Impact of Fieldbus on mill operations

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The emerging Fieldbus effort is causing a paradigm shift in operations, maintenance, and control philosophy and operation

Traditionally, signals from the field have represented one variable, the process value (PV). The identity of the transmitter, its health, and the possible multiple variables that went into calculating the PV were unknown or assumed to be correct. Bi-directional communication was impossible, until recent developments. Those developments permitted either off-line or limited on-line communication with the transmitter and valve. Most communications were accomplished with a hand-held communicator used by maintenance personnel.

The development and implementation of Fieldbus will cause a significant shift in the operations and maintenance of a mill system. System refers to the entire functional facility, not limited to the process control system. Rapid, reliable bi-directional communications will enable a change in control strategies, maintenance methodology, and reduce costs.

Fieldbus efforts

Initial efforts officially commenced in 1985 with the establishment of the Instrument Society of America (ISA) S-50 committee. S-50 is the group chartered to develop the new standard, much as similar groups developed the 4–20 mA and 3–15 psi standards.

The efforts on Fieldbus have been fraught with speculation, hyperbole, and misinformation. Multiple vendors have developed their own versions of what constitutes a fieldbus. Each has claimed to have *the* fieldbus solution. Meanwhile, the standards process has ground on, slowly but in exceedingly fine detail.

IEC/ISA standard

The standards committee for developing a new, bi-directional field communication was chartered and formed in October 1985. This initially was an ISA effort. Within a year, the International Electrotechnical Commission (IEC) teamed with ISA to make it an international effort. This joint effort is under the auspices of ISA SP-50 and IEC SC65C, WG6.

The main committee is comprised of a balanced membership of vendors, users, and other interested parties. The work, overseen by the main committee, is split into tasks accomplished by subcommittees. These subcommittees draft a working document, which is circulated for comments. The comments are reviewed by the subcommittee and incorporated into the document.

The edited document is released as a Draft Standard for ballot among the committee members. If the ballot fails (not uncommon), the objections are reviewed, incorporated, and the draft document resubmitted for balloting. Once passed, the Draft Standard is released as an International Standard.

Part of the reason for such an extended effort lies in the basic process. The standards process is one of consensus by committee. This is an inherently slow process in itself. There have been significant developments required in technology to accomplish the goals originally determined by the Fieldbus committee. When originally envisioned, existing technology would have required a file cabinet-size PDP-11 computer system perched on top of every field device, with bulky coax strung between devices, to accomplish the task. Now everything is handled in a few Application Specific Integrated Circuits (ASICs), over a single twisted pair.

Compounding the standards and technical problems has been a continuous battle among the vendors. Their efforts were concentrated on developing a standard that favored their solution or devices. They were attempting to use the standard to gain a marketplace advantage. This in-fighting produced a protracted effort.

Fieldbus Foundation

After years of costly, fruitless battles, charges and counter charges, the vendors realized they were not making progress. The theme developed that Fieldbus would be an enabling technology, not a competitive edge. The two largest vendor groups, Interoperable Systems Project Foundation (ISP) and WorldFIP-North America (WFIPNA), initiated negotiations to merge the efforts to develop a common solution, based on the ISA/IEC effort.

WorldFIP, Inc. is comprised of several subcorporations. The main ones are WorldFIP-Europe and WorldFIP-North

America. WFIPNA was composed of North American and Asia-Pacific members. While they subscribed to the intentions of WorldFIP, Inc., they were an independent entity. This permitted WFIPNA to enter into negotiations with ISP concerning the merger.

ISP was moving ahead, based on the Profibus technology for the lower layers and HART's Device Description Language (DDL) on the upper layers. WFIPNA efforts were based on the French Factory Information Protocol (FIP) designs. Neither fully complied with the standards being developed by the ISA/IEC effort. User dissatisfaction was finally being felt by both groups.

After almost a year of negotiations and legal efforts, a merger occurred between WFIPNA and ISP, creating the Fieldbus Foundation (FF). This organization, headquartered in Austin, TX, has a small support staff for administrative purposes. The technical effort is handled by over 50 technical personnel donated by member companies. These technical personnel are many of the same people who serve on the IEC/ISA standards subcommittees. This is how they are able to achieve results in the FF that parallel the standards efforts.

While the effort has been protracted, progress has been made. The Physical Layer standard was released several years ago (S-50.2). The Data Link Layer is a Draft Standard as of this writing, and should be approved shortly. The Application Layer is being rewritten to take advantage of the FF development efforts and the new technology being developed. The User Layer is a Technical Report, which the FF will take under consideration as they develop an implementable solution.

Fieldbus Foundation solution

The FF solution parallels the ISA/IEC effort due to the composition of the subcommittees. It is the stated intent of the foundation that the solution will reflect, at the minimum, a subset of the standard. Where possible (physical layer, data link layer), the solution will be fully compliant to the standard.

The physical device is a group of ASICs, customized for Fieldbus, while optimized for minimum power consumption. The intent of most vendors is the card(s) containing the ASICs will mount inside a standard transmitter body and operate off of the same amount of power currently available to field devices. The cost for Fieldbus units will not be significantly more than it is for the current models of smart transmitters.

