Integrating Fuel Systems into Building Networks

Integrating fuel systems into modern building management systems has never been more important as the critical power needs of buildings become greater and more complex. While most standard fuel equipment is not designed for integration, Earthsafe has developed its control systems and third party integration kits to conform to all of the leading open standards for building integration: **BACnet, Modbus, Metasys N2, and LON**.

Open standards for building controls is the prevailing practice, however most building systems still have some legacy of their proprietary standards. So the ability to integrate fuel systems takes some working knowledge of the leading provides of building management systems. These leading systems would be: Siemens, Johnson Controls, Honeywell, TAC (Andover), Alerton, Automated Logic.

BMS Integration Methods

The methods of integration in buildings can seem highly varied and complex. Here is an attempt to classify these methods simply. A detailed description of each is included in the attached glossary. Any and all of these standards are currently used in integrating critical building systems.

What language is being spoken **Communication Protocols**	How is the message transmitted **Communication Standards**
Modbus BACnet Metasys N2 (Johnson Controls) LonWorks (Echelon) ASCII (Veeder Root)	RS-232 Serial RS-485 Serial Ethernet

Fuel systems for critical facilities will typically consist of 3-30 equipment pieces that are internally controlled with safety interlocks, and which are integrated for monitoring into the larger building management systems. For safety and reliability reasons the interconnection of the fuel system elements is typically hard-wired using digital (on-off) and analog (4-20 mA or 0-10 VDC) signals. Similarly control links to generators and switchgear are typically hard-wired signals from output relays.

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Summary of Fuel Equipment Connectivity Capabilities

Common day tanks and pump sets for emergency generators developed as simple stand alone equipment. This was sufficient when generator systems consisted primarily of single generators with nearby fuel storage. Tank gauging / leak detection equipment had more advanced communications because they were often remotely monitored, however these are typically based only on ASCII. Here is a summary of the current state of equipment connectivity capabilities:

Fuel System Elements	**Brand Names**	**Control Basis**	**Communication Capability**
Day Tanks	Earthsafe	PLC	RS232/495 or Ethernet BACnet, Modbus, Metasys N2, Lon
	Simplex	PPCB	Output Relay
	Tramont	PPCB	Output Relay
	Pryco	Relay	Output Relay
	EC&A	Relay	Output Relay
Duplex Pump Controls	Earthsafe	PLC	RS232/495 or Ethernet BACnet, Modbus, Metasys N2, Lon
	Simplex	PPCB	Output Relay
	Red Jacket	PPCB	Output Relay
	FE Petro	PPCB	Output Relay
Tank Gauging / Leak Detection	Veeder Root	PPCB	RS232/485 or Ethernet ASCII
	Omntec	PPCB	RS232/485 ASCII
	Pneumercator	PPCB	RS232/485 ASCII Analog 4-20 mA
Tank Fill Stations	Earthsafe		RS232/495 or Ethernet BACnet, Modbus, Metasys N2, Lon
	Simplex	PPCB	Output Relay
	Pryco	PPCB	Output Relay
Multi-Tank Selection	Earthsafe		RS232/495 or Ethernet BACnet, Modbus, Metasys N2, Lon
Filtration / Polishing	Earthsafe / Racor		RS232/495 or Ethernet BACnet, Modbus, Metasys N2, Lon
	Other Typically		Modbus

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Flexible Methods of Integration via Earthsafe

Operating buildings with greater reliability and lower costs requires the monitoring of these systems to be fully integrated into the building management system. On larger fuel systems there may be a single point of integration for all fuel system equipment, while on smaller systems each piece of equipment may be directly connected to the BMS.

Fuel systems are sometimes a diverse collection of equipment supplied by various parties. In the best scenario for integration, all of the fuel system equipment is specified to be of a common manufacturer with uniform connectivity capabilities. However, the reality of complex building construction is that the scope of work is divided in different ways. The day tanks may be supplied by the generator supplier, the pumps may be from the mechanical contractor, and the tank gauge from a petroleum contractor.

Earthsafe Control Systems can be configured to a variety of circumstances to provide a fully integrated fuel system:

(a) **Complex / Uniform System**: All fuel equipment components are by Earthsafe and a single point of connection to the BMS is provided. The fuel system components are all connected via signal wires for control and Ethernet for status monitoring. At the CentraPlex or IntraPlex panel, the BMS connection is provided as BACnet, Modbus, Metasys N2, or LON.

