

White Paper

Upgrade Your System Step by Step

Tank Gauging Emulation



Emulation Provides a Simple, Cost-effective Solution for Complex Tank Gauging Upgrades

Abstract

Many tank gauging systems still rely on old mechanical devices using float or servo technology, which can provide unreliable measurements and have unreasonably high maintenance costs because of their susceptibility to failure. Despite this, plant managers can be reluctant to replace them with modern and more reliable alternatives. Replacing a complete tank gauging system is deemed too costly and partial upgrades are difficult due to communication compatibility issues. This white paper explains how emulation can provide a simple and cost-effective solution for tank gauging upgrade projects, enabling existing equipment to be replaced with devices from alternative vendors without the need for new wiring or communication networks.

Introduction

There are an estimated one million bulk liquid storage tanks in operation worldwide, many of which rely on aging tank gauging systems to support inventory management and overflow protection. Lots of these systems still incorporate mechanical devices using float or servo technology, which is susceptible to failure and can lead to unreliable measurements and unreasonably high maintenance costs. Other systems may use more modern radar technology, but could be hampered by radar level gauges which are not performing well. This can cause measurement errors and uncertainty, creating the potential for overfills which can result in safety incidents, environmental fines, clean-up costs and damage to a company's reputation. Inaccurate level measurements can also result in underutilization of tanks and transfer uncertainty, which reduces the efficiency of tank operations and could lead to a loss of profit.

Replacing or upgrading part of the existing tank gauging system would allow older mechanical equipment, or poorly performing radar level gauges, to be superseded by more advanced radar technology and control room infrastructure. The latest radar technology delivers the following benefits:

- Very reliable and accurate measurements
- Compliance with current safety standards and guidelines
- Diagnostics to help identify potential problems
- Low maintenance requirements

The latest systems also adopt open fieldbus communications that enable the user to select best-in-class devices. Wireless options extend the reach to remote tanks and reduce the time and cost of installation.

Tank Gauging System Replacement

Although plant owners and operators accept that the problems caused by mechanical devices could be solved by replacing the whole tank gauging system, many are reluctant to do so for various reasons. Replacing a complete tank gauging system is often overly complex and, for large installations, such as within refineries or terminals, it would require a sizable budget. The time frame to commission a new system can be a major obstacle. With many tank gauges and tanks taken out of operation whilst the new system is installed, the reduction in capacity and throughput can create problems for day-to-day operations, as well as having financial implications. During this period, there would also be a greater burden on plant workers, who would be required to perform manual tank gauging. This, in turn, could have an impact on plant and worker safety if not carefully handled.

Another potential problem when replacing the entire tank gauging system is the ability to integrate the new system with a plant's existing higher-level computer systems. Data from tank gauging systems normally feeds into a distributed control system, accounting, inventory and loss control systems. The transmission of data between the old gauging system and these other systems will need to be re-established and, should the existing systems be slightly out-of-date, such specialist work can be expensive. Despite the high maintenance costs, it can make more financial sense to retain the existing gauging system until the high-level systems have been upgraded, whereupon it becomes much easier and more cost-effective to integrate a new tank gauging system.

Proprietary Communications

There is a reluctance to perform partial upgrades because of communication compatibility issues between field instrumentation towards the control room. Historically, most manufacturers of tank gauging equipment have provided proprietary fieldbus options for the communications between the gauging equipment installed on the tanks and the control room. The electrical interface and protocol software is specific to individual manufacturers, which prevents level gauges, temperature devices, and other equipment developed by alternative manufacturers from communicating within that gauging system. Therefore, if the user wanted to extend or partially upgrade a system, or replace individual devices, the only option was to buy equipment from the original system supplier. Installing equipment from an alternative vendor would usually require separate cabling installed for another fieldbus network, a second operator display within the control room, and a second interface added to the existing distributed control system, all of which would add time and cost to any upgrade project. This resulted in terminal operators often deciding to continue to "make do" with their mechanical float or servo gauges.

For those unwilling or unable to perform wholesale or partial upgrades, the only other option has been to replace like-for-like mechanical devices and continue to accept the limited functionality with older technologies and the high maintenance costs these incur. But as level gauging systems age, some of the older mechanical gauges are becoming obsolete, with parts difficult and expensive to source. This is forcing the user into a very difficult decision.

