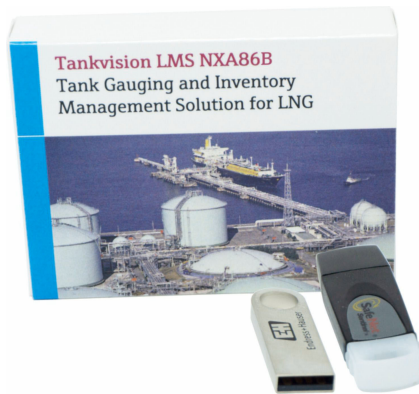# Technical Information
Tankvision LMS NXA86B

Tank Gauging

Advanced LNG tank gauging and inventory management system

Application

Tankvision LMS is specifically designed for LNG storage sites, to fulfil the needs of Receiving, Peak Shaving and Production Terminals. It handles all the data acquisition, supervisory control and monitoring required in a single fully integrated solution.

Tank farm and terminal operators have access to all measured and calculated tank parameters. Advanced modeling tools monitor the effects of boil off gas and stratification and predict potential rollover scenarios. The skin temperature monitoring enables to detect potential tank leakages.

Your benefits

- Operates under Microsoft Windows and Windows Server
- Stand-alone or redundant system architecture
- Volume calculations and correction included according to international standards (API/ASTM/JIS/GBT/IP tables)
- LNG specific features such as stratification, skin temperature monitoring and rollover prediction
- Supports all sensors commonly found on LNG storage sites (e.g. Primary/ Secondary Gauges, LTD Gauges, Leak Detection Sensors, Analyzers etc.)
- 3rd party protocols (e.g. Enraf, Saab) and drivers available for virtually any device
- OPC DA Server, OPC UA Server and Modbus connectivity

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People for Process Automation

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Function and system design

Application

Tankvision LMS is a total LNG Tank Storage and Management solution for Peak Shaving, Receiving and Production LNG facilities. The LMS system has been designed to interface to all instruments commonly found on LNG storage tanks, and to collect and present the instrument data through a range of intuitive graphical user interfaces. A typical LNG Tank will have a wide range of measurement instruments to measure Liquid Level, Liquid Density, Liquid and Vapour Temperature, Liquid and Vapour Pressure, Skin Temperature and much more.

Typically each tank would be fitted with an LTD gauge, two further level gauges configured as a Primary and Secondary, and an Alarm Gauge. The LTD gauge is a servo operated unit mounted on the tank roof. The purpose of the LTD gauge is to take accurate profiles of temperature and density throughout the liquid, and whilst not profiling provide continuous liquid level, temperature and density measurement. The Primary and Secondary gauges can be either servo and or radar operated units also mounted on the tank roof. The purpose of these gauges is to provide continuous liquid level measurement, and average liquid temperature measurement. They provide redundancy on the measurement of level and temperature. The average liquid temperature is derived from a multi point temperature sensor device. The alarm gauge is often a servo or radar based gauge configured to provide volt free contact alarm status to an independent system.

An LMS system can operate in a simple standalone configuration or as a fully redundant system where security and integrity are of paramount importance. The LMS system has a flexible and scalable architecture allowing it to be tailored to a number of different applications easily.

Gauges

The system enables seamless integration of all major types of tank level, temperature and density/mass measurement gauges.

Tank gauges are connected via Tankvision Multi Scan, Tank Scanner, other 3rd party field communication and acquisition units or directly to according communication cards fitted into the Tankvision LMS workstation PC.

Display

Parameters such as level, temperature, pressure, density, mass, flow rate, gross and standard volumes are calculated continuously and displayed. Up to 400 tanks are supported [1]. Tankvision LMS offers numerous visualizations of tank inventory data, e.g. a complete overview of connected tanks in a graphical or grid view, real time or historical trending and some more specialized views.

Connections

The data can be distributed using OPC, Web based technologies and Modbus (TCP or RTU).

Inventory Calculations

LMS can be configured to calculate certain inventory parameters for each LNG tank.
- Total observed Volume
- Gross observed Volume
- Ullage Volume
- Gross Mass
- Ullage Mass
- Liquid Mass
- Vapor Mass
- Calorific Value (Optional)
- Wobbe Index (Optional)
- Energy (Optional)

System Overview

Stand alone

The following general architecture represents a typical architecture for a LNG monitoring. It consists of a single standalone operator work station, including a single PC using Microsoft Windows Operating System and running Tankvision LMS. The PC can be fitted with multiple serial ports and each port can be configured to act as a host or slave.

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[1] 200 in fully redundant mode, more on request

