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1.0 SCOPE

This section covers standards for communications and are applicable to all design, construction and installation of communications systems for the City of Portland (COP), Bureau of Environmental Services (BES), Wastewater Group (WG), including the Columbia Blvd. Wastewater Treatment Plant, Tryon Creek Wastewater Treatment Plant and the Wastewater Pump Stations.

The requirements put forth in the sections listed below shall be considered part of the requirements of this section. If contradictions occur between this section and those listed below, the requirements of this section shall have precedence when performing work on materials and equipment covered by this section.

All Data communication design and installations shall conform to:

- TIA/EIA-568A - Commercial Building Telecommunications Standard
- TIA/EIA-569 - Commercial Building Standard for Telecommunications
- TIA/EIA-570 - Residential and Light Commercial Telecommunications
- TIA/EIA-606 - Administration Standard for the Telecommunications
- TIA/EIA-607 - Commercial Building Grounding/Bonding Requirements
- IEE 802.3 - 1990 Ethernet Standards

2.0 EQUIPMENT AND INSTALLATION

2.1 TELECOMMUNICATIONS PATHWAYS AND SPACES

2.1.1 BUILDING ENTRANCE STRUCTURE

The Entrance Facilities will include pathways for outside carriers, interbuilding backbone connections, interbuilding circuit connections and other service pathways. In some instances the entrance facility may be located in or be included as part of the Telecommunications Equipment Room.

2.1.2 TELECOMMUNICATIONS CLOSET

The telecommunications closet will serve as a junction between backbone and horizontal pathways. The closet will contain voice, data and video equipment. It will also contain termination points, cross connects and patch panels.

The telecommunications closet shall be a locked, dedicated Room. The closet shall be dedicated to telecommunications and related activities. No other electrical installations shall occupy the telecommunications closet. A minimum of two walls should be covered with 3/4" AC fireproof plywood. The minimum door size shall be 36in. wide x 80in. high (36"W x 80"H). The door shall open **out** away from the room. The floors, walls and ceilings shall be sealed to eliminate dust. All painted wall and ceiling surfaces shall be painted a light color to enhance room lighting. Lighting shall be a minimum of 540 lux measured at 3 feet above the floor.

The size of the telecommunications closet will vary with facility needs. The minimum acceptable size shall be 10 feet x 11 feet (10' x 11'). See the table in section 2.5.1 for guidelines. The room should be located at the center of the area served. Typically, there should be one telecommunications room per floor. All telecommunications closets located on separate floors shall align vertically. Each closet shall be provided with a minimum of four, 4-inch (4") sleeves or conduits to provide communication pathways. The sleeves shall be located adjacent to the entrance. Fire stopping is required on all sleeves.

All Data and video signals running from work areas via a horizontal pathway shall be terminated at a 19-inch (19") rack or approved junction panels mounted on plywood. Voice running to dedicated desks or cubes will also terminate at the same 19-inch (19") racks.

Telephones not dedicated to a desk will terminate on a 110 block, which will be wired to a PBX connection. The Entrance Protection Box will be mounted on 3/4" fireproof plywood. The plywood can either be mounted on an agreed wall location or be located in a 23-inch (23") rack. All wiring and components shall meet the standards listed under Horizontal Cabling and Work Area Sections.

2.1.3 EQUIPMENT ROOM

The Equipment Room is the major Telecommunications closet, housing the main distribution frames, PBXs, and other data equipment. It may also contain LAN equipment and may provide Entrance Facility termination points. No piping, ductwork, mechanical equipment or power cabling shall be allowed to pass through the Equipment Room. No unrelated equipment storage shall be allowed. The Equipment Room shall have single or double 36”x 80” lockable doors. Access should be kept to a minimum.

The Equipment Room shall be a locked dedicated Room. The room shall be dedicated to telecommunications and related activities. No other electrical installations shall occupy the equipment room. The minimum door size shall be 36in. Wide x 80in. High (36”W x 80”H). The door shall open out away from the room. The floors, walls and ceilings shall be sealed to eliminate dust. All painted wall and ceiling surfaces shall be painted a light color to enhance room lighting. Lighting shall be a minimum of 540 lux measured at 3 feet above the floor.

The size of the Equipment Room will vary greatly with facility and equipment needs. See the tables in sections 2.5.1 and 2.5.2 for a guideline for room and wall space design.

