CHAPTER 4

FIELD EQUIPMENT PANEL HARDWARE

1. HARDWARE CONFIGURATION. The field hardware consists of smart field panels, remote terminal units, universal programmable controllers, and unitary controllers, referred to collectively as field equipment panels. These panels are located in the vicinity of the utility systems monitored and controlled by the UMCS, and communicate with the central station or island station.

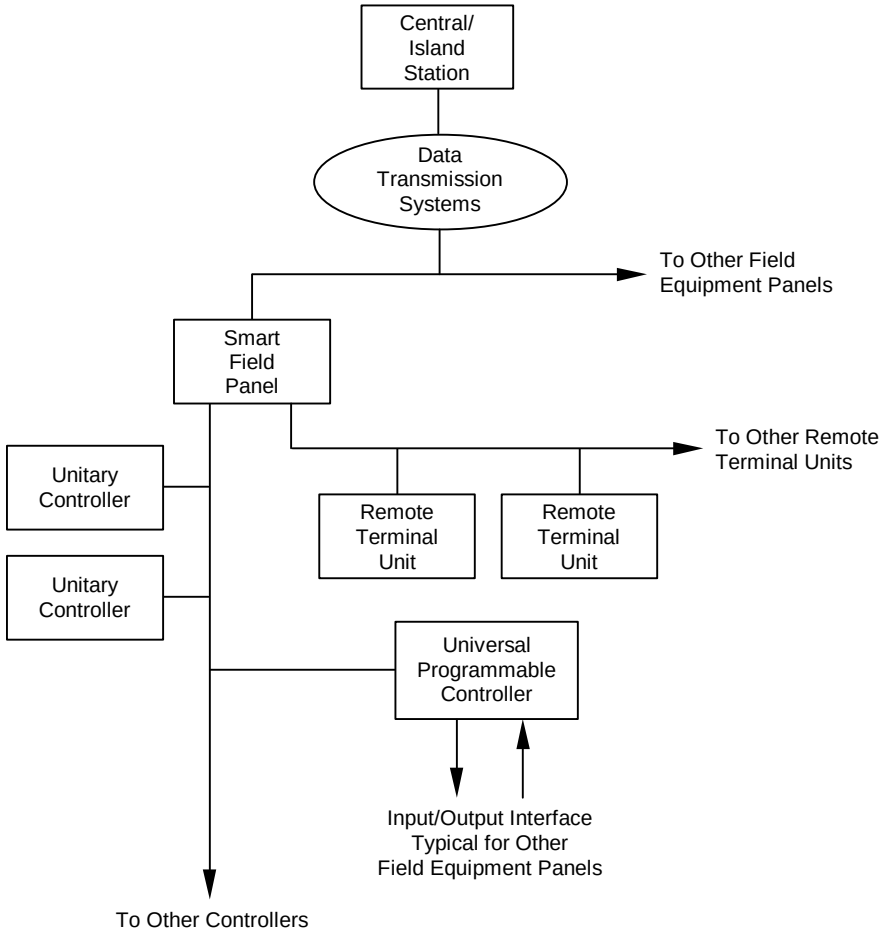

Figure 4-1. Field Hardware.

2. SMART FIELD PANEL.

a. A smart field panel contains a microprocessor, memory, real time clock, communication interface, digital and analog I/O, controls, indicators, and power supply. The smart field panel communicates with the central/island station, where the central/island station provides for operator interaction, global parameter updates, and information requests and accepts information for alarm reporting, logging of events, generation of reports, and display. The smart field panel must function in an

independent (stand-alone) mode performing the monitoring and control routines using applications software programs and operating parameters stored in the smart field panel's memory.

b. The smart field panel collects data from instruments interfaced to the utility systems and generates commands to control operating devices such as valves, dampers, motors, and relays. The smart field panel's capabilities include control of all physical parameters such as space temperature, space humidity, and supply water temperature without requiring data or operating parameters from the central/island station. The smart field panel also responds to central/island station requests for equipment operating data and status. The smart field panel transmits alarms to the central/island station for conditions such as high and low temperatures, pressures, flows, unauthorized equipment operation, and field hardware malfunction. Commands from the operator's workstation can result in the downloading of new or revised parameters to adjust setpoints or change operating parameters of equipment.

c. The smart field panel must include sufficient memory to contain the operating system, applications software, database and control sequences for all required operation. Volatile memory is required to be backed up in event of power loss. Software stored in non-volatile memory does not have to be downloaded from the central/island station after an interruption of power occurs.

