Benefits of HART Communication-Enabled Gas and Flame Detectors

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Catastrophic results can occur when a fire or a flammable/toxic gas release goes undetected in any petrochemical facility. For early warning and prompt hazard mitigation, flame detectors and gas detectors are essential tools. Clear, usable, diagnostic information from these detection instruments is extremely valuable in ensuring the devices are properly maintained, tested, and poised to protect the people, equipment, and facility in the event of an unexpected release of flammable hydrocarbons.

Figure 1: Approved for use in classified hazardous areas, the model UD10 FlexVu® Universal Display is an intelligent field display transmitter that serves as a permanently-connected HART field communicator to HART capable fire and gas detection instruments. It also provides analog/HART, discrete relay, and RS-485 Modbus outputs.

The method and the means by which a fire or gas detection instrument communicates diagnostic information to appropriate systems and personnel is the topic of this article. In particular, the HART protocol implementation is described.

The open HART protocol improves the flow of diagnostic information from process instruments including optical flame detectors and combustible /toxic gas detectors. A number of manufacturers have recently released detectors with HART protocol including their Device Descriptions (DD) files that are registered at the HART Communication Foundation. This approach ensures that end-users receive smart detectors that are completely interoperable and can be fully integrated with other HART-enabled devices and systems

Advances in Flame and Gas Detection Deliver Useful Information

In the past decade, flame and gas detection has improved due to numerous technological advancements including overall sensitivity, device accuracy and precision, false-alarm rejection, elimination of undisclosed/covert failures, and general reliability.

A number of global approval agencies including Factory Mutual (FM), Canadian Standards Association (CSA), and others have now documented performance criteria for hazard detection system certifications, providing a level of assurance to the end-user that the equipment has been tested and certified by an independent 3rd party.

In addition to these performance advancements, useful diagnostic information is also available to the user from some smart detectors. Information can include detector sensitivity settings, setup/configuration data, calibration logs, event logs, device documentation, and real-time sensor "health" information.

Background of the HART Protocol

The HART protocol is one of the first device-level field communications protocols. The HART acronym stands for "Highway Addressable Remote Transducer." It was originally implemented to provide a means for configuration of, and to obtain diagnostic information from, temperature, pressure, level, and flow transmitters. It is now one of the most commonly requested digital protocol for flame and gas detection devices.

A number of other field digital communications protocols currently exist. Modbus, Foundation Fieldbus, Profibus, and their variants are a few of the most popular.

HART is a vendor-neutral communications protocol. The HART Communication Foundation – a non-profit, independent, neutral entity – promotes and supports the adoption of the protocol across industries.

Safety Signaling on the HART Protocol

HART is a master-slave communication protocol. During normal operation, each slave (field device) communication is initiated by a master communication device. Unlike other master-slave protocols, HART can use two masters: the primary master and the secondary master. The primary master can be a programmable logic controller (PLC), distributed control system (DCS), or a personal computer (PC). A HART terminal or another PC can act as the secondary master. Slave devices include detectors, process transmitters, actuators, and controllers. They respond to HART commands from the primary or secondary master.

A key aspect of HART is that digital signals are transmitted on the same two wires that conduct the analog signal, which is almost always a 4-20 mA current loop signal. This electrical architecture permits easy retrofitting of legacy 4-20 mA sensors with HART-enabled sensors using existing wiring. More importantly, for sensors having a life-safety function, the 4-20 mA current loop provides a safety-approved, highly reliable means of signaling an alarm condition while having the ability to transmit lower priority, non-life-safety diagnostic information.

While HART protocol is not certified for safety signaling, the 4-20 mA current loop which serves as its physical transmission medium is a certified safety signaling medium. This capability provides low-cost and high-performance while enabling the safety function to be executed by the 4-20 mA current loop and the diagnostic function to be executed by HART communications.

Figure 2: The PointWatch Eclipse® infrared gas detector is available with an optional onboard intrinsically-safe and weatherproof HART communication port, enabling safe and easy field connection to the HART handheld field communicator.

Usable Information Rather than Overwhelming Data

User benefits of HART-enabled flame detectors and gas detectors include faster commissioning, improved operation and reliability, and enhanced maintenance efficiency. Typical flame and/or gas detector configuration options accessible via HART communications include:

- Real-time clock setting
- Selection of calibration-gas types
- Zero and Span Gas Calibration
- Optics cleanliness/optical integrity test information
- Loop output test
- Custom descriptor information, such as installed date, by whom, where, and type of gas to be detected

This nonvolatile device-specific information stays with the detector even after powering down and field removal.

HART communication protocol provides a valuable set of diagnostic, analysis, and reporting tools. It also provides better visibility into the detectors that are protecting assets. This enhanced visibility results in increased availability through more cost-effective maintenance and improved flame and gas detection performance. Typical fire/gas detector data-log information includes:

- Alarm history including time/date tag
- Calibration history including time/date tag
- Maximum (hot) and minimum (cold) exposed temperature log info
- Trouble/fault history
- Total hours of operation info

Accessing and Using HART Information

Users are able to access HART information from their fire and gas detectors in a range of locations such as the field, control rooms, motor control centers, and maintenance shops.

In the field, a handheld HART communicator is commonly used to complete routine operations that generally should be performed at the device such as zero/span gas calibration, or analog output loop testing. Diagnostic data often accessed in the field includes device parameters such as optics cleanliness and sensor sensitivity. It should be noted that some detectors include an intrinsically-safe onboard HART communication port, which vastly enhances the ease and safety of connecting a HART handheld communicator to the detector without requiring area de-classification.

Along the same lines, HART-enabled field-mounted display/transmitters have recently become available from some vendors. These instruments provide users with a dedicated digital readout display driven by the HART parameters provided from the connected detector. Benefits include at a glance availability of key safety information such as detected gas level, alarm status, trouble/fault conditions without requiring physical connection of a HART handheld communicator. In addition, these display/transmitters are compatible with range of different types of detectors, providing user benefits including reduced on-hand spares and training requirements since a common display can be used with all detectors.

In control rooms and maintenance shops, users typically communicate with HART flame and gas detectors using a PC-based software program referred to as asset management software. This software is also commonly used to communicate with HART process instruments and control valves for device configuration, calibration, diagnostics, and documentation purposes.

Using asset management software with a compatible host system, a large number of HART flame and gas detectors can be connected to the host I/O system. The asset management software package queries the host to learn HART detector communications layout and connection points. The detectors displayed in the software screens and their relative hierarchies are based on this scanned information. The asset management software package is used to setup or change detector configurations, manage calibration activities, monitor device status, detect alerts, and view historical configurations for the connected detectors.

Information available from safety devices brings opportunities for improvement. But to recognize and make the improvements, the information must be useful and actionable. New detectors with HART improve both the availability and the usability of information. They also enable end-users to improve the performance, protection, and ultimately, the level of safety attained at their facility.