A field interface is used to collect data from external devices such as level and temperature gauges. A host interface is used to provide data to a higher level system either via OPC or Modbus.
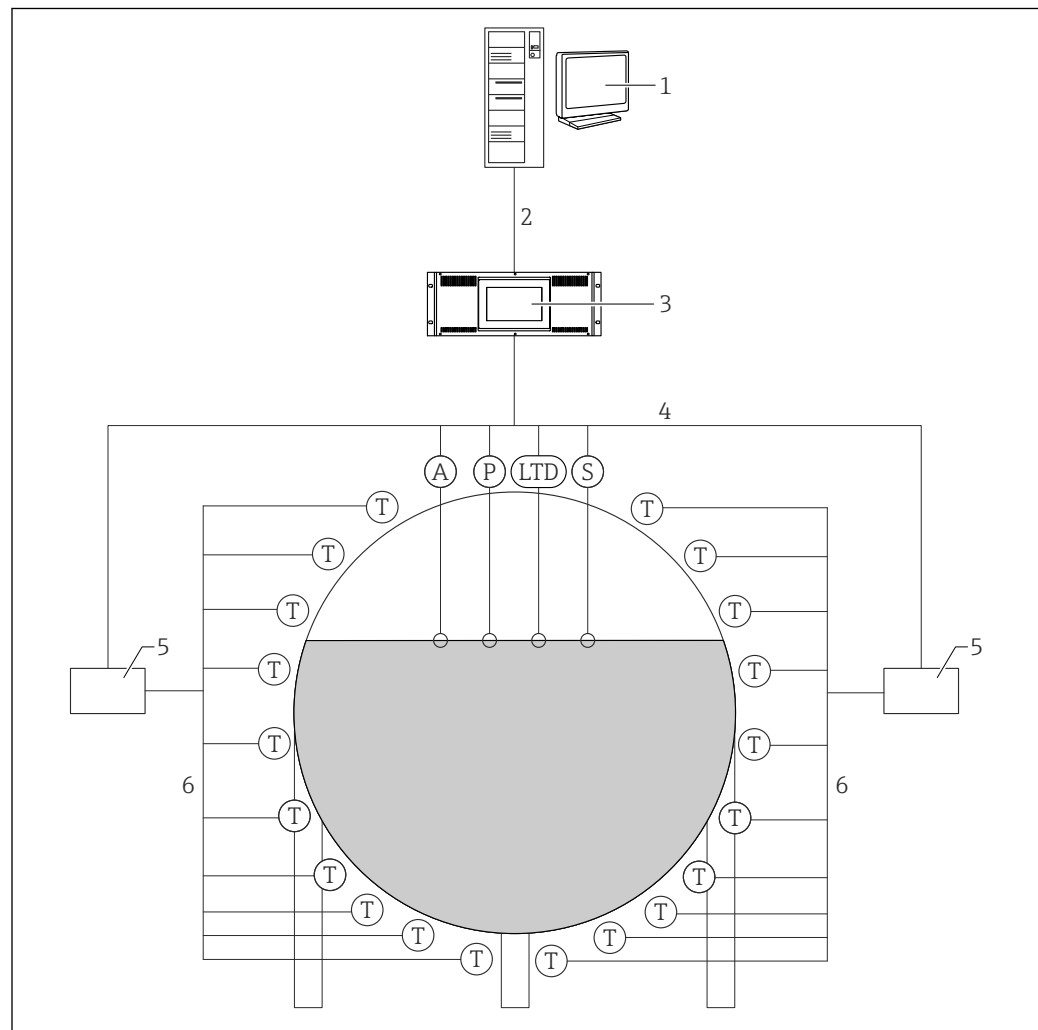
A0053274

1   Tankvision LMS NXA86
2   Ethernet
3   Tankvision Multi Scan NXA83B
4   Modbus RS485
5   Temperature multiplexer (TM188)
6   Analog (3 or 4 wires)
A   Alarm gauge
P   Primary gauge
S   Secondary gauge
LTD Level, Temperature and Density gauge
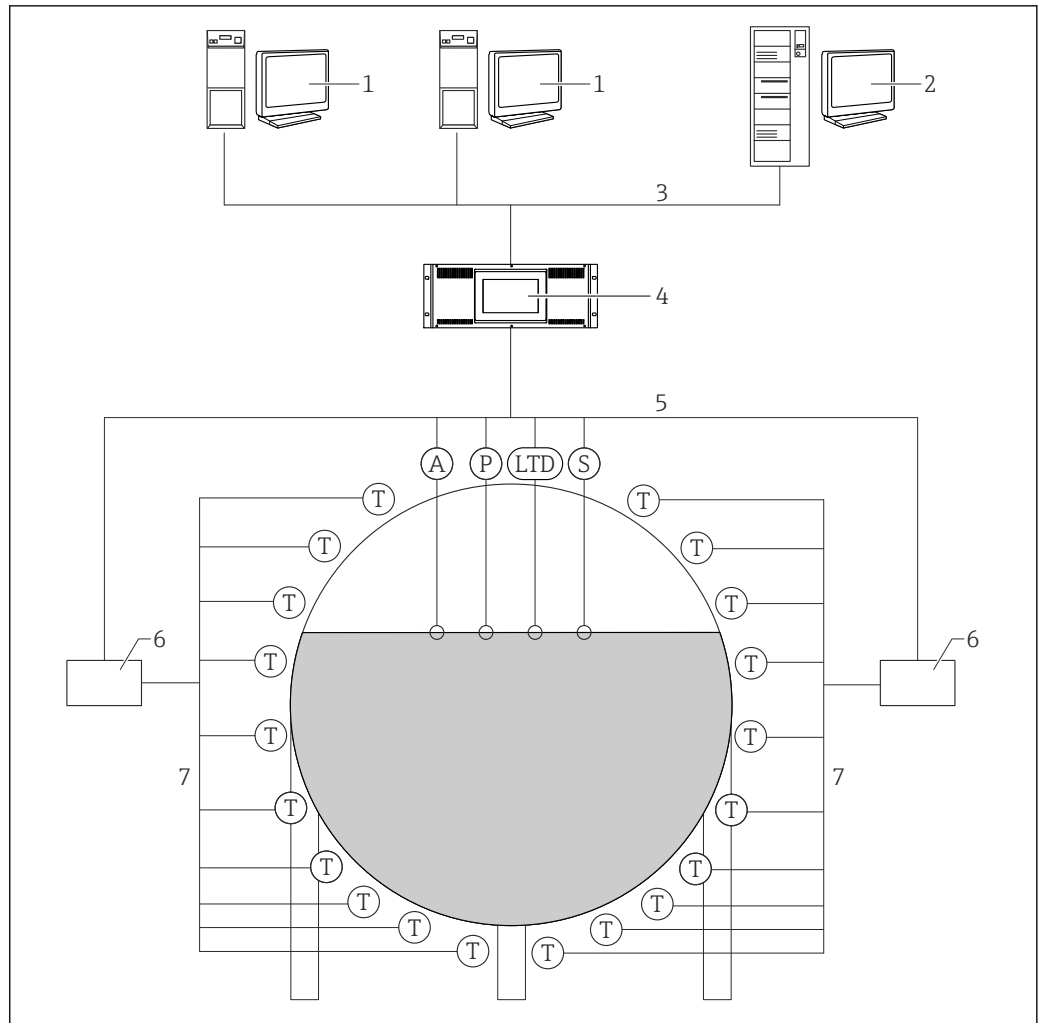*T   3 or 4 wire temperature probes for skin temperature*

The system can be designed in redundant mode.

