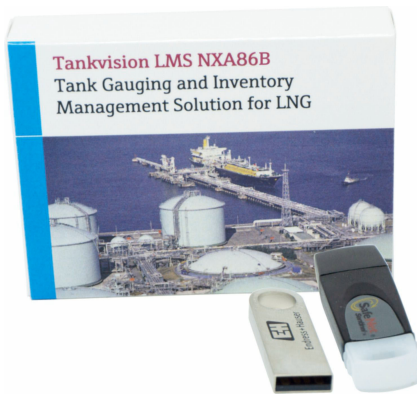


Technical Information

Tankvision LMS NXA86B

Tank Gauging
SW 18.3.3



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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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

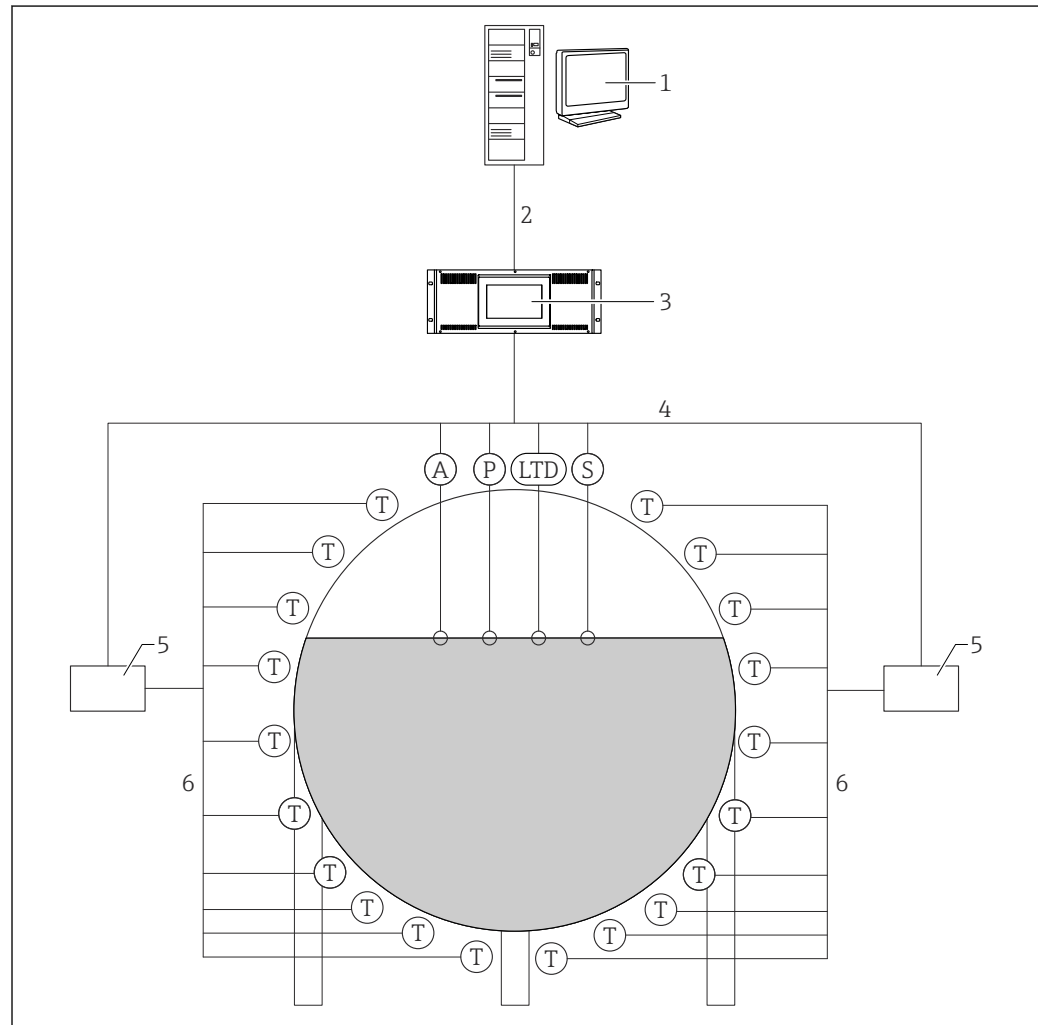
Stand alone

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.

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.

To compliment the operators' interface there is an LNG Web Client which is accessed from a modern browser over the network. The LNG Web Client allows the user to view basic stratification and rollover prediction information. In addition, it is also possible to maintain the Chemical Composition Sets which are used by the rollover prediction model.



