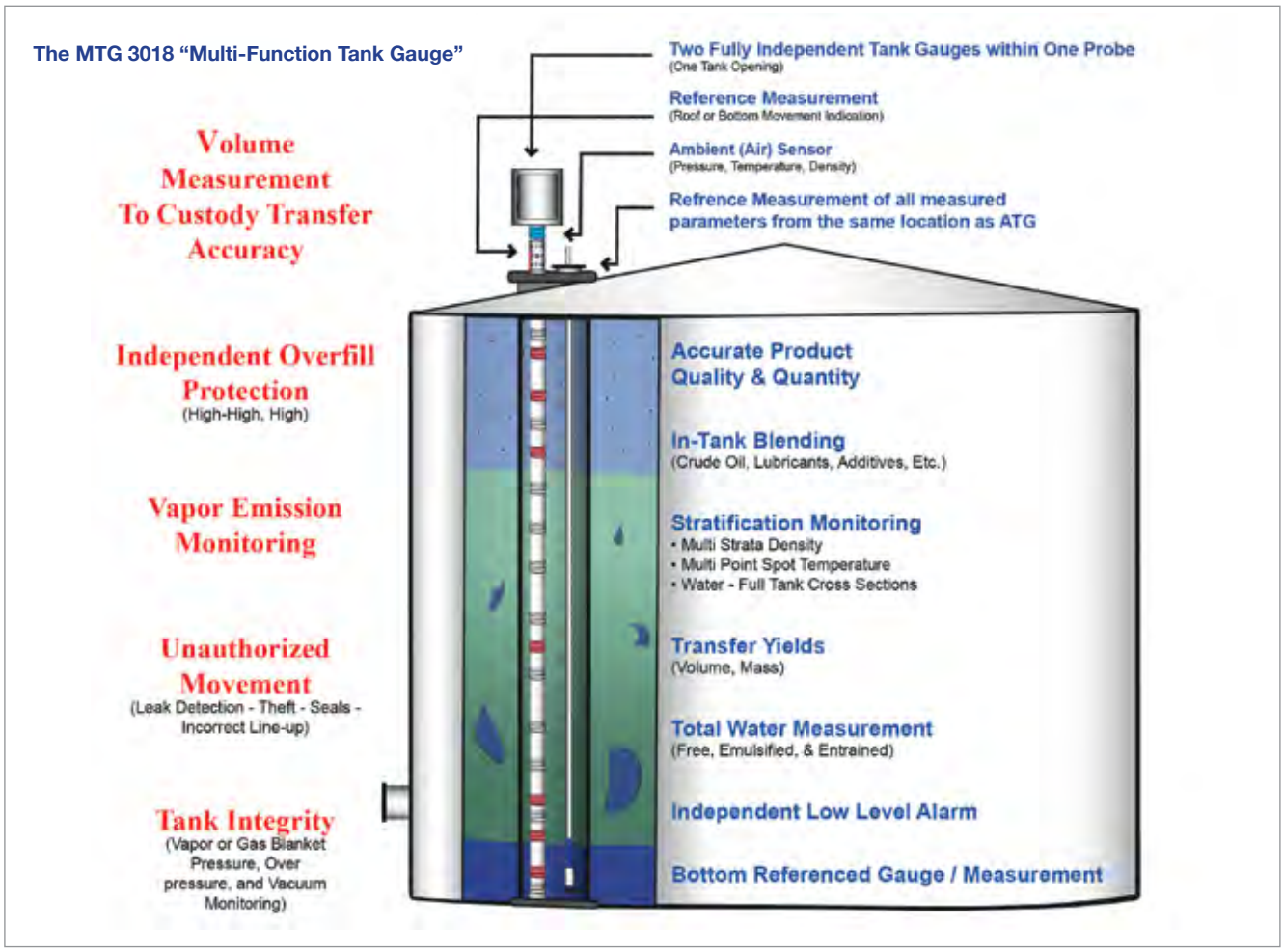
GAUGING AGAINST ACCIDENTS

Does your tank gauge provide the information you need, now and in the future?



COMPANIES USE tank gauging for inventory and the monitoring of operational conditions in their tanks.

Inventory information normally includes: tank, product, volume, level, temperature, density, and water. This is primarily based on the parameters needed to calculate volume by hybrid method (API MPMS 3.6 - Measurement of Liquid Hydrocarbons by Hybrid Tank Measurement Systems).