Tank Gauging Emulation

A solution is at hand in the form of tank gauge emulation, which makes it possible to perform an easy and cost-efficient system upgrade. Emulation - where modern gauges “speak the language” of the old gauges - enables existing gauges to be replaced with modern technology from alternative vendors, but without the need to make any changes to the communication or wiring infrastructure. The integration of the new devices into the existing tank gauging system will be seamless.

Tank gauging emulation enables users to easily replace old float or servo technology with modern radar level gauges incrementally, one gauge at a time, with minimal disruption and without the need for a large-scale CAPEX project. Upgrades can proceed as the situation demands and when budget is available.

Emulation Considerations

However, before equipment can be replaced there are certain considerations. Firstly, the emulating level gauge should be electrically compatible with the existing tank gauge system fieldbus. Poor compatibility could cause the old system to malfunction, even if the emulating gauge works well.

Secondly, all measurement data that the tank gauge system master expects to receive from the level gauges must be supported. If, for example, pressure, density, flow rate, or some other data is measured by the existing gauge, then the emulating gauge must be able to produce the same measurement data.

There may also be software commands sent out from the tank gauge master that are irrelevant for the emulating gauge. For example, a radar gauge emulating a servo gauge might receive the command to “raise the displacer to top”. This is obviously irrelevant for a radar gauge, which has no displacer, but the gauge must still provide a proper response to the tank gauge master unit, otherwise an alarm message may occur.

Emulation Technology Solutions

The large number of aging float and servo devices still currently in use come from a variety of manufacturers using different proprietary communication protocols. In general, they are all suitable for emulation. When looking to upgrade the gauges, users may not necessarily want to continue to source them from the original vendor. This may be because the vendor no longer offers the right technology, can't provide the appropriate support or there are alternative manufacturers that offer a more advanced solution.

The ability to emulate both gauges and tank management systems means users can replace both their old field devices and control room infrastructure incrementally without impacting the uptime of assets. The result is a complete modern system including state-of-the-art inventory management, connection to host computers and business system integration. The figures below are examples of how emulation can be applied.

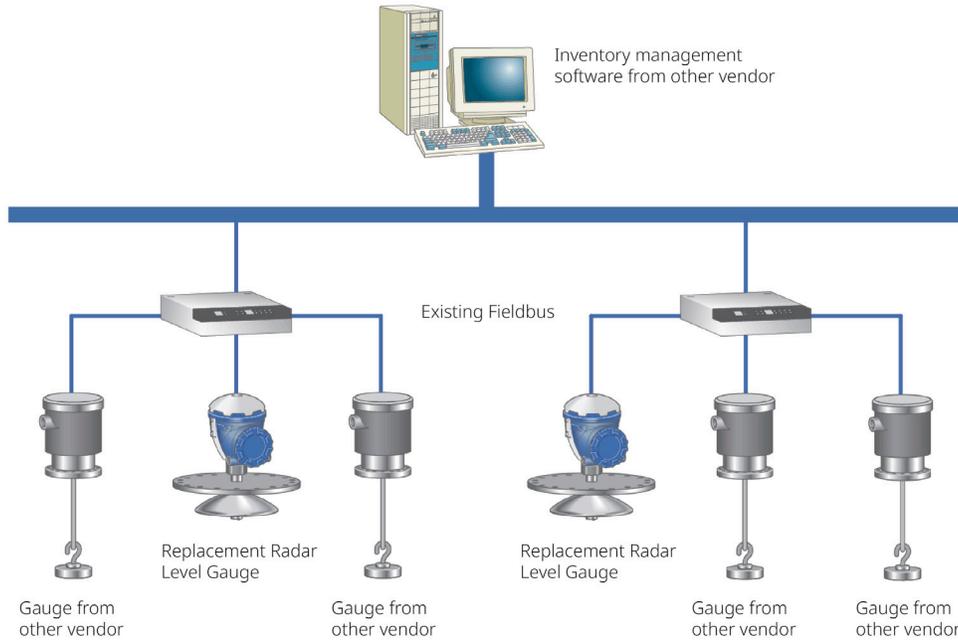


Figure 1-1. Tank Gauging Emulation , Step 1.

Tank gauging emulation allows a flexible step-by-step replacement of field or control room equipment. You can start by replacing old mechanical or malfunctioning radar devices with modern radar based level gauges using the existing field wiring and host system.