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

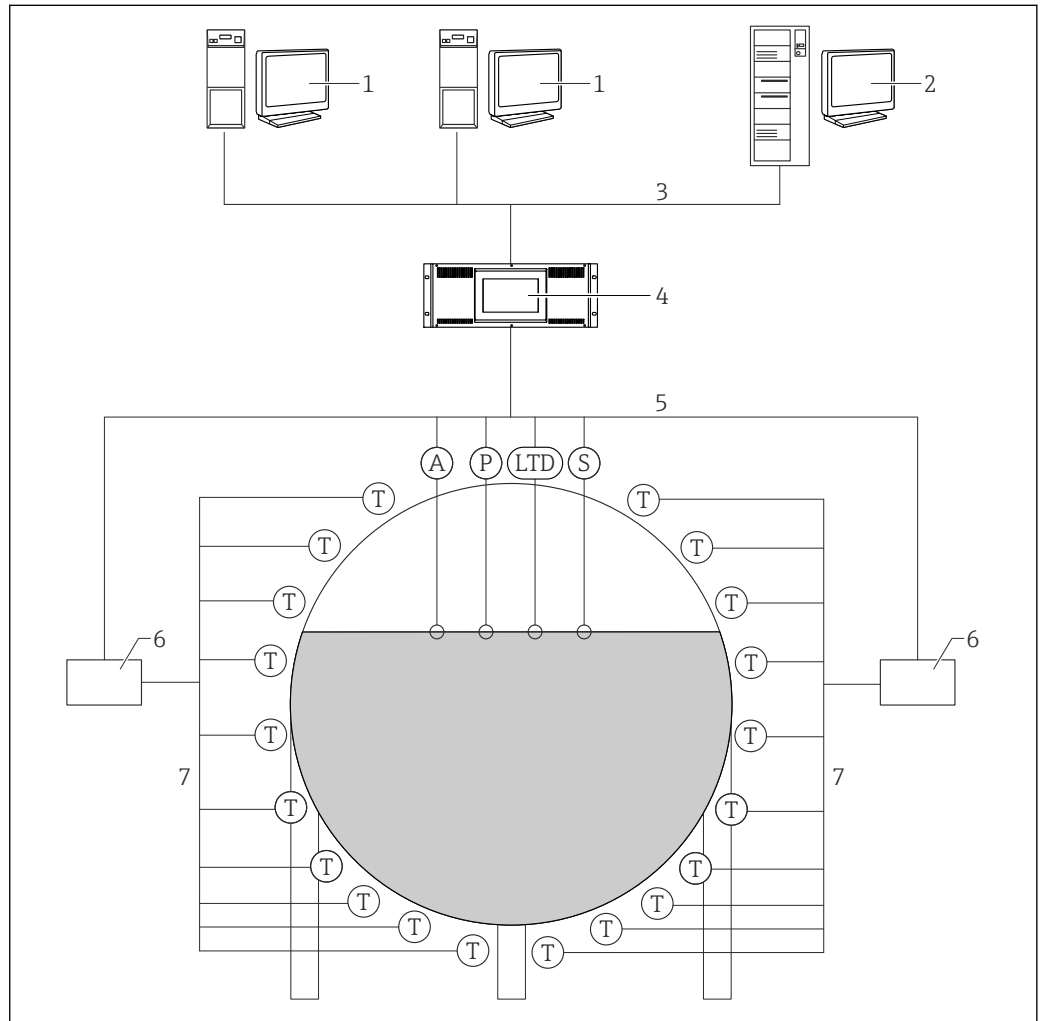
The system can be designed in redundant mode.

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 client 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

Guidelines for PC selection

When selecting the PC and operating system, consider first the number of operator stations and servers, then the number of web users and interfaces to hosts and clients, and finally the number of tanks.

- A single standalone server supporting up to 5 web clients and 5 interfaces will run sufficiently well on a standard business PC, with a Windows client operating system and SQL Server Express edition.
- Features such as server redundancy, multiple operator stations and full movements will require SQL Server Standard Edition, which places additional requirements on the amount of disk space, memory and processor power.

Many customers benefit from having multiple monitors attached to their operator stations, which may influence the choice of computer for operator and standalone stations.

Recommended System Requirements

General Requirements

Many modern field interface devices use Ethernet connections to provide data to the tank gauging system, though many sites have legacy hardware that only supports serial comms. The serial to Ethernet gap can be bridged with Serial to Ethernet converters, but having a PC with serial ports provided via an expansion card is an equally good solution.

Expansion Slots and Ports

Most accessories such as relays, site radio connectors and serial interfaces can now be connected via Ethernet, as the drive for virtualization of tank gauging systems has taken hold. However, if physical connections to a physical PC are needed ensure that your computer has PCIe expansion capability. Additional graphics cards may be required to support multiple monitors on operator stations.

