



# EMULATION: THE COST-EFFECTIVE SOLUTION TO TANK GAUGING UPGRADES

*Many terminal operators tend to make do with older tank gauging systems, as they believe upgrade projects would be too costly, complex and time-consuming. However, as Emerson's Lena Hansson explains, tank gauging emulation provides a solution that enables them to easily, efficiently and incrementally replace outdated or unreliable field or control room equipment*



**E**nsuring the safety of personnel, assets and the surrounding environment while also maximising operational efficiency is a key challenge facing storage terminal operators.

However, many of the world's estimated one million bulk liquid storage tanks are still relying on ageing tank gauging systems – incorporating mechanical devices using float or servo technology – to support overflow prevention and inventory management. This technology is susceptible to failure, and can result in unreliable measurements and high maintenance costs. Other systems may use more modern radar

technology, but could be hampered by radar level gauges which are not performing well. Measurement unreliability creates the potential for overfills, which can then result in safety incidents, fines, substantial clean-up costs, and significant damage to a company's reputation. Measurement inaccuracy can also lead to underutilisation of tanks and transfer uncertainty, making tank operations less efficient and thus affecting profitability.

## REPLACING TANK GAUGING EQUIPMENT

Many terminal operators recognise the wide-

spread benefits that can be gained by either fully or partially upgrading their existing tank gauging system, replacing older mechanical equipment with modern radar level gauges and control room infrastructure.

The latest radar technology provides measurements that are highly reliable and accurate, meets current safety standards and guidelines, offers advanced diagnostics to help pinpoint potential problems, and has very low maintenance requirements. The latest systems also adopt open fieldbus communications, enabling users to select best-in-class devices.

Yet despite accepting the many advantages

radar technology could provide, some terminal operators have been reluctant to replace their whole tank gauging system. Taking tanks out of operation whilst installing a new system would not only create problems for day-to-day operations, but would also have financial implications.

Therefore, many operators believe that replacing a complete system would be cost-prohibitive, overly complex and time-consuming, and would involve a lengthy and costly period of downtime.

A further potential problem when replacing an entire tank gauging system is integrating the new system with a terminal's existing higher-level computer systems. In many applications, data from the tank gauging system is also transferred to accounting systems, inventory/loss control systems, distributed control systems (DCS), etc. When exchanging to a new tank gauging system, the data transmission protocols between the old tank gauging system and these higher-level systems must be established for the new tank gauging system as well, which can be costly, especially if the higher-level systems are slightly out of date and require upgrading. It can often be more economical to keep the existing tank gauging system until the higher-level systems have been upgraded, when it then becomes easier and more cost-effective to integrate a new tank gauging system.

#### PARTIAL UPGRADES

For terminal operators unwilling to install a complete new tank gauging system, another option is to perform a partial upgrade. However, many have been reluctant to do so due to issues over field instrumentation communication compatibility.

Most tank gauging equipment manufacturers have provided proprietary fieldbus options for communication between their tank instruments and the control room. Each manufacturer's electrical interface and protocol software is specific to them, which prevents other manufacturers' equipment (level gauges, temperature devices, etc.) from being able to communicate within that gauging system.

Consequently, if a user wanted to partially upgrade their system or replace individual devices, they were limited to buying equipment from their original system supplier. If they wanted to install equipment from another vendor, this would usually involve installing separate cabling for another fieldbus network, a second operator display in the control room, and a second interface to the existing distributed control system, thereby adding time and cost to their upgrade project.

Those owners unwilling to either fully or partially upgrade their tank gauging systems have had to simply make do with their mechanical float or servo gauges, replacing them like-for-like when necessary and accepting the limited functionality and high maintenance costs these devices incur. However, this too is not straightforward, as some older mechanical gauges are



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

becoming obsolete, with their parts ever more difficult and expensive to source.

#### GAUGE EMULATION

Gauge emulation provides a solution to these challenges, making it possible to perform tank gauging system upgrades easily and cost-efficiently. Emulation makes it possible for modern gauges to 'talk the language' of older devices. Consequently, a system's existing gauges can be replaced with modern devices from other vendors without changes having to be made to the communication or wiring infrastructure.

Therefore, the integration of new devices

into an existing system can be performed seamlessly. With tank gauge emulation, modern radar level gauges can replace old float or servo technology incrementally, one gauge at a time, as the situation demands and when budget is available. This can be achieved with minimal disruption and without requiring a large-scale CAPEX project.