Server Client architecture

If multiple operator work stations are required, a client server architecture is normally provided.

A central server is used to collect data, and make that available to a number of client operator stations via an Ethernet network. The server will run on a Windows Server platform, SQL Server and the client/server version of Tankvision LMS.

The Client Operator Stations are based on a standard PC's, running a windows operating system. Each Client Operator station has the full functionality of the Tankvision LMS software and operates just like the Standalone version.

A0053273

1   *Tankvision LMS NXA86 client*
2   *Tankvision LMS NXA86 server*
3   *Ethernet*
4   *Tankvision Multi Scan NXA83B*
5   *Modbus RS485*
6   *Temperature multiplexer (TM188)*
7   *Analog (3 or 4 wires)*
A   *Alarm gauge*
P   *Primary gauge*
S   *Secondary gauge*
LTD *Level, Temperature and Density gauge*
T   *3 or 4 wire temperature probes for skin temperature*

The system can be designed in redundant mode.

Requirements Hardware / PC

Recommended PC Specifications

The amount of web clients or clients (server-client system architecture) is limited depending on the PC specifications:
- With an SQL Express installation and a Windows 64/32 bit Version only 2 Web or 2 application clients are supported (included in the delivery package).
- With an SQL full installation and a Windows 64 bit Version on a Server System with 16 cores up to 16 Web or application clients are supported (not included in the delivery package).

In general up to 150 Tanks on a web client are supported when in combination with a 16 bit Windows Server System with 16 cores.

| Recommended System Requirements | **General Requirements** |

General Requirements

Support for 64 bit Windows operating systems only is provided from version 18.1.0 onwards. Both 32 and 64 bit Windows operating systems were supported by 18.0.2, but prior to 18.0.2 only 32 bit Windows operating systems were supported. Tank Gauging computers typically receive data using serial communications devices; therefore it is usually simpler to use a computer equipped with serial ports. Where a large number of serial channels need to be terminated at the PC serial communications channels can be conveniently provided via Ethernet to Serial device servers.

Expansion Slots and Ports

The use of radio alarm annunciation and alarm relays require the installation of relay adapter cards. It is therefore important to ensure your PC case can accommodate these. In addition to the keyboard and mouse being connected to USB ports, tank gauging software is licensed using a USB dongle. Radio alarm annunciation requires a second sound card which may be provided using a USB module and SMS messaging also requires a USB input. It is important therefore to consider how many ports are required.

Standalone System/Client System

A system in this configuration needs a decent display adaptor and reasonable amounts of RAM and Hard Disk Space. An internal PC speaker is recommended from the point of view of tidiness and of preventing operator interference.

The choice of monitor will largely be affected by the number of tanks to be displayed and considerations about how the system will be used. A single 24" widescreen monitor is normally sufficient for a site with up to 20 tanks. Larger monitors allow more tanks to fit on the screen and multiple monitors can be used provided the computers graphics hardware supports it.

Property	Requirement
CPU	Multi-core processor (e.g. Intel Core i7 or equivalent)
Memory	8 GB RAM
Hard Drive	500+ GB
Optical Drive	CD/DVD
USB Ports	Minimum 4
Graphics	DirectX 10 device with WDDM 1.0 or higher driver
Serial Ports	See general requirements – not required for 'Client only' system
Operating System	Windows 10, 64 bit
Audio	Any Windows compatible sound device and speakers
Monitor	1,920 x 1,080 pixel display
Network	Ethernet connection

A simple RAID configuration that mirrors the hard disk to a separate device is a suggested enhancement as it will provide the system with some resilience should the disk fail. Solid state drives offer little in the way of benefit to these systems, as power consumption and faster boot times are of marginal benefit to tank gauging users.

Server System

Where you have a server computer connected to multiple client stations, the emphasis needs to be on the communications provided by the machine, not on providing a user interface for the operators. Such machines are typically sited in a back room away from the operators so don't require speakers or large monitors. Rack mounted servers work in these situations, but you need to be careful in selecting them, because 1U and 2U servers are not normally equipped with serial ports and have very limited expansion options.

RAID can improve performance of server computers particularly when used in a RAID 0+1 configuration. RAID 5 offers limited performance gains for SQL Server and tank gauging

applications, though does present some extra protection against hard disk failure, though RAID 0 would be the preferred option is disk space is not at a premium.

Property	Requirement
CPU	Multi-core (4, 6, or 8) processor (e.g. Intel E5 Xeon)
Memory	16 GB RAM (32+ GB RAM [1] if used as a virtual host)
Hard Drive	Dual 500+ GB minimum, RAID recommended
Optical Drive	CD/DVD
USB Ports	Minimum 4
Graphics	Basic VGA output
Serial Ports	See general requirements – not required for 'Client only' system
Operating System	Windows Server 2019
Audio	Not required unless using radio alarm messaging
Monitor	Yes
RAID Adapter	Hardware RAID controller
Network	Dual Ethernet connection

1)   depends on the number of virtual machines running on the host

Virtualized Tank Gauging Systems

For tank gauging systems being deployed in a virtualized environment (supported virtualized environments include Microsoft Hyper-V and VMWare ESXI), the following specification is recommended for each virtual server deployed on the host machine (based on above server recommended specifications):

Virtual Server System

Property	Requirement
Operating System	Windows Server 2019
Memory	> 16 GB RAM
Hard Drive	> 150 GB HDD Disk
Processor	> 4 Cores
Ethernet USB Server	Such as Digi USBAnywhere – to provide a location for the Tank Gauging USB Licensing Dongle. Only needed if using Microsoft Hyper-V Virtual Environment.
Serial to Ethernet Converter(s)	Such as Moxa NPort series – to provide serial communications to the virtual machine. Please note: if the field interface device selected supports Ethernet connectivity this is not required.