The operational information commonly includes: maximum fill (volume or level), available space (volume or level), fill stop time, high-high and high alarms, low-low and low alarms, temperature (high & low alarms), pressure (high & low alarms), density (high & low alarms), and free water.

The amount of data that can be used is largely due to the capabilities of the tank gauges used and the operational information they can provide. Many tank gauges provide volume, level, temperature, density, and water. *If your tank gauge was capable of providing you with data (measured or calculated) to fulfil more operational needs, why would you limit your knowledge or operational capabilities?*

We can discuss standard industry (vendor) dedicated protocols and communication topologies limiting the amount of usable data from a tank gauge. The poll rate or how fast it takes to update the tank gauge data ›

to the operator is critical for product movement, unauthorised movement, and operational alarms in larger tank farms.

A most confusing term used within tank gauging is 'wireless communication'. Simply put, in any tank farm that requires frequent communications (high duty cycle), you still need to run wire conduit to power the gauge (and additional instrumentation, data convertor, and radio). Battery-powered tank gauges and radios on single tank, low duty cycle applications work well, but are still limited by the amount of data.

Note: points of discussion on topologies should include: 1) operational functionality; 2) required data rate or poll rate; 3) security; 4) reliability; 5) redundancy; and 6) overall cost.

Does your tank gauge provide enough data for loss control, safety and environmental concerns, both now and in the future?

The American Petroleum Institute provides recommended practices as user self-imposed guidelines within the industry. API RP 2350 'Overfill Protection for Storage Tanks in Petroleum Facilities' shows a safety need for overfill protection, first required by the Department of Transportation and now by most insurance companies and other governmental agencies.

It first recommended primary overfill protection by the tank gauge and secondary overfill protection by either an independent tank gauge or independent instrument, ie, a high level alarm switch. There has been redundant tank gauge technology on the market since the mid-1990s, composed of one or more independent tank gauges within a single probe instrument, as well as redundant high level alarm switches since the late 1980s.

However, do your tank instruments have the capability of preventing the type of disaster like Buncefield (UK - 2005), a tank overfill and gas vapour cloud resulting in a fire?

How many incidents have occurred due to overpressure or a vacuum within a tank, resulting in a damaged tank and possible spill of product? On many occasions, ice has frozen over pressure relief vents. *Does your tank gauge monitor and alarm for overpressure or tank vacuum?*

Do your tank instruments have the capability of preventing the type of disaster like Buncefield?

MOVEMENT

Unauthorised movement of product is the movement of product in or out of a tank when the tank is scheduled to be stagnant (non-moving). The detection of movement of product is usually measured in terms of level movement or more accurately by mass movement. The more sensitive the measurement technology, the earlier the warning of the condition (alarming), and the lower the potential product loss. The causes of unauthorised movement are many, but include improper line-ups, piping leaks, product theft, or a tank leak. *Does your tank gauge provide you a sensitive method of detecting unauthorized movement?*

VAPOUR

Another loss control, environmental, and safety concern is vapour emissions. The monitoring of actual vapour pressure, vapour temperature, vapour density, ambient density, ambient temperature and ambient pressure provide the active parameters for calculating evaporation emissions for air quality reporting. *Does your tank gauge provide you the parameters to monitor vapour emissions?*

Similar to the monitoring of vapour emissions, some tank gauges can monitor the vapour pressure inside the tank for gas blanketing regulation. Tank gas blanketing is an effective means of preventing fires in petrochemical liquid storage tanks by eliminating the formation of product vapours. Light end product vapours could be ignited by lightning and static charges. Having a tank gauge that monitors blanketing is essential for loss control, environmental, and safety concerns.

Loss control also includes the quantity and quality of your inventoried product. By monitoring the stratification of both density and water over multiple strata you can determine the specific gravity, percentage of total water, and quality of the product. The percentage of water by strata reflects distribution of water in layers throughout the entire tank height as opposed to monitoring of water within 3ft of the bottom at the location of a standard capacitance sensor in a hybrid system. The capacitance probe doesn't account for any entrained or free water above 3ft. Also notice the probes have a tendency for blockage with viscous products such as crudes and lubes. The strata cross section measures all forms of water - free, emulsified, and entrained - over the entire liquid level of the tank. *Does your tank gauge provide multi-strata density and measurement of total water?*

Multi-strata density, temperature, and water also provide the basis for in-tank blending; based on each component product's density (specific gravity), target density (specific gravity), and target volume or tank safe fill. *Does your tank gauge provide blending capabilities?*