The software is optimized to be concise, and then complied into a machine language. This reduces the memory requirements for field devices. The software will include the ability to query the device for TAG, PV, ancillary values, serial number, current operational status, last maintenance, materials of construction, etc. Many devices may also be capable of performing control (PID and logic). They would contain information on the control configuration and logical links to other devices.

Impact on Greenfield mills

New facilities will be able to design employing the advantages of Fieldbus. With the multi-device on a single wire capability, implementation strategies can take advantage of clustering measurement and control equipment into logical bus topologies. Savings can be realized in reduced wiring costs, reduced check out during startup time, reduced costs to develop "as-built" documentation, and reduced costs for antacids.

Multidrop devices reduce wiring costs and lower the number of I/O devices required to access information. This results in a lower capital cost for the installation. These are hard dollar savings, easy to justify. Addition of devices in the future is simpler when expansion and/or increased need of measurement and control occurs.

Control in the field will yield single loop integrity. In essence, this returns to the days when there was dedicated local control, not dependent on some master system to continue functioning. This dedicated control can continue functioning, even if the control room ceases to communicate with the field.

Field control will lower installation costs by reducing the space necessary in a control room and the size of the computer system. Fieldbus will provide a path for easier integration into DCS and higher level systems. This could be the new small system of the future.

Device information could be integrated into the supervisory system as current information, not historical data. Fieldbus will integrate the full instrument database for functions such as auxiliary I/O, calibration and maintenance, service specifications, historical information, and process self diagnostics.

The transition by technical personnel from screwdriver to bus analyzer required of a sophisticated communications system will be a cost associated with Fieldbus implementation. While the intent is to offer a system relatively transparent to the user, additional training will still be required for engineering and maintenance personnel. New staging and checkout procedures must be developed to confirm the design and implementation of the technology.

Discussions with many vendors indicate that packages will be available for assisting with loop documentation. Several appear intent on linking this capability with a CAD package, such as AutoCAD®. This will require additional training for design and document personnel. Training of maintenance personnel will be required so that this information is readily available to them, as required by law.

Issues of interfacing with safety systems and other control/information systems must be resolved. The probability of an integrated plug and play package capable of addressing all requirements is low. It will be incumbent on mill engineering to ensure integration of all the elements.

When utilizing multiple devices on a single bus, issues involving redundancy of buses for security must be considered. Intrinsic safety constraints will limit bus topologies. When employing field control, long distances between devices could affect control bus topology considerations. Care must be taken

when developing control strategies and implementations concerning interlocking and cross-coupling. Consideration should be given for maintenance personnel capabilities when implementing complex strategies in the field.

With the plethora of information available, consideration should be given to bus speed requirements. Information access will be a lower priority than control data. The requirements for this information must be such that it fits the lower priority scheme.

Impact on existing mills

The normal reaction is "I have all my wiring in place; what will I save?" The most significant saving from Fieldbus implementation, as confirmed during trials, has been in the maintenance area.

OSHA 29CFR1910.119 contains a documentation requirement. As of May 1995, 50% of the mill must be accurately documented. This is increased each year until 100% compliance is achieved in 1997. Accurate documentation in a facility is a costly, time consuming, personnel-intensive process. The information contained in the devices and available over Fieldbus will make it possible to automate much of this process.

With the heavy emphasis on safety, minimizing contact with the process is important. Reduced manning at the mills requires greater efficiency in maintenance operations and increases the risk for accidents. Fieldbus enables remote (by a control or maintenance system) diagnosis and predictive maintenance capabilities. Personnel are not required to enter the frequently hostile mill environment to determine the source of potential problems. When they do, they understand what is wrong and can be prepared to affect the necessary maintenance procedures without multiple trips, as is the current practice.

Existing installations can enjoy many of the same benefits of greenfield mills. Maintenance, documentation, and improvements in process control are possible.

Existing installations have a set of problems unique to each installation. Prior installation practices may prohibit or limit the implementation of Fieldbus. Maintenance personnel must be trained in the complexities of a system with control in the field. Existing processes, while functioning, may not be understood sufficiently by mill personnel for effective field control implementation.

Paradigm shift

For years, the movement has been towards larger, more centralized control. Diagnosis and troubleshooting have been a labor intensive affair. Predictive maintenance for instrumentation and controls has been based on trending of indirect measurements, inferring the life expectancy from those results. Implementation of Fieldbus will cause a paradigm shift.

Predictive maintenance will be based on direct measurement and information obtained from the device. Automated (intelligent) systems will assist in diagnosis and troubleshooting, reducing labor content of the effort. Basic control will migrate to the field, with areas capable of self sufficient control and minimum supervisory input. High level control will take the form of quality and cost controls.

Conclusion

Fieldbus is an emerging technology. Field trials have proven the technology and begun to demonstrate the cost effectiveness of implementing it. Given the current aggressive schedule by Fieldbus Foundation, products should appear on the market in early to mid-1996. Implementing Fieldbus in an existing mill will provide reduction in operating costs as well as improvement of the operation. Planning should begin now to utilize Fieldbus products and technology effectively. TJ

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