d. The smart field panel must be equipped with a battery backed internal real time clock function to provide a time base for implementing time dependent programs. The smart field panel's real time clock must be updated by the central/island station at least once a day and upon resumption of communications with the central/island station after any data transmission system interruption.

e. A communication interface in the smart field panel converts the data output of the smart field panel to a signal compatible with the site specific data transmission system for communications with the central/island station. The communication interface must transmit and receive data at rates sufficient to support system response requirements.

f. Resumption of power after an outage will cause the smart field panel to automatically restart and establish communications with the central/island station. If the smart field panel is unable to establish communications, it must still perform all required functions while saving certain data for later uplink to the central/island station. Smart field panel shutdown based on a self-diagnosed failure in the power supply, hardware, or software must set each piece of controlled equipment to a predetermined failure mode.

g. In the situation where the smart field panel will be required to continuously collect data to be transmitted to the central/island station, it will be necessary to provide an uninterruptible power system (in lieu of the power line conditioner) for the entire smart field panel as well as any sensor and controller power required.

h. The smart field panel functionally includes the remote terminal units associated with it whether in the same enclosure or remotely located. The relationship between the central/island station, smart field panels and remote terminal units is shown in Figures 4-2 and 4-3.

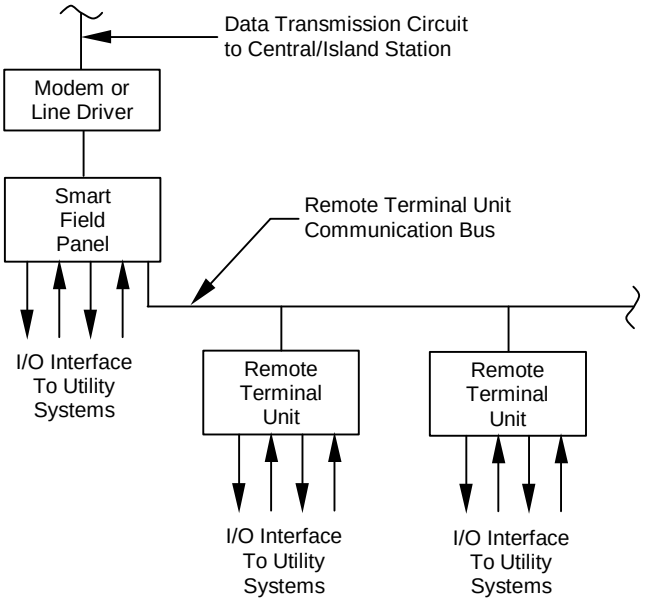

Figure 4-2. Smart Field Panel and Remote Terminal Units (System with Multiple Data Transmission Channels).

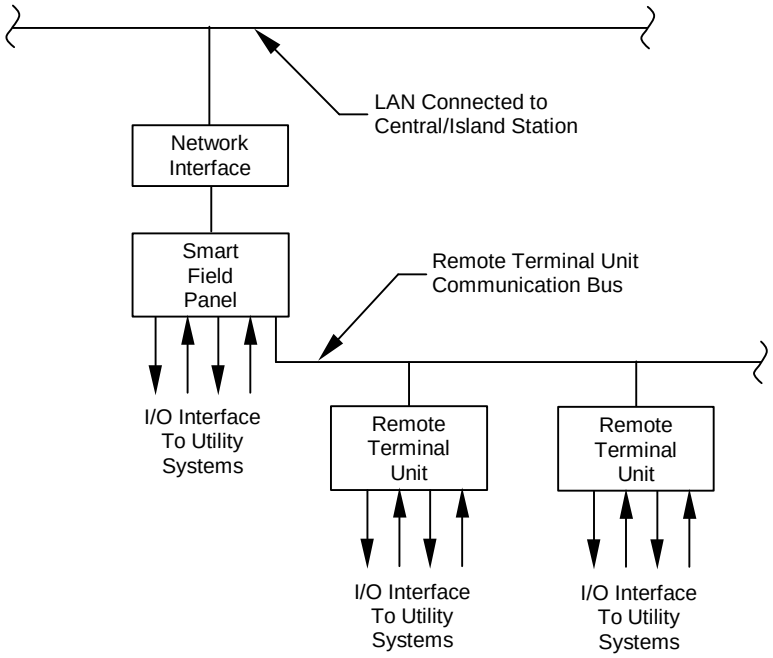

Figure 4-3. Smart Field Panel and Remote Terminal Units (System with LAN-based Smart Field Panel).