In the blending of lubricant products, heating of the feed and product tanks is normally required. However, if the product gets too hot, it can be discoloured and wasted, or require additional blending. Overheating of the product can be caused by a malfunction or incorrect setting of the heating elements, or by exposing the product to the heater for too much time. With most lubricants a specific gravity as well as coloration is specified. By using an instrument with multi- ›

point spot temperature that monitors and alarms for all RTDs individually, you are able to detect the temperature stratification of the entire tank height. When the temperature at the heating coils is too high, conventional average temperature of the process is not likely to detect the problem. *Does your tank gauge provide multi-point spot temperature with capability to monitor any temperature point or an average temperature within product - vapour temperature, ambient temperature, free water temperature?*

Temperature in the calculation of volume by hybrid method is more critical to accuracy than any other parameter including level (density or water) on most products. During the 1980s, studies supporting API MPMS 7.4 showed the influence of ground temperature on the tank bottom as influencing product temperature. The spacing of RTDs within a multi-point temperature probe usually included three within the bottom 12ft-15ft of a tank. *Does your tank gauge provide three RTDs within 12ft-15ft of the tank bottom? Are you using a temperature averaging probe combined with a capacitance probe for free water measurement on the bottom 3ft?*

Level measurement in accordance to API MPMS 3.1B, requires the capability to be measured against the manual reference hand line to calibrate or verify accuracy. If your tank gauge requires a slotted gauge well because of product turbulence when filling or emptying the tank, and the gauge physically takes up the whole diameter of the gauge well, *how do you do a manual reference gauge to calibrate or verify accuracy? How do you take a manual temperature measurement with an electronic temperature probe, density using a sample bottle or thief, and water using a manual tape and water paste?*

ACCURACY

The accuracy of a tank gauge is determined by the comparison to a known reference. If a tank gauge is installed in one physical location and a reference hand line is taken from another, it creates measurement error. The physical measurement conditions and product media are not the same as the mounting point of the gauge (gauge well and datum plates in both locations, tank bottom thickness, gauge well support, thickness of datum plate, position to tank bottom or roof, etc). The physical mounting of the ATG and access for manual reference measurements is essential for calibration and verification of accuracy. This applies to all required parameters (level, temperature, density, & water) for hybrid method. With any non-homogeneous product, an independent multi-point spot temperature probe mounted 5ft–10ft away in the open tank or second gauge well, is not measuring the same product as the ATG, again causing measurement error.

Density measured by a gauge pressure transducer installed at a flange with a cut-off valve on a tank wall is not measuring the same average product density as the product within the gauge well, which is causing a measurement error in overall calculations. Only one tank gauge technology measures all parameters for volume at the same point of the reference measurement, with or without a gauge well. Only one bottom referenced gauge has the capability to measure tank roof and bottom movement (patent pending) within the gauge well or outside of the gauge well. ATGs without this capability are again subject to measurement error. This is almost as ineffective as the original HTG Systems of the 1980s where there were multiple issues related with pressure transducers.

Density measured by a pressure transducer installed at the nozzle on a tank wall is not measuring correct average fluid density in comparison to the product within the gauge well, which will cause a measurement error in the overall calculations. Secondly, hybrid pressure transducer diaphragms are mounted in a vertical orientation that provides less sensitivity than those installed in a probe assembly with a horizontal (flat) orientation.

Thirdly, hybrid pressure transducers are mounted on the outside of a tank where they experience a larger temperature variation causing greater error than those installed in a probe assembly inside the tank where there is a more constant temperature.

Most of the traditional gauges measure outage with no compensation for roof and bottom flexing. Hybrid systems provide average density only, and with limited accuracy. The temperature in hybrid systems is not taken from the same point as level. The water measurement is limited in accuracy and in a very short range near tank bottom.

Even an accurate level without accurate temperature and water content measurements is insufficient for accurate inventory and custody transfer of product volume and/or mass – the real quantity parameters. None of the existing technologies (except for one) provide for emulsified and entrained water/product combination accounting. None of the existing technologies (except for one) provides accurate density profile in the tank in real time simultaneous to other inventory parameters.

Even partial solutions for the above measurements require multiple instruments to be installed and wired on a single tank, which in turn introduces errors of compatibility of measurements with manual gauging and sampling taken at different physical locations.

For more information on which tank gauge already provides the operational, loss control, environmental, and safety benefits described above, visit: *www.gaugingsystemsinc.com* *www.gaugingsystems.net*