Standalone System/Client System

For a standalone system consideration needs to be made of how alarms are announced and how many tank operations need to be shown on the screen. Alarms are normally accompanied by an audible buzzer, and the most convenient way of getting operators to hear this is to use a monitor with an inbuilt speaker, connected using HDMI or DisplayPort.

Multiple monitors are useful for dividing tank gauging activities to particular displays or showing multiple groups of tanks. Most modern Intel Core and AMD Ryzen processors have sufficient graphical capabilities to support the tank gauging software, a graphics card is really only needed to provide sufficient outputs to support the design of the operator station.

Property	Requirement
CPU	Multi-core processor (e.g. Intel Core i7 or equivalent)
Memory	8 GB RAM
Hard Drive	500+ GB
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 or Windows 11
Audio	Any Windows compatible sound device and speakers
Monitor	1,920 x 1,080 pixel display
Network	Ethernet connection

Where the site requires the best resilience from their tank gauging system RAID disks offer significant protection over single disk systems. For a typical standalone system and operator station, a NVMe hard disk is the most appropriate solution with a good backup regimen.

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.

Solid state disks offer the best performance for most tank gauging applications. RAID can be used to increase the system resilience, allowing features such as cold standby drives to be automatically deployed should another disk fail.

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
USB Ports	Minimum 4
Graphics	Basic VGA output
Serial Ports	See general requirements – not required for 'Client only' system
Operating System	Windows Server 2022
Audio	Not required unless using radio alarm messaging
Monitor	Yes
RAID Adapter	Hardware RAID controller
Network	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 2022
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 or VMWare 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. Examples for suitable field devices are Tankvision Multi Scan NXA83B and Tankvision Tank Scanner NXA820.

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 or Windows 11
Memory	8 GB RAM

Property	Requirement
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 is a Windows tank gauging system. Multiple windows displaying tank gauges can be shown simultaneously, with alarms and movement operations given their own space.

Many of the displays can be resized, scaled or overlapped to fit the displays your system is equipped.

Home Page

The first Graphical user Interface is the Home Page.

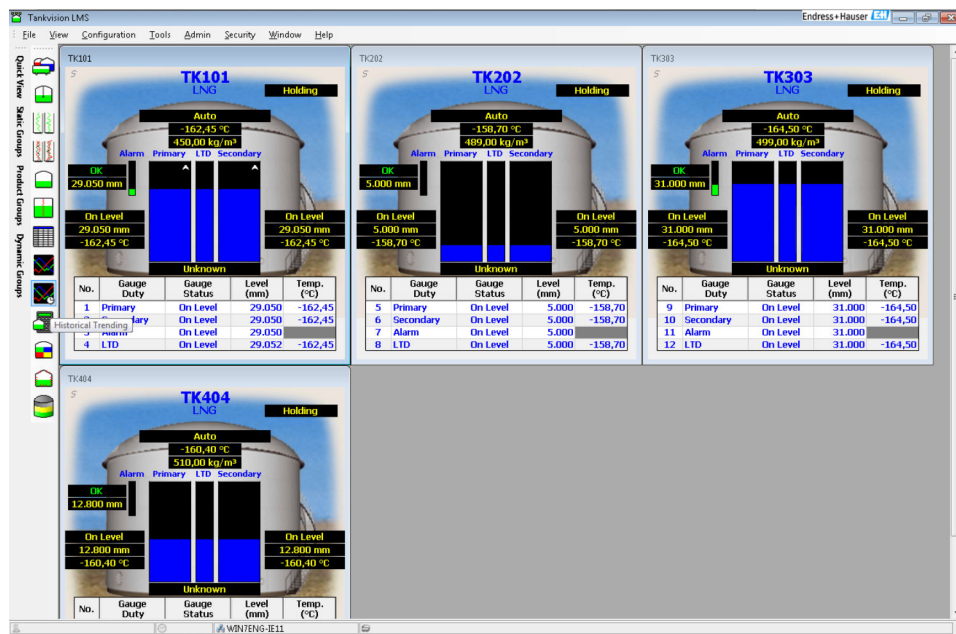
This page provides an overview of all tanks in a set of sizable graphical Windows.

The Home 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 Home 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.