The HVAC shall be capable of providing a temperature range of 64 degrees F to 74 degrees F and 30%-55% humidity. The room shall be maintained at a positive pressure to limit accumulation of dust and dirt. The HVAC shall be capable of maintaining the temperature and humidity ratings for 24 hours a day / 365 days of the year.

The Equipment should be located away from areas of high EMF and areas of flooding.

All Data equipment and Telecommunications equipment shall be located in 19” racks. All PBX switching equipment shall also be mounted in 19” racks. PBX termination panels and interconnect blocks should be located on plywood panels attached to the wall or in a 23” rack. The plywood shall be minimum of 3/4” and be rated as fire proof. When the equipment room serves as an entrance facility, the point of presence termination box shall be wall mounted on 3/4” plywood.

All Data and voice communications running from dedicated workstations, along a horizontal pathway, shall terminate at an approved patch panel in a 19” rack. All PBX connections shall be wired to a 110 intermediate block before being patched over to a 19” rack.

All related equipment shall occupy the same rack or same grouping of racks. When fiber terminations are necessary, they shall occur in an **approved** enclosure mounted in a separate 19” rack.

All wiring running in the equipment room shall conform to the standards listed in the backbone and horizontal wiring sections. Adequate cable management shall be provided for all 19" and 23" racks and wall mounted terminations. The Design Engineer shall approve all cable trays. Communications cable **shall not** occupy the same raceway as AC power unless adequate separation is provided (per NEC requirements). Typically, channel tray or ladder tray is the preferred method. Where fiber cable or fiber jumper cable is used, they will run in a separate dedicated raceway. The raceway will be identified with orange markings or painted orange. See the table in section 2.4.5 for a list of recommended equipment.

The Equipment Room shall be supplied with a source of emergency power. This Room will also have a dedicated lighting panel supplied from a UPS. Each Rack, which contains Telecommunication or Data equipment, shall be supplied from a separate breaker which will serve an AC outlet strip at each rack. Racks containing only termination blocks are not considered**.** X systems or other telecommunications systems shall be powered as needed.

2.1.3 WORK AREA

The Work Area will include telecommunications outlets, computer terminals, personal computers, computer workstations, patch cables, adapters and other equipment connecting to the telecommunications closet or equipment room.

All telecommunications outlets supporting 100-ohm UTP cable will be comprised of an outlet plate with four information outlet ports. Typically one port will be used for voice communications, the remaining ports for various forms of data communications. See Figure 1 as an example of this configuration. This is the minimum acceptable standard used. Other types of outlets currently used at this facility will be upgraded to this standard in the future. All telecommunications jacks used as outlet ports will conform to the standards and pin configurations of a standard T568A, 8-position modular jack.

Patch cords used to convey data from the telecommunications jack to equipment shall be 4 pair, Category 5A and a maximum of 10 meters in length. Patch cords used for voice communications will be a 2 pair, Category 3 and a maximum length of 10 meters. While this is a minimum standard for voice patch cords, category 5, 4-pair patch cords are also acceptable. See the table in section 2.4.4 for patch cord color identification.

2.2 TELECOMMUNICATIONS STRUCTURED CABLING

2.2.1 BACKBONE CABLING

The function of the backbone cabling is to provide interconnections between Equipment Rooms, Telecommunications Closet and Entrance structures. The backbone will also link other buildings and structures. The backbone consists of backbone cabling, intermediate cross connects and termination's, and jumpers used to make a backbone to backbone interconnection. Typically the backbone will be run as a Star Topology.

All backbone cabling providing Ethernet communications shall fall into one of the following categories:

1) Ethernet Thinwire - This shall be a 50 ohm coaxial cable comprising the following specifications - comscope #3104.
2) Fiber carrier - Multimode 62.5 / 125 micrometer optical fiber. The maximum distance for this carrier is usually 2,000 meters. Typically fiber cable used from building to building shall be stranded loose tube. Other local fiber shall be tight buffered. The fiber shall be Multimode in design, graded index with nominal 62.5 / 125 micrometers core/cladding diameter. It shall have a maximum attenuation of 3.5/1.0 db/km at 850 / 1300 nanometers and a minimum bandwidth of 160 / 500 MHZ/km at 850 / 1000 Nanometers. See the Section 2.3 on TESTING STANDARDS for performance parameters.

