

SECTION 16721

FIRE ALARM REPORTING SYSTEM

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Provide Fire Alarm Radio Reporting System.

1.02 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ELECTRONICS INDUSTRIES ASSOCIATIONS (EIA)

ANSI/EIA/TIA-222-F 1996 Steel Antenna Towers and Antenna Supporting Structures

FEDERAL STANDARD (FED-STD)

FED-STD-595 Colors Used in Government Procurement

FACTORY MUTUAL ENGINEERING AND RESEARCH CORPORATION (FM)

FM P7825 2000 Approval Guide

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C.62.41 1991 Surge Voltages in Low-Voltage AC Power Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6 1993 Enclosures for Industrial Controls and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 1999 National Electrical Code (NEC)

NFPA 72 1999 National Fire Alarm Code

UNDERWRITERS LABORATORIES, INC. (UL)

UL FPED 2000 Fire Protection Equipment Directory

UL 467 1994 (R 1986) Grounding and Bonding Equipment

UL 514A 1996 Metallic Outlet Boxes

UL 514B 1997 Fittings for Conduit and Outlet Boxes

UL 1242 2000 Intermediate Metal Conduit

1.03 GENERAL REQUIREMENT

- A. Standard Products: Materials and equipment shall be first grade, standard, current products of the manufacturer and shall be suitable for the performance of their separate functions. Where two or more pieces of equipment performing the same function are required, they shall be exact duplicates produced by one manufacturer. Equipment added to an existing system shall function in the same manner as similar components of the existing system. Material and equipment shall be standard products that essentially duplicate items that have been in satisfactory use for at least two years in projects similar in size and scope to this project. The Contractor shall identify installations where identical equipment is in service and shall provide names and telephone numbers of knowledgeable persons within the using facility.
- B. Nameplates: Major components of equipment shall have the manufacturer's name, catalog number and technical data as applicable on a non-corrosive and non-heat sensitive label affixed to the equipment.
- C. Verification of Dimensions: The Contractor shall become familiar with all details of the work, verify all dimensions in the field and shall advise the Contracting Officer of any discrepancy before performing the work.
- D. Compliance: Installed systems shall be configured in accordance with NFPA Standard 72, Chapter 5-3 "Proprietary Supervisory Stations" except as modified or annotated herein. The system shall be listed by Underwriters' Laboratories, Inc. (UL), or approved by the Factory Mutual System (FM) or another nationally approved testing laboratory, as a radio fire alarm system.
- E. Qualifications of Installer: Prior to commencing work, the Contractor shall submit data showing that he has successfully installed radio fire alarm systems, or that he has a firm contractual agreement with a subcontractor having such required experience. The data shall include the names and locations of at least two installations where the Contractor or the subcontractor referred to above, has installed such systems. The Contractor shall indicate these systems have performed satisfactorily in the manner intended for a period of not less than 18 months.
- F. Manufacturer's Representative: The Contractor shall provide the services of a factory trained and certified manufacturer's representative or technician, experienced in the installation and operation of the type of system being provided to supervise the installation, testing (including final testing) and adjustment of the system.

1.04 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTALS.

- A. Design Analysis and Calculations: Substantiating battery calculations, including ampere-hour requirements, shall be submitted for supervisory and alarm power requirements for:
 - 1. Radio alarm transceivers
 - 2. Interface panels (if provided).