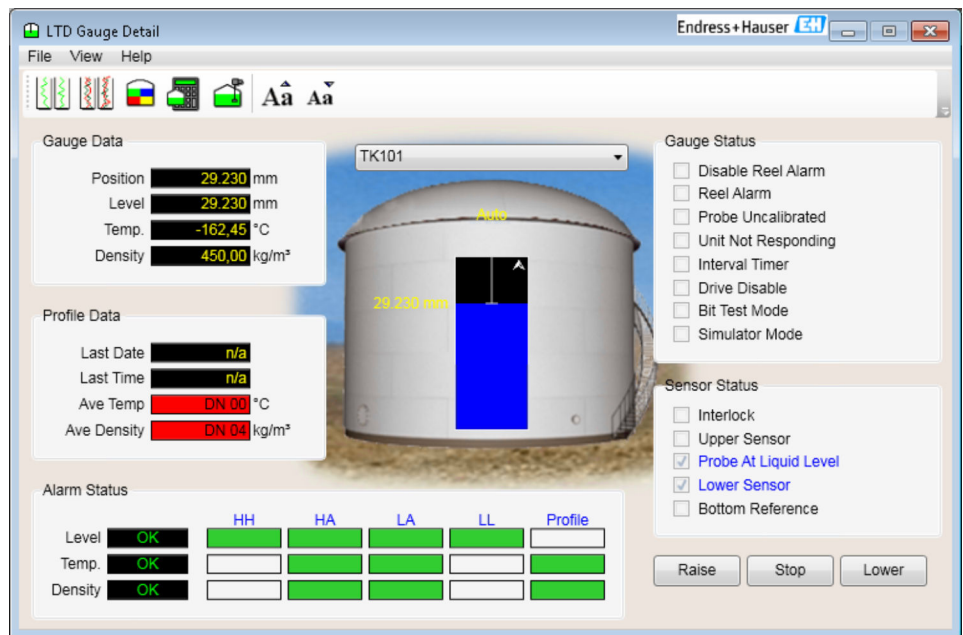
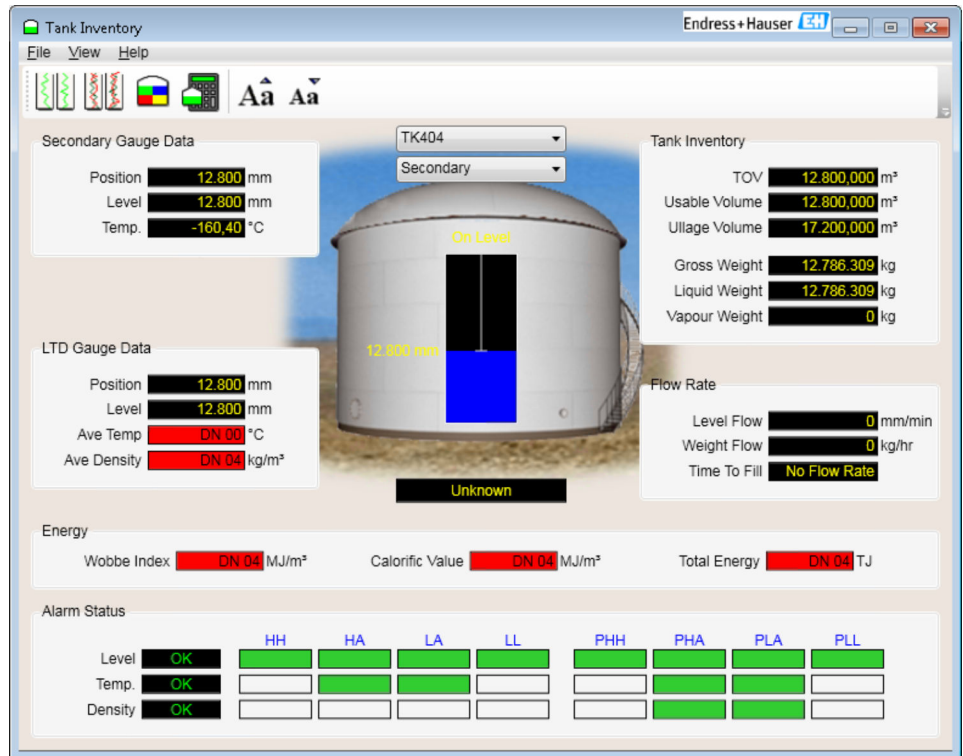


Single Tank

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.