SC Connectors (568SC) will be used as a standard. All fiber-interconnecting panels will also use SC simplex or duplex couplers. Where the final equipment connection requires a ST connector, an SC to ST jumper must be provided. The testing and performance of this cable shall be covered in the section on cable testing (Section 2.3). A compact form Fiber connector has not been adopted. We typically use MT-RJ, LC etc.

All cabling installed should be rated to operate reliably at 100 mhz or better.

Backbone cabling providing PLC communications may fall into the following categories:

- MODBUS TCP ETHERNET-Modbus TCP over Ethernet is the current PLC standard. Typically this protocol is used to communicate between Quantum and Momentum PLCs. This standard is replacing Modbus +, although Modbus + will still be used at the local level. The PLCs communicate over a redundant Ethernet ring using Hirschmann Switches for PLC connectivity.

- SY LINK Communications - Communications connecting Square D PLC to PLC using approved twinax cable and connectors. The cable is typically Belden 9463 "Blue Hose" or Carol C8001 "Blue Hose". The approved Connectors shall be Square D 72884.

- SYMAX COMMUNICATIONS - Communications connecting PLCs via a NIM card. The connection shall be made via an RS-422 termination. The RS-422 connections may have an intermediate wiring mode using either 2-pair twisted shielded wiring or a duplex fiber cable. All fiber runs will be converted to RS-422 before reaching the NIM. The Automation Planning Team (APT) will determine the exact specifications and circuit configuration.

2.2.2 HORIZONTAL CABLING

Horizontal cabling refers to all cabling extending from the work area to the Telecommunications closet or Equipment room. This will also include jumpers and wiring running in the telecommunications room from panel to panel.
Normally, Horizontal Cabling will fall under one of these two categories:

1) Four pair, 100 ohm, unshielded, twisted-pair (UTP) Cables.
2) Two-fiber, 62.5 / 125 micrometer, optical fiber cable or Jumper. All Fiber shall be terminated using SC Connectors. All fiber-interconnecting panels will also use SC couplers. Where the final equipment connection requires an ST connector, a SC to ST jumper must be provided.

All wiring running from the work area to the Telecommunications closet shall be 4-pair, 100-ohm, UTP cable. A 4-pair, 100-Ohm, UTP Cable shall support one Telecommunications / Data connector or jack. The wiring shall handle data and voice communications. All horizontal wiring running to the work area shall conform to Category 5 standards. This includes voice lines which normally conform only to Category 3 standards.

Where UTP is the normal accepted form of Horizontal cabling, it may be replaced by a fiber pair or jumper conforming to the standards listed in the Fiber Section.
The maximum length for runs of horizontal cable *shall not* exceed 90 meters. This does not include jumpers in the work area or Telecommunications closet. The maximum length for jumpers or patch cords in the work area shall be 3 meters. The maximum length for jumpers or patch cords in the telecommunications area shall be 10 meters.

Hardware used to terminate UTP cables shall be of the insulation displacement contact (IDC) type. UTP cable shall be terminated according to the color code located in the Table in section 2.4.3. Connecting hardware for 100-ohm UTP cable shall be installed at the following:

a) Main cross-connect
b) Intermediate cross-connect
c) Horizontal cabling transition points
d) Horizontal cross connect
e) Telecommunications outlet / connectors

Horizontal Cabling shall be configured as a Star Topology. Bridge taps and splices shall not be permitted as part of the copper horizontal cabling.

2.2.2 MISCELLANEOUS CABLING

This section includes data and voice cabling, which may enter the Communications room or Telecommunications Closets, from outside telephone lines. This would include ISDN, 56K, and T1 lines. All cable shall follow the standard color code as noted in the table in Section 2.4.3.

These circuits shall be handled as Category 3 lines. The circuit shall leave the PBX or telephone connection block and be terminated at an intermediate 110 block. From this 110 block the circuit shall run either to data equipment or a patch panel.

2.2.3 COMMERCIAL BUILDING BONDING AND GROUNDING REQUIREMENTS

The purpose of this requirement is to provide a reliable electrical ground point reference for all data and telecommunications cabling and equipment.