- B. Detail Drawings: Detail drawings shall be submitted and shall consist of a complete list of equipment and materials, including manufacturer's descriptive and technical literature, catalog cuts and installation instructions. In addition, the following drawings shall be provided:
1. Layout drawings of the entire system, showing location of all fire alarm equipment and devices.
 2. Wiring diagrams showing points of connection and terminals to be used.
 3. Interior wiring diagrams of each major system component.
- C. Manufacturer's technical data shall be provided as required to demonstrate that the system has been coordinated and will properly function as a unit. Data describing more than one type of item shall be clearly marked to indicate which type the Contractor intends to provide. Partial submittals will not be accepted. Submit data for the following:
1. Radio alarm transceivers in each configuration required by this specification.
 2. Interface device, unless integral with transceivers.
 3. Antennas and cables.
 4. Power supplies, including batteries.
 5. Lightning protection devices.
- D. The Contractor's submittal shall be signed by a system designer who is regularly engaged in fire protection, detection and radio alarm systems and who has had at least two years of current experience in design of these systems.
- E. Upon completion of the installation and prior to final inspection, the contractor shall furnish 'as-built' drawings. In addition, the Contractor shall furnish copies as stated herein of manuals giving complete instructions for the operation, inspection, testing and maintenance of the system including wiring diagrams.
- F. Quality Assurance Plan: The Contractor shall furnish to the Contracting Officer detailed test procedures for the fire detection and alarm system 30 days prior to performing system tests.
- G. Test Reports: Upon completion and testing of the installed system, test reports shall be submitted in booklet form showing all field tests performed to prove compliance with the specified performance criteria. Each test report shall indicate the final position of controls.
- H. Training Data: The Contractor shall provide a factory-trained, qualified instructor to conduct a minimum of 16 hours of training, to base personnel designated by the Contracting Officer, in the maintenance, troubleshooting, operation and programming of the furnished equipment. Training shall start after the system is functionally complete but prior to final acceptance tests.
- I. Installation Procedures: The installation of the system shall be in accordance with the manufacturer's published installation procedures and all applicable codes and standards referenced herein.
- J. Certificates of Compliance: Copies of the following shall be provided:
1. Current UL listings or FM approvals for the system in the configuration(s) offered.
 2. FCC Type Acceptance Grants.

3. Name(s) of personnel who will supervise installation and testing of the system, and who will provide instruction to Government personnel, with the manufacturer's certification of the qualifications of the named individual(s).
4. Certification of satisfactory operation of similar systems as described in the paragraph titled "Qualifications of Installer."

- K. Operating Instructions: The Contractor shall furnish the Contracting Officer 8 complete copies of operating instructions outlining step-by-step procedures required for system startup, operation and shutdown. Instructions shall include the manufacturer's name, model number, parts list, and a brief description of the equipment and its basic operating features. Operating instructions shall be submitted and approved prior to the start of the training course.
- L. Preventive Maintenance and Inspection: The Contractor shall furnish the Contracting Officer 8 copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The instructions shall include conduit layout, equipment layout and simplified wiring and control diagrams of the system. Maintenance instructions shall be submitted and approved prior to the start of the training course.

1.05 DELIVERIES AND STORAGE

- A. All equipment delivered and placed in storage shall be protected from weather, humidity, and temperature variations; and dirt, dust, and other contaminants.

1.06 SYSTEM OPERATION

- A. The radio system reports alarms and status changes to the Central Supervising Station. The system shall comply with NFPA 72, Chapter 5, Section 3. The system shall be connected to local building fire alarm systems, sprinkler water flow detectors, manual pull stations and extinguishing system control panels as shown herein and/or on the drawings. The system shall indicate the area of alarm and the radio link shall be supervised and operated using two-way data transmission in accordance with NFPA 72 Standards.

1.07 MONITORING FOR INTEGRITY

- A. All means of interconnecting equipment, devices and appliances, and wiring connections shall be monitored for the integrity of the interconnecting conductors or equivalent path, so that the occurrence of a single open or a single ground-fault condition in the installation conductors or other signaling channels, and the restoration of such a condition to normal, shall be automatically indicated within 200 seconds. This shall include antennas, coaxial cables and lightning arrestors (static discharge units).