Tank ID	Product Name	Alarm Status	Product Level mm	Product Temperature °C	Water Level mm	Reference Density kg/m³	TOV m³	Available Room m³	Level Flow Rate mm/min
TK014	PREM	OK	5,000	18.60	0M	1,000.00M	5,000.000	15,000.000	0
TK015	DERV	OK	5,000	18.60	0M	1,000.00M	5,000.000	15,000.000	0
TK013	UNLEADED	OK	5,000	18.60	0M	1,000.00M	5,000.000	15,000.000	0
TK011	PREM	OK	5,000	18.60	0M	1,000.00M	5,000.000	15,000.000	0
TK012	UNLEADED	OK	11,000	6.90	0M	1,000.00M	11,000.000	4,000.000	0
TK019	UNLEADED	OK	5,000	18.60	0M	1,000.00M	5,000.000	15,000.000	0
TK020	PREM	OK	5,000	18.60	0M	1,000.00M	5,000.000	15,000.000	0
TK018	DERV	OK	5,000	18.60	0M	1,000.00M	5,000.000	15,000.000	0
TK016	LPG	OK	5,000	18.60	0M	1,000.00M	5,000.000	10,000.000	0
TK017	PREM	OK	5,000	18.60	0M	1,000.00M	5,000.000	15,000.000	0
TK004	PREM	OK	5,000	18.60	0M	1,000.00M	5,000.000	15,000.000	0
TK005	UNLEADED	OK	5,000	18.60	0M	1,000.00M	5,000.000	15,000.000	0
TK003	KERO	OK	5,000	18.60	0M	1,000.00M	5,000.000	15,000.000	0
TK001	DERV	OK	5,783	18.60	0M	1,000.00M	5,783.200	14,216.800	99
TK002	LPG	OK	7,677	-1.78	0M	1,000.00M	7,677.000	7,323.000	0
TK009	DERV	OK	7,000	18.60	0M	1,000.00M	7,000.000	0.000	0
TK010	PREM	OK	5,000	18.60	0M	1,000.00M	5,000.000	15,000.000	0

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.

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. Acknowledged alarms remain on display until they become inactive, providing operators a summary of currently active alarms on the site.

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. Optionally the operator can be made to provide an explanation for the alarm.

Severity	Description	First	Last	Active
Critical	TK001 - 1 : Programmable Alarm: High High	17/02/2011 13:34		Yes
High	TK001 - 1 : Programmable Alarm: High	17/02/2011 13:34		Yes

Alarm Configuration

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

Tankvision displays these hardware alarms through the Alarm Event Viewer, however configuration of these normally requires a field technician to alter the devices' settings.

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 2 gauges fitted.

Trending

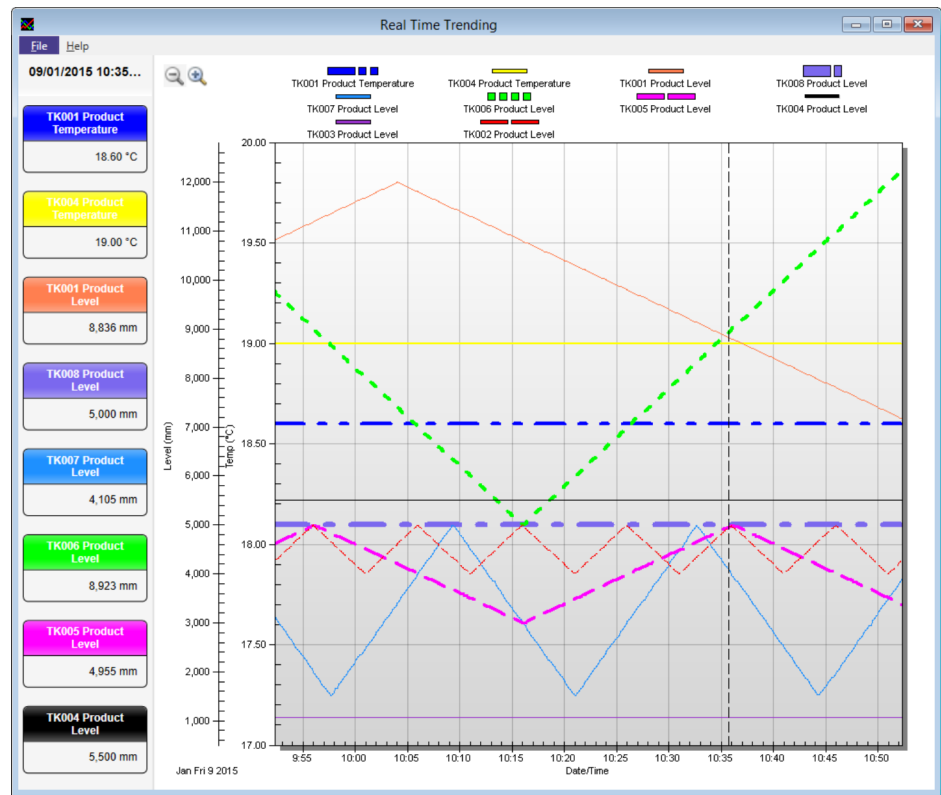
Real-time and Historical trend views are available. The Real-time view allows the user to load up to the last 24 hours of history.

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.