Each entrance facility, Equipment room and Telecommunications Closet shall be provided with a ground reference point using a solid copper bus bar. The bus bar shall be installed with insulated standoffs and be at least 1/4” thick x 2” high for each telecom closet and 1/4” thick x 4” high for each Equipment Room. The length is variable (typically the length for an Equipment Room bus-bar is 36” and telecom closets is 16”). Each bus bar shall be drilled with rows of holes according to NEMA standards. All grounds shall be attached with bolted compression fittings.

All telecommunications equipment, frames and cabinets, and voltage protectors shall be attached to a ground reference point. This ground reference point or bus bar shall be connected by a backbone of insulated solid copper cable between all closets and equipment rooms. This backbone shall be a minimum size of 3/0 AWG. The backbone shall be connected to a main grounding bus bar in the Telecommunications Entrance Facility, to an earth ground in the electrical entrance facility, and to structural steel on each floor. All bonding conductor cabling shall be colored green or labeled appropriately Per NEC standards.

2.3 TESTING STANDARDS

2.3.1 UTP CABLE

All 4-pair UTP cable, which directly connects to the backbone leaving the Telecommunications Closet or Equipment Room, shall be Category 5 cabling. These cables shall be tested to the requirements of TIA / EIA TSB-67, Level II accuracy. The primary test parameters will include:

- Wire Map
- Resistance
- Length
- Propagation Delay
- Delay Skew
- Impedance
- NEXT and ELFEXT (Near-End and Equal Level Far-End crosstalk)
- Attenuation
- ACR (Attenuation to Crosstalk Ratio
- PSNEST (Power Sum NEXT)
- PSELFEXT (Power Sum Equal Level Far-End Crosstalk)
- PSACR (Power Sum ACR)

These test parameters are described in TIA / EIA TSB-67, Chapter 5. An acceptable method of testing can be performed using automatic cable field testing devices such as:

- FLUKE DSP-4300
- WAVETEK Lantek Pro
- DATACOM TECHNOLOGIES LANcat V

2.3.2 COAXIAL CABLE

Coaxial Cable being used as part of the backbone shall be tested in with a cable scanner to determine if any fault conditions exist. A TDR test shall be performed using any the following or equivalent test devices:

- FLUKE DSP-4300
- WAVETEK LAN Cable Tester
- DATACOM TECHNOLOGIES LAN Cable and Activity Tester
- MICROTEST MT350 Value Kit Scanner

2.3.3.1 FIBER CABLE

All fiber cable shall be tested with an optical time domain reflectometer *before* being installed (while the cable is still on the spool).

All fiber cable shall be tested with an optical time domain reflectometer *after* being installed and terminated. The results of the testing shall be record on a 3.5" floppy disk or compact disc (CD) and given to the Automation Support Team (AST) representative.

Final testing on all fiber cable shall be performed using a power meter and a light source. The testing shall be performed according to TIA / EIA 126 Standards. The recommendations for attenuation are listed in the table in Section 2.4.1. The results of this test will be given to the AST representative.

Fiber cabling will conform to the labeling standards of Section 16010. The label shall designate the cable as fiber (F) and include the origination and destination. The cable shall have a unique number identifier and a number designating the fiber count. The Binder group and individual fiber count shall conform to the format in Table 2.4.4.

2.4 EQUIPMENT REQUIREMENTS

2.4.1 HORIZONTAL 62.5/125 micrometer OPTICAL FIBER CABLE TRANSMISSION PERFORMANCE PARAMETERS

Wavelength (nm)	**Maximum Attenuation(db/km)**	**Minimum Information Transmission Capacity(MHZ-km)**
850	3.75	160
1300	1.5	500

2.4.2 MAXIMUM ATTENUATION

The maximum optical attenuation per each mated, dialed-installed 568SC pair, shall not exceed 0.75 dB (perANSI/EIA/TIA-455-34 Method A, factory testing or ANSI/EIA/TIA-455-59, field testing).