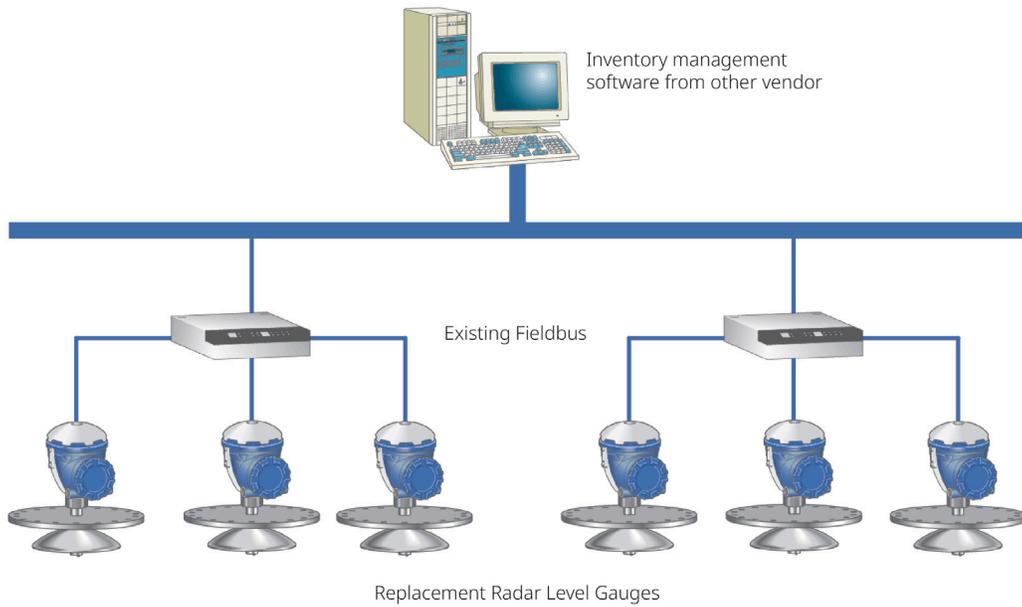


Figure 1-2. Tank Gauging Emulation , Step 2.

All field devices are changed to modern radar level gauges, but the system still uses the existing communication protocol and host system, unique to the previous manufacturer.

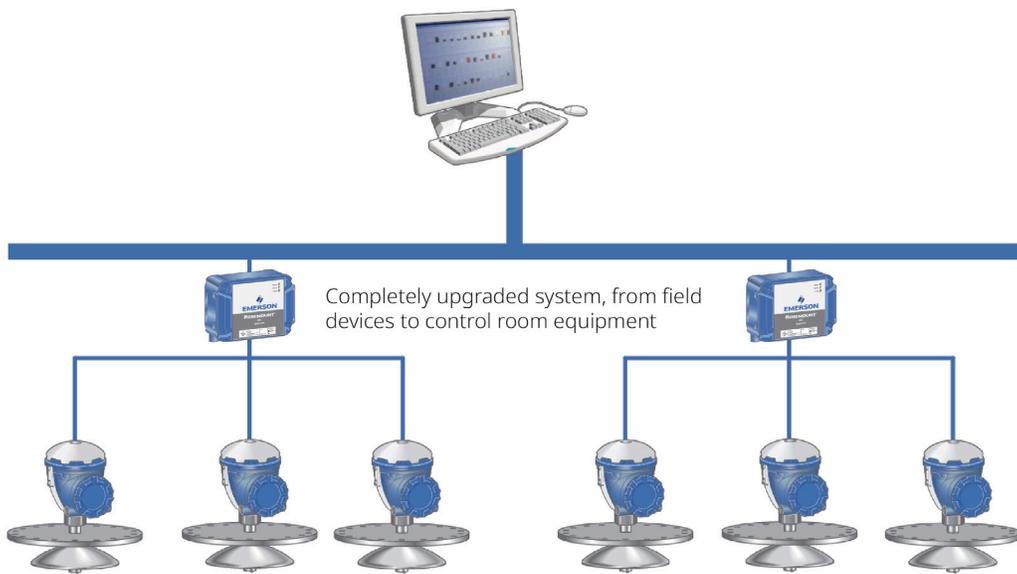


Figure 1-3. Tank Gauging Emulation , Step 3.