The figure shows a 'Report Preview' window for 'Tankvision LMS LNG Inventory Report'. The report is generated by Endress+Hauser. The table contains the following data:

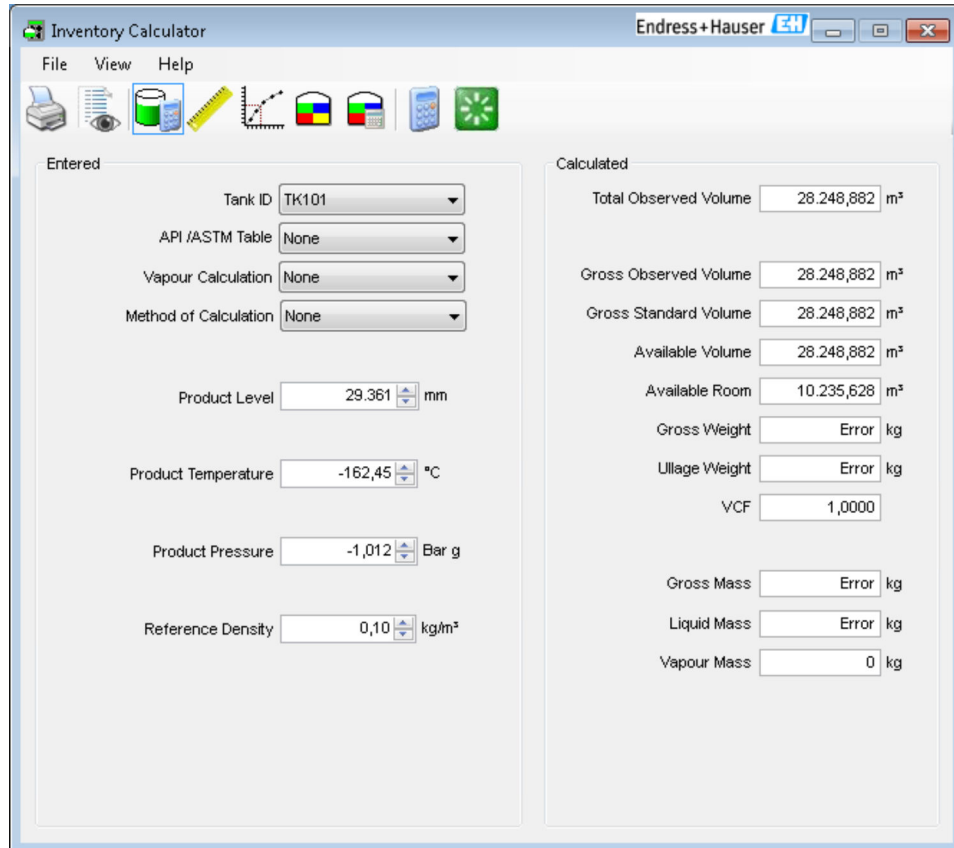
Tank	Product	Product Level (mm)	Ullage Level (mm)	Product Temp (°C)	Ref. Density (vac) (kg/m³)	Gross Observed Volume (m³)	Gross Standard Volume (m³)	Available Room (m³)	Usable Weight (kg)	Ullage Weight (kg)
TK101	LNG	30.401	9.599	-162,45	1.000,00 M	29.249,094	29.249,094	9.235,416	29.217.809	9.225.538
TK202	LNG	5.000	25.000	-158,70	1.000,00 M	5.000,000	5.000,000	25.000,000	DN 23	DN 23
TK303	LNG	31.000	9.000	-164,50	1.000,00 M	31.000,000	31.000,000	9.000,000	DN 23	DN 23
TK404	LNG	12.800	17.200	-160,40	1.000,00 M	12.800,000	12.800,000	17.200,000	DN 23	DN 23
Totals:						78.049,094	78.049,094	60.435,416	29.217.809	9.225.538

At the bottom of the report preview, it shows 'Aktuelle Seite: 1', 'Seiten gesamt: 1', and 'Zoomfaktor: 100%'.

Inventory Calculator

The system provides an Inventory Calculator which can be used as follows:

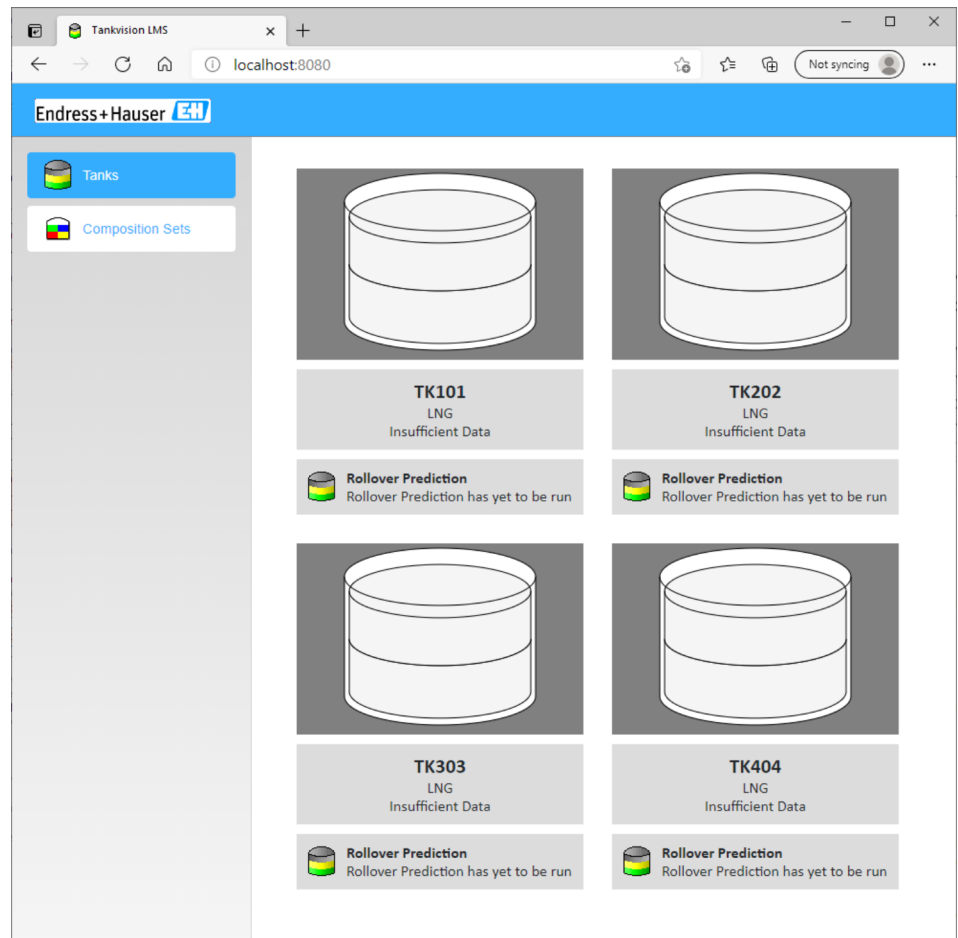
- To calculate tank inventory at user specified conditions.
- To calculate the effect of a receipt or load on current tank conditions.
- The Inventory Calculator can be used as a planning tool.



Entered	Calculated
Tank ID: TK101	Total Observed Volume: 28.248,882 m ³
API /ASTM Table: None	Gross Observed Volume: 28.248,882 m ³
Vapour Calculation: None	Gross Standard Volume: 28.248,882 m ³
Method of Calculation: None	Available Volume: 28.248,882 m ³
Product Level: 29.361 mm	Available Room: 10.235,628 m ³
Product Temperature: -162.45 °C	Gross Weight: Error kg
Product Pressure: -1.012 Bar g	Ullage Weight: Error kg
Reference Density: 0.10 kg/m ³	VCF: 1.0000
	Gross Mass: Error kg
	Liquid Mass: Error kg
	Vapour Mass: 0 kg

LNG Web Client

The LNG Web Client provides basic stratification and rollover prediction information to users via a web browser interface. In addition, it is also possible to maintain the Chemical Composition Sets which are used by the rollover prediction model.



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.

Privileges are assigned to a group, and each user is made a member of one group.

For example, a group called 'operator' would prevent members from changing the alarm set points, but allow them to create a movement.

Configuration

Configuration

This module centralizes many of the configuration aspects of the system, from inventory calculation methods, to gauge addresses and protocol options.

Access to this is normally tightly controlled, being limited to advanced users who are responsible for commissioning and maintenance of the system.

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 main 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

There are in total over 150 calculated fields available, consult the manuals or enquire of Endress +Hauser for more details.

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 °F
- IP / API / ASTM D1250 1980 Table 6B, TREF 86 °F
- IP / API / ASTM D1250 1980 Table 6D, TREF 86 °F
- 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 °C
- IP / API / ASTM D1250 1980 Table 54B, TREF 30 °C
- IP / API / ASTM D1250 1980 Table 54D, TREF 30 °C
- 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°C
- API No. 44 Molar 20°C
- COSTALD
- Enhanced COSTALD
- COSTALD – Tait
- Klosek – McKinley