PART 2 - PRODUCTS

2.01 RADIO FIRE ALARM TRANSCEIVERS

- A. Radio fire alarm transceivers shall be all solid-state and shall comply with all applicable portions of FCC Part 15 governing type acceptance. All radio fire alarm transceivers of a common configuration shall be interchangeable with the other devices furnished by the manufacturer. Each radio fire alarm transceiver, and interface device (if used), shall be the manufacturer's current commercial product completely assembled, wired, tested at the factory, and delivered ready for installation and operation. Radio fire alarm transceivers shall include a modular RF transceiver to allow a continuous interrogation/reply technique in which the transceivers are continually supervised by the Central Receiving Console. The interrogation/reply scheme shall be such that any equipment malfunction, which could prevent the transmission of alarm signals, will be recognized and reported at the Central Receiving Console within 200 seconds. The interrogation/reply technique shall also insure that any alarm from any system location will be reported to the Central Receiving Console within 90 seconds.
- B. Frequency Allocation: The specific operating frequency shall be assigned by the Contracting Officer, in consultation with the Area Radio Frequency Coordinator, within 90 days after submission of completed Application for Frequency Allocation following contract award. Transceivers shall be configured for operation on any selected frequency. Transceivers shall be single-channel synthesized, or multi-channel synthesized programmed to a single channel. The transceiver shall have a minimum frequency stability of 1.5 PPM (UHF).
- C. Radio Fire Alarm Transceiver Power Requirements: Each transceiver shall be powered by a combination of locally available 120 Vac power, and spill-proof, sealed lead acid or lead calcium battery requiring no addition of water or electrolyte. Operating power shall be obtained from a single connection to a dedicated, fused branch circuit of the building's regular 60 Hz ac service. Where a local energy fire alarm control panel is fed by the same arrangement, a common feed to both the local panel and the transceiver is permitted. In the event of loss of ac power, the transceiver shall automatically and instantaneously switch to standby battery power without loss of any alarm signals. Loss of ac power shall also activate an indicator and cause an ac failure message to be transmitted if power is not restored within 60 seconds. Power supply filtering shall prevent nuisance message transmissions caused by transient or steady state electrical disturbances. Upon restoration of ac power, transfer back to ac operation shall be automatic. Under presence of ac power, batteries shall be charged through a converter/float charge. The charger shall recharge a fully discharged battery in not more than 48 hours while the transceiver is operating under ac power. The battery and converter/battery charger shall be installed within the transceiver housing.
- D. Battery Power: The battery package shall be capable of supplying all power requirements of the transceiver.
- E. Battery Duration: Radio fire alarm transceiver standby battery capacity shall provide sufficient power to operate the transceiver in a normal standby status for a minimum of 60 hours and be capable of transmitting an alarm signal at the end of the period. Each radio fire alarm transceiver shall disconnect the standby batteries before the batteries are permanently damaged by excessive discharge.