Virtual Client System

It is possible to implement virtual servers and either virtual or physical clients. For a virtualized client system, the following is recommended:

Property	Requirement
Operating System	Windows 10, 64 bit
Memory	8 GB RAM
Hard Drive	50 GB HDD Disk
Processor	4 Cores

If using a virtual environment, a Windows based PC with network access to the remote environment will be required for operator access.

Further Information   For further information, please consult your local Endress+Hauser representative for the latest PC specifications.

Operator Interface and functions

Operator Interface   Tankvision LMS takes advantage of the intuitive nature of Windows based Graphical User Interfaces (GUI's) and multi-tasking, allowing multiple Windows to be opened simultaneously and allowing the use of other third party applications such as Microsoft Office suite to be run simultaneously.

Displays are loaded very quickly, can be scaled, minimized, maximized and moved around so that the operator can set the desktop as required.

Main Page   The first Graphical user Interface is the Main Page.

This page provides an overview of all tanks in a set of sizable graphical Windows.

The Main Page is the center console from which all other functions can be quickly and easily accessed.

Navigation through the different screens is simplified through the use of Toolbars, menus and short-cut links.

From the Main Page the user can send gauge commands through a context sensitive pop-up menu.

Tanks can be filtered on the Home Page using the Grouping features available.
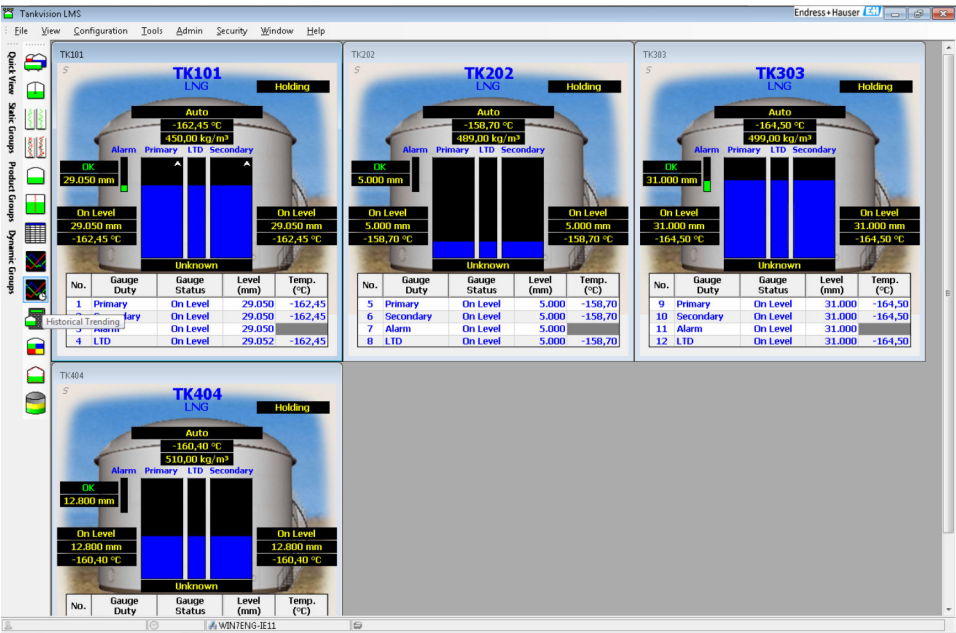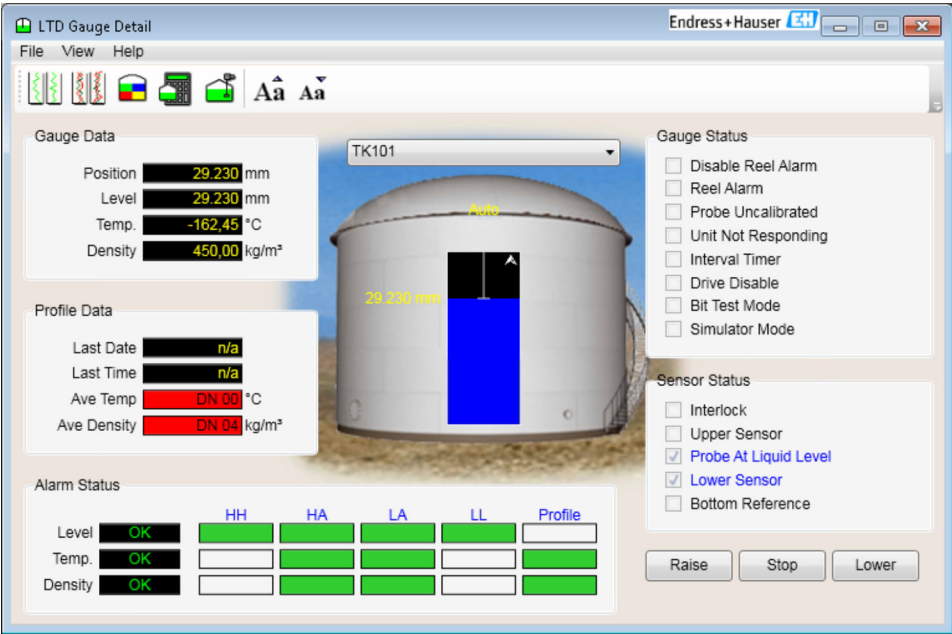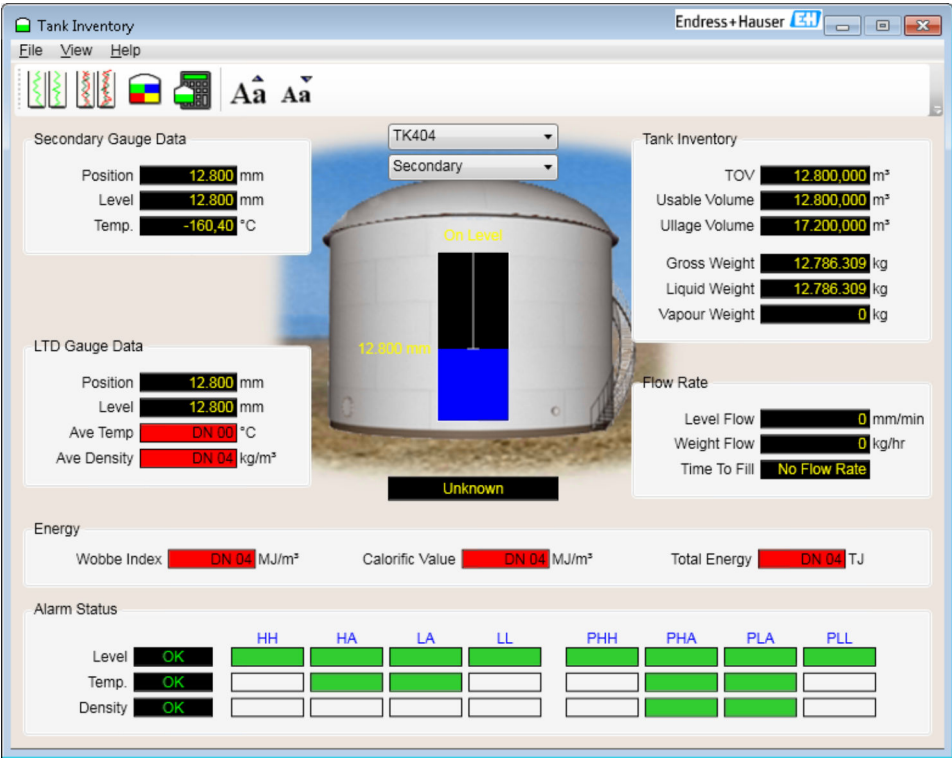