(b) **Complex / Diverse System**: Fuel components are by a variety of manufacturers. Earthsafe adapters are provided for the equipment where needed. The fuel system components are all connected via signal wires for control and monitoring. Earthsafe adapters are provided for the equipment where needed. At the IntraPlex panel, the BMS connection is provided as BACnet, Modbus, Metasys N2, or LON.

(c) **Simple System**: The individual Earthsafe OmniPlex controller (for day tank, pump set, filtration, of tank fill) is connected to the BMS as BACnet, Modbus, Metasys N2, or LON.

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Glossary of Terms for Building Integration

ASCII: American Standard Code for Information Interchange (ASCII), is a character encoding based on the English alphabet. ASCII codes represent text in computers, communications equipment, and other devices that work with text, particularly printers. Work on ASCII began in 1960, and the most recent update in 1986.

BACnet: BACnet, the ASHRAE building automation and control networking protocol, has been designed specifically to meet the communication needs of building automation and control systems for applications such as heating, ventilating, and air-conditioning control, lighting control, access control, and fire detection systems and their associated equipment. The BACnet protocol provides mechanisms by which computerized equipment of arbitrary function may exchange information, regardless of the particular building service it performs. The development of the BACnet protocol began in June, 1987. BACnet became an ASHRAE/ANSI standard in 1995, and an ISO standard in 2003.

LonWorks: LonWorks is a networking platform built on a low-bandwidth protocol created by Echelon Corporation for networking devices over media such as twisted pair, powerlines, fiber optics, and RF. It is popular for the automation of various functions within buildings such as lighting and HVAC. The platform has its origins with chip designs, power line and twisted pair signaling technology, routers, network management software, and other products from Echelon Corporation. In 1999 the communications protocol was submitted to ANSI and accepted as a standard for control networking.

Metasys N2: Metasys is a widely adopted communication protocol developed by Johnson Controls

Modbus: Modbus is a serial communication protocol published by Modicon in 1979 for use with its programmable logic controllers (PLCs). It is a standard communications protocol in industrial applications, and in buildings is common for power equipment. Modbus allows for communication between many devices connected to the same network, for example a system that measures temperature and humidity and communicates the results to a computer. Versions of the Modbus protocol exist for serial port (RS-232 / 485) and Ethernet.

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Ethernet TCP/IP: Ethernet is a computer networking technology that operates local area networks (LANs). It defines wiring and signaling standards.

> **TCP/IP:** TCP/IP is the set of communications protocols on which the Internet and most commercial networks run. It can be viewed as a set of layers. Transmission Control Protocol (TCP) is the intermediate, or transport, layer between the Internet Protocol (IP) below it, and an application above it. Using TCP, applications on networked hosts can create connections to one another, over which they can exchange streams of data. The IP standard uses IP addresses that certain electronic devices use in order to identify and communicate with each other on a computer network.

RS-232: RS-232 is a serial connection specification for electronic equipment. The standard only specifies electrical characteristics of the driver and the receiver, and does not specify or recommend any data protocol. See the information at “Serial Port”

RS-485: RS-485 is a multipoint serial connection specification. RS-485 enables the configuration of inexpensive local networks and multidrop communications links. It offers high data transmission speeds and can span relatively large distances. The standard only specifies electrical characteristics of the driver and the receiver, and does not specify or recommend any data protocol. See the information at “Serial Port”

Serial Port (RS-232 / 485) : A serial port is a serial communication physical interface through which information transfers in or out one bit at a time. The characteristics of the data transfer are defined by the following parameters:

> Baud Rate - Speed: Common bit rates are 300, 1200, 2400, 9600, 19200, and 38400 baud. The port speed and device speed must match, though some devices may automatically detect the speed of the serial port
>
> Data Bits**:** The number of data bits in each character are commonly 7 (for true ASCII) or 8 (for any kind of data, as this matches the size of a byte).
>
> Parity: Parity is a method of detecting some errors in transmission. The parity bit in each character can be set to none (N), odd (O), or even (E). The most common parity setting, however, is "none", with error detection handled by a communication protocol
>
> Stop bits: Stop bits sent at the end of every character allow the receiving signal hardware detect the end of a character and to resynchronize with the character stream. Electronic devices usually use one stop bit.
>
> Conventional notation: The D/P/S conventional notation specifies the framing of a serial connection. The most common usage on microcomputers is 8/N/1 (8N1). This specifies 8 data bits, no parity, 1 stop bit.