The whole tank gauging system is upgraded in steps, as the budget allowed: all field devices and control room equipment, including inventory management system, have been replaced. The modern standard communication protocol enables advanced data handling.

Emulation in Practice

[Figure 1-1](#) on page 4 shows an example of emulation in practice. When the emulating level gauge is connected to an old servo-based level gauge system, the existing PC-based tank gauging software accepts the emulating gauge as a servo gauge. Typically, tank data such as level, temperature, alarms and status information is received by the system hub before entering the legacy system. Data will appear on an operator screen as normal and the type of gauge will not be made visible to the operator.

Return on Investment

Maintaining aging equipment creates not only high but also non-predictive costs. The uncertainty of tank volumes caused by unreliable measurements could involve millions of dollars, depending on product type and quantity. An overflow and potential safety incident can create huge costs in terms of legal fees, safety and environmental fines, and lost business. Upgrading tank gauging systems using emulation helps to avoid these eventualities and offers a very fast return on any investment. A refinery in Texas, U.S., calculated that the cost of upgrading float and servo gauges to radar gauges on 163 tanks, divided by the annual cost savings made following the upgrade, would provide a payback period of two years and seven months.

Case Study - PTT Public Company Limited (PTT)

Emulation is a proven technology, and Emerson has a large installed base of emulation technology, with more than 4,000 gauges operating effectively in over 300 sites. One example of how this technology has brought significant benefits for a customer was at a PTT gas separation plant in Thailand, described below.

The existing radar level gauges were not able to provide reliable tank content and safety functions for the operational process and governmental verification requirements. There was a need to upgrade these devices, but to communicate with the control room system, the field device communication protocol needed to be compatible with the existing communication protocol. The only other option was to replace the entire tank gauging system in one go, but that was cost-prohibitive.

The level gauges were replaced with Rosemount™ 5900S Radar Level Gauges. Using emulation technology, the upgrade could be performed step-by-step. As a result, this PTT plant installed a reliable and safe, low-maintenance tank gauging system at a pace and budget that suited the company, without needing to replace the whole tank gauging system.

Summary

The poor performance and high cost of maintaining old mechanical level gauges no longer needs to be accepted. With proven emulation technology, users of tank gauging systems have the option to upgrade legacy gauges with modern replacements from alternative suppliers without the concern of fieldbus protocol compatibility issues. The challenges usually presented by partial or complete upgrades are avoided, enabling the latest radar-based level technology to be installed with minimal disturbance to operations.

Not many companies offer modern devices that are able to emulate other tank gauge types. Emerson's Rosemount 5900 Series, though, is a modern radar-based level gauge that does offer this capability, emulating a broad range of common legacy gauges and different fieldbus protocols.



Figure 1-4. Gauge Emulation.

Rosemount 5900 Series gauges can be installed on the existing tank openings using the same cabling and communication protocol as the previous devices, which makes the replacement of old gauges very quick and easy.

As well as emulating a range of proprietary gauge fieldbuses, Emerson's solution can also communicate with open standard fieldbuses, such as FOUNDATION™ Fieldbus or Modbus®. This functionality is important as it means the gauge can connect to these different communication networks should they be deployed at a later point.

In addition to gauge emulation, Emerson also provides emulation of old control room equipment via the Rosemount 2460 System Hub. The system hub collects measurement and status data from legacy field devices, and forwards it to a tank management system such as the Rosemount TankMaster™ Inventory Management Software to provide the operator with a real-time overview.

For additional information, visit:
www.Emerson.com/TankGaugingEmulation

 [Linkedin.com/company/Emerson-Automation-Solutions](https://www.linkedin.com/company/Emerson-Automation-Solutions)

 [Twitter.com/Rosemount_News](https://twitter.com/Rosemount_News)

 [Facebook.com/Rosemount](https://www.facebook.com/Rosemount)

 [YouTube.com/user/RosemountMeasurement](https://www.youtube.com/user/RosemountMeasurement)

Emerson Terms and Conditions of Sale are available upon request.
The Emerson logo is a trademark and service mark of Emerson Electric Co.
Rosemount is a trademark of Emerson family of companies.
All other marks are the property of their respective owners.
©2023 Emerson. All rights reserved.

00870-0400-5100 Rev AB, January 2023