Single Tank   The Single Tank Detail display provides a detailed overview of all data for a single tank.

The data includes all live and calculated values, alarm levels, flow rates and other configuration parameters.

In addition the Single Tank Detail screen provides quick access to the Density Profile and Temperature profile displays.
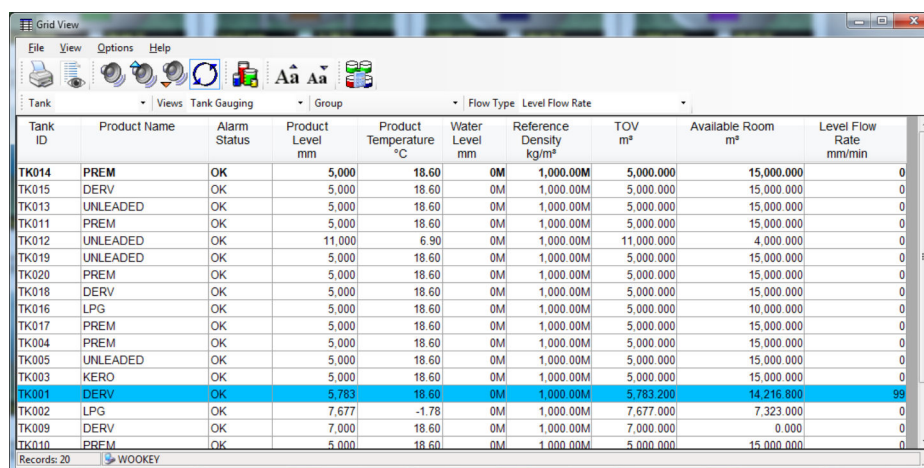
Grid View

The Grid View display is a tabular list of tank data similar to a spreadsheet.

The system comes with several pre-defined views and provides tools to the user to configure their own customized views.

Gauge commands can be sent from Grid View using the pop-up menu.

Alarm Event viewer
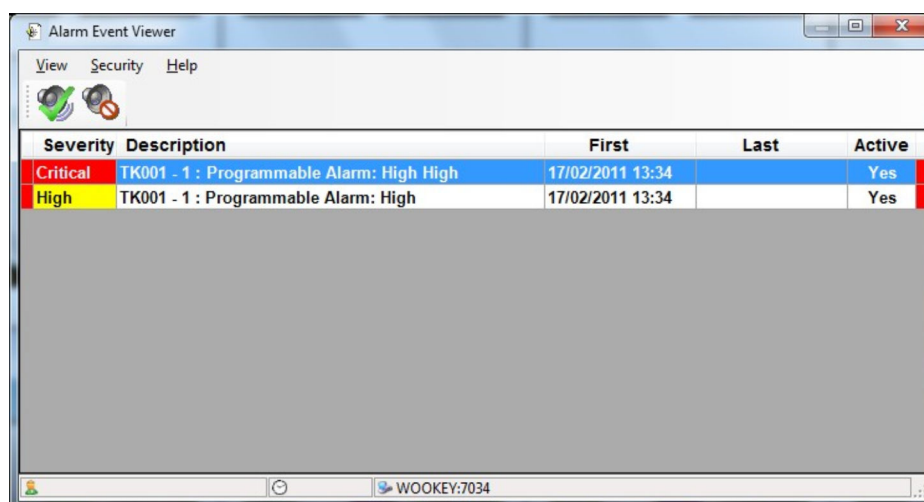
Alarms are displayed through a pop-up window.

