Upgrading Existing Tank Monitoring and Gauging Systems

Many tank gauging and monitoring systems installed during the past 15 years may lack the flexibility to meet new requirements. Tom D'Alessandro explains how the use of RS-485 communication technology can be employed to overcome these limitations safely anywhere in the world.

Changing environmental regulations and new applications have encouraged convenience store owners, retail petroleum marketers, and hypermarkets to re-evaluate the flexibility of their tank gauging and leak detection equipment. By utilizing existing RS-485 communications and four-wire networking technology, tank gauging and leak detection companies can adapt to a number of markets for a variety of sensing needs.

Figure 1: 4-wire Networking can monitor a combination of sensors

This same four-wire technology can be used to monitor combinations of sensors: leak detection, boiler temperature, refrigeration temperatures (c-stores and hypermarkets), in-station diagnostics (ISD), power surges, generator sites and their associated switch points, and more.

The combination of RS-485 and four-wire communications will solve several existing problems in the field of leak detection, as well as create a vehicle to fill new demands as they arise. Problems currently being encountered in the field of tank gauging and leak detection include difficulty adding new equipment to existing gauging and monitoring systems; high installation and maintenance costs; and an inflexibility in meeting changing environmental needs, such as in-station diagnostics and refrigeration equipment monitoring.

Figure 2: 4-wire networking is easy to wire and can readily accept new equipment

Adding flexibility and compatibility

While researching the electrical architecture and intrinsic safety of European markets, OMNTEC found that developing a way to network multiple monitoring points along one cable run would greatly expand the flexibility and adaptability of leak detection systems. Networking technology allows smaller, easier-to-wire consoles to be used. Networking along a common four-wire buss to transport

information to and from the controller also makes it easier to add new technologies or additional accessories to existing systems.

After four-wire networking is in place, a system can accommodate new accessories and additional equipment because it will no longer be required to run entirely new multi-conductor cable runs back to the console for each piece of new equipment (see figure 2). The four-wire system is designed to accept new equipment and accessories, eliminating the need to purchase new consoles or additional systems to meet additional needs.

For example, a site OMNTEC analyzed in Spain had six tanks on site, each requiring probes, interstitial sensors, sump sensors, and dispenser pan sensors. This site required 24 cables or "home runs" running back to the console. By networking the sensors along a common four-wire buss, this same system required only one home-run cable (instead of 18) for sensors and six for the magnetostrictive probes, each of which requires a dedicated cable. Changing to the four-wire buss reduced the number of homeruns from 24 to seven.

Figure 3: Networking your site significantly reduces the amount of cable required

Figure 4: Networking reduces the number of cable runs back to the main console

Conventional wiring for five sensors and two probes.

4-wire networked system wiring for 22 sensors and one probe

Reducing conduit runs, cable runs, and installation time resulted in big savings. Adding additional sensors, relays, or low voltage outputs without adding cable runs and without having to purchase additional consoles can expand this system.

Potential cost savings can be significant. According to Jim Sear, Service Manager, Fenley & Nicol Environmental reported that approximately $1,700.00 could be saved in conduit, miscellaneous fittings and labor. Allen Raymond of the Tyree Organization figured the savings at $2,000.00.

Network compatibility and adaptability

Networking technology allows a single console to be smaller and more accommodating and makes it easier to add new accessories to an existing system. The versatility of RS-485 and four-wire networking makes it possible to accommodate new regulations - such as the monitoring of enhanced vapor recovery, which has been delegated to tank gauging manufacturers - without having to add new equipment. A four-wire networked system being used to monitor fueling can be adapted to monitor refrigeration units at c-stores and hypermarkets via the same four wires (see figure 1).

The success of a networked system depends on having an interface capable of handling multiple "messages" and equipment designed to transmit and receive these "messages." RS-485 standards have been developed to ensure compatibility between sensors utilizing different technology and to

allow for reasonable success in transferring data at specified distances and data rates. The RS-485 interface is a "party-lined" communications system that will support 32 drivers and 32 receivers and provide reliable communications in electronically noisy environments. It is a specialized interface common in the data acquisition world and can be connected in either a two- or four-wire mode with cable length up to 4,000 feet. The four-wire controller acts as a "master," and the sensors as "slaves."

Figures 1 and 2 show how sensors are connected to the controller via the same four wires. Each sensor on the network must accomplish certain tasks. First, it must be capable of detecting communications intended for it. Second, each must be capable of sending communications at appropriate times and ignoring communications intended for other sensors. And third, each sensor must be able to identify its status or alarm condition. To accomplish the first and second tasks, each sensor is built with an internal microprocessor and a universal translator, which send the information to the controller via the four-wire network. The combination of the internal programming and the universal translator allows each sensor to identify itself and its location and communicate with the controller. For the third task, a sensor also needs to be able to identify three key scenarios: normal condition, alarm condition, and fault condition.

Figure 5: Principles of Electro-optic technology

Electro-optic sensors

Electro-optic sensors pass a beam of light through a prism built into the sensor. The prism reflects this beam of light to a receiver, also located on the sensor. When the receiver doesn't see the light beam, it signals the controller that an alarm condition exists. Any other condition will result in a "fault" response. A key advantage of this technology is that a leak can be simulated via a test button on the mail console, which sends a signal to each sensor to turn off its light beam. This will cause the sensor to send an alarm signal to the controller.

With network and four-wire technology being introduced to the petroleum sensing market, this technology will soon be able adapted to other markets using the same four wires, combining a variety of sensing technologies such as refrigeration, boiler temperatures, lighting outputs, in-station diagnostics, security systems, electric motor monitoring, power surges, and generator sites and their associated monitoring points. The list of possibilities is almost limitless when using these combined technologies. It has been the objective of the engineering team at OMNTEC to make four-wire technology the main thoroughfare for the leak-sensing world, thereby helping to answer three key concerns: expandability, flexibility, and reduced costs for both new and existing systems.

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