3. REMOTE TERMINAL UNIT. Remote terminal units serve as I/O devices for smart field panels and functionally are an extension of the smart field panel. The number of remote terminal units connected to a single smart field panel is limited only by the maximum number of points addressable by a smart field panel, the number of points allowed on a single communication circuit, or by alarm response time. Remote terminal units transmit their data to the smart field panel over a data transmission circuit via

modems, line drivers or LAN. The remote terminal unit contains I/O functions to handle digital and analog data, digital data error detection, and message transmission. Failure of a remote terminal unit must set each piece of controlled equipment to a predetermined failure mode. Remote terminal units will have an uninterruptible power system to sustain operation during a power failure in those situations where their associated smart field panels also require an uninterruptible power system.

4. UNIVERSAL PROGRAMMABLE CONTROLLER. Universal programmable controllers are field programmable stand-alone controllers which are used to control HVAC systems, central plant equipment, or entire small buildings. The universal programmable controller contains a seven-day calendar and a real-time clock so that building, equipment, and system operations are maintained independent of communication with the smart field panel and island or central station. Universal programmable controllers are less costly than smart field panels, but have limited I/O point capacities. Because of the potential cost benefits of universal programmable controllers, the designer will consider their use in stand-alone buildings requiring only a few points. The relationships between smart field panels and universal programmable controllers are shown in Figures 4-4 and 4-5.

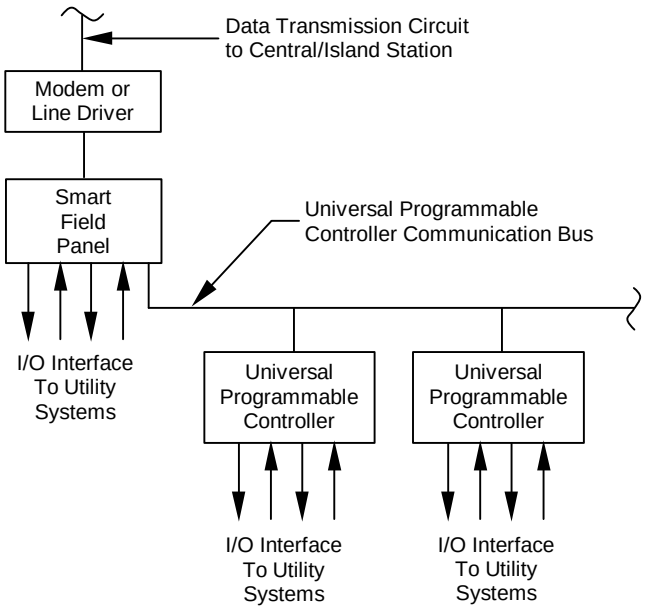

Figure 4-4. Smart Field Panel and Universal Programmable Controllers (System with Multiple Data Transmission Channels)

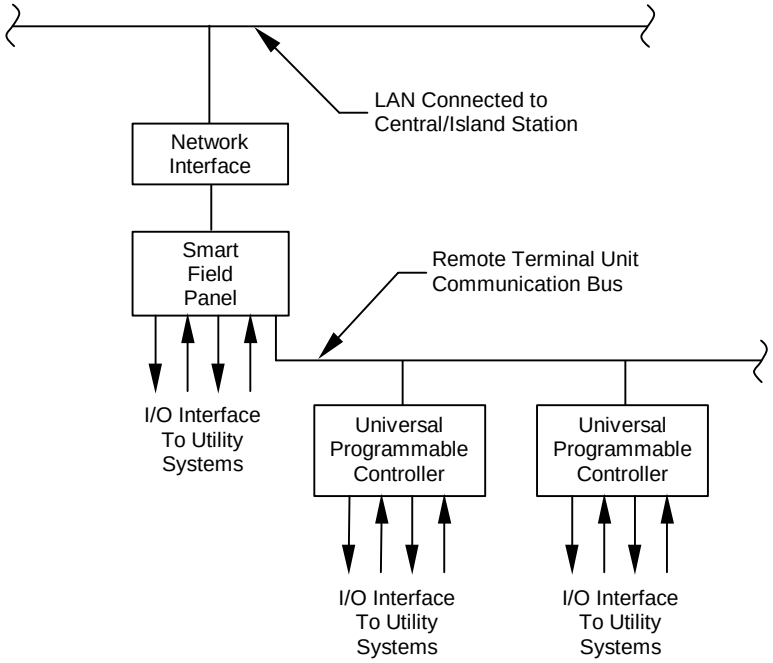

Figure 4-5. Smart Field Panel and Universal Programmable Controllers (System with LAN-based Smart Field Panels)