When a new alarm occurs the pop-up window is displayed showing the details of the alarm.

The alarm can be acknowledged through the popup or the user can view the alarm details page for more information on the alarm.

An audible warning and optional voice message can be configured to be annunciated with each alarm. In addition a relay contact can be in response to an alarm for drivers external sounders etc.

All alarms are logged to a relational database in chronological order.

When an alarm is acknowledged, the username of the currently logged on user and the date/time it was acknowledged are stored with the alarm record.

Alarm Configuration

Gauge and instrument alarms are normally raised at the gauge/instrument and communicated to the system over the field bus.

Native gauge and instrument alarms are supported.

In addition the system allows the user to configure a range of programmable alarms for product level, water level, temperature, density, flow rate, density and temperature deviation alarms, and difference alarms when a tank has two gauges fitted.

Trending

Real-time and Historical trend views are available. The Real-time view allows the user to load up to the last 24 hours of history.

The Historical trend view allows the user to view data between a start and end date.

Trend data is produced by a Trend service, which logs data to the hard drive.

Up to 6 trends can be displayed on the same graph.

The Trend view modules also provide a zoom facility and a data cursor to identify the value of data points on the trend.
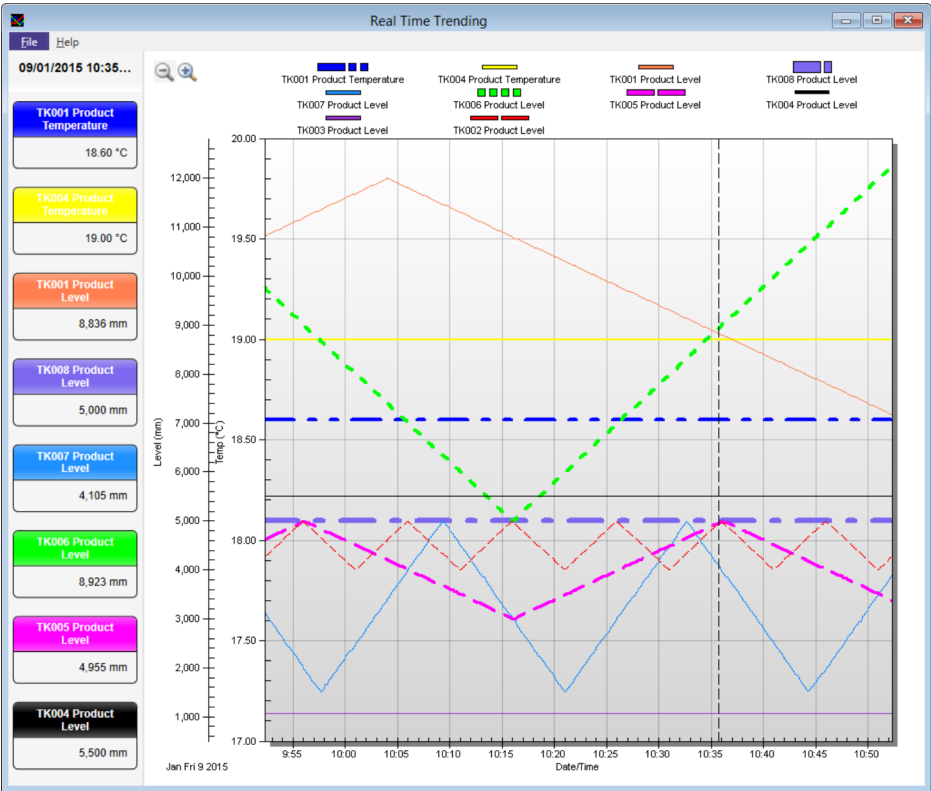
Reports

Reports can be printed on demand or scheduled. Reports are designed with Crystal Reports.

The system comes with a number of pre-formatted reports, however, reports can be customized with the use of the SAP Crystal Reports (has to be purchased separately).

Alternatively Endress+Hauser supports you with a special customized report design service that is available as additional service.

Inventory Calculator

The system provides an Inventory Calculator which can be used as follows:
- To calculate tank inventory at user specified conditions.
- To calculate the effect of a receipt or load on current tank conditions.
- The Inventory Calculator can be used as a planning tool.

User Management

User Management

The system has a very flexible security system that includes from providing full access with no passwords to stringent controls on every relevant feature.

Users and their privileges are entered through the User Configuration Module.

This is essentially a group of features for each user.

For each user you can determine their access rights on a feature by feature basis.

Access rights can be No Access, Read Only, Edit or Full Access as an Administrator.

Configuration

Tank Characteristics

Tank Characteristics is used to allocate a product to a tank, set the volume correction method for the tank, enter the maximum and minimum operating levels of the tank, enter the details of the floating roof if fitted, and modify the behavior of the inventory calculation engine.

Many of the settings are critical and access should normally be limited to certain personnel.

Gauge Integration

A wide range of different vendor gauges are supported.

Gauges are configured through the Gauge Configuration Module which allows the user to define the:
- gauge type, the tank the gauge is connected with,
- the gauge physical and logical addresses,
- gauge duty if applicable, and
- the data scans that are performed.

Different manufacturer gauges are configured slightly differently in the way that they are addressed and the format of the data scans.

When a gauge type is selected, the mandatory configuration data items are labeled and enabled as required.