ATTENUATION = CABLE Attn + CONNECTOR Attn + SPLICE Attn
CABLE Attn = Attenuation Coefficient (dB/km) x Length (km) Attenuation Coefficient 3.75 dB/km @ 850 nm for 62.5 / 125 micrometers
Connector Attn (dB) = number of connector pairs x connector loss (dB) = 2 0.75 dB = 1.5 dB
Splice Attn (dB) = number of splices (S) x splice loss (dB) = S 0.3 dB

2.4.3 COLOR CODES FOR HORIZONTAL (100 ohm) UTP CABLE

Conductor Identification	**Color Code**	**Abbreviation**
Pair 1	White-Blue Blue	(W-BL) (BL)
Pair 2	White-Orange Orange	(W-O) (O)
Pair 3	White-Green Green	(W-G) (G)
Pair 4	White-Brown Brown	(W-BR) (BR)

2.4.4 COLOR CODES FOR FIBER CABLE

Binder Group 1 = Blue	Fiber 1 = Blue
Binder Group 2 = Orange	Fiber 2 = Orange
Binder Group 3 = Green	Fiber 3 = Green
Binder Group 4 = Brown	Fiber 4 = Brown
Binder Group 5 = Slate	Fiber 5 = Slate
Binder Group 6 = White	Fiber 6 = White
Binder Group 7 = Red	Fiber 7 = Red
Binder Group 8 = Black	Fiber 8 = Black
Binder Group 9 = Yellow	Fiber 9 = Yellow
Binder Group 10 = Violet	Fiber 10 = Violet
Binder Group 11 = Pink	Fiber 11 = Pink
Binder Group 12 = Aqua	Fiber 12 = Aqua

2.4.5 PATCH CORD COLOR IDENTIFICATION

BLUE	Telephone Connection
YELLOW	LAN Connection
GREEN	Printer Connection
RED	Miscellaneous Data Connection
PINK	Cross-Over cable

2.4.6 EQUIPMENT SPECIFICATIONS

DESCRIPTION	MANUFACTURER	PART NUMBER	COMCODE NUMBER
19” Rack	Chatsworth		
23” Rack	Chatsworth		
Cross Connect Management Tray	FOTI	DLTA-HCCM1	
Vertical Wire Management Tray	FOTI	DLTA-VMW11	
19” Patch Panel	AT&T	1100cat5-48	
23” Patch Panel			
4-Plex Outlets			
Cat. 5, 8 Position Jacks			
Cable			
Cat. 5, 4-Pair Plenum Rated	COMSCOPE	CMP-00424FAS-5UC	
Cat. 5, 4-Pair Non-Plenum Rated	COMSCOPE	427101455N4 CAT5 PR1160	
Thinnet			
Fiber - 12 Fiber Indoor	SIECOR	012K81-33141-24	
Fiber Jumper – Duplex Zipcord	SIECOR	002K51-331141-24	
SYNET CABLE	Belden	9463	
Connectors -			
Fiber - SC	SIECOR	95-100-6R	
Fiber - ST	SIECOR	95-100-01r	
SC Adapter			
Cat. 5 Jack	AT&T	M100CH1-270	
SYNET	Square D	72884	
4-Plex Wall Plate	AT&T	M14A-270	106688351
110 Cross Connect Jack Panel	AT&T	110AB2-100JP12	

2.5 SPACE REQUIRED ON INSTALLATIONS

2.5.1 MINIMUM EQUIPMENT AND TERMINATION WALL SPACE

Gross Floor Space		**Wall Length**	
sq. meters	sq. feet	mm	in.
500	5,000	990	39
1,000	10,000	990	39
2,000	20,000	1,060	42
4,000	40,000	1,725	68
5,000	50,000	2,295	90
6,000	60,000	2,400	96
8,000	80,000	3,015	120
10,000	100,000	3,630	144

2.5.2 MINIMUM EQUIPMENT AND TEMINATION ROOM SPACE

Gross Floor Space		Room Dimensions	
sq. meters	sq. feet	mm	feet
7,000	70,000	3660 x 1930	12 x 6.3
10,000	100,000	3660 x 1930	12 x 6.3
20,000	200,000	3660 x 2750	12 x 9
40,000	400,000	3660 x 3970	12 x 13
50,000	500,000	3660 x 4775	12 x 15.6
60,000	600,000	3660 x 5588	12 x 18.3
80,000	800,000	3660 x 6810	12 x 22.3
100,000	1E+06	3660 x 8440	12 x 27.7

2.6 SECURITY SYSTEMS FOR PUMP STATIONS

2.6.1 SECURITY ALARM CONTROL PANELS FOR PUMP STATIONS

The following features shall be incorporated in the control panel:

- Solid-state design with keypad for keyless control to be mounted as required. Keypad shall use all ten digits (0-9) for 4-digit changeable user codes.
- Alarm windows shall be organized into logical “ZONES”, so that alarms for individual areas are grouped together.
- Entrance / Exit time delay and adjustment 0 to 60 seconds.
- System power supply (located within the panel) for conversion of 120V, 60-Hz voltage to required alarm system voltage.