5. UNITARY CONTROLLERS. Unitary controllers serve as I/O devices and special purpose controllers. Unitary controllers contain application software for the control of individual utility system equipment, such as fan coil units, variable air volume terminal boxes and dual duct mixing boxes. Unlike smart field panels, which are field programmable, unitary controllers have a fixed complement of I/O functions and fixed (or minimally configurable) applications programs. Their program accommodates specific operating requirements of utility system equipment by the selection of a small number of setpoints and operating parameters. In addition, the unitary controller does not maintain a seven-day calendar to accommodate varying daily schedules without communicating with the smart field panel. Some UMCS manufacturers allow the unitary controllers to share a common communication circuit with remote terminal units while others provide a separate communication circuit. Some manufacturers of UMCS using LAN-based field equipment allow the unitary controllers to interface directly to the LAN which connects smart field panels to the central/island station. Unitary controllers will be required to communicate with smart field panels, and a separate data transmission circuit will be shown between the smart field panel and connected unitary controllers. The relationships between smart field panels and unitary controllers are shown in Figures 4-6 and 4-7.

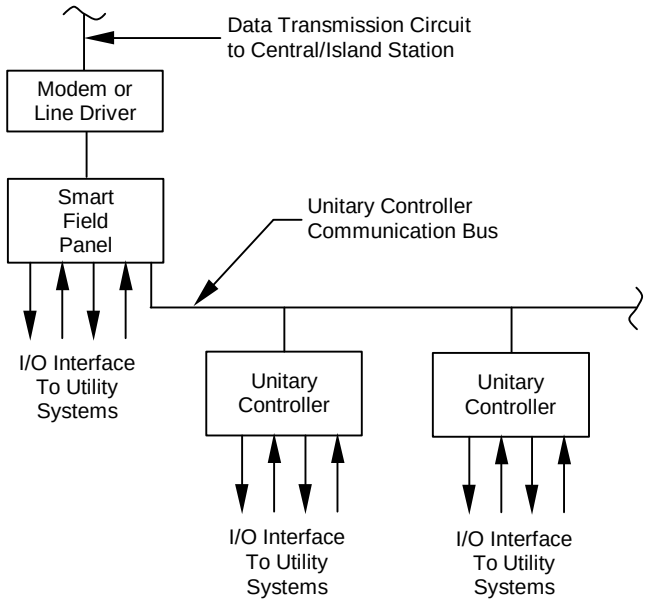

Figure 4-6. Smart Field Panel and Unitary Controllers (System with Multiple Data Transmission Channels).

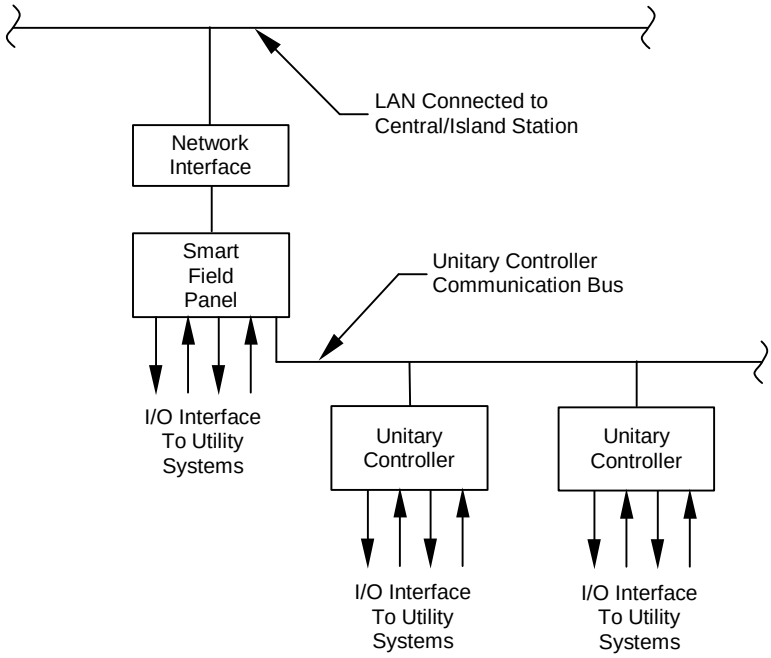

Figure 4-7. Smart Field Panel and Unitary Controllers (System with LAN-based Smart Field Panels).