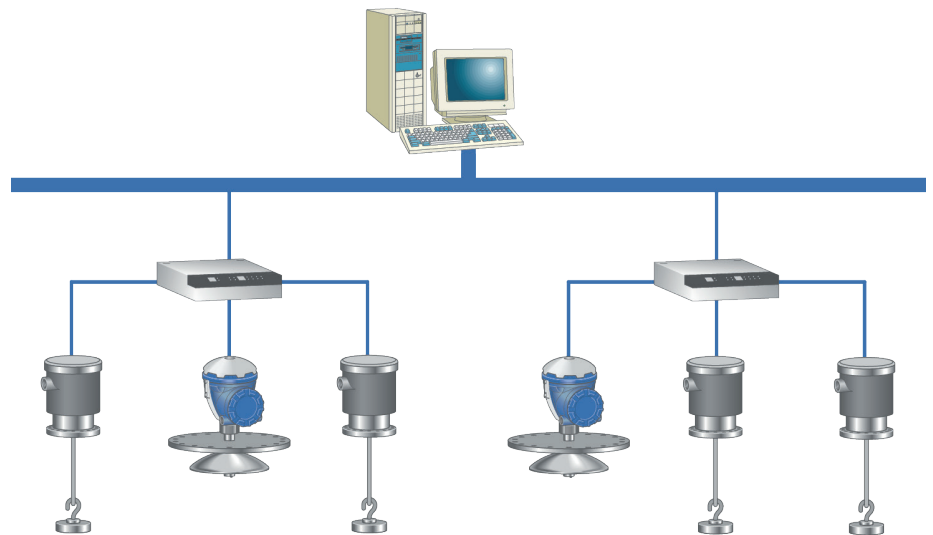
There are, however, certain considerations to be made before tank gauging equipment is replaced with emulating level gauges. First, emulating gauges must be electrically compatible with the existing tank gauging system fieldbus. Poor compatibility could lead

to a system malfunction, even if the emulating gauge is working well. Second, the measurement data the tank gauging system master expects to receive from the emulating gauges must be supported. For example, if pressure, density, flow rate, etc. is measured by an existing gauge, then an emulating gauge must be able to produce the same measurement data. Also, it is important to recognise there may be software commands sent out from the tank gauging system master that are irrelevant for the emulating gauge. As an example, a radar gauge emulating a servo gauge might receive the command to 'raise the displacer to top'. Although this is obviously irrelevant for a radar gauge, which has no displacer, the emulating gauge must still provide a proper response, otherwise an alarm message may occur.

**EMULATION TECHNOLOGY**

As previously mentioned, there are still many ageing float and servo devices in use, and these come from a variety of manufacturers using different proprietary communication protocols. In general, all these devices are suitable for emulation because the vendors have continued to use the same fieldbus hardware and the software protocol has changed very little. Users who are considering upgrading their gauges may not necessarily want to continue sourcing them from the original vendor. This could be because the original vendor no longer offers the right technology, or is unable to provide the appropriate support. It could also be because there are alternative manufacturers offering a more advanced solution.

Not many automation technology suppliers offer devices with emulation capability. However, Emerson's Rosemount 5900 Series is a modern radar level gauge that can emulate a broad range of legacy gauges and proprietary fieldbus protocols. An additional benefit of this level gauge is that it can be installed within an existing tank opening, thereby making it relatively quick and easy to replace old devices. The Rosemount 5900 can also communicate with open standard fieldbuses, such as FOUNDATION



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

Fieldbus or Modbus, thereby enabling connection to these different communication networks should they later be deployed.

When an 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 is received by the system hub before entering the legacy system.) Data will then appear on an operator screen as normal and the type of gauge will not be made visible to the operator.

As well as gauge emulation, Emerson also provides 'master' emulation, enabling the exchange of old control room equipment via its Rosemount 2460 System Hub. The hub collects data from legacy field devices and forwards it to a tank management system, thereby providing the operator with a real-time overview.

With this ability to emulate both gauges and tank management systems, terminal operators can replace their field devices and their control room infrastructure incrementally without affecting asset uptime. The result is a complete

modern system, with state-of-the-art inventory management, connection to host computers, and business system integration.

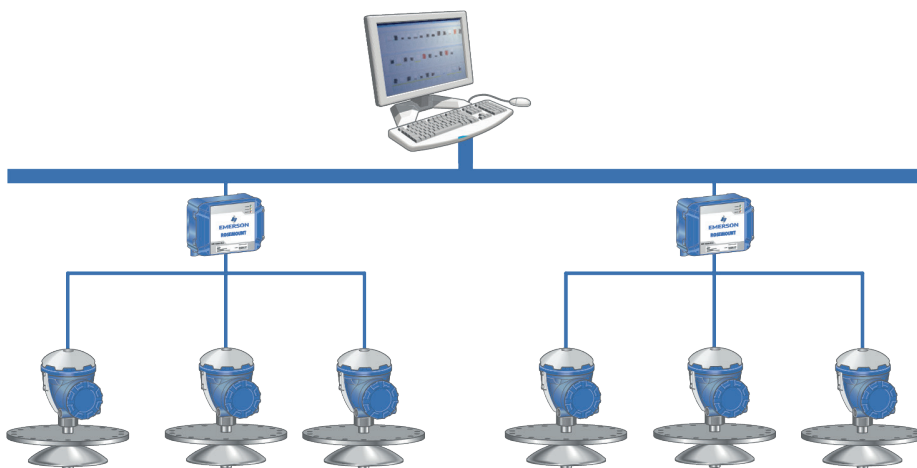
**A VERY QUICK RETURN ON INVESTMENT**

The cost of tank volume uncertainty caused by legacy equipment providing unreliable measurements can be extremely high. Should a measurement error result in an overfill, this could create huge costs in terms of legal fees, fines and business lost through damaged reputation. Using emulation as a means of upgrading tank gauging systems helps to avoid these potential consequences and provides a very quick return on any investment.

A refinery in Texas, US, 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.

**SUMMARY**

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



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

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