

PRODUCT DESCRIPTION

LRDP

Leak Detection and Integrity Monitoring for Bulk Underground Storage Tanks

The Vista LRDP (Low-Range Differential-Pressure) system is a mass-based leak detection and monitoring system for bulk fuel tanks, including USTs (underground storage tanks) and ASTs (aboveground storage tanks) [1]. It quantitatively measures the rate of any leak that might be present, giving the results in gallons per hour.

The LRDP was initially developed for the world's largest USTs, which are owned and operated by the U.S. Navy [2]. The Red Hill tanks, buried over 100 feet deep in the hills above Honolulu, are 100 feet in diameter and 250 feet high, and each contains 12.5 million gallons of fuel. The LRDP has also been used for testing some of the bulk USTs owned by the

The key component of the LRDP is the vertical reference tube.

Department of Defense (DoD) [1]. The LRDP has been integrated into the DoD Fuels Automated System (FAS), making it compatible with all the DoD's bulk fuel storage facilities.

Benefits

Fully Automated. The LRDP is a fully automated, computer-controlled system that is easily installed and operated. An operator initiates a test from the host computer, and the embedded controller located at the tank does the rest.



Rugged and Fieldworthy. The LRDP's unique, patented, "reference" tube design ensures that it achieves a high level of precision and accuracy with an off-the-shelf, industrial-grade pressure sensor.

Mobile Option. The LRDP can be permanently installed for on-line monitoring and periodic tightness testing, or it can be transported to a site for one-time tightness testing. The former is normally the preferable configuration because of the regulatory requirements for monthly monitoring of tank integrity. The LRDP, once integrated into a facility, can test

all of the tanks in a fuel farm or bulk storage terminal.

Certified Performance. In a series of third-party evaluations conducted according to the standard EPA and ASTM procedures for evaluating detection systems for bulk storage tanks [3,4], Ken Wilcox Associates, Inc. (KWA), evaluated 16 different ways of conducting a test with the LRDP, using various combinations of test length, testing frequency, and averaging of test results. Depending on test length, the LRDP can detect a leak as small as 0.38 gallons per hour in tanks up to 140 feet in diameter [5]. (The KWA evaluations were certified by the independent National Work Group on Leak Detection Evaluations.)

Description

The LRDP consists of three integrated components:

- an in-tank sensor unit for making measurements
- a local controller to implement a test and analyze the data from the test
- a host computer to initiate a test and to report and archive the results of the test

The LRDP can, with only minor hardware and software modifications, also conduct leak detection tests on ASTs.

How the LRDP Works

The key component of the LRDP is the vertical “reference” tube, which spans the full usable height of the tank (see diagram). The fuel in the tank is allowed to enter or leave the reference tube through a valve located at the bottom of the tube. When the tank is to be tested, the valve is closed, isolating the fuel in the tube from the fuel in the rest of the tank.



The uppermost portion of the reference tube, capped by the valve actuator

The level of fuel in the reference tube mimics that in the tank in every way except for the level changes due to a leak. A differential-pressure sensor, which is housed in a sealed container at the bottom of the tube (which is itself at the bottom of the tank) then detects very small changes in pressure between the fuel in the tank and the fuel in the tube, with the LRDP converting pressure changes to the equivalent level changes. Thus, when the valve is closed, the differential-pressure sensor directly senses, and the LRDP quantifies, the level

changes due to a leak (if a leak is present).

The LRDP achieves a very high level of performance against small leaks because of (1) its high precision and (2) its inherent method of compensating for the thermal expansion and contraction of the fuel in the tank. In addition, the LRDP compensates for evaporation and condensation within the tank.

The LRDP not only delivers high performance but is rugged and fieldworthy.

Most importantly, because of its unique, patented design, the LRDP eliminates the two factors responsible for the poor performance of other mass-based measurement systems—thermal drift of the pressure sensors and thermally induced vertical movement of the in-tank sensor unit. All of the sensors are mounted in a sealed container at the bottom of the tank, where temperature changes are too small to affect sensor performance; and the in-tank sensor is held in place by a bellows-type mounting system that prevents changes in tank geometry from affecting the position of the sensor.

Precision

The LRDP has a precision of 0.0002 inches when making a single level measurement, and enough sensitivity to measure volume changes as small as 0.03 gallons per hour in a 100-foot-diameter tank. This high degree of precision is obtained because the differential-pressure sensor does not have to operate over the