6. I/O FUNCTIONS. Electronic circuits enable the UMCS to interface with the utility system instrumentation and controls. Instrumentation signals from utility systems to field equipment panels are either digital or analog signals. Control signals to the utility systems from the field equipment panels are converted into digital or analog commands. Analog data to and from utility systems must be conditioned to ensure signal level and type compatibility between the I/O functions and utility systems instrumentation

and controls. Digital inputs include contact closures of limit switches, flow switches, temperature switches, and pressure switches. Digital outputs include on/off commands to relays, motor starters, or solenoid valves. Analog outputs include commands such as valve or damper positioning or remote reset of analog controllers. Analog inputs include measurements from temperature, humidity, pressure, flow and other specialized sensors.

a. Analog input (AI) functions. The AI function is the interface between analog (continuously variable) field measurements and the field equipment panel. Instruments monitoring physical properties such as temperature, flow, and pressure, require circuitry to convert the analog measurement to digital data. The AI function is designed to accept analog signals when measuring parameters such as temperature, flow, and pressure, and to convert each to a digital quantity usable by the system.

b. Analog output (AO) functions. The AO function is the interface between commands generated by the field equipment panel and controlled equipment. The field equipment panel commands are converted to an analog value which is compatible with individual controllers or local loop controls.

c. Digital input (DI) functions. The DI function provides interfacing between field equipment on/off or two-state indicators and the field equipment panel. DIs monitor both momentary and maintained contacts and serial digital pulses from electrical power meters, gas flow meters, water meters and other utility meters.

d. Digital output (DO) functions. The DO function interfaces output signals between the field equipment panel and field controls that require digital commands. DOs are capable of performing momentary or maintained switching. This allows incremental control of setpoints, and momentary contact closures for devices such as motor starters, or maintained contact closures for devices such as electric heaters, solenoid valves , and lighting.

e. Pulse accumulator functions. The pulse accumulator (PA) function interfaces pulse initiator signals from electric or natural gas meters to the field equipment panel. The PA function is provided through Dis with buffer memory to totalize pulses. The field equipment panel microprocessor periodically interrogates the buffer and resets the pulse count.

f. Binary coded decimal function. The binary corded decimal (BCD) function interfaces specialized instruments, utilizing BCD format singals, to the field equipment panel. The BCD format utilizes four-bit groups to represent the units, tens, hundreds and higher decimal positions of an analog value (for example, the analog value 6,144 is represented in BCD format as 0110 0001 0100 0100). The binary signals representing individual bits are interfaced to the field equipment panel as DIs.

7. CHILLER CONTROL PANEL. Existing electronic, pneumatic, or relay logic chiller control panels may be replaced with microprocessor chiller control panels providing the same safety and operating fnctions as the original panels. These chiller control panels have communication ports which allows them to be interfaced to a smart field panel, similar to the way a unitary controller is interfaced. This communiation interface provides two-way data transfer, allowing the UMCS to access real-time chiller status and operational data and to command the operation of the chiller. Chiller control panels will be considered in UMCS design when existing chiller controls are in poor condition or replacement is economically feasible. Chiller control panels will also be considered when the specific installation requires many UMCS input/output interfaces with the chiller. In this situation, the use of a chiller control pnael may be more cost-effective than installing the required chiller instrumentation of interface to the UMCS.

8. BOILER CONTROL PANEL. Existing electronic, pneumatic, or relay logic boiler control panels may be replaced with microprocessor boiler control panels providing the same safety and operatingfunctions as the original panels. These boiler control panels have communication ports which allows them to be interfaced to a smart field panel, similar to the way a unitary controller is interfaced. This communication interface provides two-way data transfer, allowing the UMCS to access real-time boiler status and

operational data and to command the operation to the boiler. Boiler control panels will be considered in UMCS design when existing boiler controls are in poor condition or replacement is economically feasible. Boiler control panels will also be considered when the specific installation requires many UMCS input/output interfaces with the boiler. In this situation, the use of a boiler control panel may be more cost-effective than installing the required boiler instrumentation to interface to the UMCS.