- HMD
- Nitric Acid
- Phenol
- OIML R22 STRxMASS
- OIML R22 STRxVOL
- JIS K2250 STRxVOL
- ASTM D1555 Benzene 60°F
- ASTM D1555 Cumene 60°F
- ASTM D1555 Cyclohexane 60°F
- ASTM D1555 Ethylbenzene 60°F
- ASTM D1555 Styrene 60°F
- ASTM D1555 Toluene 60°F
- ASTM D1555 MXYlene 60°F
- ASTM D1555 OXYlene 60°F
- ASTM D1555 PXYlene 60°F
- ASTM D1555 F300-350 60°F
- ASTM D1555 F350-400 60°F
- ASTM D1555 Benzene 15°C
- ASTM D1555 Cumene 15°C
- ASTM D1555 Cyclohexane 15°C
- ASTM D1555 Ethylbenzene 15°C
- ASTM D1555 Styrene 15°C
- ASTM D1555 Toluene 15°C
- ASTM D1555 MXYlene 15°C
- ASTM D1555 OXYlene 15°C
- ASTM D1555 PXYlene 15°C
- ASTM D1555 C148-176 15°C
- ASTM D1555 C176-204 15°C
- ASTM D1555 Benzene 20°C
- ASTM D1555 Cumene 20°C
- ASTM D1555 Cyclohexane 20°C
- ASTM D1555 Ethylbenzene 20°C
- ASTM D1555 Styrene 20°C
- ASTM D1555 Toluene 20°C
- ASTM D1555 MXYlene 20°C
- ASTM D1555 OXYlene 20°C
- ASTM D1555 PXYlene 20°C
- ASTM D1555 C148-176 20°C
- ASTM D1555 C176-204 20°C
- 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.

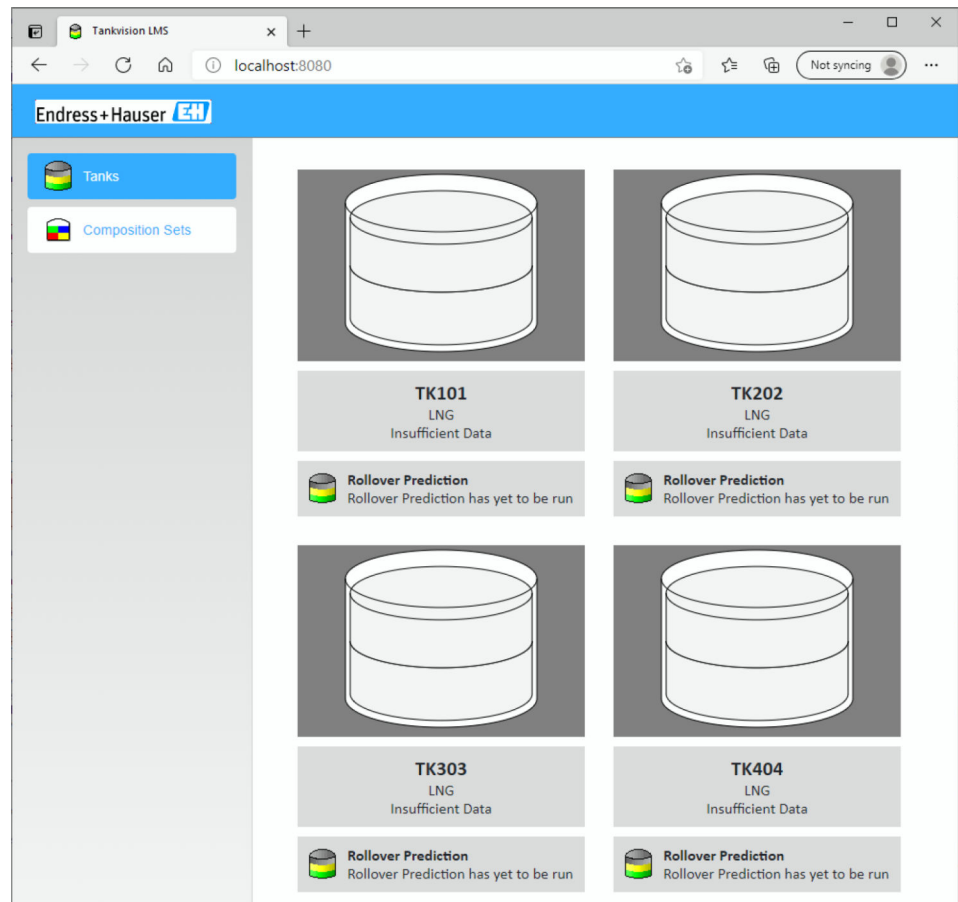
The time to rollover and the stratification status can be transmitted to the site DCS for further annunciation. A unique feature of the rollover prediction model is its ability to infer heat and mass transfer coefficients from the real time LTD profiles.

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 pre-defined 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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