Endress+Hauser
- Proservo
- Micropilot and Tank Side Monitor
- Levelflex and Tank Side Monitor

Honeywell Enraf
- 811 Servo
- 854 Servo
- 873 Radar

Emerson
- TRL2 Radar
- Rex Radar
- Pro Radar

Motherwell
- 4000 Mark/Space
- 2800i Servo

Scientific Instruments
- 6280
- 6290
- 7000

Whessoe
- 1311/2006 Float and Tape WM500
- 1311/1140 Servo WM500
- 1315/2006 Float and Tape WM550
- 1315/1140/1141 Servo WM550
- ITG 50/60/70

Varec
- 1800 Mark/Space
- 1900 Mark/Space

L&J
TankWay

Inventory Calculations

Calculations

Tankvision Professional calculates tank inventory to all of the most used API/ASTM standards. The calculated data items are summarized below:
- Total Observed Volume (TOV)
- Gross Observed Volume (GOV)
- Water Volume
- Usable/Pumpable Volume
- Ullage Volume
- Gross Standard Volume
- Standard Usable Volume
- Gross Mass
- Usable Mass
- Ullage Mass
- Gross Weight
- Usable Weight
- Ullage Weight

- Vapour Gross Standard Volume
- Vapour Mass
- Dead Stock

If you want to include a parameter not mentioned here ask Endress+Hauser for availability.

Calculation Standards

- Manual VCF
- TCF
- DCF
- API TP25 1998 Table 24E
- API TP27 2007 Table 24E
- API 1952 Table 54
- API TP27 2007 Table 54E
- DCF SEA
- Density table
- Chemical Polynomial 1
- Chemical Polynomial 2
- ASTM D1250 1952 Table 6
- IP / API / ASTM D1250 1980 Table 6A
- IP / API / ASTM D1250 1980 Table 6B
- IP / API / ASTM D1250 1980 Table 6C
- IP / API / ASTM D1250 1980 Table 6D
- IP / API / ASTM D1250 1980 Table 24A
- IP / API / ASTM D1250 1980 Table 24B
- IP / API / ASTM D1250 1980 Table 24C
- IP / API / ASTM Light Hydrocarbon Liquids 1986 Table 54
- IP / API / ASTM D1250 1980 Table 54A
- IP / API / ASTM D1250 1980 Table 54B
- IP / API / ASTM D1250 1980 Table 54C
- IP / API / ASTM D1250 1980 Table 54D
- IP Petroleum Measurement Paper No.3 1988 Table 60A
- IP Petroleum Measurement Paper No.3 1988 Table 60B
- IP Petroleum Measurement Paper No.3 1988 Table 60D
- IP / API / ASTM D1250 1980 Table 6A, TREF 86 ℉
- IP / API / ASTM D1250 1980 Table 6B, TREF 86 ℉
- IP / API / ASTM D1250 1980 Table 6D, TREF 86 ℉
- IP / API / ASTM D1250 1980 Table 6A, user TREF
- IP / API / ASTM D1250 1980 Table 6B, user TREF
- IP / API / ASTM D1250 1980 Table 6D, user TREF
- IP / API / ASTM D1250 1980 Table 54A, TREF 30 ℃
- IP / API / ASTM D1250 1980 Table 54B, TREF 30 ℃
- IP / API / ASTM D1250 1980 Table 54D, TREF 30 ℃
- IP / API / ASTM D1250 1980 Table 54A, user TREF
- IP / API / ASTM D1250 1980 Table 54B, user TREF
- IP / API / ASTM D1250 1980 Table 54D, user TREF
- ASTM D1250 2004 Table 6A
- ASTM D1250 2004 Table 6B
- ASTM D1250 2004 Table 6C
- ASTM D1250 2004 Table 6D
- ASTM D1250 2004 Table 24A
- ASTM D1250 2004 Table 24B
- ASTM D1250 2004 Table 24C
- ASTM D1250 2004 Table 54A
- ASTM D1250 2004 Table 54B
- ASTM D1250 2004 Table 54C
- ASTM D1250 2004 Table 54D
- ASTM D1250 2004 Table 60A
- ASTM D1250 2004 Table 60B
- ASTM D1250 2004 Table 60C
- ASTM D1250 2004 Table 60D
- IP PM3 TP27 2007 Table 60E
- D4311 1990 Table 1
- D4311 1990 Table 2
- D4311 1996 Table 1
- D4311 2009 Table 1
- D4311 2009 Table 2

- D4311 2015 Table 1
- D4311 2015 Table 2
- Francis
- API No. 44 Molar 15℃
- API No. 44 Molar 20℃
- COSTALD
- Enhanced COSTALD
- COSTALD – Tait
- Klosek – McKinley
- HMD
- Nitric Acid
- Phenol
- OIML R22 STRxMASS
- OIML R22 STRxVOL
- JIS K2250 STRxVOL
- ASTM D1555 Benzene 60℉
- ASTM D1555 Cumene 60℉
- ASTM D1555 Cyclohexane 60℉
- ASTM D1555 Ethylbenzene 60℉
- ASTM D1555 Styrene 60℉
- ASTM D1555 Toluene 60℉
- ASTM D1555 MXylene 60℉
- ASTM D1555 Oxylene 60℉
- ASTM D1555 PXylene 60℉
- ASTM D1555 F300-350 60℉
- ASTM D1555 F350-400 60℉
- ASTM D1555 Benzene 15℃
- ASTM D1555 Cumene 15℃
- ASTM D1555 Cyclohexane 15℃
- ASTM D1555 Ethylbenzene 15℃
- ASTM D1555 Styrene 15℃
- ASTM D1555 Toluene 15℃
- ASTM D1555 MXylene 15℃
- ASTM D1555 Oxylene 15℃
- ASTM D1555 PXylene 15℃
- ASTM D1555 C148-176 15℃
- ASTM D1555 C176-204 15℃
- ASTM D1555 Benzene 20℃
- ASTM D1555 Cumene 20℃
- ASTM D1555 Cyclohexane 20℃
- ASTM D1555 Ethylbenzene 20℃
- ASTM D1555 Styrene 20℃
- ASTM D1555 Toluene 20℃
- ASTM D1555 MXylene 20℃
- ASTM D1555 Oxylene 20℃
- ASTM D1555 PXylene 20℃
- ASTM D1555 C148-176 20℃
- ASTM D1555 C176-204 20℃
- JIS LPG
- JIS 2A
- JIS 2B
- JIS 2D
- JIS Asphalt

If you want to include a calculation not mentioned here ask Endress+Hauser for availability.