- F. **Battery Supervision:** Each radio alarm transceiver shall constantly monitor and supervise its battery power supply. A Battery Fault message shall be transmitted when battery voltage under load falls below 85 percent of the rated battery voltage, but in any case prior to the point at which the battery will fail to operate the transceiver and before the low battery disconnect activates. A Battery Fault message will also be transmitted upon disconnection or removal of the battery supply, or charging system faults.
- G. **Painting:** Radio fire alarm transceiver housings, and interface housings, shall be factory painted with polyester powder-coat paint. The finish color shall be "Fire Engine Red." Painted surfaces damaged during installation shall be repainted to match the existing paint.
- H. **Interfacing Indicators and Controls:** Radio fire alarm transceivers shall incorporate provisions for interconnection to building alarm systems as defined in the paragraph titled "RADIO TRANSCEIVER INTERFACE DEVICE." At the manufacturer's option, all circuitry, switches and controls necessary to the functions required for radio fire alarm transceivers may be contained in one housing or in two separate housings. If two separate housing are utilized, all requirements for radio transceivers as stated herein remain in effect.
- I. **Environmental Operating Requirements:** Radio fire alarm transceivers shall be designed for reliable operation in an ambient temperature range of -30° C to +60° C (-22° F to +140° F). Where required herein, standard model transceivers shall be provided in enclosures suitable for adverse climatic conditions including 100-mph winds, high humidity, ice, snow, and rain. Radio fire alarm transceivers with integral fire alarm control panel shall be designed for reliable operation in an ambient temperature range of 0° C to +50° C (+32° F to +122° F).
- J. **Lock:** Internal components shall be protected from vandalism by a tamper-proof lock on the enclosure door. The housing shall allow access to all internal components for testing, servicing and replacement at the installation site. Locks for all transceivers shall be keyed alike.
- K. **Mounting:** Transceiver housings shall be designed for universal mounting on walls, light poles or pedestals. Mounting shall utilize lag bolts, anchor bolts, stainless steel banding, mounting brackets or a shackle/bolt combination, as applicable to the specific installation. Transceivers shall be installed in locations easily accessible for maintenance.
- L. **Radio Fire Alarm Transceiver Housings:** The housings on radio fire alarm transceivers shall be fabricated from protected metal conforming, as a minimum, to NEMA Standard 1 for indoor locations and NEMA 3R for exterior locations. Provision shall be made for conduit (minimum 3/4 inch ID) entry and attachment at no fewer than two places on the housing. Switches and other controls shall not be accessible without the use of a key.
- M. **Generation of Signals:** Each radio fire alarm transceiver shall provide for a prioritized transmission of all initiated signals; alarms shall always have reporting priority. The transceiver shall transmit all alarms, troubles and status changes at programmed intervals until receipt of the message is acknowledged via return message by the radio fire alarm Central Receiving Console.
- N. **Power Output:** The radio frequency (RF) power output of each radio fire alarm transceiver shall be a minimum of 4 watts or as required for reliable reception over long distances. Note: UHF frequencies between 450 to 470 MHz are limited to 2 watts maximum power output.

- O. Memory: Radio fire alarm transceivers shall have full memory capability. Simultaneous or subsequent actuation of any individual messages (from zones not initially in alarm), including those actuated during “off air” periods, shall not result in the loss of messages. Such messages shall be stored until they are successfully transmitted.
- P. Transceiver Identity Code: Each radio fire alarm transceiver shall transmit a distinct identity code as part of all signals emanating from the transceiver. The transceiver must provide the capability for setting the code or address in the field using no special tools. The identity code shall allow entry of up to four digits.
- Q. Message Designations: Each radio fire alarm transceiver shall allow as a minimum, or as required, no less than ten distinct and individually identifiable message designations as to the types or causes of transmitter actuation:
 - 1. Zone Messages: Zone messages shall be transmitted upon automatic or manual actuation of the transceiver input. The building and zone causing the actuation shall be individually identified by this transmission; each radio fire alarm transceiver shall be capable of transmitting as a minimum four unique alarm messages identifiable at the Central Receiving Station as fire or auxiliary type zones with a description of the zone. The transceiver shall also be capable of transmitting a trouble signal for each alarm zone. In addition, restoration of the zone input to normal shall result in a specific restoration signal being transmitted to indicate the return of the zone to normal supervisory condition.
 - 2. Test Message: Each radio fire alarm transceiver shall be capable of responding to automatic continuous or scheduled polls as well as manually activated system or individual transceiver polls. Where the schedule method is selected, automatic testing will occur at least once each 24 hours—at intervals of from one to 24 hours, selectable in one-hour increments—and the time(s) of occurrence shall be specified by the user. The Central Receiving Console CPU module clock shall regulate scheduled tests. Transceiver response to test messages shall include their current status including identification of all off-normal conditions.
 - 3. Tamper Message Designations Each radio fire alarm transceiver shall provide for connection of an optional enclosure tamper and/or tilt switch and shall transmit a message automatically when the switch is activated. The message shall be identified as Tamper and shall include the transceiver identity code and building or location identification. The transceiver shall transmit an End of Tamper signal when the tamper switch is returned to the normal position.
 - 4. Trouble Message Designation Each radio fire alarm transceiver shall provide automatic transmission of the following separate identifiable trouble messages:

- a. Zone Trouble Reported if the transceiver input wiring is disarranged so as to compromise transceiver integrity or if the local building fire alarm system connected to the transceiver input signals a trouble condition. This message shall be identified by the building and zone in which the fault occurred. When the fault is corrected, the transceiver shall transmit an End of Trouble message with the same identification.
- b. AC Fail Reported in the event that failure of the main operating power source of the transceiver has existed for 60 seconds. This message shall be identified by the transceiver identity code and building. When ac power is restored, the transceiver shall transmit an End of AC Fail message with the same identification.
- c. Battery Fault Reported if the battery supply voltage under load falls below 85% of its rated voltage, or if the battery supply is disconnected from the transceiver, or if the battery charger voltage is high or low. This message shall be identified by the transceiver identity code and building. When the battery is recharged, replaced or reconnected, the transceiver shall transmit an End of Battery Fault message with the same identification.

2.02 RADIO TRANSCEIVER INTERFACE DEVICE

- A. Each radio fire alarm transceiver shall provide electrically supervised connections to local fire alarm control panels, sprinkler system flow devices and such other alarm and supervisory devices as indicated herein or on the drawings. Each transceiver shall provide electrical supervision for both open and ground conditions on interconnection wiring between the transceiver and a local fire alarm control panel, interface panel, or other alarm supervisory device. A ground fault condition or open condition in any of these circuits shall cause transmission of a trouble message identifying the affected zone. Where existing local control panels or devices do not provide isolated contact arrangements for transmission of alarm and trouble signals, an appropriate interface device will be provided to maintain system supervision in accordance with NFPA requirements. Where local fire alarm control panels do not provide a supervised alarm output for operation of interface panels, interface panels or devices shall be located within the local fire alarm panel or within three feet of the fire alarm control panel and all interconnecting wire shall be in conduit. Interface devices shall be completely assembled, wired and tested at the factory and delivered ready for installation and operation.
- B. Enclosure: When furnished as an independent, self-contained device, the interface device enclosure shall comply with paragraph 2.1.8.3.
- C. Indicators: Transceivers shall have alarm (red) and trouble (yellow) indicators to show the status of each reporting zone. Restoration of the alarm or trouble signals shall extinguish the associated zone indicator.
- D. Access: Switches and any other controls shall not be accessible without the use of a key. Access to controls shall be by unlocking and opening a panel or door.

- E. Mounting: When furnished as an independent, self-contained device, interface housings shall be designed for universal mounting on walls, light poles or pedestals. Mounting shall utilize lag bolts, anchor bolts, stainless steel banding, mounting brackets or a shackle/bolt combination, as applicable to the specific installation.
- F. Inputs/Outputs: Each radio fire alarm transceiver shall provide a minimum of four alarm circuit inputs (zones) for the purpose of connection to local fire alarm control panels, sprinkler water flow detectors, manual pull stations and extinguishing system control panels, utilizing Form A dry contacts. The specific zone quantities for each building shall be as shown and where additional zones are required they shall be provided.

