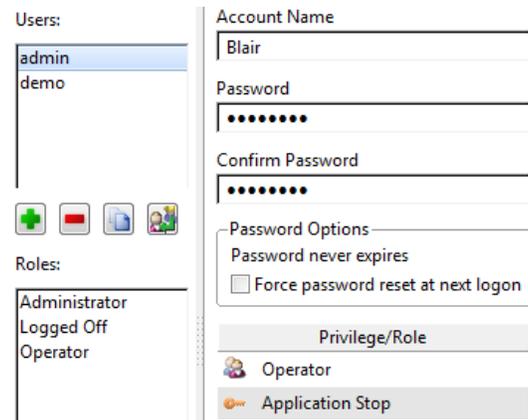


## Security

Access the integrated security manager from the VTScada user interface. Using a set of drop-down menus, administrators can:

- Add and remove an unlimited number of users
- 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

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



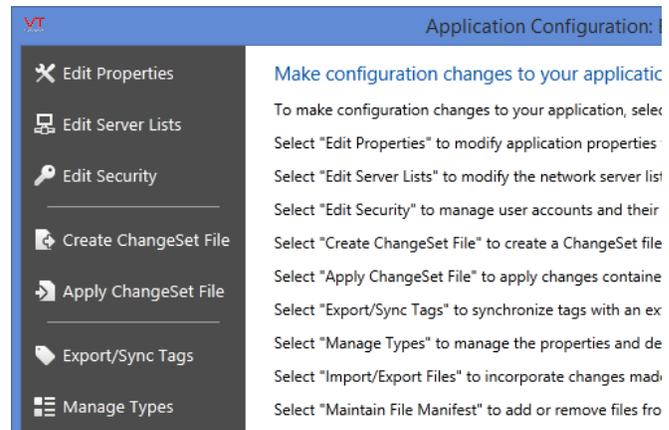
## Networking

The VTScada 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 seconds, a 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 the system can manage. VTScada 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

VTScada 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

VTScada Marine system installations 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 marine systems 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 Level Monitoring (Gauging)
- Pump and Valve Control Systems

#### Pipe Laying Barge (GAL Offshore Resources)

- Complete Controls Refit

#### Tignish Sea, Offshore Tug (Halifax Grain)

- Remote Glass Bridge on Attached Barge

#### Burin Sea, Offshore Supply Vessel (Secunda Marine)

- Alarm and Monitoring System
- Tank Level Monitoring (Gauging)
- Pump and Valve Control Systems

#### Svitzer Canada, Point Valliant

- Alarm and Monitoring
- Tank Level Gauging

### Government Projects

#### CCGS Sir William Alexander, High Endurance Multi-Tasked Vessel Light Icebreaker

- Alarm and Monitoring
- Tank Level Monitoring (Gauging)

#### CCGS Edward Cornwallis, High Endurance Multi-Tasked Vessel Light Icebreaker

- Alarm and Monitoring
- Tank Level Monitoring (Gauging)

#### CCGS Earl Grey, Medium-endurance Multi-tasked Vessel (Canadian Coast Guard)

- Alarm and Monitoring
- Tank Level Monitoring (Gauging)
- Woodward Genset Controller User Interface (Installation and configuration by others)

#### CCGS Terry Fox, Heavy Icebreaker (Canadian Coast Guard)

- 40 Ton Crane Control System
- Clutch Control System
- Alarm and Monitoring System
- Tank Level Monitoring (Gauging)
- Woodward Genset Controller User Interface (Installation and configuration by others)

#### CCGS Henry Larsen, Medium Icebreaker (Canadian Coast Guard)

- Alarm and Monitoring System Feasibility Study

#### CCGS Leonard J. Cowley, Offshore Patrol Vessel (Canadian Coast Guard)

- Alarm and Monitoring System
- Tank Level Monitoring (Gauging)

#### CCGS Hudson, Oceanographic Science Vessel (Canadian Coast Guard)

- CAT Engine Monitoring System

#### CCGS Alfred Needler, Fishery Science Vessel (Canadian Coast Guard)

- Alarm and Monitoring System
- Tank Level Monitoring (Gauging)

#### CCGS Teleos, Fishery Science Vessel (Canadian Coast Guard)

- Alarm and Monitoring System (Work 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 Level Monitoring (Gauging)
- Alarm and Monitoring System Simulator (Canadian Coast Guard)
- Diagnostics and Maintenance Training Simulator
- Remote Lighthouse Monitoring (Canadian Coast Guard)
- Marine Navigation Services

#### CCGS Louis S. St-Laurent, Heavy Icebreaker (Canadian Coast Guard)

- Inlet Guide Vane Control for Centrifugal Compressor (bubbler system)
- Research Vessel Atlantic Champion (Canadian Department of Fisheries and Oceans)
- Alarm and Monitoring System

#### CCGS Cygnus, Offshore Patrol Vessel (Canadian Coast Guard)

- Power Management System (Installation and configuration by others)
- Bearing Temperature Monitoring System

## 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 VTScada software portion of their system. Support for hardware components may be available through the hardware manufacturer.

*Updated February 24, 2015*