Application packages

LNG Rollover Prediction Model   This model allows the user to visualize the evolution of temperature, density, boil-off and the layer thickness of the stratified layers within an LNG tank.

The model can be run with either manual or live data, and is a fully integrated feature of the total LNG Tank Management solution. If the model predicts a potential rollover, the model will display the time to rollover as a rollover alarm.

The time to rollover and the stratification status can be transmitted to the site DCS for further annunciation. A unique feature of the rollover prediction model is its ability to infer heat and mass transfer coefficients from the real time LTD profiles.

The rollover predictions are sensitive to heat and mass transfer coefficients that control mass and energy transfer between the stratified layers.

In Endress+Hauser's software, the heat transfer coefficient can be fed in by the user (manual mode) or can be inferred from an in built empirical correlation (empirical mode).

However, there is a third mode called inverse mode where a novel approach is used to estimate heat and mass transfer coefficients from the real time level-temperature-density (LTD) profiles using the inverse method.

Compositions of stratified liquid layers and vapour space in the tank must be entered to enable the rollover prediction. This can be done manually, based on input from external sources or where predefined compositions are available in Tankvision LMS, the composition which most closely matches the temperature and density of the layer can be automatically selected. The Rollover prediction can be shown on LMS or on a separate Webpage like below.
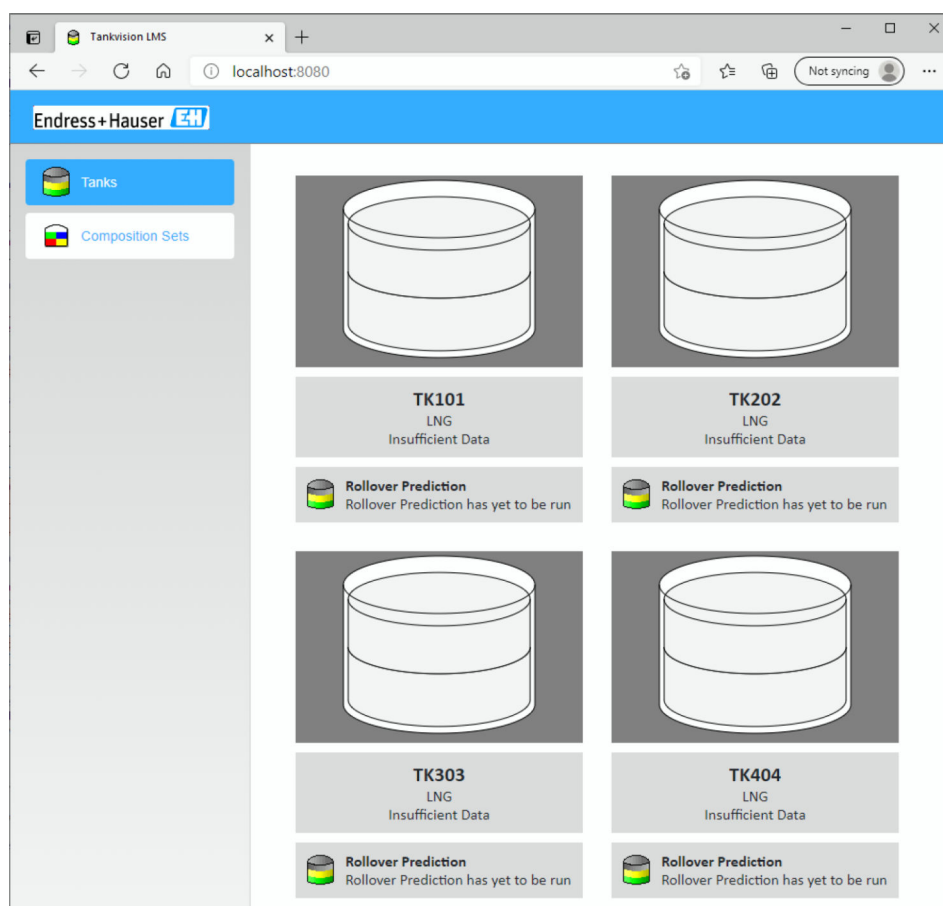
Ordering information

Detailed ordering information is available from your nearest sales organization www.addresses.endress.com or in the Product Configurator at www.endress.com:

1. Select the product using the filters and search field.
2. Open the product page.

3. Select **Configuration**.

Product Configurator - the tool for individual product configuration
- Up-to-the-minute configuration data
- Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability to order directly in the Endress+Hauser Online Shop

Documentation

Downloads

For an overview of the technical documentation provided, visit the Downloads area of the Endress+Hauser website (www.endress.com/downloads).

For an overview of the scope of the associated Technical Documentation, refer to the following:
- *Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from the nameplate
- *Endress+Hauser Operations app*: Enter serial number from nameplate or scan matrix code on nameplate.

Operating instructions

BA00390G

System Configuration

BA00391G

DCC Communications Configuration

BA00393G

Maintenance

BA01293G

OPC Tank Data Server

BA01294G

OPC TG Client Configuration

BA01654G

System Monitor

BA01700G

Installation

BA01701G

System Operation

BA01702G

Rollover Prediction in LNG storage tanks

BA01703G

Skin Temperatures

BA01704G

LNG Stratification Detection

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