2.03 RADIO FIRE ALARM SYSTEM PERIPHERAL EQUIPMENT

- A. Radio Fire Alarm Transceiver Antenna: Antennas shall be vertically polarized with a driving point impedance of 50 ohms. The antennas may be omnidirectional or directional, as appropriate. All antennas shall be installed external to buildings and shall be located in accordance with manufacturer recommendations, well away from overhead power circuits. Antennas shall be of corrosion-resistant materials and designed to withstand wind velocities of 100 mph. Each transceiver shall have its own antenna; a single antenna shall provide for both transmitter and receiver operation of the transceiver. All antennas shall be provided with static discharge units (lightning arrestors) installed and grounded in accordance with the requirements of NFPA 70.
- B. Antenna Cables: Coaxial cables shall be 50 ohm RG type (or equivalent) with minimum 95% shield and shall include PL and BNC type fittings or connectors as appropriate.
- C. Conduit: Conduit and fittings shall comply with UL 6, UL 1242 and UL 797.
- D. Ground Rods: Where used, ground rods shall be of copper-clad steel conforming to UL 4561 not less than 5/8 inch in diameter by ten feet in length and shall be bonded to the building grounding electrode system in accordance with the requirements of NFPA 70.
- E. Power Supply: Operating power shall be as specified elsewhere in this document.
- F. Wiring: Wiring shall be in accordance with NFPA 70 and as follows: wire for branch circuits shall be 12 AWG solid copper minimum; wiring for signaling circuits shall be 18 AWG minimum, type FPL or equivalent type listed or approved for fire alarm system installations. All station wiring shall be color-coded.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. All work shall be installed as shown and in accordance with the manufacturer's recommendations, unless otherwise specified. Electrical work shall be in accordance with NFPA 70.

- B. Continuity of Protection: During the installation of this system, there shall be no loss of function of the existing base fire alarm system, or of the local building alarm systems connected thereto. Transfer of local alarm system connections from the existing base alarm systems shall not result in loss of alarm transmitting or receiving capability. Temporary interruption of individual building alarm connections, not to exceed eight hours duration, will be permitted at the discretion of the Contracting Officer.
- C. Power Supply for the System: A single branch-circuit connection for supplying power to the fire alarm system shall be provided. The backup power supply shall be automatically energized upon failure of the normal power supply.
- D. Wiring: Wiring shall be installed in rigid conduit, intermediate metallic conduit or electrical metallic tubing. The conductors for the fire alarm system shall not be installed in conduits, junction boxes or outlet boxes with conductors of lighting and power systems. The sum of the cross-sectional areas of individual conductors shall not exceed 40 percent of the interior cross-sectional area of conduit. Ample gutter space to accommodate all wiring shall be provided. Coaxial cables for antennas shall be installed entirely within minimum 3/4-inch conduit and shall not be installed with any other system conductors other than ground conductors.
- E. Overvoltages And Surge Protection

3.02 POWER LINE SURGE PROTECTION

- A. All equipment power supplies shall be protected from power line surges in accordance with IEEE C62.41 Category B. Fuses shall not be used for surge protection.

3.03 GROUNDING

- A. Antenna masts and static discharge unit ground terminals shall be grounded in accordance with the requirements of NFPA 70, Article 810-21 and the manufacturer's instructions. Static discharge units and their enclosures shall be located inside the buildings as close as practicable to the antenna lead-in point of entry. Where used, ground rods shall not protrude more than six inches above grade. Noncurrent-carrying metallic parts associated with new fire alarm equipment shall have maximum resistance to solid earth ground not to exceed the following values:

Antennas/static discharge units	10 ohms
Radio alarm transceivers	10 ohms
Interface panels	10 ohms

3.04 TESTING

- A. The Contractor shall notify the Contracting Officer ten days before the performance and acceptance tests are to be conducted. The tests shall be performed in the presence of the Contracting Officer or designated representative and under the supervision of the fire alarm system manufacturer's factory-trained and -certified representative. The Contractor shall furnish all instruments and personnel required for the tests.

- B. Performance Testing: Upon completion of the installation, the Contractor shall subject the system to a complete functional and operational performance test. This test shall determine that the system is free from grounded or open circuits. When all corrections have been made, the system shall be retested to assure that it is functional. Copies of performance test reports shall be submitted in accordance with section titled "SUBMITTALS."
- C. Acceptance Test: The test shall be in accordance with applicable requirements of NFPA 72, Chapter 7, and shall verify that all previous deficiencies have been corrected. The test shall include the following:
1. Tests to indicate that there are no grounded or open circuits.
 2. Tests of each radio alarm transceiver function.
 3. Tests of radio fire alarm Central Receiving Console for all required functions.
 4. Tests of normal and emergency power supplies.
 5. Tests of each antenna system, maximum VSWR = 1.5:1

END OF SECTION