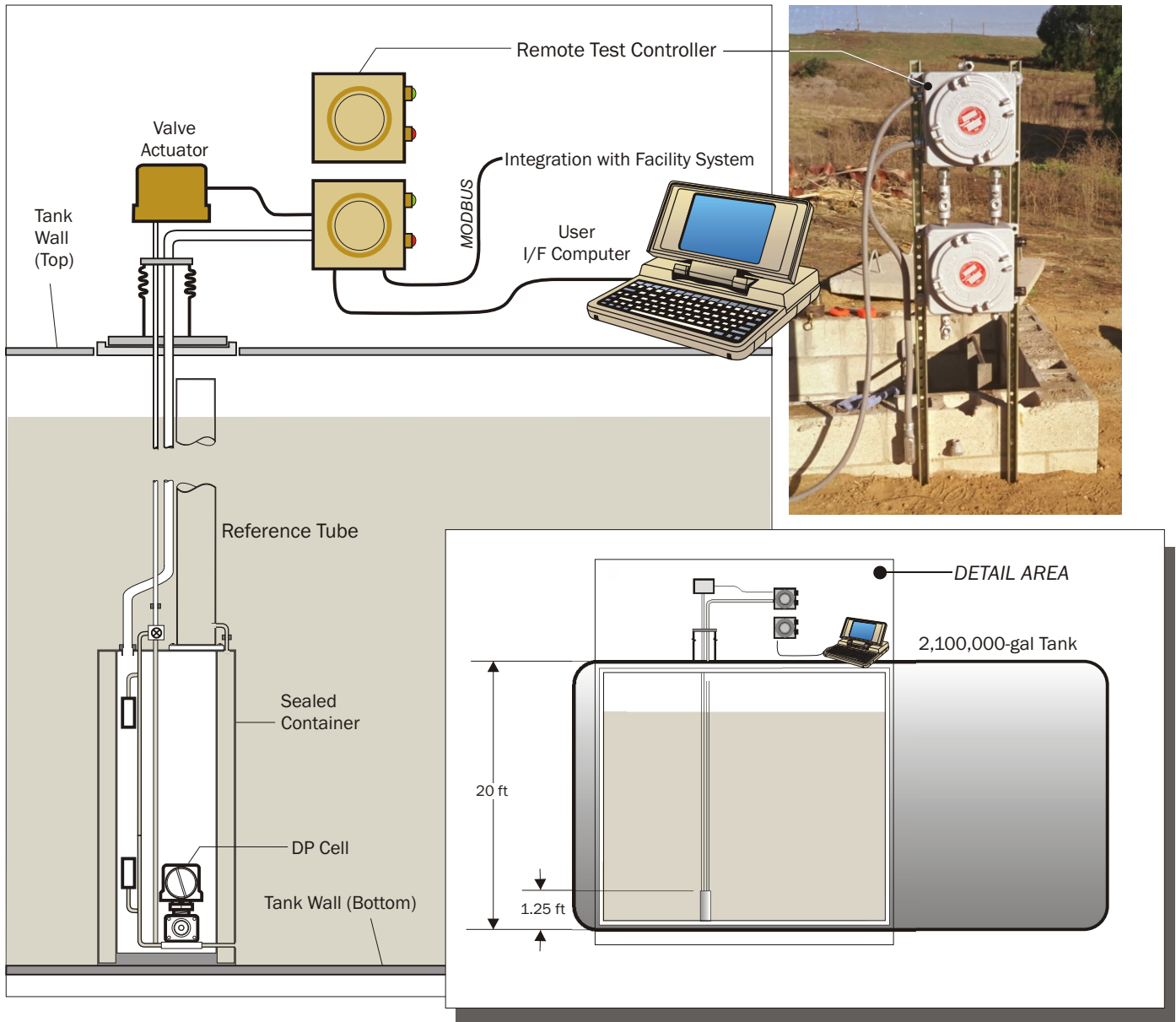


The sensor housing eliminates thermal drift of the sensors and prevents vertical movement.

entire height of the tank; it only has to operate over the difference between the level in the tube and the level in the tank (perhaps 0.8 feet in a 20-foot-high tank, for example). This configuration increases the precision of the measurement made by the DP sensor, in such a 20-foot-high tank, by a factor of at least 240 over a system that does not use a reference tube.

Performance

The performance of the LRDP depends on the size of the tank, the duration of the test, and the number of tests averaged [1,5]. KWA evaluated the LRDP’s performance with various combinations of these factors, coming up with 16 evaluated, approved ways to implement a leak detection test. The only variables in these 16 applications of the LRDP are test duration, testing frequency (allowing for differences in the requirements for monitoring vs. those for



tightness testing), number of tests averaged together, and probability of false alarm [5]. In terms of performance and operation, the LRDP was designed to meet the California regulatory guidelines for bulk tanks [6], but it has general application for all states.

The LRDP is approved by the National Work Group on Leak Detection Evaluations in the following respects:

- Test length can be either 24 or 48 hours.

- Multiple tests (i.e., either four or five) can be averaged for the purpose of increasing reliability and/or increasing detection sensitivity.
- The LRDP can be used for a variety of regulatory options (i.e., monthly monitoring to detect leaks of 1.0, 2.0 and 3.0 gallons per hour and precision testing to detect leaks of 0.2 gallons per hour.)
- It can be used on all vertical-walled tanks with capacities greater than 50,000 gallons

and diameters less than 140 feet.

The LRDP outperforms other in-tank leak detection and monitoring systems by a factor of 4 to 8, depending on the averaging scheme that is used [5]. What this means is that the LRDP has a lower probability of false alarm and/or better detection sensitivity than other methods. When the LRDP is used for monthly monitoring, it is implemented in such a way that it maintains a probability of detection (P_D) of

95% against the target leak rate specified by the regulatory agency and a probability of false alarm (P_{FA}) less than 0.002%. The LRDP can also be used to meet annual precision testing requirements at 0.2 gallons per hour with a $P_D > 95\%$ and a $P_{FA} < 5\%$.

Data Averaging to Enhance Performance

Averaging the results of two or more tests improves not only the detectable leak rate but also the P_D and P_{FA} over that obtained in a single test. Performance improves as the number of tests averaged increases. For example, when the results of five 24-hour tests are averaged, the LRDP's performance increases by a factor of 2.2 (i.e., the square root of 5) over its

performance in a single 24-hour test.

The performance of the LRDP scales with the surface area of the liquid in the tank—i.e., the smaller the tank, the smaller the leak that can be detected in a single test. In tanks less than 59 feet in diameter, for example, a single 24-hour test can detect a

leak of 0.2 gallons per hour with a $P_D = 95\%$ and a $P_{FA} = 5\%$, as documented in the KWA evaluation. In an 88-foot-diameter tank, the minimum detectable leak rate for a single 24-hour test was 0.45 gallons per hour, versus 0.38 gallons per hour for a single 48-hour test. Averaging improves the results even further.

Acknowledgments

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