- Battery backup, to provide power whenever AC power fails. System shall consist of battery charger and rechargeable battery. Backup shall be sized for a 4-hour operation and have enough reserve left to operate the audible alarm siren for a period of 30 minutes. Recharge of battery under *all* circumstances shall take no longer than 24 hours.
- Controls shall allow for an automatic siren with operating interval adjustable from 10 to 30 minutes. Manual override provisions shall silence alarm.
- Test Switch shall be used to simulate alarm condition.
- Control circuitry shall accommodate all sensors. In addition, two isolated Normally Open (NO) relay contacts shall be provided, which close during an alarm condition for interconnection to the telemetry alarm panel and programmable control.

2.6.2 MANUFACTURER

System shall be a FBI (Fire Burglary Instruments, Inc.) Star XL4600 system including controller and keypad, ADEMCO VISTA-185 or equal.

2.6.3 SENSORS

Provide magnetic sensors that can be mounted on steel doors and that are compatible with the specified control panel. Sensors shall be tamper-proof; i.e., all wire terminations shall be inside the sensor and not brought out through screw terminals. Sensors shall be by FBI, or equal.

2.6.4 SIREN

Siren shall be rated at 25W and 100 dB at 10 feet. Siren shall be installed on the side of the building in a weatherproof housing. Siren and enclosure components shall be by FBI, or equal.

SECURITY ALARM SYSTEM FOR PUMP STATIONS – INSTALLATION

The keypad shall be mounted as shown on the construction drawings and mounted in a box that is suitable for mounting the keypad. (For flush mounting, a two-gang mud ring, for surface mounting, a box that is 4 11/16 inch square.) The control panel shall be mounted adjacent to the hydra panel in a housing that is constructed similar to the MCC or a panel designed to house miscellaneous panels.

2.6.5 OUTSIDE LIGHTING CONTROL FOR PUMP STATIONS

Where required for pump stations, provide an outside lighting control system for performing all of the functions shown on the Drawings. Use a STANLEY GARAGE DOOR OPENER RECEIVER and no others.

1. Provide a garage door opener that is programmed to the channel that is used by the Pump Maintenance Shop (PUMA).
2. Provide a 120/24 VAC transformer for use as a power supply for the garage door opener.
3. Provide a time-delay-off-relay, 0-60 min.
4. Provide a non-metallic box capable of housing the radio receiver and the transformer
5. Provide a double pole, double throw (DPDT) light switch.
6. Provide 300-watt quartz lights as required.

To operate the outside lights using the remote radio transmitter; press the transmitter button. This will energize the time-delay-off-relay, which will in turn operate the 300-watt quartz light. The light will remain on for 10 minutes. No other lights are operated. To operate the outside lights using the light switch inside the station; turn the switch on. This will energize the time-delay-off-relay, which will in turn operate the 300-watt quartz light. This light will remain on 10 min. after the switch is turned off. At the same time the switch is turned on, any other outside lights will be turned on and allowed to warm up. Upon turning the light switch off, any other outside lights will be turned off at that time.

2.7 FIRE ALARM SYSTEMS

A variety of fire alarm panels and systems are used throughout the Columbia Blvd. WWTP and it's associated pump stations. All systems must have minimum of the following standards to be acceptable.

1. Local panel display
   The display shall indicate alarm status, zone status and misc. trouble alarms
   The display shall be addressable through a local keyboard
2. Battery back up
   The battery system shall operate a minimum of four hours on loss of power.
3. Addressable alarm zones
   Each Zone or element shall be addressable via specific number and noun name.
4. Remote monitoring output
   The system shall have the capability to be monitored for Zone and Administrative Alarms. The output can be via relay or Communications protocol. If a Communications protocol is used it should conform to the LONMARK standards.
5. Audible Alarm

Alarm shall be audible locally at the panel. The alarm shall have the capability of being silenced through the keypad.

6. Test Capabilities
   The system shall have the capabilities of testing and zoning monitoring without effecting total system operation. Zones or elements can be taken out of service without effecting system operation.

The E/I department has not adopted a specific communication standard for fire systems at this time.